

Medical Math

Conversions, Fluid Therapy (Fluid Rates and Boluses), Additives, CRIs and Dilutions, and Labelling

Conversions

What is conversion?

Changing from one form to another

Units change but the two sides of the equation are equivalent/equal

Conversions: Weight

Pounds

Divide pounds by 2.2

Example: 25 lbs ÷ 2.2

Example: 87 lbs ÷ 2.2

Kilograms

= kilograms

= 11.36 kg

= 39.54 kg

Pounds

= pounds

= 52.8 lbs

= 13.2 lbs

Kilograms

Multiply kilograms x 2.2

Example: 24 kg x 2.2

Example: 6 kg x 2.2



Let's practice!

Convert:

35 lbs → kgs

- Going from smaller unit to larger unit

- Going to divide

$$35 \text{ lbs} \div 2.2 = 15.91 \text{ kg}$$

29.5 kgs → lbs

$$29.5 \text{ kg} \times 2.2 = 64.9 \text{ lbs}$$

44 lbs → kgs

$$44 \text{ lbs} \div 2.2 = 20 \text{ kg}$$

Convert:

0.9 lbs → kgs

$$0.9 \text{ lbs} \div 2.2 = 0.41 \text{ kg}$$

***Use your zeroes!**

- Always put a zero before a decimal if your amount is <1
- If you are putting a decimal after your 1s place, add a zero after for clarification.
- Examples: 0.19 and 12.0

53 kgs → lbs

$$53 \text{ kg} \times 2.2 = 116.6 \text{ lbs}$$

82.7 lbs → kgs

$$82.7 \text{ lbs} \div 2.2 = 37.59 \text{ kg}$$

Conversions: Mass



$$\text{mcg} \div 1000$$

1 mcg

$$= \text{mg}$$

$$\text{mg} \div 1000$$

0.001 mg

$$= \text{g}$$

0.00001 g



$$= \text{mcg}$$

1,000,000 mcg

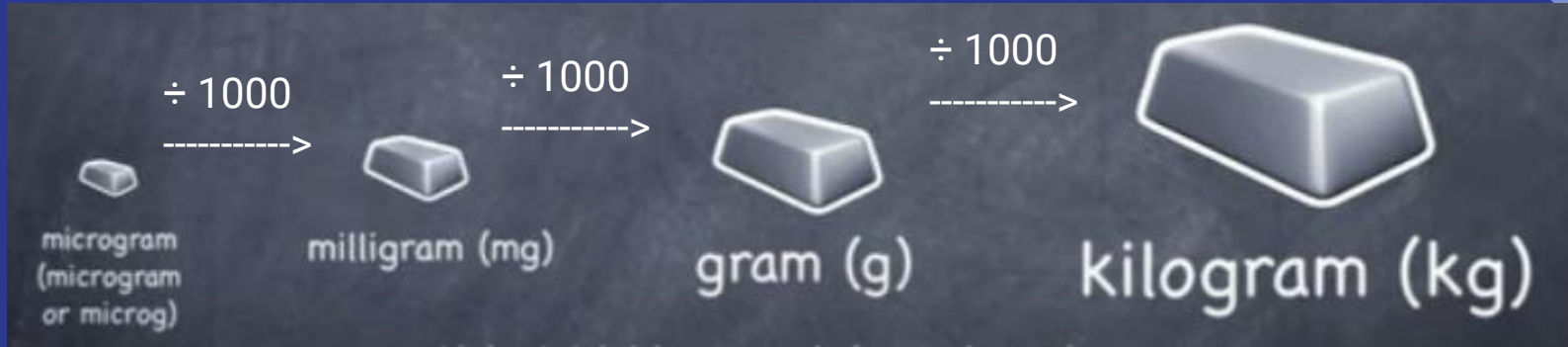
$$= \text{mg}$$

$$\text{mg} \times 1000$$

1,000 mg

$$\text{g} \times 1000$$

1 g

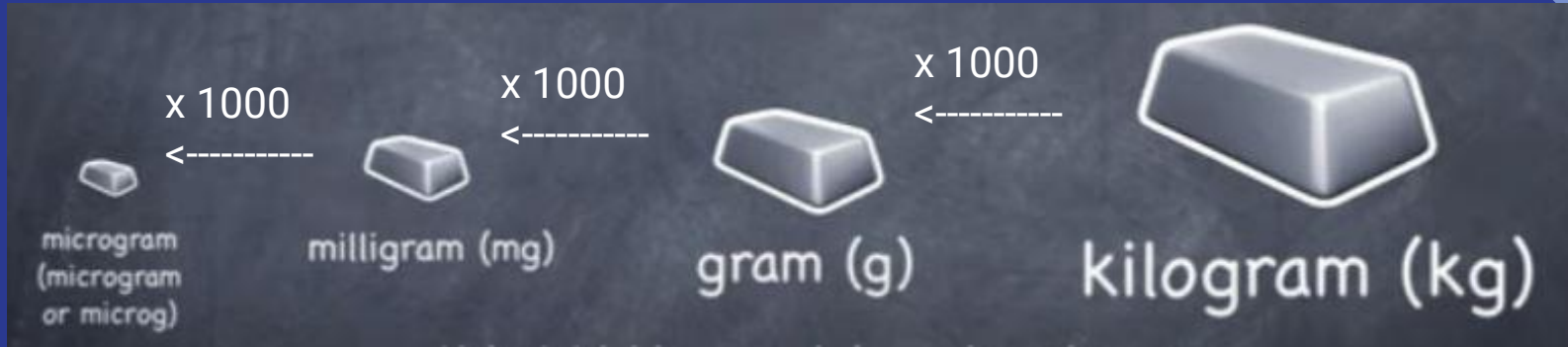


Each unit above is 1000 times smaller than the unit to its right

When converting **mcg** \rightarrow **mg**, DIVIDE by 1000 ($\text{mcg} \div 1000 = \text{mg}$)

When converting **mg** \rightarrow **g**, DIVIDE by 1000 ($\text{mg} \div 1000 = \text{g}$)

When converting **g** \rightarrow **kg**, DIVIDE by 1000 ($\text{g} \div 1000 = \text{kg}$)



Each unit above is 1000 times larger than the unit to its left

When converting **kg** → **g**, MULTIPLY by 1000 ($\text{kg} \times 1000 = \text{g}$)

When converting **g** → **mg**, MULTIPLY by 1000 ($\text{g} \times 1000 = \text{mg}$)

When converting **mg** → **mcg**, MULTIPLY by 1000 ($\text{mg} \times 1000 = \text{mcg}$)

Three Easy Steps

Identify Units

- What is your starting unit?
- What is your ending unit?

Determine Size

- Is your starting unit smaller than your ending unit?

or
- Is your starting unit larger than your ending unit?

Determine Action

- If you are converting from a smaller unit to a larger one,
DIVIDE

or
- If you are converting from a larger unit to a smaller one,
MULTIPLY



Let's practice!

Convert:

350 mcg → mg

- Going from smaller unit to larger unit

- Need to divide

$$350 \text{ mcg} \div 1000 = 0.35 \text{ mg}$$

***Use your zeroes!**

14 g → mg

$$14 \text{ g} \times 1000 = 14,000 \text{ mg}$$

97 mg → mcg

$$97 \text{ mg} \times 1000 = 97,000 \text{ mcg}$$

Convert:

73 mg → g

$$73 \text{ mg} \div 1000 = 0.073 \text{ g}$$

2.6 mg → mcg

$$2.6 \text{ mg} \times 1000 = 2,600 \text{ mcg}$$

0.49 kg → g → mg

$$0.49 \text{ kg} \times 1000 = 490 \text{ g}$$

$$490 \text{ g} \times 1000 = 490,000 \text{ mg}$$

Convert:

1,640 mcg → mg → g

$$1,640 \text{ mcg} \div 1000 = 1.64 \text{ mg}$$

$$1.64 \text{ mg} \div 1000 = 0.00164 \text{ g}$$

84 mcg → mg

$$84 \text{ mcg} \div 1000 = 0.084 \text{ mg}$$

37.8 g → mg

$$37.8 \text{ g} \times 1000 = 37,800 \text{ mg}$$

Conversions: Temperature

Fahrenheit

Subtract 32, then divide by 1.8

Example: $(100.7^{\circ}\text{F} - 32) \div 1.8$

Example: $(97.6^{\circ}\text{F} - 32) \div 1.8$

Celsius

= ° Celsius

= 38.16°C

= 36.44°C

Fahrenheit

= ° Fahrenheit

= 104.0°F

= 99.5°F

Celsius

Multiply x 1.8, then add 32

Example: $40^{\circ}\text{C} \times 1.8 + 32$

Example: $37.5^{\circ}\text{C} \times 1.8 + 32$



Let's practice!

Convert:

35°C → °F

$$35\text{ °C} \times 1.8 + 32 = 95\text{ °F}$$

102.7°F → °C

$$(102.7\text{ °F} - 32) \div 1.8 = 39.2\text{ °C}$$

38.4°C → °F

$$38.4\text{ °C} \times 1.8 + 32 = 101.1\text{ °F}$$

Quick Reference Range: normal canine/feline temps are between **37.5°C** and **39°C** (= 99.5°F - 102.2°F)

Fluid Therapy

Multiple types of fluids

- Plasmalyte A
- Lactated Ringers (LRS)
- Normosol-R
- Normosol-M
- D5W
- 0.9% NaCl
- 0.45% NaCl
- Hetastarch (HES)

Different rate calculations for fluids

- Maintenance Rates
- Surgical Rates
- Boluses

Three phases of fluid delivery:

1. Resuscitation

- Rapid restoration of intravascular volume (“shock dose”/hypovolemic shock)
- Usually given as bolus(es)

2. Replacement

- Rapid volume expansion
- Correct fluid deficits from dehydration
- Replace ongoing fluid losses (V/D, renal disease)
- Diuresis

3. Maintenance

- Fluids that meet the patient’s metabolic needs
 - Consider caged vs. active
 - Consider sick vs. healthy



**WE INTERRUPT THIS PROGRAM
TO BRING YOU AN EMERGENCY
MESSAGE ABOUT:**

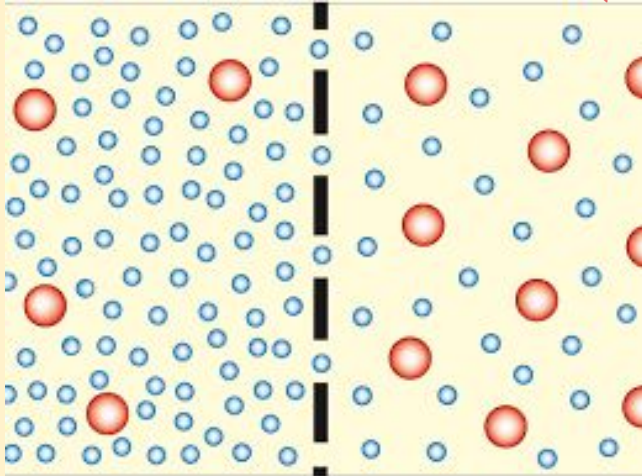
OSMOSIS

Osmosis

The spontaneous diffusion of water (or solvent) across a semipermeable membrane from a weakly/less concentrated solution to a more highly concentrated solution.

Water molecules = solvent (liquid)

Solid molecules = solute (solids)



Low concentration
Few **solid** molecules

High concentration
Many **solid** molecules

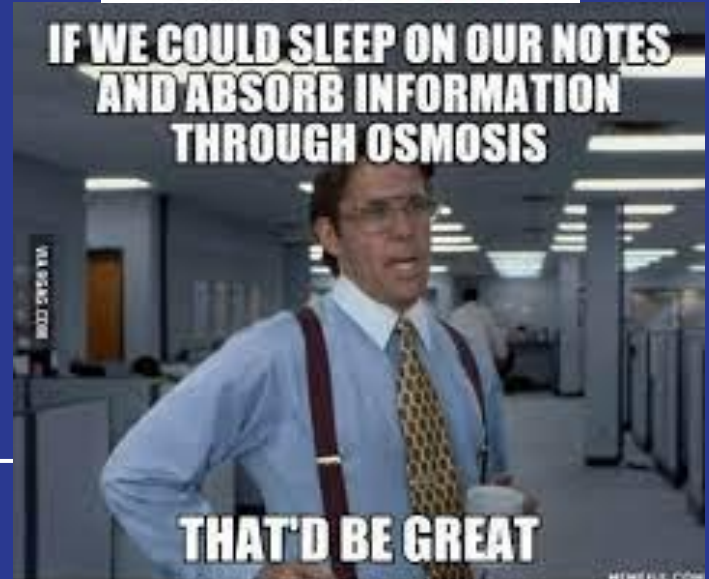


Sleeping next to my notes



hoping that they go into
my brain by **osmosis**

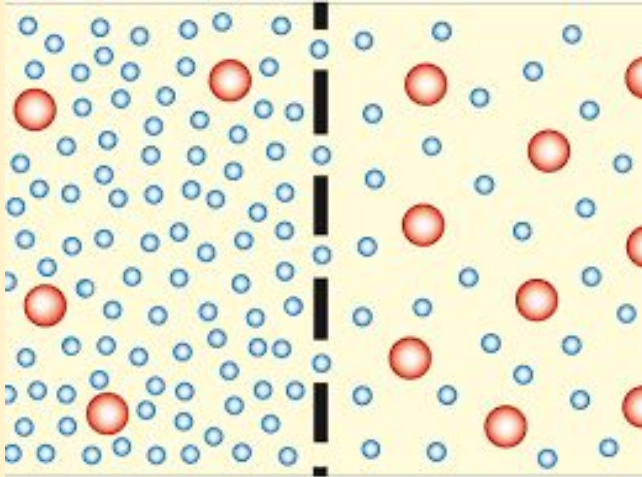
**IF WE COULD SLEEP ON OUR NOTES
AND ABSORB INFORMATION
THROUGH OSMOSIS**



THAT'D BE GREAT

Osmosis

Boys (solvent, can move across membrane)
Girls (solute, stuck on the side they are on)



Low concentration
Few **girls** and many **boys**

High concentration
Many **girls** and few **boys**



Imagine you're at a party where all the **girls** are sitting down and can't stand up (solute). Only **boys** (solvent) can move around the room.

9 **boys**
1 **girl**

1 **boy**
9 **girls**

In order to have the most equal mingling, 8 boys from the left side of the room will move to the right side of the room.

In other words, they will move from an area of **LOW** solute (girl) concentration to an area of **HIGH** solute (girl) concentration.

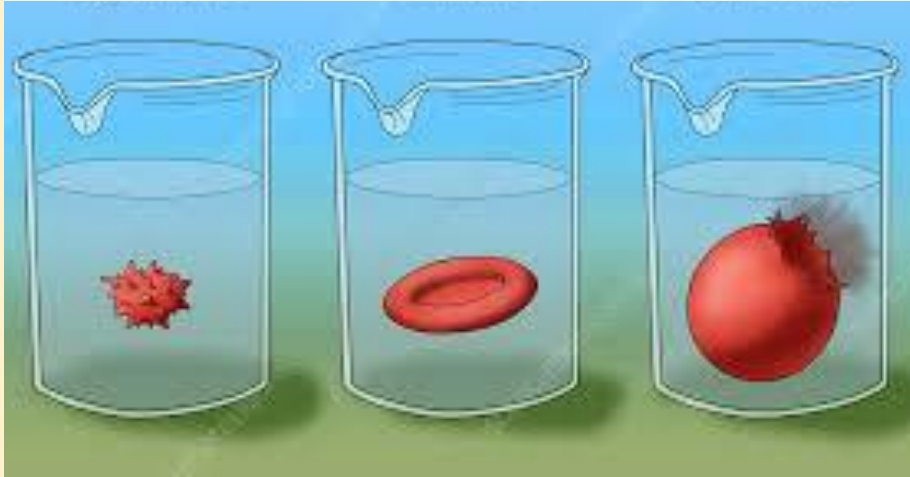
This will lead to an equal distribution and equal concentration of boys and girls on **BOTH** sides.

Osmosis

Hypertonic

Isotonic

Hypotonic



High
concentration
solution

Equal
concentration
solution

Low
concentration
solution

Fluid moves
OUT of cell
(shrivels)

Fluid moves
INTO and **OUT**
of cell

Fluid moves **INTO**
cell
(swells/ruptures)

Hyper-, iso-, and hypo- are **comparison** words. You can't talk about a hypertonic solution without having something else to compare it to.

Hypertonic - concentration is *higher than* a compared solution

Isotonic - concentration is *the same as* a compared solution

Hypotonic - concentration is *lower than* a compared solution

We'll compare the solution in the jar to the "solution" in the cell = the cytoplasm

Review:

What are the parts of a solution? Give examples.

Solvent = the liquid portion.
This is often water.

Solute = the solid portion,
dissolved in the solvent.
Can be salts, sugar, proteins,
or other molecules.

Solution A = 100ppm & B = 500ppm
Describe A compared to B.

Solution A has a lower
concentration of solute than
Solution B ($100 < 500$).

Solution A is **hypotonic** to
Solution B.

Which direction would water
flow in the previous question?

Water would flow across a
membrane **from Solution A
to Solution B.**

Review:

Describe the result if a cell is put into a hypertonic solution.

A hypertonic solution has a HIGHER concentration of solute than the cell.

Water will move from inside the cell (LOWER concentration) to outside of the cell.

This will cause the cell to **shrivele** up.

Describe the relationship of a glass of pure water to a cell in terms of tonicity.

A glass of pure water has no solutes and is only solvent.

A cell has numerous solutes in its cytoplasm.

The water is **hypotonic** to the cell.

CONVERSELY, the cell is **hypertonic** to the water.

What happens if you put that cell in that glass of pure water?

Water (solvent) will move across the cell membrane from the glass **INTO** the cell.

Water moves from a lower concentrated solution to a higher concentrated solution.

The water is hypotonic (lower concentration) to the cell (higher concentration).

This will cause the cell to **swell**, and possibly **lyse/rupture**.

**THIS NOW CONCLUDES THE
EMERGENCY MESSAGE. WE WILL
RETURN TO YOUR REGULARLY
SCHEDULED PROGRAM.**

THANK YOU!

Types of fluids

Crystalloid

An aqueous solution composed of water and small solutes such as glucose, mineral salts, electrolytes, and other water-soluble molecules.

- Balanced - with various electrolytes, salts
- Saline - only NaCl

- Easily absorbed and redistributed from intravascular space into interstitial space

Colloid

A homogenous mixture of insoluble particles suspended in fluid. These particles generally are larger than the solutes of a crystalloid.

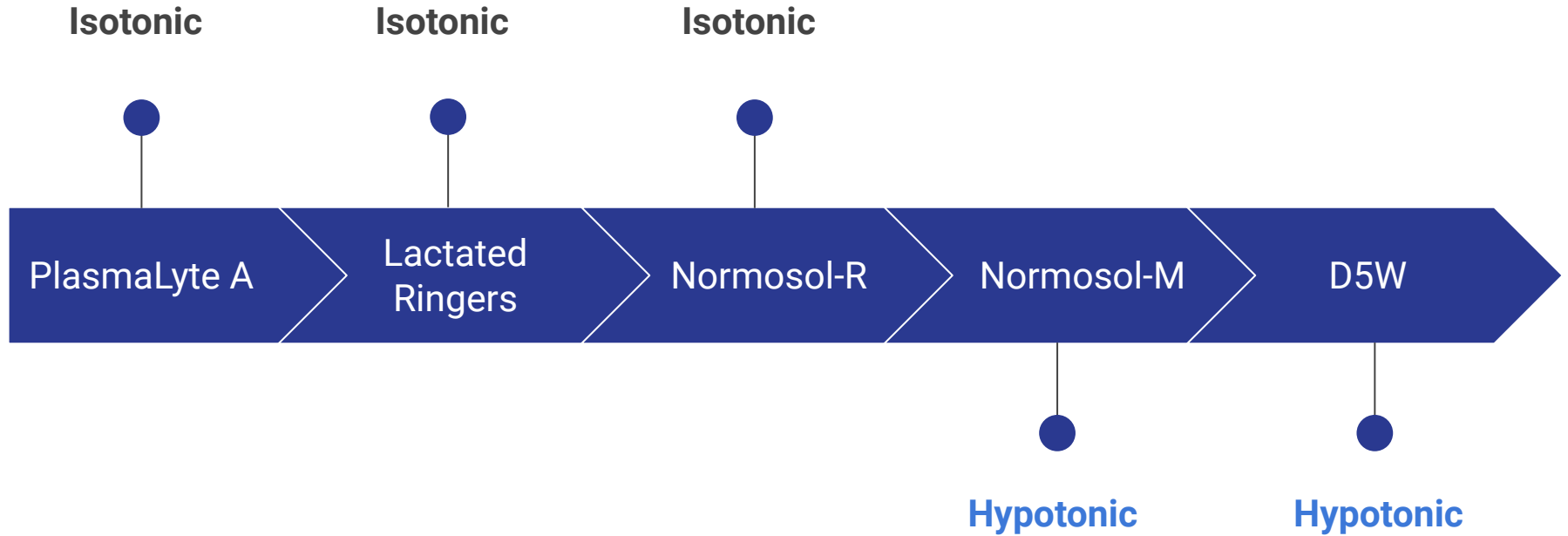
- Synthetic/artificial
- Natural

- Larger molecules keep the majority of the colloid fluids in the intravascular system longer



CRYSTALLOIDS

Balanced



CRYSTALLOIDS

Saline

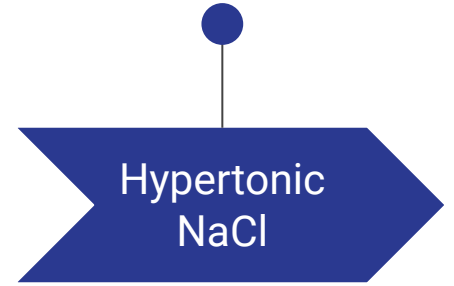
Isotonic



Hypotonic



Hypertonic



Crystalloids

- Differences in electrolyte concentrations
- Canine plasma osmolarity = 290 - 310
- Feline plasma osmolarity = 308 - 335

Normosol-M and D5W are considered hypotonic because even though they BEGIN as isotonic solutions, the sugar (Dextrose) is rapidly metabolized, and the remaining fluid contains little to no additional solute.

Solution	Na+ (mEq/L)	Cl- (mEq/L)	K+ (mEq/L)	Mg++ (mEq/L)	Glucose (g/L)	Osmolarity (mOsm/L)
LRS	130	109	4	0	0	273
Normosol-R	140	98	5	3	0	296
Plasmalyte	140	98	10	3	0	296
Normosol-M	40	40	13	3	50	364
D5W						252
0.9% saline	154	154	0	0	0	308
0.45% saline	77	77	0	0	0	154

COLLOIDS

Hetastarch



Crystalloid Maintenance Rate

30ml per pound per day

**This and the following rates discussed are AAVEC's standard rates. Variations exist at other clinics.

So what exactly does that 1xM rate mean?

For every 1lb of animal, you will give 30ml fluid in a day.

OR

In one day, you will give 30ml fluid for each 1lb that your patient weighs.

OR

$$\mathbf{30ml \times \underline{\hspace{1cm}} lb \div 24hr}$$

(rate will be in **ml/hr**, so use 24 hours)

30ml per pound per day

OR

30ml/lb/day

= 1xM

Calculate:

50lb dog, 1xM

Multiply our weight by the fluids per pound (30ml)

$$30\text{ml} \times 50\text{lb}$$

Then divide by 24 hours

$$\div 24\text{hr} = 62.5\text{ml/hr}$$

Set the pump rate for
63ml/hr

Round up when decimal is
0.5 or greater

19lb dog, 1xM

$$30\text{ml} \times 19\text{lb} \div 24\text{hr} =$$

$$23.75\text{ml/hr}$$

Set the pump rate for
24ml/hr

88lb dog, 1xM

$$30\text{ml} \times 88\text{lb} \div 24\text{hr}$$

$$= 110\text{ml/hr}$$

Set the pump rate for
110ml/hr

Now what if you want a rate other than 1xM?

For example:

2xM

You can use original formula:

$$30\text{ml} \times \text{_____ lb} \div 24\text{hr} \times 2$$

Or you can put that factor of 2 in somewhere else:

$$(30 \times 2)$$

$$\underline{60}\text{ml} \times \text{_____ lb} \div 24\text{hr}$$

60ml per pound per day

OR

$$30\text{ml/lb/day} \times 2$$

$$= 2\text{xM}$$

Calculate:

35lb dog, 2xM (way 1)

Multiply our weight by the fluids per pound (30ml)

$$30\text{ml} \times 35\text{lb}$$

Then divide by 24 hours

$$\div 24\text{hr} = 43.75\text{ml/hr}$$

which is 1xM, so now multiply by 2 to get 2xM

$$43.75\text{ml/hr} \times 2 =$$

$$87.5\text{ml/hr}$$

Set the pump rate for 88ml/hr

35lb dog, 2xM (way 2)

Multiply 2x30 because 2xM is double the fluids per lb

$$60\text{ml} \times 35\text{lb}$$

Then divide by 24 hours

$$\div 24\text{hr} = 87.5\text{ml/hr}$$

Set the pump rate for 88ml/hr

13lb cat, 2xM

$$60\text{ml} \times 13\text{lb} \div 24\text{hr}$$

$$= 32.5\text{ml/hr}$$

Set the pump rate for 33ml/hr

Calculate:

67.3lb dog, 2xM

$$60\text{ml} \times 67.3\text{lb} \div 24\text{hr}$$

$$= 168.25\text{ml/hr}$$

Set the pump rate for
168ml/hr

7.4lb cat, 2xM

$$60\text{ml} \times 7.4\text{lb} \div 24\text{hr}$$

$$= 18.5\text{ml/hr}$$

Set the pump rate for
18ml/hr

*Round DOWN if <10 lb

125lb dog, 2xM

$$60\text{ml} \times 125\text{lb} \div 24\text{hr}$$

$$= 312.5\text{ml/hr}$$

Set the pump rate for
313ml/hr

You can apply the same rules to other maintenance rates.

1.5xM

You can use original formula:

$$30\text{ml} \times \underline{\hspace{2cm}} \text{ lb} \div 24\text{hr} \times 1.5$$

Or you can put that factor of 1.5 in somewhere else:

(30 x 1.5)

$$\underline{45}\text{ml} \times \underline{\hspace{2cm}} \text{ lb} \div 24\text{hr}$$

45ml per pound per day

OR

30ml/lb/day x 1.5

= 1.5xM

You can apply the same rules to other maintenance rates.

0.5xM

You can use original formula:

$$30\text{ml} \times \text{_____ lb} \div 24\text{hr} \times 0.5$$

Or you can put that factor of 0.5 in somewhere else:

(30 x 0.5)

$$\underline{15}\text{ml} \times \text{_____ lb} \div 24\text{hr}$$

15ml per pound per day

OR

$$30\text{ml/lb/day} \times 0.5$$

$$= \mathbf{0.5xM}$$

Calculate:

59lb dog, 1.5xM (way 1)

Multiply our weight by the fluids per pound (30ml)

$$30\text{ml} \times 59\text{lb}$$

Then divide by 24 hours

$$\div 24\text{hr} = 73.75\text{ml/hr}$$

which is 1xM, so now multiply x1.5 to get 1.5xM

$$43.75\text{ml/hr} \times 1.5 = 110.625\text{ml/hr}$$

Set the pump rate for 111ml/hr

27lb dog, 0.5xM (way 2)

Multiply 30x0.5 because 0.5xM is half the fluids per lb

$$15\text{ml} \times 27\text{lb}$$

Then divide by 24 hours

$$\div 24\text{hr} = 16.875\text{ml/hr}$$

Set the pump rate for 17ml/hr

18.5lb cat, 1.5xM

$$45\text{ml} \times 13\text{lb} \div 24\text{hr} =$$

$$34.6875\text{ml/hr}$$

Set the pump rate for 35ml/hr

You also may (less frequently) see:

3xM

You can use original formula:

$$30\text{ml} \times \text{_____ lb} \div 24\text{hr} \times 3$$

Or you can put that factor of 3 in somewhere else:

(30 \times 3)

$$90\text{ml} \times \text{_____ lb} \div 24\text{hr}$$

90ml per pound per day

OR

30ml/lb/day \times 3

= 3xM

You also may (less frequently) see:

0.75xM

You can use original formula:

$$30\text{ml} \times \text{_____ lb} \div 24\text{hr} \times 0.75$$

Or you can put that factor of 0.75 in somewhere else:

(30 x 0.75)

$$\underline{22.5}\text{ml} \times \text{_____ lb} \div 24\text{hr}$$

22.5ml per pound per day

OR

30ml/lb/day x 0.75

= 0.75xM

Calculate:

29lb dog, 3xM

$$90\text{ml} \times 29\text{lb} \div 24\text{hr} =$$

108.75ml/hr

Set the pump rate for
109ml/hr

74lb dog, 0.75xM

$$22.5\text{ml} \times 74\text{lb} \div 24\text{hr} =$$

69.375ml/hr

Set the pump rate for
69ml/hr

11lb cat, 3xM

$$90\text{ml} \times 11\text{lb} \div 24\text{hr} =$$

41.25ml/hr

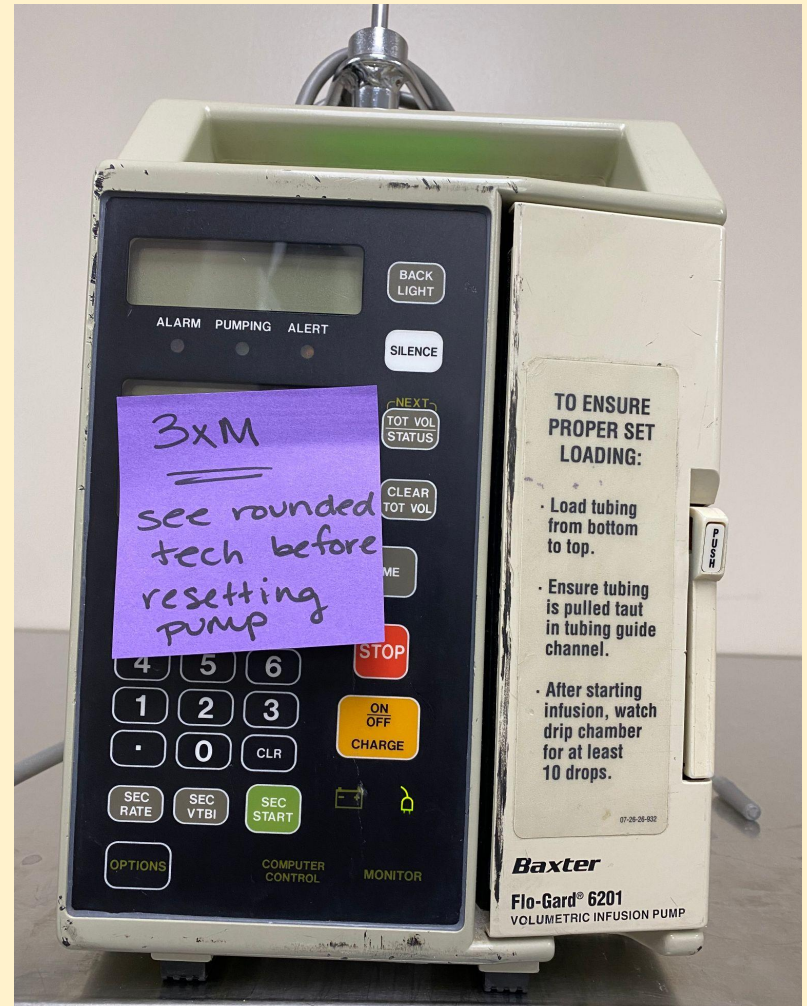
Set the pump rate for
41ml/hr

Take note!

If you have a patient on a rate of fluids greater than 2xM, put a note on the pump indicating that.

Often, 2.5xM or 3xM are only used for a brief period of time (1 - 3 hours).

The patient will be reassessed frequently to determine if such a high fluid rate is still warranted.



Colloid Maintenance Rate

20ml per kg per day

So what does that mean?

For every 1kg of animal, you will give 20ml colloid fluids in a day.

OR

In one day, you will give 20ml colloid fluids for each 1kg that your patient weighs.

OR

$$20\text{ml} \times \text{_____ kg} \div 24\text{hr}$$

(rate will be in **ml/hr**, so use 24 hours)

20ml per kg per day

OR

20ml/kg/day

= 1xM



Let's practice!

Calculate:

35kg dog, 1xM HES

Multiply our weight by the fluids per kilogram (20ml)

$$20\text{ml} \times 35\text{kg}$$

Then divide by 24 hours

$$\div 24\text{hr} = 29.17\text{ml/hr}$$

**Set the pump rate for
29ml/hr**

**Round down when decimal is
smaller than 0.5**

4.7kg cat, 1xM HES

$$20\text{ml} \times 4.7\text{kg} \div 24\text{hr} =$$

$$3.916\text{ml/hr}$$

Set the pump rate for 4ml/hr

48lb dog, 1xM HES

$$48\text{lb} \div 2.2 = 21.818\text{kg}$$

$$20\text{ml} \times 21.818\text{kg} \div 24\text{hr} =$$

$$18.18\text{ml/hr}$$

**Set the pump rate for
18ml/hr**

Surgical Rate

5ml per kg per hour

So what does that mean?

For every 1kg of animal, you will give 5ml fluid in an hour.

OR

In one hour, you will give 5ml fluid for each 1kg that your patient weighs.

OR

5ml x _____ kg per hr

(rate will be in **ml/hr**)

5ml per kg per hour

OR

5ml/kg/hr

= surgical rate

SOMETIMES, the doctor will request 10ml/kg/hr. This is an older formula, but in an emergency surgery, can still be warranted for animals that are severely “behind” on their fluid needs.



Let's practice!

Calculate:

44kg dog, sx rate

Multiply our weight by the fluids per kg (5ml)

$$5\text{ml} \times 44\text{kg} = 220\text{ml /hr}$$

**Set the pump rate for
220ml/hr**

19.3kg dog, sx rate

$$5\text{ml} \times 19.3\text{kg} = 96.5\text{ml /hr}$$

**Set the pump rate for
97ml/hr**

6.4kg cat, sx rate

$$5\text{ml} \times 6.4\text{kg} = 32\text{ml /hr}$$

**Set the pump rate for
32ml/hr**

Calculate:

47lb dog, sx rate

Find the weight in kg

$$47\text{lb} \div 2.2 = 21.36\text{kg}$$

Multiply our weight by the fluids per kg (5ml)

$$5\text{ml} \times 21.36\text{kg} = 106.8\text{ml/hr}$$

**Set the pump rate for
107ml/hr**

29kg dog, sx rate**

$$10\text{ml} \times 29\text{kg} = 290\text{ml/hr}$$

**Set the pump rate for
290ml/hr**

7.3lb cat, sx rate

$$7.3\text{lb} \div 2.2 = 3.318\text{kg}$$

$$5\text{ml} \times 3.32\text{kg} = 16.6\text{ml/hr}$$

**Set the pump rate for
16ml/hr**

**DVM requests 10ml/kg/hr

Special Circumstances

Combining Fluid Rates

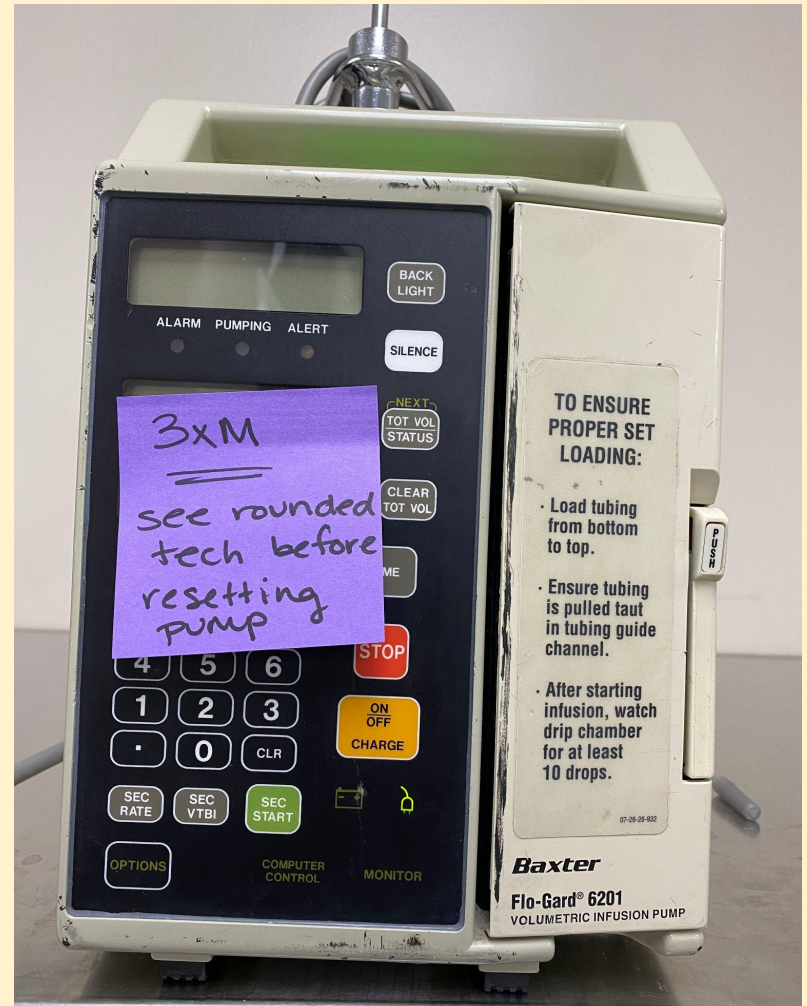
Often, a patient will be on more than one type of fluid.

How do we manage multiple fluid rates?

Add them up!

- Fluids are cumulative
- Rate 1 + Rate 2 = Total Rate

Let's look at some examples:



Example 1: Daisy is a 28lb Beagle. She is on 1xM PlasmaLyte and 1xM HES.

a) What is her **PlasmaLyte** rate?

$$28\text{lb} \times 30\text{ml} \div 24 \text{ hr} = \mathbf{35\text{ml/hr}}$$

b) What is her **Hetastarch** rate?

$$28\text{lb} \div 2.2 = 12.72\text{kg}$$

$$12.72\text{kg} \times 20\text{ml} \div 24 \text{ hr} = 10.6\text{ml/hr}$$

Round to **11ml/hr**

c) What is her **total fluid** rate?

PlasmaLyte + **Hetastarch** = **total rate**

$$\mathbf{35\text{ml/hr} + 11\text{ml/hr} = 46\text{ml/hr}}$$



Example 2: Briggs is a 79lb Lab x. He is on 1.5xM PlasmaLyte and an Insulin CRI at 8 ml/hr.

a) What is his **PlasmaLyte** rate?

$$79\text{lb} \times 45\text{ml} \div 24 \text{ hr} = \mathbf{148\text{ml/hr}}$$

b) What is his **Insulin** rate?

This is given =

$$\text{Insulin rate} = \mathbf{8\text{ml/hr}}$$

c) What is his **total fluid** rate?

$$\mathbf{\text{PlasmaLyte} + \text{Insulin} = \text{total rate}}$$

$$\mathbf{148\text{ml/hr} + 8\text{ml/hr} = 156\text{ml/hr}}$$



Example 3: Madame Meow is an 8.3lb DSH. She is on 0.5xM PlasmaLyte, 1xM HES, and a Fentanyl CRI at 3mcg/kg/hr.

a) What is her **PlasmaLyte** rate?

$$8.3\text{lb} \times 15\text{ml} \div 24 \text{ hr} = \mathbf{5.2\text{ml/hr}}$$

b) What is her **Hetastarch** rate?

$$8.3\text{lb} \div 2.2 = 3.77\text{kg}$$

$$3.77\text{kg} \times 20\text{ml} \div 24 \text{ hr} = \mathbf{3.1\text{ml/hr}}$$

c) What is her **Fentanyl CRI** rate?

$$3.77\text{kg} \times 3\text{mcg/kg/hr} \div 50\text{mcg/ml} = 0.226\text{ml/hr}$$

$$\text{Dilute with } 2.77\text{ml NaCl for } 3=3 = \mathbf{3\text{ml/hr}}$$

d) What is her **total fluid** rate?

$$\mathbf{\text{PlasmaLyte} + \text{Hetastarch} + \text{Fentanyl} = \text{total rate}}$$

$$\mathbf{5.2\text{ml/hr} + 3.1\text{ml/hr} + 3\text{ml/hr} = 11.3\text{ml/hr}}$$

11.3ml/hr



We don't want to forget about the potential for fluid overload though!

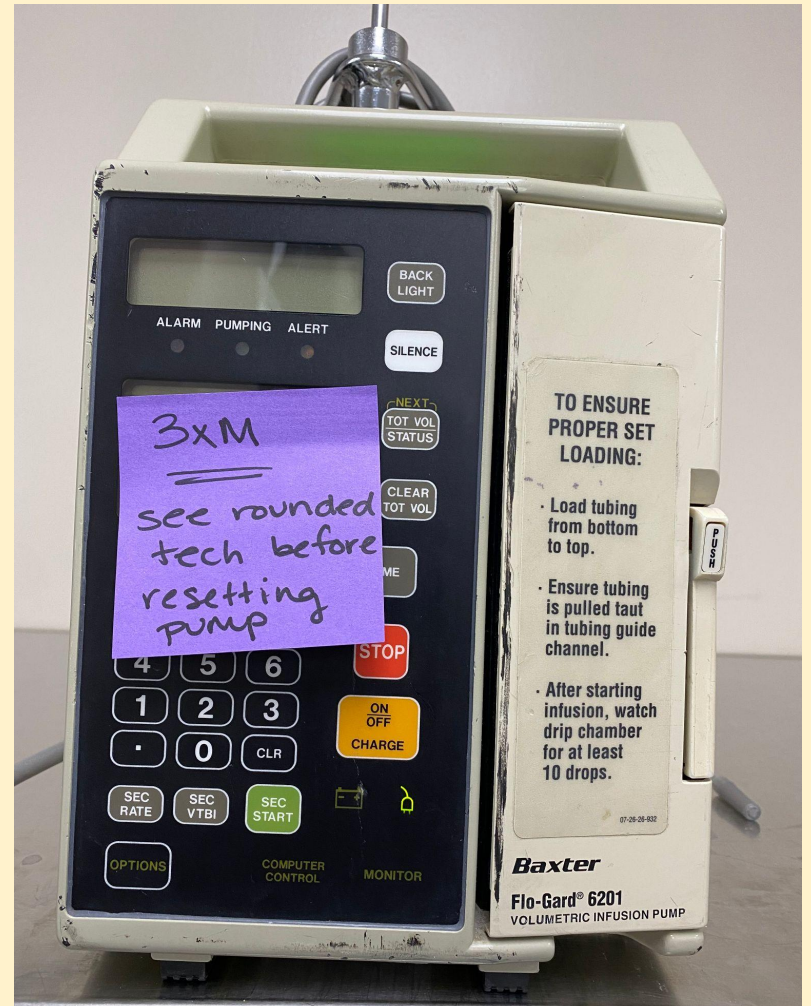
Frequently, we are given instructions to run a number of different fluids at

a total of __ xM.

We still add them up, but might have to make some adjustments

- Always keep rates for “special fluids”
 - Medication CRIs
 - Colloids (HES, blood)
- We can adjust our crystalloid rate though

Let's look at some examples:



Example 4: Daisy is a 28lb Beagle. She is on 1xM PlasmaLyte and 1xM HES. The DVM wants a total of 1xM.

a) What is her **PlasmaLyte** rate?

$$28\text{lb} \times 30\text{ml} \div 24 \text{ hr} = \mathbf{35\text{ml/hr}}$$

b) What is her **Hetastarch** rate?

$$28\text{lb} \div 2.2 = 12.72\text{kg}$$

$$12.72\text{kg} \times 20\text{ml} \div 24 \text{ hr} = 10.6\text{ml/hr}$$

Round to **11ml/hr**

c) What is her **total fluid** rate?

PlasmaLyte + **Hetastarch** = **total rate**

$$\mathbf{35\text{ml/hr} + 11\text{ml/hr} = 46\text{ml/hr}}$$

But our fluid “cap” is 1xM, or 35ml/hr. Now what?



PlasmaLyte + Hetastarch = total rate

$$\underline{\hspace{1cm}} \text{ ml/hr} + \underline{\hspace{1cm}} \text{ ml/hr} = \underline{\hspace{1cm}} \text{ ml/hr}$$

And we are told our total rate = 1xM, so **35ml/hr**

$$\underline{\hspace{1cm}} \text{ ml/hr} + \underline{\hspace{1cm}} \text{ ml/hr} = \mathbf{35 \text{ ml/hr}}$$

a) **Hetastarch** is a colloid - don't adjust that rate.

$$\underline{\hspace{1cm}} \text{ ml/hr} + \mathbf{11 \text{ ml/hr}} = \mathbf{35 \text{ ml/hr}}$$

b) **PlasmaLyte** is a crystalloid - this is where we make rate adjustments.

$$\underline{\hspace{1cm}} \text{ ml/hr} + \mathbf{11 \text{ ml/hr}} = \mathbf{35 \text{ ml/hr}}$$

Solve by taking **total rate** and subtract **special rate(s)**

$$\mathbf{35 \text{ ml/hr}} - \mathbf{11 \text{ ml/hr}} = \underline{\hspace{1cm}} \text{ ml/hr}$$

$$\mathbf{35 \text{ ml/hr}} - \mathbf{11 \text{ ml/hr}} = \mathbf{24 \text{ ml/hr}}$$



Example 5: Madame Meow is an 8.3lb DSH. She is on 0.5xM PlasmaLyte, 1xM HES, and a Fentanyl CRI at 3mcg/kg/hr. **We want a total of 1xM.**

a) What is her **PlasmaLyte** rate?

$$8.3\text{lb} \times 15\text{ml} \div 24 \text{ hr} = \mathbf{5.2\text{ml/hr}}$$

b) What is her **Hetastarch** rate?

$$8.3\text{lb} \div 2.2 = 3.77\text{kg}$$

$$3.77\text{kg} \times 20\text{ml} \div 24 \text{ hr} = \mathbf{3.1\text{ml/hr}}$$

c) What is her **Fentanyl CRI** rate?

$$3.77\text{kg} \times 3\text{mcg/kg/hr} \div 50\text{mcg/ml} = 0.226\text{ml/hr}$$

$$\text{Dilute with } 2.77\text{ml NaCl for } 3=3 = \mathbf{3\text{ml/hr}}$$

d) What is her **total fluid** rate?

$$\mathbf{\text{PlasmaLyte} + \text{Hetastarch} + \text{Fentanyl} = \text{total rate}}$$

$$\mathbf{5.2\text{ml/hr} + 3.1\text{ml/hr} + 3\text{ml/hr} = 11.3\text{ml/hr}}$$



??? ml/hr

Total of 1xM = $8.3\text{lb} \times 30\text{ml} \div 24\text{ hr} = 10.4\text{ml/hr}$

PlasmaLyte + **Hetastarch** + **Fentanyl** = total rate

___ml/hr + ___ml/hr + ___ml/hr = 10.4ml/hr

a) **Hetastarch** is a colloid - don't adjust that rate.

___ml/hr + 3.1ml/hr + ___ml/hr = 10.4ml/hr

b) **Fentanyl CRI** is a medication - don't adjust that rate.

___ml/hr + 3.1ml/hr + 3ml/hr = 10.4ml/hr

c) **PlasmaLyte** is a crystalloid - this is where we make rate adjustments.

Solve by taking **total rate** and subtract **special rate(s)**

$10.4\text{ml/hr} - 3.1\text{ml/hr} + 3\text{ml/hr} = \text{___ml/hr}$

$10.4\text{ml/hr} - 3.1\text{ml/hr} + 3\text{ml/hr} = 4.3\text{ml/hr}$



10.4ml/hr

Boluses

___ml over ___time

What IS a bolus?

A volume of fluid (or a dose of medication) given rapidly and at one time.

How do you calculate a bolus?

(A) You are told an amount over a time period

Give 500ml over 1hr

(B) You are told a dose over a time period

Give 10ml/kg over 1hr

How do you set your pump for a bolus?

- Need to calculate and set rate
- Need to determine and set VTBI

_____ml over _____time

= bolus rate

Example 1: Give 500ml over 1hr

We need to set our pump.

How much fluid are we giving?

DON'T OVERTHINK THIS!

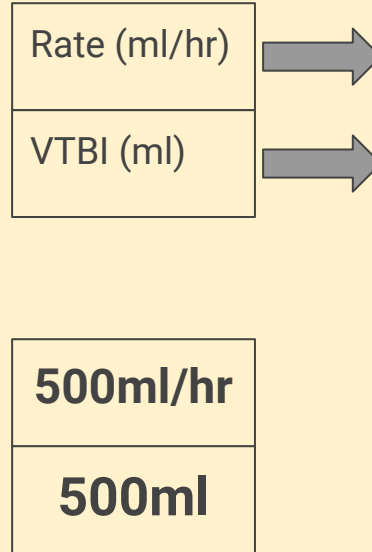
500ml - This is our Volume Io Be Infused (VTBI)

How fast are we giving it?

Over 1 hour ... or PER hour (/hr)

This looks a lot like a *rate*, right? It is.

500ml/hr - This is our RATE





Let's practice!

Calculate:

200ml over 1hr

How much are we giving?
200ml
That is our VTBI

Set the VTBI for 200ml

How fast are we giving it?

Over 1 hour (or per hr)(/hr)
Volume/Time = Rate
200ml/hr for 1 hour

**Set the pump rate for
200ml/hr**

475ml over 1hr

How much are we giving?
475ml
That is our VTBI

Set the VTBI for 475ml

How fast are we giving it?

Over 1 hour (or per hr)(/hr)
Volume/Time = Rate
475ml/hr for 1 hour

**Set the pump rate for
475ml/hr**

1200ml over 1hr

How much are we giving?
1200ml = VTBI

Set the VTBI for 1200ml

How fast are we giving it?

Over 1 hour (or per hr)(/hr)
Volume/Time = Rate
1200ml/hr for 1 hour
**But most of the pumps don't
allow this high of a rate!**

**Set the pump rate for
999ml/hr or OPEN****

Example 2: Give 500ml over 30min

We need to set our pump.

How much fluid are we giving?

DON'T OVERTHINK THIS!

500ml - This is our Volume Io Be Infused (VTBI)

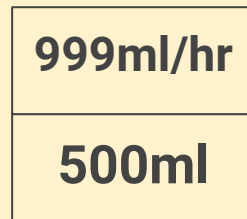
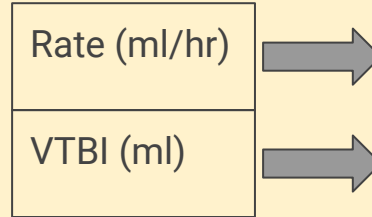
How fast are we giving it?

Over 30min ... which is half an hour

There are two half hours in a whole hour, so multiply your volume by 2 to get your rate

$$500\text{ml} \times 2 =$$

1000ml/hr - This is our RATE (well, 999ml/hr)



Frequently, you will be asked to give boluses over 30min, 20min, 15min, 10min...

Knowing the right multiplication factor saves time and headaches! Don't be this person!



If over 30min

Multiply volume by **2**

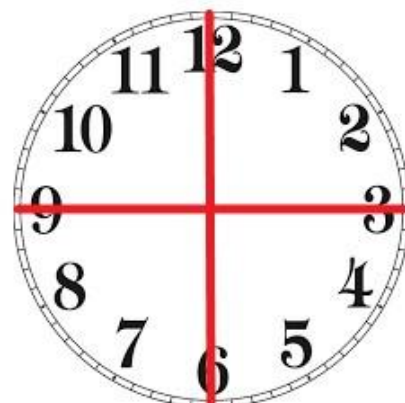
(30 x 2 = 60min)



If over 20min

Multiply volume by **3**

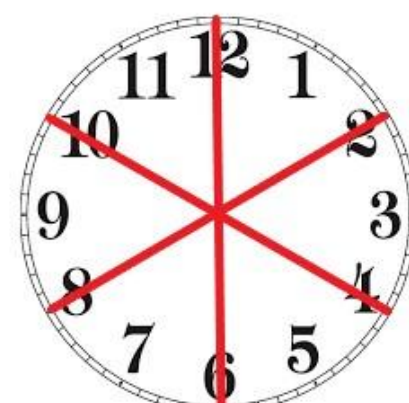
(20 x 3 = 60min)



If over 15min

Multiply volume by **4**

(15 x 4 = 60min)



If over 10min

Multiply volume by **6**

(10 x 6 = 60min)

Another way to think about it...

Example 3: Give 100ml over 15min. How do we set the pump?

How much fluid are we giving?

Remember - usually you are GIVEN the VTBI, or the volume (amount) of fluids you want to give.

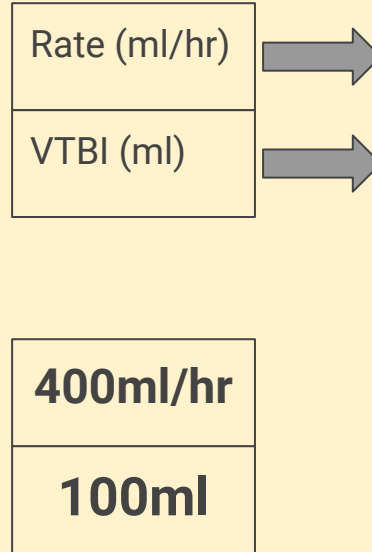
100ml - This is our Volume Io Be Infused (VTBI)

How fast are we giving it?

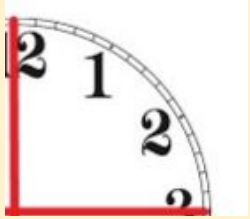
Over 15min ... = a quarter of an hour (/hr)

There are 4 quarters in a whole, so you will be giving the fluids 4 times as fast.

100ml x 4 = 400ml/hr - This is our RATE

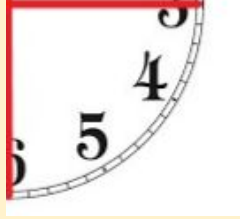


If it helps to visualize this: Give 100ml over 15 min. Set the pump.



In the first 15 minutes, we want our patient to get 100ml

100ml



In the second 15 minutes, our patient will get another 100ml

100ml



In the third 15 minutes, our patient will get another 100ml

100ml



In the fourth 15 minutes, our patient will get yet another 100ml

100ml

So, if we are asked to give 100ml over 15min, but then consider what would happen if we continued the same rate for a full hour, the volume that the patient *would* receive in that hour is what the ml/hr rate is.

400ml/hr
100ml

$$100\text{ml} + 100\text{ml} + 100\text{ml} + 100\text{ml} = 400\text{ml}$$

For a more mathematical formula: **Give 100ml over 15 min. Set the pump.**

$$\text{Rate} = \frac{\text{Volume}}{\text{Time}}$$

Remember units - for rate, use **hours**

$$\text{Rate} = \frac{100\text{ml}}{0.25\text{hr}}$$

$$100\text{ml} \div 0.25\text{hr} = 400 \text{ ml/hr}$$

$$\text{Rate} = 400\text{ml/hr}$$

400ml/hr
100ml

Cheat Sheet

Over 30min Rate = $\frac{\text{Volume (ml)}}{0.5\text{hr}}$

*Over 20min Rate = $\frac{\text{Volume (ml)}}{0.33\text{hr}}$

Over 15min Rate = $\frac{\text{Volume (ml)}}{0.25\text{hr}}$

*Over 10min Rate = $\frac{\text{Volume (ml)}}{0.167\text{hr}}$

*Dividing by 0.33 or 0.167 give an approximate rate because those numbers are rounded



Let's practice!

Calculate:

350ml over 30min

How much are we giving?
350ml

That is our VTBI

Set the VTBI for 350ml

How fast are we giving it?

Over 30min (or per $\frac{1}{2}$ hr)

Volume/Time = Rate

$350\text{ml} \div 0.5\text{hr} = 700\text{ml/hr}$

OR

$350\text{ml} \times 2 = 700\text{ml/hr}$

Set the Rate for 700ml/hr

80ml over 15min

How much are we giving?
80ml

That is our VTBI

Set the VTBI for 80ml

How fast are we giving it?

Over 15min (or per $\frac{1}{4}$ hr)

Volume/Time = Rate

$80\text{ml} \div 0.25\text{hr} = 320\text{ml/hr}$

OR

$80\text{ml} \times 4 = 320\text{ml/hr}$

Set the Rate for 320ml/hr

150ml over 20min

How much are we giving?
150ml = VTBI

Set the VTBI for 150ml

How fast are we giving it?

Over 20min (or per $\frac{1}{3}$ hr)

Volume/Time = Rate

$150\text{ml} \div 0.33\text{hr} = 454.5\text{ml/hr}$

OR

$150\text{ml} \times 3 = 450\text{ml/hr}$

Set the Rate for 450ml/hr

Calculate:

40ml over 10min

How much are we giving?
40ml = VTBI

Set the VTBI for 40ml

How fast are we giving it?

Over 10min (or per $\frac{1}{6}$ hr)

$$40\text{ml} \div 0.167\text{hr} = 239.5\text{ml/hr}$$

OR

$$40\text{ml} \times 6 = 240\text{ml/hr}$$

Set the Rate for 240ml/hr

1L over 30min

How much are we giving?
1000ml = VTBI

Set the VTBI for 1000ml

How fast are we giving it?

Over 30min (or per $\frac{1}{2}$ hr)

$$1000\text{ml} \div 0.5\text{hr} = 2000\text{ml/hr}$$

OR

$$1000\text{ml} \times 2 = 2000\text{ml/hr}$$

**Set the Rate for 1999ml/hr
or OPEN line****

280ml over 20min

How much are we giving?
280ml = VTBI

Set the VTBI for 280ml

How fast are we giving it?

Over 20min (or per $\frac{1}{3}$ hr)

$$280\text{ml} \div 0.33\text{hr} = 848.4\text{ml/hr}$$

OR

$$280\text{ml} \times 3 = 840\text{ml/hr}$$

Set the Rate for 840ml/hr

Fluid Additives

What are common fluid additives?

Why do we need them?

How to calculate additives in

- Fluid bags
 - Buretols
 - Syringes
-

What are common fluid additives?

1. **KCl (Potassium Chloride)**
 - Concentration: 2 mEq/ml
2. **KPhos (Potassium Phosphates)**
 - Concentration: 4.4 mEq/ml
3. **B-Vitamins**
 - Multiple vitamin complex
4. **Dextrose**
 - Concentration: 50% solution
5. **Reglan**
 - Concentration: 5mg/ml



Why do we need fluid additives?

- 1. KCl (Potassium Chloride)**
 - Electrolyte supplementation
 - Treat hypokalemia
- 2. KPhos (Potassium Phosphates)**
 - Electrolyte supplementation
 - Treat hypokalemia, hypophosphatemia
- 3. B-Vitamins**
 - Water-soluble (not stored in body)
 - Metabolic processes, brain & neurological function, immune function, production of hormones, co- /enzymes proteins, and fatty acids, DNA expression and regulation, cell communication, creating new RBCs
- 4. Dextrose**
 - Treat hypoglycemia
 - Provide some nutritional support
- 5. Reglan**
 - Gut motility stimulator (upper GI)
 - Antiemetic (also prevents esophageal reflux)



How do we add our additives?

Let's deal with **KCl**.

Usually, you are given instructions to add ___mEq/L
KCl to a patient's fluids.

What does this mean?

For every 1000ml fluids, you will add ___mEq of KCl



WAY 1

Ex: We want 10mEq/L KCl and we are starting with a full 1L fluid bag. How much KCl do we need?

$$\frac{\text{given mEq}}{1\text{L}} : \frac{x \text{ mEq}}{1\text{L}}$$

$$\frac{10\text{mEq}}{1\text{L}} \quad \begin{array}{c} \bullet \nearrow \\ \bullet \searrow \end{array} \quad \frac{x \text{ mEq}}{1\text{L}}$$

Solving for x by cross-multiplying:

$$10\text{mEq} \times 1\text{L} = 1\text{L} \times x \text{ mEq}$$

$$10\text{mEq} = x \text{ mEq}$$

$$x = 10\text{mEq}$$

Now convert to ml (divide by concentration of bottle)

$$10\text{mEq} \div 2\text{mEq/ml} = 5\text{ml}$$

You will add 5ml KCl to a 1L bag for 10mEq/L KCl.

$$\frac{\text{given mEq}}{1\text{L}} : \frac{x \text{ mEq}}{1\text{L}}$$

$$x = \text{wanted mEq}$$

Divide by concentration (mEq/ml)

$$= \text{wanted ml}$$

WAY 1

Ex: We want 30 mEq/L KCl and we are starting with 600ml in our fluid bag.

$$\frac{\text{given mEq}}{1\text{L}} : \frac{x \text{ mEq}}{600\text{ml}}$$

$$\frac{30\text{mEq}}{1000\text{ml}} : \frac{x \text{ mEq}}{600\text{ml}}$$

Solving for x by cross-multiplying:

$$30\text{mEq} \times 600\text{ml} = 1000\text{ml} \times x \text{ mEq}$$

$$18000 \text{ mlmEq} = 1000x \text{ mlmEq}$$

Divide both sides by 1000ml to isolate x

$$18.0 \text{ mEq} = x \text{ mEq}$$

$$x = 18 \text{ mEq}$$

Now convert to ml (divide by concentration)

$$18\text{mEq} \div 2\text{mEq/ml} = 9\text{ml}$$

You will add 9ml KCl to a bag with 600ml fluid for 30mEq/L KCl.

WAY 2

Ex: We want 10mEq/L KCl and we are starting with a full 1L fluid bag.

Convert mEq to ml.

$$10\text{mEq} \div 2\text{mEq/ml} = 5\text{ml KCl}$$

Divide ml of KCl by ml in one liter.

$$5\text{ml} \div 1000\text{ml} = 0.005\text{ml KCl (per 1 ml fluid)}$$

Multiply by amount of fluid in bag.

$$0.005\text{ml KCl} \times 1000\text{ml} = 5\text{ml KCl}$$

This is the amount of KCl to add.

You will add 5ml KCl to a 1L bag for 10mEq/L KCl.

This works for KPhos too!

Just remember to use the correct concentration.

WAY 2

Ex: We want 30 mEq/L KCl and we are starting with 600ml in our fluid bag.

Convert mEq to ml.

$$30\text{mEq} \div 2\text{mEq/ml} = 15\text{ml KCl}$$

Divide ml of KCl by ml in one liter.

$$15\text{ml} \div 1000\text{ml} = 0.015\text{ml KCl (per 1 ml fluid)}$$

Multiply by amount of fluid in bag.

$$0.015\text{ml KCl} \times 600\text{ml} = 9\text{ml KCl}$$

This is the amount of KCl to add.

You will add 9ml KCl to a 600ml bag for 30mEq/L KCl.

WAY 3

Ex: We want 10mEq/L KCl and we are starting with a full 1L fluid bag.

Convert your fluid amount in ml into L.

$$1000\text{ml} \div 1000\text{ml} = 1 \text{ L}$$

Multiply fluid in L by amount of KCl desired.

$$1\text{L} \times 10\text{mEq/L} = 10\text{mEq KCl}$$

Divide by concentration of KCl.

$$10\text{mEq KCl} \div 2\text{mEq/ml} = 5\text{ml KCl}$$

This is the amount of KCl to add.

You will add 5ml KCl to a 1L bag for 10mEq/L KCl.

This works for KPhos too!

Just remember to use the correct concentration.

WAY 3

Ex: We want 30 mEq/L KCl and we are starting with 600ml in our fluid bag.

Convert your fluid amount in ml into L.

$$600\text{ml} \div 1000\text{ml} = 0.6 \text{ L}$$

Multiply fluid in L by amount of KCl desired.

$$0.6\text{L} \times 30\text{mEq/L} = 18\text{mEq KCl}$$

Divide by concentration of KCl.

$$18\text{mEq KCl} \div 2\text{mEq/ml} = 9\text{ml KCl}$$

This is the amount of KCl to add.

You will add 9ml KCl to a 600ml bag for 30mEq/L KCl.

Way 1

Calculate:

20mEq/L KCl, 1L

$$\frac{20 \text{ mEq}}{1\text{L}} : \frac{x \text{ mEq}}{1\text{L}}$$

$$20\text{mEq} \times 1\text{L} = x \text{ mEq} \times 1\text{L}$$

$$20\text{mEq} = x \text{ mEq}$$

$$x = 20 \text{ mEq}$$

$$20\text{mEq} \div 2\text{mEq/ml} = 10\text{ml}$$

Add 10ml KCl to 1L bag

40mEq/L KCl, 750ml

$$\frac{40 \text{ mEq}}{1000\text{ml}} : \frac{x \text{ mEq}}{750\text{ml}}$$

$$40\text{mEq} \times 750\text{ml} = x \text{ mEq} \times 1000\text{ml}$$

$$30,000\text{mEqml} = 1000x \text{ mEqml}$$

$$x = 30 \text{ mEq}$$

$$30\text{mEq} \div 2\text{mEq/ml} = 15\text{ml}$$

Add 15ml KCl to 750ml bag

15mEq/L KCl, 400ml

$$\frac{15 \text{ mEq}}{1000\text{ml}} : \frac{x \text{ mEq}}{400\text{ml}}$$

$$15\text{mEq} \times 400\text{ml} = x \text{ mEq} \times 1000\text{ml}$$

$$6,000\text{mEqml} = 1000x \text{ mEqml}$$

$$x = 6 \text{ mEq}$$

$$6\text{mEq} \div 2\text{mEq/ml} = 3\text{ml}$$

Add 3ml KCl to 400ml bag

Way 2

Calculate:

20mEq/L KCl, 1L

$$20 \text{ mEq/L} \div 2\text{mEq/ml} = 10\text{ml/L}$$

$$10\text{ml/L} \div 1000\text{ml} = 0.01\text{ml KCl per 1ml fluids}$$

$$0.01\text{ml KCl per each ml fluids} \times 1000\text{ml (in bag)} = 10\text{ml}$$

Add 10ml KCl to 1L bag

40mEq/L KCl, 750ml

$$40 \text{ mEq/L} \div 2\text{mEq/ml} = 20\text{ml/L}$$

$$20\text{ml/L} \div 1000\text{ml} = 0.02\text{ml KCl per 1ml fluids}$$

$$0.02\text{ml KCl per each ml fluids} \times 750\text{ml (in bag)} = 15\text{ml}$$

Add 15ml KCl to 750ml bag

15mEq/L KCl, 400ml

$$15 \text{ mEq/L} \div 2\text{mEq/ml} = 7.5\text{ml/L}$$

$$7.5\text{mEq} \div 1000\text{ml} = 0.0075\text{ml KCl per 1ml fluids}$$

$$0.0075\text{ml KCl per each ml fluids} \times 400\text{ml (in bag)} = 3\text{ml}$$

Add 3ml KCl to 400ml bag

Way 3

Calculate:

20mEq/L KCl, 1L

$$1000\text{ml} \div 1000\text{ml/L} = 1\text{L}$$

$$1\text{L} \times 20\text{mEq/L} = 20\text{mEq}$$

$$20\text{mEq} \div 2\text{mEq/ml} = 10\text{ml}$$

Add 10ml KCl to 1L bag

40mEq/L KCl, 750ml

$$750\text{ml} \div 1000\text{ml/L} = 0.75\text{L}$$

$$0.75\text{L} \times 40\text{mEq/L} = 30\text{mEq}$$

$$30\text{mEq} \div 2\text{mEq/ml} = 15\text{ml}$$

Add 15ml KCl to 750ml bag

15mEq/L KCl, 400ml

$$400\text{ml} \div 1000\text{ml/L} = 0.4\text{L}$$

$$0.4\text{L} \times 15\text{mEq/L} = 6\text{mEq}$$

$$6\text{mEq} \div 2\text{mEq/ml} = 3\text{ml}$$

Add 3ml KCl to 400ml bag

Calculating **KPhos** as an additive works exactly the same way as KCl, but the *concentration is different*.

Usually, you are given instructions to add ___mEq/L KPhos to a patient's fluids.

What does this mean?

For every 1000ml fluids, you will add ___mEq of KPhos



Ex: We want 20mEq/L KPhos and we are starting with a full 1L fluid bag. How much KPhos do we need?

$$\frac{\text{given mEq}}{1\text{L}} : \frac{x \text{ mEq}}{1\text{L}}$$

$$\frac{20\text{mEq}}{1\text{L}} : \frac{x \text{ mEq}}{1\text{L}}$$

Solving for x by cross-multiplying:

$$20\text{mEq} \times 1\text{L} = 1\text{L} \times x \text{ mEq}$$

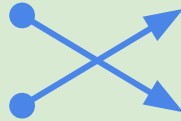
$$20\text{mEq} = x \text{ mEq}$$

$$x = 20\text{mEq}$$

Now convert to ml (divide by concentration)

$$20\text{mEq} \div 4.4\text{mEq/ml} = 4.54\text{ml}$$

You will add 4.5ml KPhos to a 1L bag for 20mEq/L KPhos.



$$\frac{\text{given mEq}}{1\text{L}} : \frac{x \text{ mEq}}{1\text{L}}$$

$$x = \text{wanted mEq}$$

Divide by concentration (mEq/ml)

$$= \text{wanted ml}$$

Ex: We want 15 mEq/L KPhos and we are starting with 550ml in our fluid bag.

$$\frac{\text{given mEq}}{1\text{L}} : \frac{\mathbf{x} \text{ mEq}}{550\text{ml}}$$

$$\frac{15\text{mEq}}{1000\text{ml}} : \frac{\mathbf{x} \text{ mEq}}{550\text{ml}}$$

Solving for **x** by cross-multiplying:

$$15\text{mEq} \times 550\text{ml} = 1000\text{ml} \times \mathbf{x} \text{ mEq}$$

$$8250 \text{ mlmEq} = 1000\mathbf{x} \text{ mlmEq}$$

Divide both sides by 1000ml to isolate **x**

$$8.25 \text{ mEq} = \mathbf{x} \text{ mEq}$$

$$\mathbf{x} = 8.25 \text{ mEq}$$

Now convert to ml (divide by concentration)

$$8.25\text{mEq} \div 4.4\text{mEq/ml} = 1.875\text{ml}$$

You will add 1.9ml KPhos to a bag with 550ml fluid for 15mEq/L KPhos.

Way 1

Calculate:

10mEq/L KPhos, 1L

$$\frac{10 \text{ mEq}}{1\text{L}} : \frac{x \text{ mEq}}{1\text{L}}$$

$$10\text{mEq} \times 1\text{L} = x \text{ mEq} \times 1\text{L}$$

$$10\text{mEq} = x \text{ mEq}$$

$$x = 10 \text{ mEq}$$

$$10\text{mEq} \div 4.4\text{mEq/ml} = 2.27\text{ml}$$

Add 2.3ml KPhos to 1L bag

5mEq/L KPhos, 300ml

$$\frac{5 \text{ mEq}}{1000\text{ml}} : \frac{x \text{ mEq}}{300\text{ml}}$$

$$5 \text{ mEq} \times 300\text{ml} = x \text{ mEq} \times 1000\text{ml}$$

$$1,500\text{mEqml} = 1000x \text{ mEqml}$$

$$x = 1.5 \text{ mEq}$$

$$1.5 \text{ mEq} \div 4.4\text{mEq/ml} = 0.34\text{ml}$$

Add 0.34ml KPhos to 300ml bag

25mEq/L KPhos, 500ml

$$\frac{25 \text{ mEq}}{1000\text{ml}} : \frac{x \text{ mEq}}{500\text{ml}}$$

$$25\text{mEq} \times 500\text{ml} = x \text{ mEq} \times 1000\text{ml}$$

$$12,500\text{mEqml} = 1000x \text{ mEqml}$$

$$x = 12.5 \text{ mEq}$$

$$12.5\text{mEq} \div 4.4\text{mEq/ml} = 2.84\text{ml}$$

Add 2.8ml KPhos to 500ml bag

Way 2

Calculate:

10mEq/L KPhos, 1L

$$10 \text{ mEq/L} \div 4.4\text{mEq/ml} = 2.27\text{ml/L}$$

$$2.27\text{ml/L} \div 1000\text{ml} = 0.00227\text{ml KPhos per 1ml fluids}$$

$$0.00227\text{ml KPhos per each ml fluids} \times 1000\text{ml (in bag)} = 2.27\text{ml}$$

Add 2.3ml KPhos to 1L bag

5mEq/L KPhos, 300ml

$$5 \text{ mEq/L} \div 4.4\text{mEq/ml} = 1.136\text{ml/L}$$

$$1.136\text{ml/L} \div 1000\text{ml} = 0.001136\text{ml KPhos per 1ml fluids}$$

$$0.001136\text{ml KPhos per each ml fluids} \times 300\text{ml (in bag)} = 0.34\text{ml}$$

Add 0.34ml KPhos to 300ml bag

25mEq/L KPhos, 500ml

$$25 \text{ mEq/L} \div 4.4\text{mEq/ml} = 5.68\text{ml/L}$$

$$5.68\text{ml/L} \div 1000\text{ml} = 0.00568\text{ml KPhos per 1ml fluids}$$

$$0.00568\text{ml KPhos per each ml fluids} \times 500\text{ml (in bag)} = 2.84\text{ml}$$

Add 2.8ml KPhos to 500ml bag

Way 3

Calculate:

10mEq/L KPhos, 1L

$$1000\text{ml} \div 1000\text{ml/L} = 1\text{L}$$

$$1\text{L} \times 10\text{mEq/L} = 10\text{mEq}$$

$$10\text{mEq} \div 4.4\text{mEq/ml} = 2.27\text{ml}$$

Add 2.3ml KPhos to 1L bag

5mEq/L KPhos, 300ml

$$300\text{ml} \div 1000\text{ml/L} = 0.3\text{L}$$

$$0.3\text{L} \times 5\text{mEq/L} = 1.5\text{mEq}$$

$$1.5\text{mEq} \div 4.4\text{mEq/ml} = 0.34\text{ml}$$

Add 0.34ml KPhos to 300ml bag

25mEq/L KPhos, 500ml

$$500\text{ml} \div 1000\text{ml/L} = 0.5\text{L}$$

$$0.5\text{L} \times 25\text{mEq/L} = 12.5\text{mEq}$$

$$12.5\text{mEq} \div 4.4\text{mEq/ml} = 2.84\text{ml}$$

Add 2.8ml KPhos to 500ml bag

B-vitamins are a different additive beast.

Usually, you are given instructions to add ___ml/L B-vitamins to a patient's fluids.

So what does this mean?

For every 1000ml fluids, you will add ___ml of B-vits

This additive is very straightforward!

If you are asked to add 2ml/L B-vits and you have a 1L bag....

That's right! You are adding 2ml B-vits to that bag.

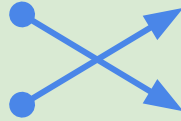


WAY 2

Ex: We want 2ml/L B-vits and we are starting with a full 1L fluid bag. How much B-vits do we need?

$$\frac{\text{given ml}}{1L} : \frac{x \text{ ml}}{1L}$$

$$\frac{2 \text{ ml}}{1L} : \frac{x \text{ ml}}{1L}$$



Solving for x by cross-multiplying:

$$2 \text{ ml} \times 1L = 1L \times x \text{ ml}$$

$$2 \text{ ml} = x \text{ ml}$$

$$x = 2 \text{ ml}$$

You will add 2ml B-vits to a 1L bag for 2ml/L B-vits.

$$\frac{\text{given ml}}{1L} : \frac{x \text{ ml}}{1L}$$

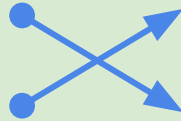
$$x = \text{wanted ml}$$

Ex: We want 1ml/L B-vits and we are starting with a fluid bag with 450ml in it.

$$\frac{\text{given ml}}{1\text{L}} : \frac{x \text{ ml}}{1\text{L}}$$

$$\frac{1 \text{ ml}}{1000\text{mL}} : \frac{x \text{ ml}}{450 \text{ mL}}$$

Solving for **x** by cross-multiplying:



$$1\text{ml} \times 450\text{ml} = 1000\text{ml} \times x \text{ ml}$$

$$450 \text{ ml/ml} = 1000x\text{ml/ml}$$

Divide both sides by 1000ml to isolate **x**

$$0.45 \text{ ml} = x \text{ ml}$$

$$x = 0.45 \text{ ml}$$

You will add 0.45ml B-vits to a 450ml bag for 1ml/L B-vits.

$$\frac{\text{given ml}}{1\text{L}} : \frac{x \text{ ml}}{1\text{L}}$$

$$x = \text{wanted ml}$$

WAY 2

Ex: We want 1ml/L B-vits and we are starting with 450ml in our fluid bag.

Do we need to convert our units to ml?

No way! B-vits is already dosed in ml, so we do not need to do this first step!

Divide ml of BVits by ml in one liter.

$$1\text{ml} \div 1000\text{ml} = 0.001\text{ml BVits (per 1 ml fluid)}$$

Multiply by amount of fluid in bag.

$$0.001\text{ml BVits} \times 450\text{ml} = 0.45\text{ml KCl}$$

This is the amount of B-vits to add.

You will add 0.45ml B vits to a 450ml bag for 1ml/L B-vits.

WAY 3

Ex: We want 1ml/L B-vits and we are starting with 450ml in our fluid bag.

Convert your fluid amount in ml into L.

$$450\text{ml} \div 1000\text{ml} = 0.45 \text{ L}$$

Multiply fluid in L by amount of Bvits desired.

$$0.45\text{L} \times 1\text{ml/L} = 0.45\text{ml Bvits}$$

Do we need to divide by concentration?

No way! B-vits is already dosed in ml, so we do not need to do any more steps!

This is the amount of B-vits to add.

You will add 0.45ml B vits to a 450ml bag for 1ml/L B-vits.

Way 1

Calculate:

2ml/L BVits, 1L

$$\frac{2 \text{ ml}}{1\text{L}} : \frac{x \text{ ml}}{1\text{L}}$$

$$2\text{ml} \times 1\text{L} = x \text{ ml} \times 1\text{L}$$

$$2\text{ml} = x \text{ ml}$$

$$x = 2\text{ml}$$

Add 2ml BVits to 1L bag

1ml/L BVits, 480ml

$$\frac{1 \text{ ml}}{1\text{L}} : \frac{x \text{ ml}}{480\text{ml}}$$

$$1\text{ml} \times 480\text{ml} = x \text{ ml} \times 1\text{L}$$

$$1\text{ml} \times 480\text{ml} = x \text{ ml} \times 1000\text{ml}$$

$$480\text{ml} = 1000x \text{ ml}$$

$$\frac{480\text{ml}}{1000\text{ml}} = \frac{1000x \text{ ml}}{1000\text{ml}}$$

$$x = 0.48\text{ml}$$

Add 0.48ml BVits to 480ml bag

1.5ml/L Bvits, 910ml

$$\frac{1.5 \text{ ml}}{1\text{L}} : \frac{x \text{ ml}}{910\text{ml}}$$

$$1.5\text{ml} \times 910\text{ml} = x \text{ ml} \times 1\text{L}$$

$$1.5\text{ml} \times 910\text{ml} = x \text{ ml} \times 1000\text{ml}$$

$$1365\text{ml} = 1000x \text{ ml}$$

$$\frac{1365\text{ml}}{1000\text{ml}} = \frac{1000x \text{ ml}}{1000\text{ml}}$$

$$x = 1.37\text{ml}$$

Add 1.37ml BVits to 910ml bag

Way 2

Calculate:

2ml/L BVits, 1L

$2\text{ml/L} \div 1000\text{ml} = 0.002\text{ml}$
BVits per 1ml fluids

$0.002\text{ml BVits per each ml}$
fluids x 1000ml (in bag) =
2ml

Add 2ml BVits to 1L bag

1ml/L BVits, 480ml

$1\text{ml/L} \div 1000\text{ml} = 0.001\text{ml}$
BVits per 1ml fluids

$0.001\text{ml BVits per each ml}$
fluids x 480ml (in bag) =
0.48ml

**Add 0.48ml BVits to 480ml
bag**

1.5ml/L Bvits, 920ml

$1.5\text{ml/L} \div 1000\text{ml} =$
 $0.0015\text{ml BVits per 1ml}$
fluids

$0.0015\text{ml BVits per each ml}$
fluids x 920ml (in bag) =
1.37ml

**Add 1.37ml BVits to 910ml
bag**

Way 3

Calculate:

2ml/L BVits, 1L

$$1000\text{ml} \div 1000\text{ml/L} = 1\text{L}$$

$$1\text{L} \times 2\text{ml/L} = 2\text{ml}$$

Add 2ml BVits to 1L bag

1ml/L BVits, 480ml

$$480\text{ml} \div 1000\text{ml/L} = 0.48\text{L}$$

$$0.48\text{L} \times 1\text{ml/L} = 0.48\text{ml}$$

Add 0.48ml KPhos to 480ml bag

1.5ml/L Bvits, 920ml

$$920\text{ml} \div 1000\text{ml/L} = 0.92\text{L}$$

$$0.92\text{L} \times 1.5\text{ml/L} = 1.37\text{ml}$$

Add 1.37ml KPhos to 920ml bag

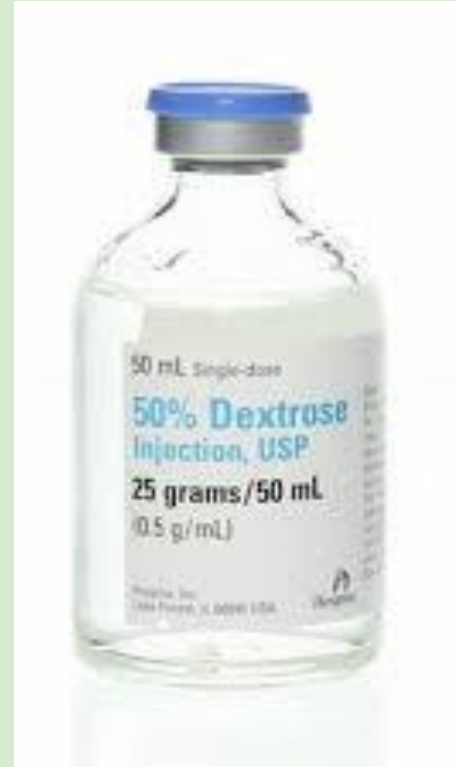
Dextrose can be given as a bolus or as an additive.

(We will discuss boluses in pharmacology)

Usually, you are given instructions to add ___% Dextrose to a patient's fluids.

What does this mean?

You are making the concentration of your fluids ___% Dextrose



WAY A

Ex: We want 5% Dextrose and we are starting with a full 1L fluid bag. How much Dextrose do we need?

$$\frac{\text{wanted \%} \times \text{fluid volume}}{\text{concentration \%}} = x \text{ ml}$$

$$\frac{5\% \times 1000\text{ml}}{50\%} = x \text{ ml}$$

$$\frac{5000\text{ml}\%}{50\%} = x \text{ ml}$$

$$100\text{ml} = x \text{ ml}$$

$$x = 100 \text{ ml}$$

You will add 100ml Dextrose to a 1L bag for 5% Dextrose.

First, remove that same amount from the fluid bag.

$$1000\text{ml} - 100\text{ml fluid} + 100\text{ml Dextrose} = 1000\text{ml}$$

$$\frac{\text{wanted \%} \times \text{fluid volume}}{\text{concentration \%}} = \underline{\hspace{2cm}} \text{ ml Dextrose}$$

Dextrose Additive - A Visual Representation

1000 ml LRS



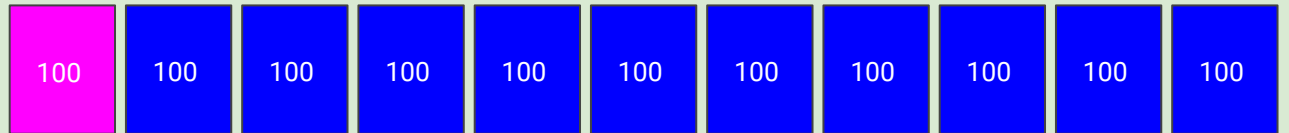
10 x 100 ml LRS



100 ml Dextrose



100 ml + 1000 ml = 1100 ml



100 ml + 900 ml = 1000 ml



WAY A

Ex: We want 2.5% Dextrose and we are starting with a 350ml in a fluid bag. How much Dextrose do we need?

$$\frac{\text{wanted \%} \times \text{fluid volume}}{\text{concentration \%}} = x \text{ ml}$$

$$\frac{2.5\% \times 350\text{ml}}{50\%} = x \text{ ml}$$

$$\frac{875\text{ml}\%}{50\%} = x \text{ ml}$$

$$17.5\text{ml} = x \text{ ml}$$

$$x = 17.5 \text{ ml}$$

You will add 17.5ml Dextrose to a 350ml bag for 2.5% Dextrose.

First, remove that same amount from the fluid bag.

$$350\text{ml} - 17.5\text{ml fluid} + 17.5\text{ml Dextrose} = 350\text{ml}$$

$$\frac{\text{wanted \%} \times \text{fluid volume}}{\text{concentration \%}} = \underline{\hspace{2cm}} \text{ ml Dextrose}$$

Calculate (way A):

5% Dextrose, 850ml

wanted % x fluid volume = x ml
concentration %

$$\frac{5\% \times 850\text{ml}}{50\%} = x \text{ ml}$$

$$\frac{4250\text{ml}\%}{50\%} = x \text{ ml}$$

$$85\text{ml} = x \text{ ml}$$

$$x = 85 \text{ ml}$$

Add 85ml Dextrose to 850ml bag

2.5% Dextrose, 150ml

wanted % x fluid volume = x ml
concentration %

$$\frac{2.5\% \times 150\text{ml}}{50\%} = x \text{ ml}$$

$$\frac{375\text{ml}\%}{50\%} = x \text{ ml}$$

$$7.5\text{ml} = x \text{ ml}$$

$$x = 7.5 \text{ ml}$$

Add 7.5ml Dextrose to 150ml bag

7.5% Dextrose, 400ml

wanted % x fluid volume = x ml
concentration %

$$\frac{7.5\% \times 400\text{ml}}{50\%} = x \text{ ml}$$

$$\frac{3000\text{ml}\%}{50\%} = x \text{ ml}$$

$$60\text{ml} = x \text{ ml}$$

$$x = 60 \text{ ml}$$

Add 60ml Dextrose to 400ml bag

WAY B

Ex: We want 5% Dextrose and we are starting with a full 1L fluid bag. How much Dextrose do we need?

$$C_1 V_1 = C_2 V_2$$

$$\text{Concentration}_1 \text{Volume}_1 = \text{Concentration}_2 \text{Volume}_2$$

$$50\% \times x = 5\% \times 1000$$

$$50x = 5000$$

$$x = 100 \text{ ml}$$

You will add 100ml Dextrose to a 1L bag for 5% Dextrose.

First, remove that same amount from the fluid bag.

$$1000\text{ml} - 100\text{ml fluid} + 100\text{ml Dextrose} = 1000\text{ml}$$

$$C_1 V_1 = C_2 V_2$$

Stock = 1



$$C_1 = 50\% \\ V_1 = x$$

Dilution = 2



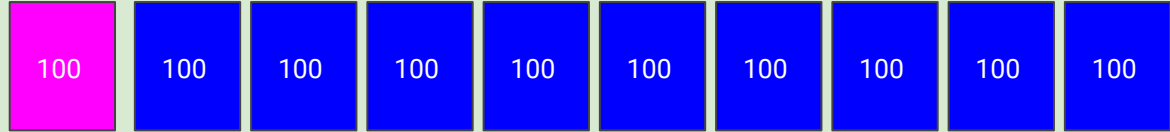
$$C_2 = 5\% \\ V_2 = 1000\text{ml}$$

Dextrose Additive - A Visual Representation

5% is one tenth (1/10) of 50%

Need to dilute 1:9 (1 part + 9 parts = 10 parts)

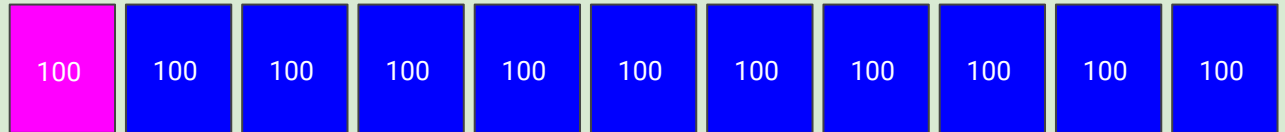
100 ml + 900 ml = 1000 ml
= 5% Dextrose solution



When you don't remove the 100ml from the bag, you create a
1:10 dilution (1 part + 10 parts = 11 parts)

This makes your Dextrose actually 4.5% in the bag, not 5%.

100 ml + 1000 ml = 1100 ml
= 4.5% Dextrose solution



Calculate (way B):

5% Dextrose, 850ml

$$C_1V_1 = C_2V_2$$

$$50 \times x = 5 \times 850$$

$$50x = 4250$$

$$\frac{50x}{50} = \frac{4250}{50}$$

$$x = 85 \text{ ml}$$

Add 85ml Dextrose to 850ml bag

2.5% Dextrose, 150ml

$$C_1V_1 = C_2V_2$$

$$50 \times x = 2.5 \times 150$$

$$50x = 375$$

$$\frac{50x}{50} = \frac{375}{50}$$

$$x = 7.5 \text{ ml}$$

Add 7.5ml Dextrose to 150ml bag

7.5% Dextrose, 400ml

$$C_1V_1 = C_2V_2$$

$$50 \times x = 7.5 \times 400$$

$$50x = 3000$$

$$\frac{50x}{50} = \frac{3000}{50}$$

$$x = 60 \text{ ml}$$

Add 60ml Dextrose to 400ml bag

Reglan is one of the most involved calculations for additives. (It is really more of a CRI).

Usually, you are given instructions to add ____mg/kg/day Reglan to a patient's fluids.

What does this mean?

You are adding an amount of Reglan to your fluids such that in 24 hours, your patient will receive a ____mg/kg dose.

We need several pieces of information for this calculation.

1. **Reglan dose (given by DVM)**
2. **Patient's weight**
3. **Fluid rate**
4. **Amount of fluid in bag**



Ex: We want **1mg/kg/day** Reglan for Spanky, a **35kg** Lab. Spanky is currently at a fluid rate of **1xM** and we are about to start a **new 1L bag**. How much Reglan do we need?

Calculate fluid rate:

$$35\text{kg} \times 2.2 = 77\text{lb}$$

$$77\text{lb} \times 30\text{ml} \div 24\text{hr} = 96.25\text{ml/hr}$$

Convert **weight** in kg to pounds (x 2.2)

Calculate **fluid rate** (pounds x 30 ÷ 24)

Calculate CRI:

$$35\text{kg} \times 1\text{mg/kg/day} = 35\text{mg/day}$$

$$35\text{mg/day} \div 24 \text{ hr/day} = 1.458\text{mg/hr}$$

$$1.458\text{mg/hr} \div 96.25\text{ml/hr} = 0.01515\text{mg/ml}$$

$$0.01515\text{mg/ml} \times 1000\text{ml} = 15.15\text{mg}$$

$$15.15\text{mg} \div 5\text{mg/ml} = 3.03\text{ml}$$

Multiply **weight** in kg by desired **Reglan dose**

Convert day → hours (÷ 24) = how many mg/hr

Divide by **fluid rate** = # of mg Reglan per 1ml fluid

Multiply by **fluid amount in bag** = mg Reglan needed

Divide by Reglan concentration = ml Reglan needed

Add 3ml Reglan to 1L bag.

Ex: We want **1mg/kg/day** Reglan for Jojo, a **13kg** Beagle. Jojo is currently at a fluid rate of **2xM** and we are about to start a **new 1L bag**. How much Reglan do we need?

Calculate fluid rate:

$$13\text{kg} \times 2.2 = 28.6\text{lb}$$

$$28.6\text{lb} \times 60\text{ml} \div 24\text{hr} = 71.5\text{ml/hr}$$

Calculate CRI:

$$13\text{kg} \times 1\text{mg/kg/day} = 13\text{mg/day}$$

$$13\text{mg/day} \div 24 \text{ hr/day} = 0.541\text{mg/hr}$$

$$0.541\text{mg/hr} \div 71.5\text{ml/hr} = 0.00757\text{mg/ml}$$

$$0.00757\text{mg/ml} \times 1000\text{ml} = 7.57\text{mg}$$

$$7.57\text{mg} \div 5\text{mg/ml} = 1.52\text{ml}$$

Add 1.5ml Reglan to 1L bag.

Convert **weight** in kg to pounds (x 2.2)

Calculate **fluid rate** (pounds x (30x2) ÷ 24)

Multiply **weight** in kg by desired **Reglan dose**

Convert day → hours (÷ 24) = how many mg/hr

Divide by **fluid rate** = # of mg Reglan per 1ml fluid

Multiply by **fluid amount in bag** = mg Reglan needed

Divide by Reglan concentration = ml Reglan needed

Ex: We want **1mg/kg/day** Reglan for Pancake, a **48kg** Great Dane mix. Pancake is currently at a fluid rate of **0.5xM** and we are about to start a **new 1L bag**. How much Reglan do we need?

Calculate fluid rate:

$$48\text{kg} \times 2.2 = 105.6\text{lb}$$

$$105.6\text{lb} \times 15\text{ml} \div 24\text{hr} = 66\text{ml/hr}$$

Calculate CRI:

$$48\text{kg} \times 1\text{mg/kg/day} = 48\text{mg/day}$$

$$48\text{mg/day} \div 24 \text{ hr/day} = 2\text{mg/hr}$$

$$2\text{mg/hr} \div 66\text{ml/hr} = 0.0303\text{mg/ml}$$

$$0.0303\text{mg/ml} \times 1000\text{ml} = 30.3\text{mg}$$

$$30.3\text{mg} \div 5\text{mg/ml} = 6.06\text{ml}$$

Add 6ml Reglan to 1L bag.

Convert **weight** in kg to pounds (x 2.2)

Calculate **fluid rate** (pounds x (30÷2) ÷ 24)

Multiply **weight** in kg by desired **Reglan dose**

Convert day → hours (÷ 24) = how many mg/hr

Divide by **fluid rate** = # of mg Reglan per 1ml fluid

Multiply by **fluid amount in bag** = mg Reglan needed

Divide by Reglan concentration = ml Reglan needed

Ex: We want **2mg/kg/day** Reglan for Anastasia, a **4.5kg** Dachshund mix. Anastasia is currently at a fluid rate of **1xM** and we are about to start a **new 1L bag**. How much Reglan do we need?

Calculate fluid rate:

$$4.5\text{kg} \times 2.2 = 9.9\text{lb}$$

$$9.9\text{lb} \times 30\text{ml} \div 24\text{hr} = 12.375\text{ml/hr}$$

Convert **weight** in kg to pounds (x 2.2)

Calculate **fluid rate** (pounds x 30 ÷ 24)

Calculate CRI:

$$4.5\text{kg} \times 2\text{mg/kg/day} = 9\text{mg/day}$$

$$9\text{mg/day} \div 24 \text{ hr/day} = 0.375\text{mg/hr}$$

$$0.375\text{mg/hr} \div 12.375\text{ml/hr} = 0.0303\text{mg/ml}$$

$$0.0303\text{mg/ml} \times 1000\text{ml} = 30.3\text{mg}$$

$$30.3\text{mg} \div 5\text{mg/ml} = 6.06\text{ml}$$

Multiply **weight** in kg by desired **Reglan dose**

Convert day → hours (÷ 24) = how many mg/hr

Divide by **fluid rate** = # of mg Reglan per 1ml fluid

Multiply by **fluid amount in bag** = mg Reglan needed

Divide by Reglan concentration = ml Reglan needed

Add 6ml Reglan to 1L bag.

Reglan Cheat Sheet

Reglan Dose	Fluid Rate	Reglan Added to 1L Bag
1mg/kg/day	1xM	3ml
1mg/kg/day	2xM	1.5ml
1mg/kg/day	0.5xM	6ml
2mg/kg/day	1xM	6ml
2mg/kg/day	2xM	3ml
2mg/kg/day	0.5xM	12ml

ALWAYS calculate your Reglan additives, but the 1-1-3 rule of thumb can help you double-check your calculation

Bags vs. Syringes vs. Burets



Does it really matter?

Consider:

- Duration of medication
- Volume of medication
- Fluid rate of patient
- Frequency of adjustments

What would you choose?

39kg dog, 2xM, 20mEq/L KCl

Put additives in **fluid bag**

Why?

2xM = 215ml/hr

20mEq/L is a low-medium KCL dose

Buretrol only holds 150ml

11kg cat, 1xM, 5% Dextrose

Put additives in **buretrol**

Why?

1xM = 30ml/hr

Dextrose is one of the most commonly adjusted additives

- Don't want to waste fluids if decreasing or stopping Dextrose
- Buretrol would last 5 hours

15lb dog, 1xM, 2ml/L Bvits

Put additives in **fluid bag**

Why?

1xM = 19ml/hr

B-vits rarely are adjusted

What would you choose?

13kg dog, 1xM, 30mEq/L KPhos

Put additives in **buretrol**

Why?

1xM = 36ml/hr

30mEq/L is a fairly high KPhos dose

- May need to adjust dose with some frequency

110lb dog, 1.5xM, 2.5% Dextrose

Put additives in **fluid bag**

Why?

1.5xM = 206ml/hr

The entire bag will run over ~5hours.

A buretrol only holds 150ml

2.5kg cat, 1xM, 2ml/L Bvits **and** 20mEq/L KCl

Put Bvits additives in **fluid bag**

Then draw those up in a syringe and add KCl to that **syringe**

Why?

1xM = 6.9ml/hr

- B-vits rarely are adjusted, can add to whole bag
- Rate is low, a syringe will last ~8.5hours
- Allows for easy adjustment of KCl

What would you choose?

54lb dog, 1xM, 1mg/kg/day Reglan

Put additives in **fluid bag**

Why?

1xM = 68ml/hr

Reglan is rarely *not* included in whole fluid bag

A buretrol would last < 3 hrs

9lb puppy, 2xM, 2ml/L Bvits **and**
2.5% Dextrose

Put Bvits additives in **fluid bag**

Add Dextrose to **buretrol** or
syringe

Why?

1xM = 22.5ml/hr

- B-vits rarely are adjusted, can add to whole bag
- Buretrol would last ~6.5hrs
- Syringe would last < 3 hrs
- Either allows for easy adjustment of Dextrose

17lb cat, 1xM, 30mEq/L KCl **and**
10mEq/L KPhos

Put both additives in **buretrol**

Why?

1xM = 21ml/hr

Buretrol would last ~6.5hrs

Allows for easy adjustment of both KCl and KPhos without wasting a lot of fluids if they need to be adjusted

CRIs and Dilutions

What is a CRI?

Why do we use CRIs?

How to calculate CRIs

- Straight
- Diluted

What is a CRI?

Constant Rate Infusion

Medication continuously administered to a patient at a controlled rate to maintain consistent plasma levels of that medication.

Why do we use CRIs?

- Achieve appropriate levels of
 - Pain management
 - Sedation
 - Anesthesia
 - Blood pressure management
 - Electrolyte supplementation
 - Insulin
 - Nutrition (via a feeding tube)
- Easy titration and rate adjustment
- Avoid peak and trough levels of medications



Fentanyl is one of the most common CRIs.

Fentanyl is a narcotic opioid used to treat moderate to severe pain. It is 80-100x more potent than morphine. It depresses the CNS which regulates sensation in the body.

Frequently used for

- HBC/trauma/fractures
- IVDD
- Surgical and post-operative pain management

Fentanyl is typically prescribed at a rate of 1-5mcg/kg/hr, usually after an initial bolus/loading dose.

CONCENTRATION and DOSAGE is in **mcg

**Fentanyl is light sensitive - cover your bag or syringe.



WAY 1

Ex: Mikey is an 8y MN Dachshund who weighs 11kg. We want to give a 3mcg/kg bolus of Fentanyl, followed by a 3mcg/kg/hr CRI of Fentanyl.

Calculate our bolus:

$$3\text{mcg} \times 11\text{kg} = 33\text{mcg}$$

(dose x weight)

$$33\text{mcg} \div 50\text{mcg/ml} = 0.66\text{ml}$$

(amount in mcg \div concentration)

Our bolus is 0.66ml Fentanyl

Calculate our CRI:

$$(3\text{mcg} \times 11\text{kg})/\text{hr} = 33\text{mcg/hr}$$

$$33\text{mcg/hr} \div 50\text{mcg/ml} = 0.66\text{ml/hr}$$

Our CRI rate is 0.66ml/hr

BUT

This is a puny little amount.

In general, for rates <1ml/hr you want to dilute.



Why dilute?

- Maintaining IVC patency
 - KVO rate
- Accuracy of delivery
 - Occlusions
- Easy in adjusting CRI rate

Dilution: Make a 1=1 solution.

What does this mean?

$$\underline{1}\text{mcg/kg/hr} = \underline{1}\text{ml/hr}$$

This does **not** mean a 1:1 solution.

This means that the two parts (Fentanyl part and NaCl part) are equal volumes

From our previous calculations, we know that

$$3\text{mcg/kg/hr} = 0.66\text{ml/hr}$$

A 1=1 dilution would create a mixture of Fentanyl and NaCl such that

$$\underline{3}\text{mcg/kg/hr} = \underline{3}\text{ml/hr}$$

0.66ml Fentanyl

+ x ml NaCl

3 ml

Solve for x

$$3\text{ml} - 0.66\text{ml} = 2.34\text{ml}$$

$$\mathbf{x = 2.34\text{ml NaCl}}$$



Now that we know our Fentanyl amount (0.66ml) and NaCl amount (2.34ml) needed for one hour of our CRI, we can calculate how long we want the CRI to run.

Considerations:

- Rate - how often are you going to have to change syringes?
- Time - how long will the patient need this medication?
 - Transferring?
 - Weaning?
- Medication availability - does the hospital have adequate stock?

Let's make the CRI for 10 hours.

Rate = 3ml/hr because our dilution is 3mcg/kg/hr = 3ml/hr

Total volume = 30ml (3ml/hr x 10hr), so use a 35ml syringe

0.66ml Fentanyl	x10hr	= 6.6ml Fentanyl
+ <u>2.34ml NaCl</u>	x10hr	= 23.4ml NaCl
3 ml	x10hr	= 30ml total



WAY 2

Ex: Mikey is an 8y MN Dachshund who weighs 11kg. We want to give a 3mcg/kg bolus of Fentanyl, followed by a 3mcg/kg/hr CRI of Fentanyl.

Bolus = 0.66ml Fentanyl

CRI Dilution:

We want a 1=1 dilution for 10 hours.

$3\text{ml/hr} \times 10\text{hr} = 30\text{ml}$ (get a 35ml syringe)

Multiply your CRI time by your kg and dose.

$10\text{hr} \times 11\text{kg} \times 3\text{mcg} = 330\text{mcg}$ Fentanyl

Divide by concentration to get ml.

$330\text{mcg} \div 50\text{mcg/ml} = 6.6\text{ml}$ Fentanyl

Subtract Fentanyl from total ml to find ml NaCl.

$30\text{ml total} - 6.6\text{ml Fentanyl} = 23.4\text{ml NaCl}$



Calculate:

39kg dog, 4mcg/kg/hr
Fentanyl CRI

$$39\text{kg} \times 4\text{mcg/kg/hr} = 156\text{mcg/hr}$$

$$156 \text{ mcg/hr} \div 50\text{mcg/ml} = 3.12\text{ml/hr}$$

Would you dilute this?
Why or why not?

What size syringe would you use?
Why?

4.5kg cat, 3mcg/kg/hr
Fentanyl CRI

$$4.5\text{kg} \times 3\text{mcg/kg/hr} = 13.5\text{mcg/hr}$$

$$13.5 \text{ mcg/hr} \div 50\text{mcg/ml} = 0.27\text{ml/hr}$$

Would you dilute this?
Why or why not?

$$3\text{ml} - 0.27\text{ml(F)} = 2.73\text{ml(S)} \\ \times 10\text{hr}$$

$$30\text{ml} - 2.7\text{ml(F)} = 27.3\text{ml(S)}$$

26kg dog, 5mcg/kg bolus, then
5mcg/kg/hr Fentanyl CRI

Bolus:
 $26\text{kg} \times 5\text{mcg/kg} = 130\text{mcg}$

$$130\text{mcg} \div 50\text{mcg/ml} = 2.6\text{ml Fentanyl}$$

CRI:
 $26\text{kg} \times 5\text{mcg/kg/hr} = 130\text{mcg/hr}$

$$130\text{mcg/hr} \div 50\text{mcg/ml} = 2.6\text{ml/hr}$$

$$5\text{ml} - 2.6\text{ml(F)} = 2.4\text{ml(S)} \\ 50\text{ml} - 26\text{ml(F)} = 24\text{ml(S)}$$

Midazolam is a benzodiazepine, used as an anxiolytic, sedative, and anticonvulsive. It is frequently included in a pre-med cocktail prior to anesthetic induction. It is more efficient than Diazepam.

Frequently used for

- Sedation or as a pre-anesthetic medication
- Seizure control, muscle relaxant properties

Midazolam is typically prescribed at a rate of 0.2 - 0.4mg/kg/hr, usually after an initial bolus/loading dose.

**Midazolam is light sensitive - cover your bag or syringe.



WAY 1

Ex: Potato is a 3y MN Lab who weighs 30kg. We want to start a 0.3mg/kg/hr CRI of Midazolam.

Calculate our CRI:

$$(0.3\text{mg} \times 30\text{kg})/\text{hr} = 9\text{mg/hr}$$
$$9\text{mg/hr} \div 5\text{mg/ml} = 1.8\text{ml/hr}$$

Our CRI rate is 1.8ml/hr

Would you dilute this?

Yes

- Ease of changing rate
- No concern for fluid overload in this patient

No

- Rate is >1ml/hr



Wait - what dilution will we make?! The dose is 0.3mg/kg/hr.

Dilution: Make a 0.1=1 solution.

What does this mean?

$$\underline{0.1} \text{mg/kg/hr} = \underline{1} \text{ml/hr}$$

From our previous calculations, we know that

$$0.3 \text{mg/kg/hr} = 1.8 \text{ml/hr}$$

A 0.1=1 dilution would create a mixture of Midazolam and NaCl such that

$$\underline{0.3} \text{mg/kg/hr} = \underline{3} \text{ml/hr}$$



Let's run this for 10 hours:

$$\begin{array}{r} 1.8 \text{ml Midazolam} \\ + \quad \underline{x \text{ ml NaCl}} \\ 3 \text{ ml} \end{array} \quad \text{Solve for } x$$

$$3 \text{ml} - 1.8 \text{ml} = 1.2 \text{ ml}$$

$$x = \mathbf{1.2 \text{ml NaCl}}$$

$$\begin{array}{r} 1.8 \text{ml Midaz} \\ + \quad \underline{1.2 \text{ml NaCl}} \\ 3 \text{ ml} \end{array} \quad \begin{array}{l} \times 10 \text{hr} \\ \times 10 \text{hr} \\ \times 10 \text{hr} \end{array} \quad \begin{array}{l} = \mathbf{18 \text{ml Midaz}} \\ = \mathbf{12 \text{ml NaCl}} \\ = \mathbf{30 \text{ml total}} \end{array}$$

WAY 2

Ex: Potato is a 3y MN Lab who weighs 30kg. We want to start a 0.3mg/kg/hr CRI of Midazolam.

CRI Dilution:

We want a 0.3 = 3 dilution for 10 hours.

$$3\text{ml} \times 10\text{hr} = 30\text{ml} \text{ (get a 35ml syringe)}$$

$$\text{Rate} \times \text{time} = \text{total volume}$$

Multiply your CRI time by your kg and dose.

$$10\text{hr} \times 30\text{kg} \times 0.3\text{mcg} = 90\text{mg Midazolam}$$

Divide by concentration to get ml.

$$90\text{mg} \div 5\text{mg/ml} = 18\text{ml Midazolam}$$

Subtract Midazolam from total ml to find ml NaCl.

$$30\text{ml total} - 18\text{ml Midazolam} = 12\text{ml NaCl}$$



Calculate:

8kg dog, 0.2mg/kg/hr
Midazolam CRI

$$8\text{kg} \times 0.2\text{mg/kg/hr} = 1.6\text{mg/hr}$$

$$1.6\text{ mg/hr} \div 5\text{mg/ml} = 0.32\text{ml/hr}$$

Would you dilute this?
Why or why not?
0.2 = 2 dilution

$$2\text{ml} - 0.32\text{ml(M)} = x\text{ ml(S)}$$
$$1.68\text{ml} = x$$

$$x10\text{hr}$$
$$20\text{ml} - 3.2\text{ml(M)} = 16.8\text{ml(S)}$$

2.7kg cat, 0.3mg/kg/hr
Midazolam CRI *

$$2.7\text{kg} \times 0.3\text{mg/kg/hr} = 0.81\text{mg/hr}$$

$$0.81\text{ mg/hr} \div 5\text{mg/ml} = 0.162\text{ml/hr}$$

***When calculating, keep decimals & round at the end.**

$$3\text{ml} - 0.162\text{ml(M)} = 2.838\text{ml(S)}$$
$$x10\text{hr}$$

$$30\text{ml} - 1.62\text{ml(M)} = 28.38\text{ml(S)}$$

61kg dog, 0.3mg/kg bolus, then
0.2mg/kg/hr Midazolam CRI

Bolus:
 $61\text{kg} \times 0.3\text{mg/kg} = 18.3\text{mg}$

$$18.3\text{mg} \div 5\text{mg/ml} = 3.66\text{ml}$$

Midazolam

CRI:
 $61\text{kg} \times 0.2\text{mg/kg/hr} = 12.2\text{mg/hr}$

$$12.2\text{mg/hr} \div 5\text{mg/ml} = 2.44\text{ml/hr}$$

No dilution necessary.
X10hr = 24.4ml in syringe

Dopamine is a positive inotropic agent. It helps treat low blood pressure, low cardiac output, and improves renal blood flow. At higher rates, α 1-, β 1-, and β 2-adrenergic effects are seen: increases in vasoconstriction and contractility.

Frequently used for

- hypotension

Dopamine is typically prescribed at a rate of 2-10 **mcg/kg/min**.

It must ALWAYS be diluted.

CONCENTRATION is in **mg

DOSAGE is in **mcg

RATE is **/min

**Dopamine is light sensitive - cover your bag or syringe.



WAY 1

Ex: Pooh Bear is a 12y MN Cavalier King Charles Spaniel who weighs 7kg. We want to start a Dopamine CRI at 5mcg/kg/min.

Calculate our CRI:

$$(5\text{mcg} \times 7\text{kg})/\text{min} = 35\text{mcg}/\text{min}$$

$$35\text{mcg}/\text{min} \times 60\text{min}/\text{hr} = 2,100\text{mcg}/\text{hr}$$

$$2,100\text{mcg}/\text{hr} \div 1000 = 2.1\text{mg}/\text{hr}$$

$$2.1\text{mg}/\text{hr} \div 40\text{mg}/\text{ml} = 0.0525\text{ml}/\text{hr}$$

Our CRI rate is 0.0525ml/hr

This has to be diluted!

What do you pick? 5 = 5? 5 = 2.5?

How will this translate if the rate goes up or down?

What is the dog's 1xM fluid rate? =19ml/hr

Find dose per min.

Convert to dose per hour.

Convert mcg to mg.

Divide by concentration for ml/hr.



Considering what this drug does...

- More fluids might not be a problem.
BUT CONSIDER THAT
- Patient is probably already on a combination of a crystalloid fluid rate >1xM and/or a colloid fluid rate.
- Still be conservative in your dilutions.

Dilution: Make a 1=1 solution.

Here, 1=1 dilution would create a mixture of Dopamine and NaCl such that

$$\underline{5} \text{mcg/kg/min} = \underline{5} \text{ml/hr}$$

$$+ \frac{0.0525 \text{ml Dopamine} + x \text{ ml NaCl}}{5 \text{ ml}} \quad \text{Solve for } x$$

$$5 \text{ml} - 0.0525 \text{ml} = 4.9475 \text{ml NaCl}$$

And let's run this for 10 hours.

$$50 \text{ml} - 0.525 \text{ml Dopamine} = 49.475 \text{ml NaCl}$$

Put **0.53ml** Dopamine and **49.47ml NaCl** in a 60ml syringe and run at **5ml/hr**.



Let's change the dilution.

Here, a **1 = 0.5 dilution** would create a mixture of Dopamine and NaCl such that

$$\underline{5} \text{mcg/kg/min} = \underline{2.5} \text{ml/hr}$$

$$+ \frac{0.0525 \text{ml Dopamine} + x \text{ ml NaCl}}{2.5 \text{ ml}} \quad \text{Solve for } x$$

$$2.5 \text{ml} - 0.0525 \text{ml} = 2.4475 \text{ml NaCl}$$

And let's run this for 10 hours.

$$25 \text{ml} - 0.525 \text{ml Dopamine} = 24.475 \text{ml NaCl}$$

Put **0.53ml Dopamine** and **24.47ml NaCl** in a 35ml syringe and run at **2.5ml/hr**



WAY 2

Ex: Pooh Bear is a 12y MN Cavalier King Charles Spaniel who weighs 7kg. We want to start a Dopamine CRI at 5mcg/kg/min.

CRI Dilution:

We want a 5 = 5 dilution for 10 hours.

$$5\text{ml} \times 10\text{hr} = 50\text{ml} \text{ (get a 60ml syringe)}$$

Convert from minutes to hours.

$$10\text{hr} \times 60\text{min/hr} = 600\text{min}$$

Multiply your CRI time by your kg and dose.

$$600\text{min} \times 7\text{kg} \times 5\text{mcg} = 21,000\text{mcg Dopamine}$$

Convert from mcg to mg.

$$21,000\text{mcg} \div 1000\text{mcg/mg} = 21\text{mg Dopamine}$$

Divide by concentration to get ml.

$$21\text{mg} \div 40\text{mg/ml} = 0.525\text{ml Dopamine}$$

Subtract Dopamine from total ml to find ml NaCl.

$$\text{Rate} \times \text{time} = \text{total volume}$$

$$50\text{ml total} - 0.525\text{ml Dopamine} = 49.475\text{ml NaCl}$$



Calculate:

28kg dog, 2mcg/kg/min
Dopamine CRI

$$28\text{kg} \times 2\text{mcg/kg/min} \\ = 56\text{mcg/min}$$

$$56\text{ mcg/min} \times 60 \\ = 3,360\text{mcg/hr}$$

$$3,360\text{mcg/hr} \div 1000 \\ = 3.36\text{mg/hr}$$

$$3.36\text{mg/hr} \div 40\text{mg/ml} \\ = 0.084\text{ml/hr}$$

$$2\text{ml} - 0.084\text{ml} = 1.916\text{ml}$$

x10hr

$$20\text{ml} - 0.84\text{ml(D)} = 19.16\text{ml(S)}$$

5.1kg cat, 4mcg/kg/min
Dopamine CRI

$$5.1\text{kg} \times 4\text{mcg/kg/min} \\ = 20.4\text{mcg/min}$$

$$20.4\text{ mcg/min} \times 60 \\ = 1,224\text{mcg/hr}$$

$$1,224\text{mcg/hr} \div 1000 \\ = 1.224\text{mg/hr}$$

$$1.224\text{mg/hr} \div 40\text{mg/ml} \\ = 0.0306\text{ml/hr}$$

$$4\text{ml} - 0.0306\text{ml} = 3.9694\text{ml}$$

x10hr

$$40\text{ml} - 0.31\text{ml(D)} = 39.69\text{ml(S)}$$

43kg dog, 5mcg/kg/min
Dopamine CRI

$$43\text{kg} \times 5\text{mcg/kg/min} \\ = 215\text{mcg/min}$$

$$215\text{ mcg/min} \times 60 \\ = 12,900\text{mcg/hr}$$

$$12.900\text{mcg/hr} \div 1000 \\ = 12.9\text{mg/hr}$$

$$12.9\text{mg/hr} \div 40\text{mg/ml} \\ = 0.3225\text{ml/hr}$$

$$5\text{ml} - 0.3225\text{ml} = 4.6775\text{ml}$$

x10hr

$$50\text{ml} - 3.2\text{ml(D)} = 46.8\text{ml(S)}$$

Dobutamine is a positive inotropic agent. It helps treat low blood pressure, low cardiac output, and improves renal blood flow. Primarily β 1-adrenergic agonist effects are seen: greater cardiac output by increasing heart rate and increasing stroke volume (via enhanced contractility).

Frequently used for

- hypotension

Dobutamine is typically prescribed at a rate of 5-20**mcg/kg/min**.

It must ALWAYS be diluted.

****CONCENTRATION is in mg**

****DOSAGE is in mcg**

****RATE is /min**

****Dobutamine is light sensitive - cover your bag or syringe.**



WAY 1

Ex: Pooh Bear is a 12y MN Cavalier King Charles Spaniel who weighs 7kg. We want to start a Dobutamine CRI at 5mcg/kg/min.

Calculate our CRI:

$$(5\text{mcg} \times 7\text{kg})/\text{min} = 35\text{mcg}/\text{min}$$

$$35\text{mcg}/\text{min} \times 60\text{min}/\text{hr} = 2,100\text{mcg}/\text{hr}$$

$$2,100\text{mcg}/\text{hr} \div 1000 = 2.1\text{mg}/\text{hr}$$

$$2.1\text{mg}/\text{hr} \div 12.5\text{mg}/\text{ml} = 0.168\text{ml}/\text{hr}$$

Our CRI rate is 0.168ml/hr

This has to be diluted!

What do you pick? 5 = 5? 2.5 = 5?

How will this translate if the rate goes up or down?

What is the dog's 1xM rate? =19ml/hr



Dilution: Make a 1=1 solution.

Here, 1=1 dilution would create a mixture of Dobutamine and NaCl such that

$$\underline{5} \text{mcg/kg/min} = \underline{5} \text{ml/hr}$$

$$+ \frac{0.168 \text{ml Dobutamine} + x \text{ ml NaCl}}{5 \text{ ml}} \quad \text{Solve for } x$$

$$5 \text{ml} - 0.168 \text{ml} = 4.832 \text{ml NaCl}$$

And let's run this for 10 hours.

$$50 \text{ml} - 1.68 \text{ml Dobutamine} = 48.32 \text{ml NaCl}$$

Put **1.68ml** Dobutamine and **48.32ml NaCl** in a 60ml syringe and run at **5ml/hr**.



WAY 2

Ex: Pooh Bear is a 12y MN Cavalier King Charles Spaniel who weighs 7kg. We want to start a Dobutamine CRI at 5mcg/kg/min.

CRI Dilution:

We want a 5 = 5 dilution for 10 hours.

$$5\text{ml} \times 10\text{hr} = 50\text{ml (get a 60ml syringe)}$$

$$\text{Rate} \times \text{time} = \text{total volume}$$

Convert from minutes to hours.

$$10\text{hr} \times 60\text{min/hr} = 600\text{min}$$

Multiply your CRI time by your kg and dose.

$$600\text{min} \times 7\text{kg} \times 5\text{mcg} = 21,000\text{mcg Dobutamine}$$

Convert from mcg to mg.

$$21,000\text{mcg} \div 1000\text{mcg/mg} = 21\text{mg Dobutamine}$$

Divide by concentration to get ml.

$$21\text{mg} \div 12.5\text{mg/ml} = 1.68\text{ml Dobutamine}$$

Subtract Dobutamine from total ml to find ml NaCl.

$$50\text{ml total} - 1.68\text{ml Dobutamine} = 48.32\text{ml NaCl}$$



Norepinephrine is a catecholamine and one of the hormones responsible for the “fight-or-flight” response to stress. It is a neurotransmitter that is active in the both peripheral and central nervous system. Some effects that it has on the body include increases in blood pressure (via peripheral vasoconstriction), heart rate*, and blood glucose levels.

Frequently used to

- Treat critical hypotension

Norepinephrine is typically prescribed as a CRI rate of 0.2-2mcg/kg/min.

CONCENTRATION is in **mg

DOSAGE is in **mcg

RATE is **/min

**Norepinephrine is light sensitive - cover your bag or syringe.

*The primary heart rate increase is usually less than the reflex reduction of heart rate due to the increased BP, so you would more likely see a net *decreased* heart rate.



WAY 1

Ex: Cocoa Puff is a 9y FS Poodle x who weighs 15kg. The DVM wants to start a Norepinephrine CRI at 1mcg/kg/min.

Calculate our CRI:

$$(1\text{mcg} \times 15\text{kg})/\text{min} = 15\text{mcg}/\text{min}$$

$$15\text{mcg}/\text{min} \times 60\text{min}/\text{hr} = 900\text{mcg}/\text{hr}$$

$$900\text{mcg}/\text{hr} \div 1000 = 0.9\text{mg}/\text{hr}$$

$$0.9\text{mg}/\text{hr} \div 1\text{mg}/\text{ml} = 0.9\text{ml}/\text{hr}$$

Our CRI rate is 0.9ml/hr Norepinephrine.

We should dilute this. (<1ml/hr)

What do you pick?

How will this translate if the rate goes up or down?

What is the dog's 1xM fluid rate? = 41ml/hr

Find dose per min.

Convert to dose per hour.

Convert mcg to mg.

Divide by concentration for ml/hr.



This is the same way we calculated Dopamine and Dobutamine.

What dilution would you pick?

Let's do a **1 = 1 dilution**

This would create a mixture of Norepinephrine and NaCl such that

$$\underline{1} \text{mcg/kg/min} = \underline{1} \text{ml/hr}$$

$$+ \frac{0.9 \text{ml Norepinephrine} + x \text{ ml NaCl}}{1 \text{ml}} \quad \text{Solve for } x$$

$$1 \text{ml (total)} - 0.9 \text{ml Norepi} = 0.1 \text{ml NaCl}$$

And let's run this for 10 hours.

$$10 \text{ml} - 9 \text{ml Norepinephrine} = 1 \text{ml NaCl}$$

Put **9ml** Norepinephrine and **1ml NaCl** in a 12ml syringe and run at **1ml/hr**.



WAY 2

Ex: Cocoa Puff is a 9y FS Poodle x who weighs 15kg. The DVM wants to start a Norepinephrine CRI at 1mcg/kg/min.

CRI Dilution:

We want a 1 = 1 dilution for 10 hours.

$$1\text{ml} \times 10\text{hr} = 10\text{ml} \text{ (get a 12ml syringe)}$$

Rate x time = total volume

Convert from minutes to hours.

$$10\text{hr} \times 60\text{min/hr} = 600\text{min}$$

Multiply your CRI time by your kg and dose.

$$600\text{min} \times 15\text{kg} \times 1\text{mcg} = 9,000\text{mcg Norepinephrine}$$

Convert from mcg to mg.

$$9,000\text{mcg} \div 1000\text{mcg/mg} = 9\text{mg Norepinephrine}$$

Divide by concentration to get ml.

$$9\text{mg} \div 1\text{mg/ml} = 9\text{ml Norepinephrine}$$

Subtract Norepi from total ml to find ml NaCl.

$$10\text{ml total} - 9\text{ml Norepinephrine} = 1\text{ml NaCl}$$



Mannitol is an osmotic diuretic. Its molecules cause cellular dehydration by drawing fluid out from intracellular space (inside cells) into extracellular space (i.e. into blood/lymph fluid). This fluid movement decreases intracranial pressure.

Frequently used for

- Head trauma
- Glaucoma
- Other causes of swelling and edema

Mannitol is typically prescribed at a rate of 0.25g-1g/kg, usually over 20-30 minutes.

**CONCENTRATION is in %

DOSAGE is usually in **grams

****Crystallizes at cooler temps - keep in incubator until use and use a filter when administering.**

**Mannitol is light sensitive - cover your bag or syringe.



Ex: Peanut is a 6y FS Min Pin who weighs 4kg. We want to start give Mannitol at 0.5g/kg over 30min.

Calculate our CRI:

Multiply dose by weight.

$$(0.5\text{g} \times 4\text{kg}) = 2\text{g}$$

Convert from g to mg.

$$2\text{g} \times 1000\text{mg/g} = 2,000\text{mg}$$

Divide by concentration to get ml needed.

$$2,000\text{mg} \div 200\text{mg/ml} = 10\text{ml}$$

Calculate rate (we want this to go over 30min)

$$10\text{ml} \times 2 = 20\text{ml/hr}$$

*remember, there are two 30min in 1hr

Rate = 20ml/hr

VTBI = 10ml



Remember - a concentration of 20%

= 200mg/ml

Calculate:

37kg dog,
0.5g/kg Mannitol over 30min

$$37\text{kg} \times 0.5\text{g/kg} = 18.5\text{g}$$

$$18.5\text{ g} \times 1000 = 18,500\text{mg}$$

$$18,500\text{mg} \div 200\text{ mg/ml} \\ = 92.5\text{ml Mannitol}$$

$$92.5\text{ml} \times 2 = 185\text{ml/hr}$$

$$\text{Rate}^* = 185\text{ml/hr}$$
$$\text{VTBI} = 92.5\text{ml}$$

*most syringe pumps don't
allow rates this high

6.3kg cat,
0.25g/kg Mannitol over 20min

$$6.3\text{kg} \times 0.25\text{g/kg} = 1.575\text{g}$$

$$1.575\text{ g} \times 1000 = 1,575\text{mg}$$

$$1,575\text{mg} \div 200\text{ mg/ml} \\ = 7.875\text{ml Mannitol}$$

$$7.9\text{ml} \times 3 = 23.7\text{ml/hr}$$

$$\text{Rate} = 23.7\text{ml/hr}$$
$$\text{VTBI} = 7.9\text{ml}$$

14kg dog,
1g/kg Mannitol over 30min

$$14\text{kg} \times 1\text{g/kg} = 14\text{g}$$

$$14\text{g} \times 1000 = 14,000\text{mg}$$

$$14,000\text{mg} \div 200\text{ mg/ml} \\ = 70\text{ml Mannitol}$$

$$70\text{ml} \times 2 = 140\text{ml/hr}$$

$$\text{Rate} = 140\text{ml/hr}$$
$$\text{VTBI} = 70\text{ml}$$

Lidocaine is an antiarrhythmic and an anesthetic. It is used locally to numb skin and surrounding tissue (SQ, IM). It is also used IV to treat certain cardiac arrhythmias in dogs (ventricular-based, diagnosed by ECG).

Frequently used as

- Local anesthetic or nerve block
- Antiarrhythmic for certain cardiac conditions
- Part of an analgesia cocktail intra- and post-op (FLK, MLK, HLK, etc).

Lidocaine is typically prescribed as a repeatable bolus of **2mg/kg**, followed by a CRI rate of **10-80mcg/kg/min** (with a goal of weaning over time).

**CONCENTRATION is in %

DOSAGE is in **mg AND **mcg**

** **Do NOT use in cats** - hypersensitivity and negative cardiovascular effects

**Lidocaine is light sensitive - cover your bag or syringe.



Sometimes, you will make up a Lidocaine CRI in a syringe and run it straight (undiluted).

Consider the length of time the CRI will be needed when calculating and determining syringe size.

CRI IN A SYRINGE

Ex: George is an 8y MN Boxer who weighs 30kg. We want to start a Lidocaine CRI at 50mcg/kg/min.



WAY 1

Ex: We want to start 50mcg/kg/min Lidocaine for George, a 30kg Boxer. We will run this straight (undiluted) in a syringe. How much Lidocaine do we need?

Calculate our CRI:

$$(50\text{mcg} \times 30\text{kg})/\text{min} = 1,500\text{mcg}/\text{min}$$

$$1,500\text{mcg}/\text{min} \times 60\text{min}/\text{hr} = 90,000\text{mcg}/\text{hr}$$

$$90,000\text{mcg}/\text{hr} \div 1000 = 90\text{mg}/\text{hr}$$

$$90\text{mg}/\text{hr} \div 20\text{mg}/\text{ml} = 4.5\text{ml}/\text{hr}$$

Find dose per min (dose x kg).

Convert to dose per hour (x 60).

Convert mcg → mg (÷ 1000).

Divide by concentration for ml/hr.

Our CRI rate is 4.5ml/hr

How long do we plan on being on the CRI?

Let's go with 10 hours (we may adjust rate depending on patient's response).

$$4.5\text{ml}/\text{hr} \times 10\text{hr} = 45\text{ml Lidocaine.}$$

Put 45ml Lidocaine in a 60ml syringe and run at 4.5ml/hr.



WAY 2 - sort of but not really

Ex: We want to start 50mcg/kg/min Lidocaine for George, a 30kg Boxer. We will run this straight (undiluted) in a syringe. How much Lidocaine do we need?

Calculate our CRI:

$$(50\text{mcg} \times 30\text{kg})/\text{min} = 1,500\text{mcg}/\text{min}$$

$$1,500\text{mcg}/\text{min} \div 1000\text{mcg}/\text{mg} = 1.5\text{mg}/\text{min}$$

$$1.5\text{mg}/\text{min} \times 60\text{min}/\text{hr} = 90\text{mg}/\text{hr}$$

$$90\text{mg}/\text{hr} \div 20\text{mg}/\text{ml} = 4.5\text{ml}/\text{hr}$$

Find dose per min (dose x kg).

Convert to mcg \rightarrow mg (\div 1000).

Convert min \rightarrow hr (\times 60).

Divide by concentration for ml/hr.

Our CRI rate is 4.5ml/hr

How long do we plan on being on the CRI?

Let's go with 10 hours (we may adjust rate

$$4.5\text{ml}/\text{hr} \times 10\text{hr} = 45\text{ml Lidocaine.}$$

Put 45ml Lidocaine in a 60ml syringe and run at 4.5ml/hr.



Sometimes, you will make up a fluid bag with Lidocaine in it and run it at a maintenance rate for a number of hours.

*We usually will use 0.9% NaCl to dilute Lidocaine.

- D5W, LRS, LRS with Dextrose, 0.45% NaCl, and 0.45% NaCl with Dextrose are also compatible.

CRI IN A FLUID BAG

Ex: George is an 8y MN Boxer who weighs 30kg. We want to start a Lidocaine CRI at 50mcg/kg/min at 1xM.



WAY 1 - In a Fluid Bag

Ex: We want **50mcg/kg/min** Lidocaine for George, a **30kg** Boxer. George is currently at a fluid rate of **1xM** and we are about to start a **new 1L bag**. How much Lidocaine do we need?

Calculate fluid rate:

$$30\text{kg} \times 2.2 = 66\text{lb}$$

$$66\text{lb} \times 30\text{ml} \div 24\text{hr} = 82.5\text{ml/hr}$$

Convert **weight** in kg to pounds (x 2.2)

Calculate **fluid rate** (pounds x 30 ÷ 24)

Calculate CRI:

$$30\text{kg} \times 50\text{mcg/kg/min} = 1500\text{mcg/min}$$

$$1500\text{mcg/min} \times 60\text{min/hr} = 90,000\text{mcg/hr}$$

$$90,000\text{mcg/hr} \div 1000\text{mcg/mg} = 90\text{mg/hr}$$

$$90\text{mg/hr} \div 82.5\text{ml/hr} = 1.0909\text{mg/ml}$$

$$1.0909\text{mg/ml} \times 1000\text{ml} = 1,090.9\text{mg}$$

$$1,090.9\text{mg} \div 20\text{mg/ml} = 54.5\text{ml}$$

Multiply **weight** in kg by desired **Lidocaine dose**

Convert min → hour (x 60) = how many mcg/hr

Convert mcg → mg (÷ 1000) = how many mg/hr

Divide by **fluid rate** = mg Lido/ml fluid in bag needed

Multiply by **fluid amount in bag** = mg Lidocaine needed

Divide by Lidocaine concentration = ml Lidocaine needed

Add 54.5ml Lidocaine to 1L bag. Run it at 83ml/hr.

****Like Dextrose, REMOVE an equal volume of fluid from the bag FIRST before adding Lidocaine.**

WAY 1 - In a Fluid Bag - ALTERNATIVE ORDER

Ex: We want **50mcg/kg/min** Lidocaine for George, a **30kg** Boxer. George is currently at a fluid rate of **1xM** and we are about to start a **new 1L bag**. How much Lidocaine do we need?

Calculate **fluid rate**:

$$30\text{kg} \times 2.2 = 66\text{lb}$$

$$66\text{lb} \times 30\text{ml} \div 24\text{hr} = 82.5\text{ml/hr}$$

Convert **weight** in kg to pounds (x 2.2)

Calculate **fluid rate** (pounds x 30 ÷ 24)

Calculate **CRI**:

$$30\text{kg} \times 50\text{mcg/kg/min} = 1500\text{mcg/min}$$

$$1500\text{mcg/min} \times 60\text{min/hr} = 90,000\text{mcg/hr}$$

$$90,000\text{mcg/hr} \div 1000\text{mcg/mg} = 90\text{mg/hr}$$

$$90\text{mg/hr} \div 20\text{mg/ml} = 4.5\text{ml/hr}$$

$$4.5\text{ml/hr} \times 1000\text{ml} = 4,500\text{ml/hr}$$

$$4,500\text{ml/hr} \div 82.5\text{ml/hr} = 54.5\text{ml}$$

Multiply **weight** in kg by desired **Lidocaine dose**

Convert min → hour (x 60) = how many mcg/hr

Convert mcg → mg (÷ 1000) = how many mg/hr

Divide by Lidocaine concent. = ml/hr Lidocaine needed

Multiply by **fluid amount in bag** = mg Lidocaine needed

Divide by **fluid rate** = ml Lidocaine needed in bag

Add 54.5ml Lidocaine to 1L bag. Run it at 83ml/hr.

****Like Dextrose, REMOVE an equal volume of fluid from the bag FIRST before adding Lidocaine.**

WAY 2 - In a Fluid Bag

Ex: We want **50mcg/kg/min** Lidocaine for George, a **30kg** Boxer. George is currently at a fluid rate of **1xM** and we are about to start a **new 1L bag**. How much Lidocaine do we need?

Calculate **fluid rate**:

$$30\text{kg} \times 2.2 = 66\text{lb}$$

$$66\text{lb} \times 30\text{ml} \div 24\text{hr} = 82.5\text{ml/hr}$$

Calculate **CRI**:

$$1000\text{ml} \div 82.5\text{ml/hr} = 12.12\text{hr}$$

$$12.12\text{hr} \times 60\text{min} = 727.27\text{min}$$

$$727.27\text{min} \times 50\text{mcg/kg/min} \times 30\text{kg} = 1,090,909\text{mcg}$$

$$1,090,909\text{mcg} \div 1000\text{mcg/mg} = 1,090.9\text{mg}$$

$$1,090.9\text{mg} \div 20\text{mg/ml} = 54.5\text{ml}$$

Convert **weight** in kg to pounds (x 2.2)

Calculate **fluid rate** (pounds x 30 ÷ 24)

Divide **fluid amount in bag** by **fluid rate** = hours in bag

Convert hr → min (x 60) = minutes in bag

Multiply minutes in bag x **Lidocaine dose** x **weight** = mcg

Convert mcg → mg (÷ 1000) = mg of Lidocaine

Divide by Lidocaine concentration = ml Lidocaine needed

Add 54.5ml Lidocaine to 1L bag. Run it at 83ml/hr.

****Like Dextrose, REMOVE an equal volume of fluid from the bag FIRST before adding Lidocaine.**

Furosemide (Lasix) is a loop diuretic. It helps reduce fluid retention and build-up (edema). It works by decreasing reabsorption of sodium in the kidneys (the osmotic effect = less water absorbed, so greater urine production). It can cause electrolyte abnormalities. Patients receiving Lasix should ALWAYS have water available.

Frequently used to

- Reduce edema and fluid retention in the body
 - Heart failure, liver disease, renal disease
- Treat hypertension (not a primary med)

Lasix is typically prescribed as a repeatable dose of

- 2-4mg/kg (dogs)
- 0.5-2mg/kg (cats)

or as a CRI rate of

- 0.25-1mg/kg/hr (dogs)
- 0.25-0.6mg/kg/hr (cats)
(with a goal of weaning over time).

**Lasix is light sensitive - cover your bag or syringe.

**Dilute with 0.9% NaCl

(precipitate may form in acidic solutions)



Ex: Rambo is an 13y MN Maine Coon who weighs 12kg. We want to give a 1mg/kg bolus of Lasix IV, followed by a 0.4mg/kg/hr CRI of Lasix.

Calculate our bolus:

$$1\text{mg} \times 12\text{kg} = 12\text{mg}$$

$$12\text{mg} \div 50\text{mg/ml} = 0.24\text{ml}$$

(dose x weight)

(amount in mg \div concentration)

Our bolus is 0.24ml Lasix IV.

Calculate our CRI:

$$(0.4\text{mg} \times 12\text{kg})/\text{hr} = 4.8\text{mg/hr}$$

$$4.8\text{mg/hr} \div 50\text{mg/ml} = 0.096\text{ml/hr}$$

Our CRI rate is 0.096ml/hr Lasix.

BUT

We are going to need to dilute this because it is such a small amount (<<1ml/hr).



Look familiar? This is the same way we calculated Fentanyl CRIs.

What dilution should we do?

Consider what Lasix is used for - a diuretic for cases of CHF and edema and other conditions where you want to be very cautious about fluid overload.

From our previous calculations, we know that

$$0.4\text{mg/kg/hr} = 0.096\text{ml/hr}$$

Make a 0.4 = 1 dilution which would create a mixture of Lasix and NaCl such that

$$\underline{0.4}\text{mg/kg/hr} = \underline{1}\text{ml/hr}$$

$$+ \frac{0.096\text{ml Lasix}}{1\text{ ml}} + \frac{x\text{ ml NaCl}}{1\text{ ml}} = 1\text{ ml} \quad \text{Solve for } x$$

$$1\text{ml} - 0.096\text{ml Lasix} = x\text{ ml NaCl}$$

x = 0.9ml NaCl



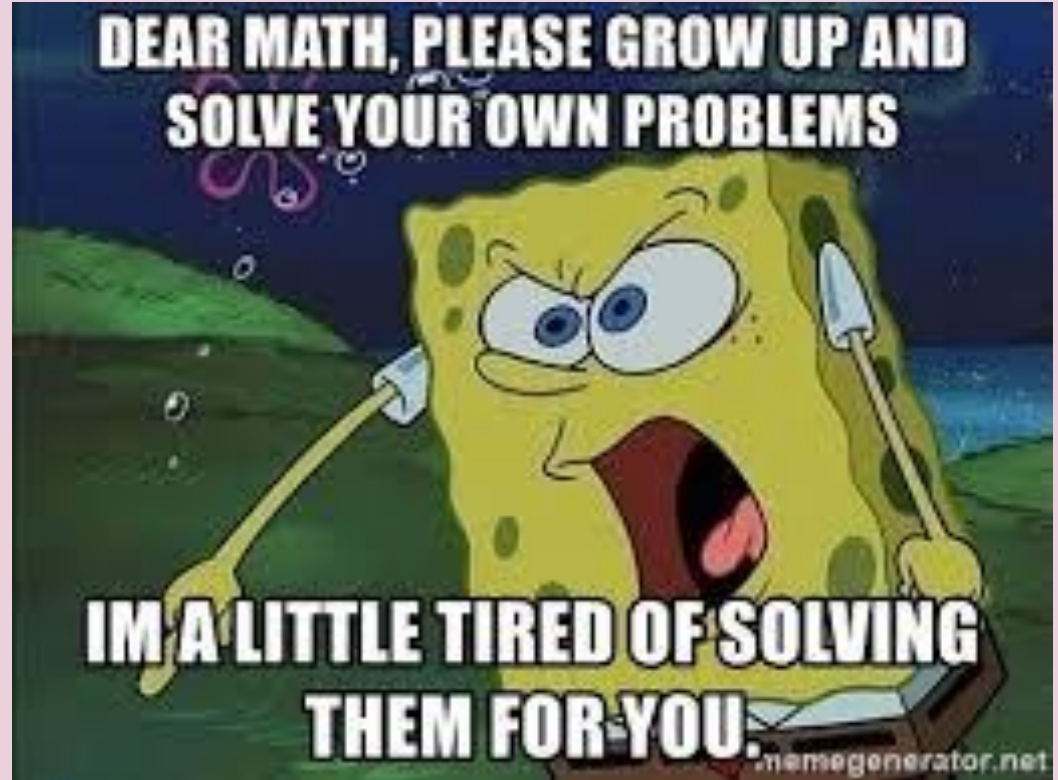
If we run this for 10 hours:

$$\begin{array}{lll} 0.096\text{ml Lasix} & \times 10\text{hr} & = 0.96\text{ml Lasix} \\ \underline{+ 0.904\text{ml NaCl}} & \times 10\text{hr} & = \underline{9.04\text{ml NaCl}} \\ 1\text{ml total} & \times 10\text{hr} & = 10\text{ ml total} \end{array}$$

Use a 12ml syringe for your diluted Lasix CRI.

Special Types of CRIs

- Insulin CRIs
- Surgical CRIs
- Nutritional CRIs



Insulin is a hormone produced by the pancreas to convert glucose in the blood to energy for cells. Diabetes is a result of the body's inability to produce adequate insulin or the inability to properly use it. Insulin is available in both short-acting and long-acting forms.

ONLY HUMULIN R (short-acting) is used in a CRI.

Frequently used to

- Regulate uncontrolled DM (diabetes mellitus)
- Treat DKA (diabetic ketoacidosis)

Humulin R is typically started at a CRI rate of

- 5ml/hr for cats
 - 10ml/hr for dogs
- (with a goal of weaning over time).

Only use **HUMULIN R in an insulin CRI.

Use appropriate **U-100 syringe for dosing.

Insulin is kept in the **refrigerator.

****Bleed 50 ml** of the insulin CRI line after adding insulin to the bag



Ex: Tippy is a 7y FS DLH who weighs 7kg. After 6 hours of rehydration with IVF, we want to start an insulin CRI at 5ml/hr.

Calculate how much insulin is needed:

Insulin is measured in **units**

Each unit of a U-100 syringe = 0.01ml

7kg x 2.2units = 15.4 units



You will need 15.4units of Humulin R in a U-100 syringe.

**It is impossible to draw up exactly 15.4 units - use your best judgment and/or round DOWN

**Humulin R should be CLEAR and COLORLESS
- Gently roll bottle to mix and resuspend proteins

**Use aseptic technique and use an alcohol swab on the top of the insulin bottle before puncture

1 unit per pound

OR

2.2 units per kg

Ex: Tippy is a 7y FS DLH who weighs 7kg. We want to start an insulin CRI at 5ml/hr.

Add insulin to the bag:

Use a 250ml bag of 0.9% NaCl.

Tips & tricks

*Invert the bag so that the medication port is “up”

- *Firmly* pierce the medication port straight on with the U-100 needle
 - Be cautious of bending the needle
 - Watch to see drops of insulin added to bag

OR

- Use a large bore needle (20g-18g) to pierce the medication port
 - Using the shaft of the needle as a path or slip-and-slide, insert your U-100 needle into the larger needle and add insulin to the bag

Invert the bag several times to mix well - you don't want insulin to remain in the small “pocket” of the medication port.



Ex: Tippy is a 7y FS DLH who weighs 7kg. We want to start an insulin CRI at 5ml/hr.

Bleed the line:

Insulin (and other proteins) bind to plastic. Allowing some fluid to flow through the line prior to starting CRI on a patient allows insulin to coat the potential insulin-binding surfaces.

- What happens if you don't bleed the line?

For an initial period of time, the patient will not receive appropriate insulin dosing, if any. We don't want to waste that time not treating the problem.

- How much fluid do I bleed out?

50ml is the volume generally accepted to adequately coat the line.

****Don't forget to bleed the CRI through any extension set(s) and bifurcator you may need.**



Ex: Tippy is a 7y FS DLH who weighs 7kg. We want to start an insulin CRI at 5ml/hr.

Start your patient on your CRI:

Run your CRI at 5ml/hr (standard starting rate for a cat) or whatever rate the DVM instructs.

Remember to adjust any other fluids the patient may be on to account for the new insulin CRI rate.

Total fluid rate = $1.5 \times M$

$7\text{kg} \times 2.2 = 15.4 \text{ lbs}$

$15.4\text{lbs} \times 45\text{ml/hr} \div 24 \text{ hours} = 28.87\text{ml/hr}$

Fluids are running at $29\text{ml/hr} = 1.5 \times M$

When starting an insulin CRI at 5ml/hr, deduct an equivalent amount from the total fluid rate.

$29\text{ml/hr} - 5\text{ml/hr} = 24\text{ml/hr}$

Decrease non-CRI fluids to 24ml/hr.



Adjusting an Insulin CRI

When a patient is on an insulin CRI, we will be monitoring their BGs frequently and increasing or decreasing the CRI rate as needed.

There are laminated cage cards with BG parameters and corresponding instructions for adjusting the rate in the Treatment Room.

Any patient on an insulin CRI should have one of these cards attached to their cage.

The charts are a guideline. Always notify the DVM of a patient's BG results to make a final determination for what rate adjustment is needed.

*Don't forget to adjust your other fluid rate to keep the patient at the proper total maintenance



Calculate:

37kg dog,
Insulin CRI at 10ml/hr

$$37\text{kg} \times 2.2\text{units/kg} \\ = 81.4\text{units}$$

What type of Insulin?
= Humulin R

What syringe will you use?
= U-100

6.95lb cat,
Insulin CRI at 5ml/hr

$$6.95\text{lb} \times 1\text{unit/lb} \\ = 6.95\text{units}$$

How much is this in ml?
= 0.07ml

What fluid bag (type and
size) will you use?
=250ml 0.9% NaCl

14kg dog,
Insulin CRI at 8ml/hr

$$14\text{kg} \times 2.2\text{units/kg} \\ = 30.8\text{units}$$

Where is insulin kept?
= in lab fridge

What type of action does
Humulin R have?
=short-acting

Surgical CRIs

FLK = Fentanyl, Lidocaine, Ketamine

Commonly used analgesic cocktail CRI for surgeries, procedures, and some patients with severe pain.

Frequently used for

- Pre-, intra-, and post-operative pain control
- Managing severely painful patients

FLK is typically started at a CRI rate of 1-2ml/kg/hr.

**FLK is light sensitive - cover your bag or syringe.

**0.9% NaCl is preferable, but other fluids may be OK

** **Do NOT use FLK in cats** - due to Lidocaine hypersensitivity and negative cardiovascular effects
Can use FK instead.



FLK = Fentanyl, Lidocaine, Ketamine

Need: 500ml bag of 0.9% NaCl

Remove 40ml

Add Fentanyl = 20ml

Add Lidocaine = 18.75ml

Add Ketamine = 1.25ml

40ml

Label your bag with 1 medication label **PER** medication (3 total).

Other comparable CRIs are **MLK** (Morphine) and **HLK** (Hydromorphone).



MLK = Morphine, Lidocaine, Ketamine

Need: 1000ml bag of 0.9% NaCl

Remove "y" ml*

Add Morphine = 20mg

Add Lidocaine = 240mg (12ml)

Add Ketamine = 200mg (2ml)

"y" ml

Label your bag with 1 medication label **PER** medication (3 total).

*At this time, we do not carry Morphine, so we do not make this CRI.

HLK = Hydromorphone, Lidocaine, Ketamine

Need: 1000ml bag of 0.9% NaCl

Remove 93ml

Add Hydromorphone = 12ml

Add Lidocaine = 75ml

Add Ketamine = 6ml

93ml

Label your bag with 1 medication label **PER** medication (3 total).

*This CRI would be a special request from a DVM. Verify the quantities of medications with them prior to making the CRI.

Calculate:

37kg dog, FLK at 1ml/kg/hr

$$37\text{kg} \times 1\text{ml/kg} \\ = 37\text{ml/hr}$$

8lb cat, FK at 1.5ml/kg/hr

$$8\text{lb} \div 2.2 = 3.636\text{kg} \\ 3.636\text{kg} \times 1.5\text{ml/kg} \\ = 5.45\text{ml/hr} \\ = 5\text{ml/hr}$$

14kg dog, FLK at 2ml/kg/hr for
1hr, then 1ml/kg/hr

$$14\text{kg} \times 2\text{ml/kg} = 28\text{ml/hr} \\ 14\text{kg} \times 1\text{ml/kg} = 14\text{ml/hr} \\ = 28\text{ml/hr} \rightarrow 14\text{ml/hr}$$

Nutritional CRIs

Feeding tubes are a frequent occurrence at the hospital. Whether it is due to an inability to eat or an unwillingness to eat, a feeding tube allows a patient to get the nutritional support they need.

There are a number of types of feeding tubes:

- Nasoesophageal (NE tube)
- Nasogastric (NG tube)
- Esophagostomy (E tube)
- Gastrostomy (G tube, PEG tube)
- Jejunostomy (usually as a J-through-G tube)

Some are short term (days) and others can be in place for much longer.

Placement and type is based on a patient's specific needs.

Depending on the type of tube, feeding can occur as boluses or as a CRI.

Based on RER calculation = Resting Energy Requirements



Nutritional CRIs

Ex: Timmy is a 5kg DSH. He has an NE tube. We want to start Recovery liquid at 3ml/hr ($\frac{1}{4}$ his RER). Describe how you will calculate and set this up for the patient.

We are *given* our rate: 3ml/hr.
There is no math!

Liquid diets, slurries, gruels, and bolus feedings will be discussed in the Nutrition Portion of the class.

Notes:

- These diets need to be refrigerated when not in use.
- Because of this, only small amounts (~6 hours worth) at a time should be set up on a pump.
- Changing the bag (q6h) and line (q24h) reduce bacterial contamination risks.



Medication Labels

ALWAYS use a medication label for any additive, CRI, or other drug or substance you put in a syringe or add to a fluid bag.

Let's say it together -

ALWAYS USE A MEDICATION LABEL!

Use one label for each medication added.

- If you add Reglan to a fluid bag
= 1 label (on bag)
- If you add KCl and KPhos to a buretrol
= 2 labels (on buretrol)
- If you add Bvits to a bag and Dextrose to a buretrol
= 2 labels (1 on bag, 1 on buretrol)
- If you make a bag of FK for a cat surgery
= 2 labels (on bag)



MEDICATION ADDED

PATIENT	RM #
DRUG	
AMOUNT	RATE ML/HR
ADDED BY	BASE SOL'N.
DATE	TIME
EXP. DATE	

THIS LABEL MUST BE AFFIXED TO ALL INFUSION FLUIDS CONTAINING ADDITIONAL MEDICATION



**MEDICATION
ADDED TO I.V.**

Time	Date	By
Drug	Quantity	
_____	_____	
_____	_____	
_____	_____	

Expires: Date _____ Time _____

Medication Labels

PATIENT Socks Reed

RM #

DRUG Fentanyl

3mcg/kg/hr = 3ml/hr

AMOUNT 2.2ml Fent.

RATE 3ml/hr **ML/HR**

ADDED BY 27.8ml NaCl

BASE SOL'N NaCl

DATE LR 8/18/20

TIME 4pm

EXP. DATE

**THIS LABEL MUST BE AFFIXED TO ALL INFUSION FLUIDS
CONTAINING ADDITIONAL MEDICATION**

How would you label this?

39kg dog, 2xM, 20mEq/L KCl

Put additives in **fluid bag**

One label on fluid bag

11kg cat, 1xM, 5% Dextrose

Put additives in **buretrol**

One label on buretrol

15lb dog, 1xM, 2ml/L Bvits

Put additives in **fluid bag**

One label on fluid bag

How would you label this?

13kg dog, 1xM, 30mEq/L KPhos

Put additives in **buretrol**

One label on buretrol

110lb dog, 1.5xM, 2.5% Dextrose

Put additives in **fluid bag**

One label on fluid bag

2.5kg cat, 1xM, 2ml/L Bvits **and**
20mEq/L KCl

Put Bvits additives in **fluid bag**

Then draw that up in a syringe & add KCl to **syringe**

One label on fluid bag (Bvits)

THEN

TWO labels on syringe (both)

OR

Put your Bvits in a **fluid bag**
and KCl in a **buretrol**

One label on fluid bag

One label on buretrol

How would you label this?

54lb dog, 1xM, 1mg/kg/day Reglan

Put additives in **fluid bag**

One label on fluid bag

9lb puppy, 2xM, 2ml/L Bvits **and**
2.5% Dextrose

Put Bvits additives in **fluid bag**

Add Dextrose to **buretrol** or
syringe

One label on fluid bag (Bvits)

One label on buretrol (Dextr.)

OR

One label on fluid bag (Bvits)

THEN

TWO labels on syringe (both)

17lb cat, 1xM, 30mEq/L KCl **and**
10mEq/L KPhos

Put both additives in **buretrol**

Two labels on buretrol

CONGRATULATIONS!

You survived

Medical Math

Conversions, Fluid Therapy (Fluid Rates and Boluses), Additives,
CRIs and Dilutions, and Labelling