Medication Calculations- part 2

CHARLES STURT UNIVERSITY

Learning Skills

Introduction:

Common calculations required in nursing include finding volumes needed for oral or injected dose and working out IV infusion flow and drip rates. All these calculations require the application of the various maths skills looked at in previous worksheets.

This sheet will teach you to:

- Calculate flow rate of IV infusions in mL/h
- Calculate IV infusion drip rates
- Find volume and time of IV infusions

1. Calculating flow rate for an IV infusion

Depending upon the type of pump used and medication to be given a flow rate or a drip rate may need to be calculated to set up an infusion.
Flow rate for an IV infusion is measured in millilitres per hour (mL/h). The formula to calculate flow rate is:

$$\boxed{flow\ rate = \frac{volume}{time}}$$

Example

A patient requires 1000mL of fluid IV over 8 hours. Find the flow rate.

$$flow\ rate = \frac{volume}{rate} = \frac{1000mL}{8h} = \frac{250}{2} mL/h = 2\overline{)25^{1}0}^{\ 12\ 5} = 125mL/h$$

Note

Flow rates need to be expressed to the nearest whole number so follow normal rounding rules, taking division through to 1 decimal place when necessary.

Example

A patient is to receive 600mL 5% Dextrose in water IV to be infused over 4 hours. Calculate the rate in mL/ h to be delivered by the pump.

$$flow\ rate = \frac{600}{4} mL/h = \frac{300}{2} mL/h = 2\overline{)3^{1}00}^{\ 1\ 50} = 150mL/h$$

2. Finding a drip rate

To calculate the rate in drops per minute (dpm) we need to know the volume to be delivered in millilitres, the time in minutes and the rate of the giving set.

Giving sets usually deliver at 20 drops per mL **(macrodrip)** or 60 drops per mL **(microdrip)**. Some sets may deliver at 15 drops per mL.

To calculate drip rate:

$$\boxed{drip\ rate = \frac{volume \times drops\ /\ mL}{time(h) \times 60}}$$

Note

Drip rates also need to be expressed to the nearest whole number so follow normal rounding rules, taking division through to 1 decimal place when necessary.

Example

800 mL of fluid is to be given intravenously to a patient over 6 hours. The IV set delivers at 20 drops/mL. Calculate the drip rate?

$$\text{drip rate} = \frac{\text{volume(mL)} \times \text{drops/mL}}{\text{time(h)} \times 60}$$

$$= \frac{800 \times 20}{6 \times 60} = \frac{800 \times 20^{\div 20}}{6 \times 60_{\div 20}} = \frac{800 \times 1}{6 \times 3} = \frac{800}{18} = \frac{400}{9} = \quad 9\overline{)\,4\ {}^{4}0\ {}^{4}0.{}^{4}0}^{\,0\ 4\ 4.4} = 44 \text{ drops/min}$$

The calculation can be simplified if you do some cancelling before multiplying tops and bottoms

Example

A teenager who is badly dehydrated is to receive 1.5 L over 10 hours of re-hydration fluid by IV infusion. The giving set delivers 20 drops/mL. Calculate the drip rate?

Volume to be received = 1.5L = 1500mL

$$drip\ rate = \frac{1500 \times 20}{10 \times 60} = \frac{1500 \times 20^{\div 20}}{10 \times 60_{\div 20}} = \frac{1500 \times 1}{10 \times 3} = \frac{1500}{30} = \frac{150}{3} = 50dpm$$

Example

A patient is to receive 200 mL of fluid over 40 minutes with a giving set of 20 drops/mL. How many dpm will the pump need to be set to?

Here the <u>time is given in minutes</u> so the $\times 60$ is not required on the bottom line.

$$drip\ rate = \frac{200 \times 20}{40} = \frac{400\cancel{0}}{4\cancel{0}} = \frac{400}{4} = 100dpm$$

Example

Calculate the drip rate if a patient is to receive 45 mL/h of fluid through

i. a microdrip set.

ii. a macrodrip set

iii. a 15 drops/mL set

A flow rate of 45 mL/h equates to a volume of 45 mL over a 1 hour period.

i. $$drip\ rate = \frac{45 \times 60}{1 \times 60} = \frac{45 \times \cancel{60}}{1 \times \cancel{60}} = \frac{45}{1} = 45dpm$$

ii. $$drip\ rate = \frac{45 \times 20}{1 \times 60} = \frac{45 \times 20^{\div 20}}{1 \times 60_{\div 20}} = \frac{45 \times 1}{1 \times 3} = \frac{45}{3} = 15dpm$$

iii. $$drip\ rate = \frac{45 \times 15}{1 \times 60} = \frac{45 \times 15^{\div 15}}{1 \times 60_{\div 15}} = \frac{45 \times 1}{1 \times 4} = \frac{45}{4} = 4\overline{)45.^{1}0}^{\,11.2} = 11dpm$$

3. Other calculations

At times the flow rate or drip rate may be known but the volume or the time may be unknown. This requires the formulae to be re-arranged.

To find the volume :

$$\boxed{volume(mL) = rate(mL/h) \times time(h)}$$

To find the time :

$$\boxed{time(h) = \frac{volume(mL)}{rate(mL/h)}}$$

To find time:

$$\boxed{time(h) = \frac{volume(mL) \times drops/mL)}{drip\ rate(dpm) \times 60}}$$

Example

A patient is receiving 100mL/h of a solution for 1.5 hours. How much fluid are they receiving?

Flow rate = 100mL/h
time = 1.5 h
We need to calculate the volume.

$$volume\ (mL) = rate(mL/h) \times time(h) = 100 \times 1.5 = 150mL$$

So the patient is receiving 150 mL

Example

A patient is prescribed 2000mL (2L) of a dextrose saline solution. The flow rate is set at 160mL/h. How long will the infusion take?

Flow rate = 160mL/h
volume = 2000mL.
We need to calculate the time.

$$time(h) = \frac{volume(mL)}{rate(mL/h)} = \frac{2000}{160} = \frac{200\cancel{0}}{16\cancel{0}} = \frac{200}{16} = \frac{100}{8} = \frac{50}{4} = 4\overline{)\ 5^{1}0.^{2}0}^{\ 1\ \ 2.\ 5} = 12.5h$$

To convert 0.5 hours to minutes, multiply by 60: 0.5 x 60 = 30 minutes

Time needed for infusion is 12 hours and 30 minutes

Example

A patient is ordered 1500mL 2.5% Dextrose in water IV, through a giving set 15 drops/mL at a rate of 40dpm. How many hours will it take for the IV to infuse?

Volume = 1500mL
Drop factor = 15drops/mL
Drip rate = 40dpm
We need to calculate time(h)

$$time = \frac{volume \times drops/mL}{dpm \times 60} = \frac{1500 \times 15}{40 \times 60} = \frac{1500 \times 1}{40 \times 4} = \frac{1500}{160} = \frac{150}{16} = \frac{75}{8}$$

$$= 8\overline{)75.^{3}0} = 9.3h$$

Time needed for infusion is approximately 9 hours and 18 minutes.

4. Some exercises to try

1) 500ml is to infuse over a 5 hour period. Find the flow rate in mL/h?

2) Mr Smith is to receive 800mL of an antibiotic via an IV infusion over 15 hours. Calculate the flow rate to be set?

3) An infusion is to run for 30 minutes and is to deliver 200mL. What is the rate of the infusion in mL/h?

4) Calculate the flow rate if 1.2L is to be infused over 24 hours?

5) An order states that 500mL albumin 5% is to be given in 4 hours. What is the flow rate that should be set?

6) A young adult has been prescribed 1000mL of 5% Dextrose to be administered over a period of 10 hours, through a set delivering 20 drops/mL. What drip rate in dpm should be established?

7) i) A young child has been prescribed 800mL of Hartmans's solution to be administered over twenty hours, using a set delivering at 20 drops/mL. Find the drip rate?

   ii) If the medication is to be delivered over 10 hours what would the drip rate be?

8) A patient is ordered 100mL to be infused over 45 minutes via a 20 drops/mL giving set. What drip rate should be set?

9) A patient is ordered 200mL to be infused over 30 minutes via a microdrop set. What drip rate should be established?

10) What drip rate is required to administer 500mL of whole blood via a blood giving set (15 drops/mL) over a period of 4 hours?

11) A patient is receiving an IV infusion at the rate of 80mL/h. Calculate the drip rate via a 20 drops/mL giving set?

12) Find the drip rate if a patient is receiving fluid at the flow rate of 120mL/h through a 20 drops/mL giving set?

13) A patient is receiving 260mL/h of a solution for 1.3 hours (1 hour and 18 minutes). How much have they received?

14) A patient is prescribed 1L of a saline solution. The rate is set at 150mL/h. How long will the infusion take? Give your answer to the nearest minute.

15) You are monitoring an IV infusion of 1000mL 5% Dextrose that has been running at a rate of 80dpm via a macro giving set. How long will the infusion take?

5. Solutions

1) 100mL/h
2) 53mL/h
3) 400mL/h
4) 50mL/h
5) 125mL/h
6) 33 dpm
7) i)13 dpm ii) 27 dpm
8) 44 dpm
9) 400 dpm
10) 31 dpm
11) 27 dpm
12) 40 dpm
13) 338 mL
14) 6.6 hours or about 6 hours and 36 min
15) time = 4.1h or about 4h 6min.

6. For more information

Visit our Learning Skills website at http://www.csu.edu.au/division/studserv/maths/index.htm

7. References

The following resources will provide you with further useful information on this topic:

Gatford,J.D and Phillips,N. (2006). *Nursing Calculations*. UK:Churchill Livingstone.