A monthly series of quick reference guides to some of the basic tools of nursing. Whether you are a student nurse, need to update your skills or are teaching others the guides will be a useful aid to your practice

Calculating drug dosage

This covers the numeracy skills required in the administration of intravenous (IV) therapy in the acute setting

MANUALLY CONTROLLED DRIPS

To set up a manually controlled drip accurately by eye, you need to be able to count the number of drops per minute which will equate to the amount prescribed. The formula for this calculation is:

$$\text{RATE} = \frac{\text{VOLUME (IN DROPS)}}{\text{TIME (IN MINUTES)}}$$

To calculate the volume in drops, you need to know how many drops of the fluid ordered are contained in one millilitre(ml). You should find this information on the packaging of the administration set. The volume in mls is then multiplied by the number of drops per ml to give the volume in drops. Similarly, to find the rate in minutes, you need to change the hours into minutes by multiplying by 60. For the calculations within this guide a drop factor of 20 drops per ml for clear fluids and 15 drops per ml for blood are assumed. For the prescription 1 litre of saline in 6 hours the equation looks like this:

$$\text{RATE} = \frac{1{,}000 \times 20}{6 \times 60}$$

This can be simplified by cancelling (dividing top and bottom by the same number). If you use a calculator at this stage make sure that you also estimate, as it is easy to make a mistake when entering numbers composed of several digits:

$$\text{RATE} = \frac{1{,}\cancel{000}^{500} \times \cancel{20}^{1}}{\cancel{6}^{3} \times \cancel{60}^{3}}$$

The calculation is completed by multiplying across the top lines and the bottom line.

$$\text{RATE} = \frac{500}{9} \text{ drops per minute}$$

Use a calculator to simplify this to a sensible answer, bearing in mind what it is that you are calculating. The calculator will have given the answer as 55.555555. since we are trying to work out a number of drops, it is sensible to round up to a whole number. The answer is therefore 56 drops per minute.

ELECTRONICALLY CONTROLLED DRIPS

The given equation works for intravenous prescriptions for manually controlled administration equipment and also for electronically controlled drip counters which are set as a rate of mls per hour.

For example, how long will a 100ml infusion of sodium bicarbonate last if it is running at 42 drops per minute?

$$\text{RATE} = \frac{\text{VOLUME (IN DROPS)}}{\text{TIME (MINS)}}$$

We can substitute values for RATE and volume to get the following equation:

$$42 = \frac{100 \times 20}{\text{TIME (MINS)}}$$

If we multiply both sides of the equation by time and divide both sides by 42 we get:

$$\text{TIME} = \frac{100 \times 20}{42} \text{ (estimate } 100\text{x}20 \div 40 = 50\text{)}$$

Using the calculator, the answer is 47.6 minutes, or approximately 48 minutes.

TIPS FOR SAFE PRACTICE

The arithmetic calculations which nurses may be required to do in the field of IV therapy can be complicated. Prescriptions need to be read carefully and the different elements sorted out before starting to calculate.

Always question unusual answers and be very careful when moving to another area or when dealing with preparations with which you are not familiar.

Calculating drug dosage

SYRINGE DRIVERS

Smaller amounts of IV fluid, usually containing drugs, are delivered using a syringe driver. Most syringe drivers are designed for a specific size of syringe and can be adjusted to deliver a specific number of mls per hour. Others, less commonly used, measure millimetres (mm) per hour and so the size of syringe is vitally important to the calculation.

To calculate the amount of drug that a patient is receiving, prescriptions are often in the form of a 1mg/ml or 10mg/ml solution. Depending on the preparation strength of a drug, this may mean that the syringe is not completely filled to start with.

EXAMPLE

A prescription for Tramadol requires 100mg to be given over five hours. The syringe driver which holds a 20ml syringe, is set to deliver 2ml/hour. The drug is available in ampoules containing 50mg/ml and is to be diluted in normal saline. How is the solution made up?

FIRST STEP: calculate the rate per hour of the prescribed drug.

100mg in 5 hours = $\frac{100}{5}$mg in 1 hour
= 20mg per hour

SECOND STEP: given that the syringe driver delivers 2ml per hour, calculate the strength of solution required to give 20mg/hour.

20mg/hr and 2ml/hr implies
20mg in 2ml = 10mg in 1ml

THIRD STEP: calculate how to make up 20ml of solution containing 10mg/ml when the drug is available as 50mg/ml. This is similar to the first example.
Calculate total amount of drug needed: 20ml of a 10mg/ml solution will contain 20 x 10mg = 200mg.
Decide how to make up the solution: if the drug comes in 1ml ampoules each containing 50mg, four will provide 200mg.

If this is not immediately obvious, use the formula

$$\text{DOSE} = \frac{\text{WHAT YOU WANT}}{\text{WHAT YOU'VE GOT}} \times \text{WHAT IT'S IN}$$

When the known amounts are substituted, you get

$$\text{DOSE} = \frac{200}{50} \times 1 = 4\text{ml}$$

The solution is therefore made up of 4 x 1ml ampoules of Tramadol plus 16ml diluent. This will give 200mg Tramadol in 20ml = 10mg/ml.

If the syringe delivers 2ml/hour, the patient will get 2 x 10 (20mg) of Tramadol per hour or a total of 20 x 5 (100mg) over five hours.

CALCULATION BASED ON PATIENT WEIGHT

For amounts relevant to children and also for potent drugs prescribed for adults, drugs and IV fluids are often prescribed according to body weight.

Although calculations involving such prescriptions may appear daunting at first, if taken in logical steps, they are no more difficult than those you have already tackled.

A baby weighing 4.6kg is to have IV dextrose 10 per cent at a rate of 120ml/kg/day. What rate should the IV pump be set in)ml/hour)?

FIRST STEP: what is the total volume required over a 24-hour period?

The baby weighs 4.6kg. 120ml/kg = 120 x 4.6. Estimate a sensible answer. By rounding the 20 down and the 4.6 up, the answer can be estimated to be something in the region of 100 x 5 = 500. Using the calculator, we get 120 x 4.6 = 552ml.

SECOND STEP: use the IV calculation formula

$$\text{RATE} = \frac{\text{VOLUME}}{\text{TIME}}$$

Inserting the known quantities as follows:

$$\text{RATE} = \frac{552}{24}\ \text{mls/hour}$$

Cancel to simplify or use your calculator. (Remember to estimate first.)

$$\text{RATE} = \frac{552}{24}$$ simply means 552÷24=23

ANSWER: the IV pump needs to be set to deliver 23ml/hr

TIPS FOR SAFE PRACTICE

A rough estimation should always be made, especially if a calculator is being used.

The best way to avoid serious errors is to know what a sensible amount for the specific drug and size of patient should be

Further reading

Cohen D, Atere-Roberts E (1996) *Carefree Calculations for Healthcare Students.* London, MacMillan.
Gatford J, Anderson R (1996) *Nursing Calculations. Second edition.* Edinburgh, Churchill Livingstone.
Lapham R, Agar H (1995) *Drug Calculations for Nurses: a Step-by-Step Approach.* London, Arnold

Coming soon

April 14	CPR
May 5	Electrocardiography