Paediatric Nursing Preceptorship Programme

MEDICINES MANAGEMENT: SUPPORTIVE BOOKLET

Version: 1.0 September 2017
Review: August 2018

This is a controlled document. Whilst this document may be printed, the electronic version posted on the PIER website is the controlled copy. Any printed copies of this document are not controlled.

As a controlled document, this document should not be saved onto local or network drives but should always be accessed from the PIER website.

Acknoweldgements: Thank you to Allison Ahvee, Mandy Cooper, Kim Edwards, Helen Frizell, Sally Gray, Elaine Hartley, Jill Thistlethwaite, Emma Redmond, Elli Rushton and Sarah West for their involvement and permission to adapt medicines management workbooks from Dorset County Hospital NHS Foundation Trust, Hampshire Hospitals NHS Foundation Trust, Poole Hospital NHS Foundation Trust, Portsmouth Hospitals NHS Trust, Salisbury NHS Foundation Trust, University Hospital Southampton NHS Foundation Trust, Western Sussex Hospitals NHS Foundation Trust and the Wessex Neonatal Nurse Preceptorship Programme.

Contents

Legal aspects of medicine management

Administration of medicines is an integral part of practice and irrespective of route used there are always risks associated. Current medicines management guidance emphasises the importance of recognising this through identifying that all registered practitioners are personally accountable for their practice. Including any acts and omissions in care delivered (NMC, 2015). It is important that any involvement in the administration of medicines involves both consideration and professional judgement of its potential impact upon the patient (NMC 2010). You have a professional obligation to act in the best interests of your patients. Where deviation from this duty of care occurs and causes actual harm, a patient or relative can sue for negligence. While an employer will be liable for any claims made against mistakes that have occurred due to issues that they have failed to prevent (e.g. removing faulty equipment), mistakes that occur due to an individual acting outside their level of competence can lead to nurses being directly sued for negligence. It is important you recognise personal limitations and practice within your contracted and expected professional role.

When it is unclear who holds liability for the patients harm, the Bolam principle can be applied. This principle states this if an individual acts in accordance with practice that is accepted as appropriate by a body of peers (i.e. those with the same experiences, qualifications and working within the same situation), they cannot be held as negligent.

One way of making sure any medicine you administer is safe for your patient, is to follow the "five rights" of medicine management:

1) Right patient
2) Right time
3) Right drug
4) Right dose
5) Right route

Between 2016/2017, 10,600 new clinical negligence claims were made and cost the NHS £1.6billion. It is anticipated that this is a figure will rise as an increasing awareness and number of patients who are prepared to challenge the standard of care received. It is therefore important you are familiar with using and accessing guidance that supports and identifies your accountability in your clinical practice.

There are four main areas of law in which clinical negligence claims can be made. These are identified below to demonstrate how professional accountability can be determined.

Type	Description	Examples
Criminal Law	Law that holds an individual/s as accountable to the public	* the administration of a drug by the wrong route and resulting in the death of a patient
Civil	Law that allows an individual to hold another individual as accountable	* if negligence is implicated in the cause of injury or death
Employment law	Law that holds an individual accountable to their employer	* when an individual has consistently performed below of their employers expectations
Public law	Law that holds the individual accountable to their profession (such as the NMC)	* failure to comply with professional standards

Anaphylaxis

Anaphylaxis is a life threatening condition that involves an individual experiencing a rapid, generalised or immunological reaction to a substance to which the patient has become sensitised to (Resuscitation Council UK. 2008). This is different from experiencing an allergic reaction, in which symptoms are not life threatening, are milder and more localised (e.g. individual presents with a rash or itching).

However, if a patient has an allergy to a an allergen such as an ingredient within a medicine, they ***can*** be at risk of developing anaphylaxis if exposed to this same ingredient in other medicines e.g. a penillicin allergy could cause anaphylaxis if the individual was given any penicillin based antibiotic.

The pathophysiology of a true anaphylaxis reaction often follows a second or subsequent exposure to the allergen. This is because the initial contact to the allergen causes the individual to develop IgE antibodies (a protein that recognises allergens as foreign body). When the individual has a subsequent exposure to the allergen, the IgE antibodies trigger a rapid release of chemicals that instigate a systemic reaction that causes an extreme inflammatory response as the body "fights" the allergen. This leads to vasodilation and increased vascular permeability, increased heart rate and cardiac contraction, bronchocontriction and pulmonary vasoconstriction.

Signs of anaphylaxis therefore include:

- Obstructed airway
- Breathing difficulties (from the airway obstruction)
- Cardiovascular collapse (hypotension and tachycardia)
- Mucosal changes and skin rashes
- Gastrointestinal disturbance (vomiting)

Presentation of anaphylaxis usually occurs within minutes of the individual's exposure to the allergen. However delayed reactions are possible. Once an anaphylactic reaction occurs, if left untreated, the individual will become unconscious and die.

Another type of similar reaction, called an ***anaphylactoid*** reaction occurs on the first exposure to an allergen. The individuals response unlike anaphylaxis in not immunological, but is related to the rate to which the medicine is administered. Rapid administration of the medicine causes a release of chemicals such as histamine cause flushing of the individual's skin. This flushing has given rise to the name of "redman syndrome" to describe a common sign of this reaction. Whilst this reaction has a different name, the presentation and the treatment will be exactly the same as an anaphylactic reaction.

The management of anaphylaxis depends on the severity of the reaction but you should always follow the resuscitation council's pathway (above) to guide your actions. A severe reaction should be treated as a medical emergency and prompt action is vital.

Whilst not always possible, prevention and preparation for anaphylaxis should be undertaken when administering any medication. This includes being aware of the patient's medical history and past reactions/experiences during drug administration and understanding the side effects of drugs that may evoke anaphylactoid reactions.

Anaphylaxis

Resuscitation Council (UK)

Anaphylactic reaction?

↓

Airway, Breathing, Circulation, Disability, Exposure

↓

Diagnosis - look for:
- Acute onset of illness
- Life-threatening Airway and/or Breathing and/or Circulation problems [1]
- And usually skin changes

↓

- **Call for help**
- Lie patient flat
- Raise patient's legs

↓

Adrenaline [2]

↓

When skills and equipment available:
- Establish airway
- High flow oxygen
- IV fluid challenge [3]
- Chlorphenamine [4]
- Hydrocortisone [5]

Monitor:
- Pulse oximetry
- ECG
- Blood pressure

1 Life-threatening problems:

Airway:	swelling, hoarseness, stridor
Breathing:	rapid breathing, wheeze, fatigue, cyanosis, SpO_2 < 92%, confusion
Circulation:	pale, clammy, low blood pressure, faintness, drowsy/coma

2 Adrenaline *(give IM unless experienced with IV adrenaline)*

IM doses of 1:1000 adrenaline (repeat after 5 min if no better)

• Adult	500 micrograms IM (0.5 mL)
• Child more than 12 years:	500 micrograms IM (0.5 mL)
• Child 6 -12 years:	300 micrograms IM (0.3 mL)
• Child less than 6 years:	150 micrograms IM (0.15 mL)

Adrenaline IV to be given **only by experienced specialists**
Titrate: Adults 50 micrograms; Children 1 microgram/kg

3 IV fluid challenge:

Adult - 500 – 1000 mL
Child - crystalloid 20 mL/kg

Stop IV colloid if this might be the cause of anaphylaxis

	4 Chlorphenamine (IM or slow IV)	5 Hydrocortisone (IM or slow IV)
Adult or child more than 12 years	10 mg	200 mg
Child 6 - 12 years	5 mg	100 mg
Child 6 months to 6 years	2.5 mg	50 mg
Child less than 6 months	250 micrograms/kg	25 mg

(Resuscitation Council UK 2008)

Safe administration of non intravenous medicines – process overview

Action	Rationale
Check the prescription for correct drug/fluid name, dose, route, patient, for any allergies and time last given or due to be given and if any have to given on full or empty stomach (if oral drug)	To confirm suitability of medicine administration
Ensure patient/family aware of need to administer medicine	To gain informed consent/assent from patient and family
Check if patient is currently receiving medicine i.e. check if nil by mouth, have eaten/not eaten (if applicable)	To determine suitability of administering medicine
Prepare your environment for drug/fluid administration: • Clean hands • Gather all the equipment you will need to prepare the medicine • Check any drug/fluids against prescription and formulary and confirm if further diluents are needed, compatible solutions, side effects, contraindications, stability/storage needs (have they been met?) and duration of administration • Check any drug/fluid expiry dates and if premade, inspect content for signs of tampering (cracks or puncture marks), discoloration or sediment • Perform any medicine/fluid calculations (in silence) and separately from second checker (if required)	To ensure that you have everything you need to safely prepare the medicine/fluid prescribed To ensure that the medicine/fluid is safe to administer To ensure full concentration is used during calculations
Prepare medicine/fluids are per prescription and manufacturers/formulary instructions	To ensure the medicine/fluid is prepared for as per evidence based practice
With second checker (if applicable), prepared medicine and prescription chart to patient bedside and confirm patient's identity against prescription chart and name band.	To ensure patient receives correct medicine/fluid
Confirm patient ready/available to receive medicine and administer medicine as per prescription and instructions	To ensure medicine is administered safely
Dispose of any single use equipment as per Trust policy	Safe disposal of clinical waste. Prevention of cross infection
Document administration (or omissions) in appropriate documentation e.g. drug chart	To ensure that future doses can be administered safely

Fluid balance

Fluid in the body is held either within the cells or within a circulatory system in the body. The amount of fluid in each is balanced through fluid moving in and out of the cells and circulatory systems by osmosis. The administration of intravenous fluids involves careful monitoring of the patient to ensure that they are not receiving too much or too little fluid, according to their individual needs. Different types of fluid are therefore administered to maintain or restore the individual's natural fluid balance.

A risk of giving too much fluid or fluid that contains too little or too much of certain electrolytes can cause pulmonary oedema and the further loss of important electrolytes that help regulate and maintain many important body functions.

Can caring for individuals requiring intravenous fluids; you must undertake thorough assessments of their fluid needs before and during the administration of prescribed fluids. This includes:

- Taking and recording heart rate, blood pressure, temperature and noting any clinical features of oedema or dehydration (looking at skin integrity, fontanelle status etc)
- Measuring urine output and regular calculation of patients fluid balance (comparing fluid intake against fluid output)
- Daily weights
- Serum electrolyte levels (blood sampling)

Electrolytes

Electrolytes are chemicals (ions) found in your body and maintain important bodily functions such as regulating heartbeat. The more common electrolytes you will come across include calcium, magnesium, potassium, sodium, phosphate and chloride. This can be included in the fluids you administer to help treat any abnormal electrolyte levels. It is important that you **NEVER** administer neat electrolytes; they must always be diluted as instructed (check Children's BNF and manufacturer's instructions).

Fluid calculations

Calculations for the normal fluid requirements of a child (also known as "maintenance") are calculated using the patient's weight in the following formula:

(100 ml for each of the first 10kg) + (50ml for each kg 11-20) + (20 ml for each additional kg) / 24hour

Example: If a child weighs 25kg, their maintenance fluids would be:

(100mL x 10kg) = 1000mL

1000 + (50mL x 10kg) = 1500mL

1500mL + (20mL x 5kg) = 1600mL (in 24 hours)

1600 / 24hrs = 66.67mL/hr (or 67mL/hr)

*** Your go ***

Using the following weights, calculate the patients total maintenance fluid:

- 6kg
- 32kg

Safe administration of intravenous medicines and fluids

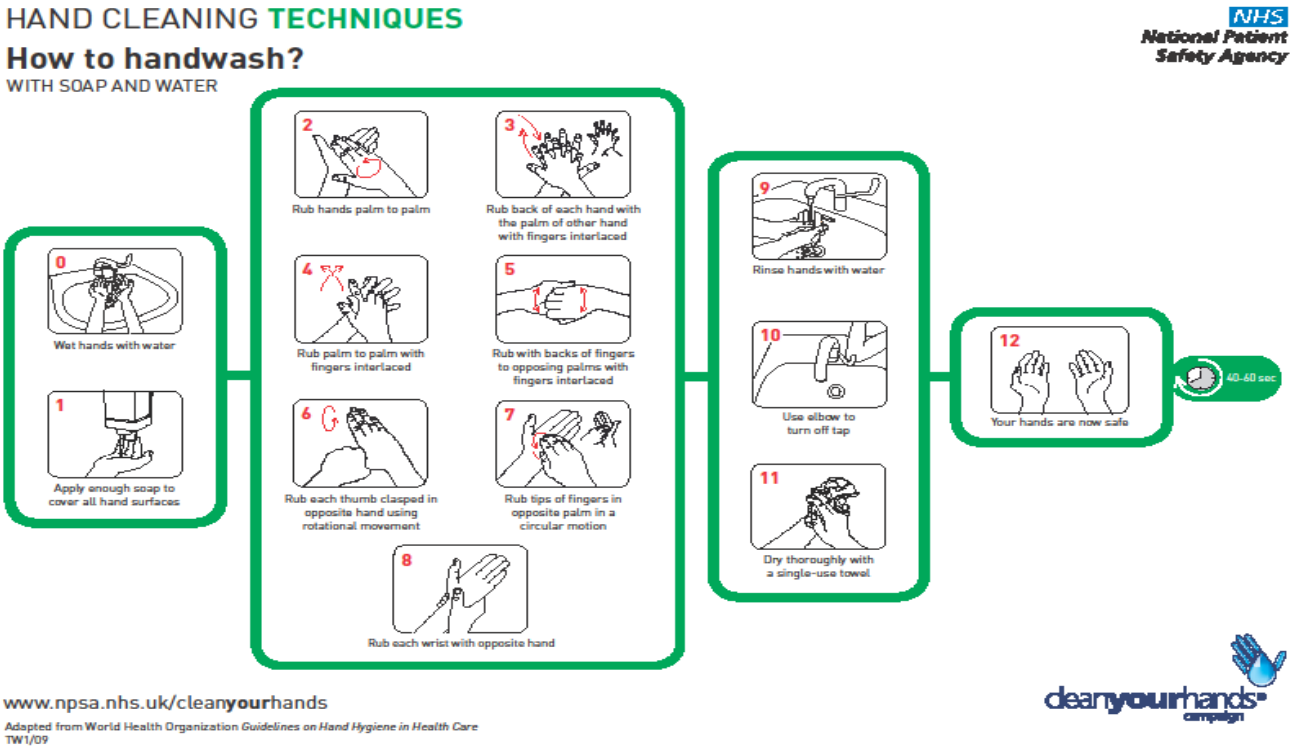
A common complication of intravenous therapy is the introduction of infection to the patient. To deliver intravenous care that is free from all potentially infectious microorganism requires a sterile environment; something only achievable in operating theatre settings.

For this reason, asepsis[1] is viewed as a feasible and appropriate method in reducing healthcare acquired infections (HAIs) (RCN, 2012; Loveday *et al*., 2014).

Reducing infection rates can also be achieved by the following:

1) Checking all packaging is intact and in date
2) Inspecting medicine container/solution for punctures, air bubbles, discolouration, haziness or particles
3) Checking the expiry date of the medicine/solution

Hand washing is recognised as the most important element to any procedure that healthcare professionals can undertake (Loveday *et al*., 2014). You must remember to use hand washing techniques identified by the National Patient Safety Agency before preparation and/or administration of intravenous drugs and fluids. This techniques includes ensuring that your hands are wet (using tepid water) before applying soap. You must then rub the soap in to all surfaces of your hands. Always make sure you rinse your hand thoroughly before drying.



[1] a technique that is free from pathogenic micro-organisms (ASAP, 2011)

Safe administration of intravenous medicines and fluids

Aseptic Non-Touch Technique (ANTT™)

EPIC3[2] recognises that whilst there is no one recommended approach to safely achieve asepsis in practice, ANTT is noted to be an accepted structure for ensuring asepsis is accomplished (Loveday *et al*., 2014). ANNT is internationally used as it follows evidence based, peer reviewed clinical practice that standardises practice for the most common aseptic practices (including intravenous therapy).

Within the ANTT approach, there are two methods that can be employed. Both methods follow the same strict ANTT™ principles but allow you to determine and acknowledge the level of precautions you need to take t to ensure the safety of your patient is achieved.

	Standard ANTT	Surgical ANTT
Procedure description	• the procedure is technically simple • the procedure is short in duration (<20 minutes) • involves small number of key-sites/key-parts	• the procedure is technically complex • the procedure is long (>20 minutes) • involves a large key-sites and/ or key-parts
Key elements of ANTT method	• use non sterile gloves • use micro critical aseptic fields to protect key parts (e.g. syringe packet to protect syringe tip)	• use sterile gloves • use critically main field to protect key parts (i.e. sterile dressing sheet) • use full barrier precautions

It is important to note, any ANTT™ procedure must avoid any touching/contamination ***key parts or key sites***[3] which are components of the procedure that have direct contract with the patient and therefore could introduce infection if contaminated. In intravenous therapy, a standard-ANTT™ is deemed suitable as the procedure is usually quick, involves few key parts which are easily protected by micro critical fields.

All intravenous medicines and fluids must be prepared in a clinical room that is clutter free and easy to clean before and after use. Whilst standard ANTT™ doesn't require a sterile continue, you should use a designated and wipeable tray prepare and store any intravenous treatment. This tray must be cleaned with detergent wipes and allowed to dry before use and ensure you only place necessary equipment in the tray, i.e. syringe and needle when removed from packaging to prevent any key parts from being contaminated.

Reconstitution/Dilution and rate of administration

Medicines and fluids are available in a variety of different forms/mediums, such as pre diluted ampules, vials and bags, or as a dry powder that must be diluted with a compatible solution (also known as reconstituting) before use. It is your responsibility to check the form prescribed intravenous treatments carefully and determine whether further dilution is required. This displacement value accounts for the extra "space' taken up by the volume of powder once added to the powder. For example, you might add 10mls but the displacement value means that the total amount of solution mixed with the powder creates a total volume of 11mls. This value is therefore very important and must be considered when calculating the volume you require to administer the prescribed amount.

[2] national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England

[3] **Key parts** - any piece of equipment that will directly or indirectly touch the patient e.g. syringe tip, intravenous fluid line etc
Key site – any area on the patient in that if contaminated with likely cause infection e.g. open wound, site of cannula

Safe administration of intravenous medicines and fluids

It is important to also note that any medicines you are administering may require additional dilution with a compatible solution before you can safely administer them. The failure to dilute some drugs can cause significant harm to your patients, including phlebitis, extravasation or, in the case of concentrated potassium chloride, cardiac arrest. Similarly, dilution with incompatible solutions or an inappropriate of administered can cause harm to the patient. Instructions on how to safely prepare and administer any medicine or fluid can be found in the Children's BNF or in the manufacture's leaflet. If you can not find clear information, you must contact your pharmacy department.

The rate of administration can be delivered as:

- a ***bolus*** - slowly administered over several minutes e.g. 3-5 minutes
- ***intermittent infusion*** – delivered over several minutes or a few hours e.g. 20 minutes or 2 hours
- ***continuous infusion*** - ranging from hours to days e.g. 24 hours

If infusional administration is required you must use your local intravenous therapy pumps but not before you have received training on how to use them safely. You must also be aware of when the intravenous giving set being used needs to be changed – this information can be gained from your local Trust policy or from the RCN infusional guidelines (2016).

Calculating the speed of administration through a pump is also a skill you must be familiar with. You can practice this in the drug calculation section.

Intravenous therapy and stability

The stability (and therefore safety of the medicine) can be affected by light, temperature and pH and as a result, each medicine has its own storage instructions (visible on the items packaging). As the stability can also be affected during reconstitution or further dilution, preparation of, specific instructions in the children's BNF or within the manufacturer's instructions must be followed. You should also avoid mixing drugs where possible (including administering more than one drug at a time) unless agreed with your local pharmacy department.

Syringe size

During the preparation and administration of medicines, an appropriately sized syringe must be considered and used. Most importantly, you should be aware that the smaller the syringe, the great pressure it experts on the patients intravenous device. Fundamentally, the pressure exerted is proportionate to the surface are of the plunger, therefore, like a stiletto heal, the smaller, thinner syringes (5mLs and below) exert more pressure than a 20mL or larger syringe). For this reason, it is generally safer to use a larger syringe to administer drugs. However, the use of larger syringes can result in excessive volumes of fluid being administered (Evans and Dixon 2006). Therefore, the use of a 10mL syringe for the majority of intravenous therapies or general intravenous access is considered the best sized syringe to use.

Nursing observations

No matter what type of medicine or fluid you are administering, you must observe you intravenous access device before, during and after administration. You should record your observations on your Trusts agreed documentation; including any extravasation or phlebitis scores. To do this, you must expose the intravenous access device so easy observation is achievable.

Safe administration of intravenous medicines and fluids

Common complications of intravenous therapy

Infiltration /Extravasation

Infiltration and extravasation are the more common complications associated with using intravenous access devices. Both terms are used to describe the inadvertent administration of a solution in to the tissue instead of the vein, following a blockage, misplaced or dislodged intravenous access device. However, the type of the solution involved in this leak determines whether it is an infiltration or extravasation. The different descriptions and management strategies involved for both are highlighted below.

	Description	Signs	Action to take
Infiltration	The leakage of a non-irritant or non-vesicant solutions e.g. 0.9% Sodium Chloride	• Resistance • Leaking • Pain • Swelling • Redness or blanching	Treatment will depend on the severity of the infiltration, but generally involves: * Stopping the infusion and aspirating any solution * Escalate to medical team members * Remove cannula (once confirmed by medical staff) * Elevate limb and administer analgesia * Document
Extravasation	The leakage of an irritant or vesicant solution e.g. aciclovir	• Resistance • Leaking • Pain • Swelling • Redness or blanching	* The infusion should be stopped immediately * Leave the intravenous access device in and aspirate as much fluid as possible * Escalation quickly and obtain senior help (Consultant on call/ registrar/ bleep holder) * Elevate limb and administer analgesia * Obtain local extravasation kit/box * Contact Plastics team * Document

Haematoma

Haematoma is term used to describe the leakage of blood in to the tissue from the vein, commonly from the removal of peripheral intravenous access devices such as a cannula. On the removal of a cannula, you should apply pressure at the site for 3-5 minutes to help to prevent the formation of a haematoma. If you notice any bleeding from the exit site of a tunnelled central line (e.g. Hickman line), apply pressure to the jugular of neck on same side that the line is inserted to stop bleeding, call for help and with sterile gauze, apply to entry/exit site for 5 minutes.

Prevention

The intravenous access device exit site must be inspected at least once daily and always before, during and after the administration of any medicines or fluids. The device should be covered by a transparent dressing that is permeable to water vapour (e.g. IV 3000, Tegaderm). These observations should then be documented in the patient nursing care records so any changes in the intravenous device exit site can be easily determined.

Safe intravenous administration – the process overview

Action	Rationale
Check the prescription for correct drug/fluid name, dose, route, patient, for any allergies and time last given or due to be given	To confirm suitability of medicine/fluid administration
Ensure patient/family aware of need to administer drug/fluid	To gain informed consent/assent from patient and family
Check if patient is currently receiving any infusional medicines/fluid and confirm their compatibility with drug/fluid prescribed	To determine suitability of administering medicine/fluid
Prepare your environment for drug/fluid administration: • With clean hands, clean intravenous tray and allow to dry • Gather all the equipment you will need to prepare the medicine/fluid • Check any drug/fluids against prescription and formulary and confirm if further diluents are needed, compatible solutions, side effects, contraindications, stability/storage needs (have they been met?) and duration of administration • Check any drug/fluid expiry dates and if premade, inspect content for signs of tampering (cracks or puncture marks), discoloration or sediment • Perform any medicine/fluid calculations (in silence) and separately from second checker	To ensure that you have everything you need to safely prepare the medicine/fluid prescribed To ensure that the medicine/fluid is safe to administer To ensure full concentration is used during calculations
Wash hands using the six stage hand washing technique, dry hands thoroughly and apply non-sterile gloves	To promote asepsis
Prepare medicine/fluids are per prescription and manufacturers/formulary instructions Ensure that you protect any key parts or key site	To ensure the medicine/fluid is prepared for as per evidence based practice To minimise equipment contamination
Remove gloves and clean/wash hands	To promote asepsis
With second checker, take clean non sterile gloves, medicine/fluids and prescription chart to patient bedside and confirm patient's identity against prescription chart and name band. Stop any infusions that are currently running that are not compatible with medicine/fluid to be given.	To ensure patient receives correct medicine/fluid To prevent any potential medicine/ fluid interactions from occurring
Expose intravenous access device and assess for any signs of phlebitis or extravasation, if none noted, continue with administration – always escalate any concerns to senior colleagues/nurse in charge	To ensure access device is suitable to use
Wash or gel hands and apply clean non-sterile gloves	To promote asepsis and protect yourself against any bodily fluids
Clean the intravenous needleless device (bung) using Trust agreed detergent wipe for at least 30 seconds, and allow to dry (for 30 seconds)	To remove any pathogens on the needleless device
Confirm patency of intravenous device by giving a slow bolus of 0.9% sodium chloride using a push-pause technique. If no signs of pain, swelling or redness, administer prescribed medicine/fluids as per instructions (i.e. slow bolus or infusion) and using ANTT technique. Before and after any medicine or fluid, always administer a compatible solution to confirm patency of the intravenous device; always observe the intravenous device throughout for any signs of phlebitis or extravasation	To ensure intravenous device safe to use and medicine/fluid is administered safely
Disconnect any intravenous medicine/fluid are per Trust guidelines (following ANTT). Ensure intravenous device patency is confirmed by slowly bolusing 0.9% sodium chloride and clamping line at the same time as pushing the last 1 ml of 0.9% sodium chloride in	To ensure medicine is administered safely
Re-secure intravenous device as necessary and dispose of any single use equipment as per Trust policy	Safe disposal of clinical waste. Prevention of cross infection
Clean any reusable equipment as per Trust policy, wash hands and document intravenous therapy administered in appropriate documentation e.g. drug chart	To ensure that future doses can be administered safely

Drug calculations

An important of any medicine and fluid administration has two key purposes. As children are of varying weights, the amounts of either will be different for every child. However, medicines and fluids are manufactured in set amounts. Being able to carry out drug calculations will ensure that you are able to confirm the prescribe dose/amount is correct for your patient and to ensure that from the stock of medicines/fluids you have you administer the correct amount.

It is important that you always check the prescribed dose and frequency of administration in the Children's BNF. Any concerns or questions about the prescription must be discussed with the medical staff and the medicine should not be given. Even if the child has received the drug, it does not mean that it was correct.

Unit conversion

Commonly used medicines will be prescribed in milligram (mg) or microgram (mcg or µg) quantities, but the medicine will be dispensed in grams (g). For fluids, milliliters (mL) are often prescribed, but bags of fluids can be dispensed in litres (L). You will therefore have to be able to calculate the prescribed amount from the available volume

Remember:

1 gram (g)	=	1000 milligrams(mg)
1 milligram (mg)	=	1000 micrograms (mcg or µg)
1 litre (L)	=	1000 millilitre (mL)

Therefore, to change from grams to milligrams, milligrams to micrograms or litres to millilitres, **multiply** the amount by 1000 and to change amounts from milligrams to grams, micrograms to milligrams or milliliters to litres, you **divide** by 1000.

e.g.

multiply		**divide**	
4g	= 4000mg	4500mg	=4.5g
0.25g	= 250mg	200mg	= 0.2g
0.05g	= 50mg	75mg	= 0.075g
1mg	=1000 micrograms	2400 micrograms	=2.4mg
0.005mg	=5 micrograms	150 micrograms	=0.15mg
1.5 L	= 1500mL	3100mL	= 3.1L
0.6L	= 600mL	255mL	= 0.25L

*** Your go ***

1440mg	=	g
200micrograms	=	mg
2450litres	=	mL
4.75g	=	mg

Drug calculations

Sometimes your calculation may recreate an answer that has several decimal places. As syringes and pumps can only deal with 0.1ml increments, you need to be able to round your answer to the most appropriate answer; so to not over or under dose your patient.

The general rule is to round the number up if the decimal point is 5 or above, and we round down, if the decimal point is 4 or below.

e.g.

7.233mL	= 7.2mL
1.588mg	= 1.6mg
0.465g	= 0.5g

*** Your go ***

7.665mg	=	mg
1.3333g	=	g
1.1456mL	=	mL
10.456mg	=	mg

General drug calculations

The following formula can be used as an aid to work out the quantity of medicine of fluid you need to take from the available stock to obtain the prescribed amount:

$$\text{Volume/amount required} = \frac{\text{what you want}}{\text{what you've got}} \times \text{volume (available)}$$

e.g. You need to administer 200mg of pipercilliantazobactum. It comes in 2.25g in 10mL (when diluted)

How many mLs do you need?

1) Convert either the dose from mg to g or the vial amount from grams to mg (to allow you to calculate the volume of pipercilliantazobactum you will need.

   = 200mg = 0.2g or 2.25g = 2250mg

2) Carry out your drug calculation:

   0.2g / 2.25g x 10mL = 0.88mL (or 200mg/2250mg x 10 = 0.88mL)

3) Round your decimal to the nearest 0.1

   0.88mLs = <u>0.9mL</u>

Drug calculations

You can also use this approach to calculate tablets or capsules prescribed.

e.g. You need to administer 3mg of dexamethasone. The stock available is 500 microgram tablets (i.e. 1 tablet provides 500 micrograms).

How many tablets do you need?

1) Convert with dose or tablet dose e.g. 3mg = 3000mg microgram or 500 microgram = 0.5mg

2) Carry out your drug calculation:

3000mg / 500microgram x 1 = 6 tablets (or 3mg / 0.5mg x 1 = 6 tablets)

3) No need to round your decimal as it is a whole tablet you need!

*** Your go ***

Calculate the amount (in mLs) you would need to draw up to give 23mg ranitidine. Drug comes in 75mg in 5mL.

Calculate (in mg) the amount you would need to draw up to give 115mg Teicoplanin. Drug comes as 200mg in 3mLs.

You need to give a dose of 750mg of paracetamol. The patient has asked for tablets. Each tablet are available as 500mg. How many tablets would you give?

Drug calculations

Confirming prescription calculations

Many doses prescribed are based on the child's weight. You must be able to confirm the prescribed dose before calculating and administering any medicines.

e.g. The dose required is 4mg/kg (i.e. 4mg per kg). The child weighs 11kg.

The dose required = 4mg x 11kg = 44mg

Be careful to check if the dose per weight is related to each dose or if it is a total dose that the child can receive in 24 hours that must be split in smaller doses.

e.g. The dose required is 5mg/kg/24hours and 3 divided doses (or TDS). The child weighs 15kg

The dose required is 4mg x 11kg = 75mg/day

75mg / 3 = 25 mg /dose

*** Your go ***

What dose should be prescribed for a drug that should be 4mg/kg/day in two divided doses for a child weighing 17kg?

Volumes

Dilution

You may notice instructions in the Children's BNF or the manufacturer's instructions to dilute the drug amount further. You need to be able to use this information to safely dilute and administer the prescribed medicine or fluid.

e.g. A patient has been prescribed aciclovir. They require 450mg. You notice that the Children's BNF requests you dilute the final dose in a volume of water for injection or 0.9% Sodium Chloride that gives you a concentration of 5mg/mL.

What will be the total amount of fluid you will need to administer the aciclovir safely in?

450mg to be diluted in 5mg/mL = 450mg / 5mg = 90mL

Drug calculations

*** Your go ***

What is the total volume a prescribed drug should be diluted up in to if the dose is 200mg and the final concentration should be 4mg/mL?

What is the total volume a prescribed drug should be diluted up in to if the dose is 5g and the final concentration should be 4mg/mL?

Sometimes the dilution instructions for a drug are expressed in different ways, for example:

Dilute 50:50 means dilute the drug solution with an equal volume of diluent, i.e. dilute 1mL drug solution with 1mL diluent to give 2mL.

Dilute 1 part with 4 parts means dilute 1 part drug solution with 4 parts diluent, i.e. dilute 1mL drug solution with 4mL diluent to give 5mL.

Dilute 1 in 20 means dilute 1 part drug solution to a total volume of 20 parts, i.e. dilute 1mLdrug solution with 19mL diluent to give 20mL.

Percentage

Drug concentration may be displayed as % (w/v). This simply means that the percentage is the number of grams dissolved in each 100mL of the solution.

e.g. 0.9% Sodium Chloride means that 0.9g of Sodium Chloride is dissolved in each 100mL of the fluid

Sometimes, a prescription requires you to draw up a certain amount of grams or milligrams from such solutions and so you must be able to convert the percentage value in to your drug calculation.

e.g. A patient is prescribed 2g of glucose to be given as glucose 5% injection.

What volume (mL) do you give?

1) 5% Glucose = 5g per 100mLs

2) 2g / 5g x 100mLs = 40mLs

Drug calculations

*** Your go ***

In mLs, what is the volume you would need to administer 6g of a solution that comes in 4%?

Ratio

This form of volume is usually only used for measuring the concentration of drugs such as adrenaline (epinephrine). The concentration of these medicines is displayed as containing 1 in 1000 or 1 in 10000. This simply means that there is 1g in every 1000mL or 10000mL respectively.

e.g. How many mL would you need to give 1mg of adrenaline (epinephrine) using 1 in 10,000 vial?

1) Convert 1 in 1000 in to grams = 1g in 1000mL

2) Convert either available grams in to milligrams = 1g x 1000 = 1000mg (or milligram dose to grams 1mg / 1000 = 0.001g)

3) 1mg / 1000mg x 1000 = <u>1mL</u> (or 0.001g/1g x 1000 = 1ml)

*** Your go ***

In mL, what is the volume you would need to administer 2mg of a 1 in 100 solution?

In mL, what is the volume you would need to administer 40mg of a 1 in 10000 solution?

Drug calculations

Infusion Calculations

Some medicines and fluids are prescribed to be administered slowly, over several minutes or hours. The rate is often related to the potency of the solution so please always follow instructions as per Children's BNF and the manufacturer.

To administer a volume over an hour or more, you can simply use the volume amount of solution that needs to be given and **divide** it by the number of hours.

e.g. to administer 500mL over 4 hours

500mL / 4 hours = 125mL/hr

However, to administer a solution in less than an hour (i.e. over several minutes), you must work out how many of those minutes there are in 1 hours and **multiply** that number that the volume you need to give.

e.g. to administer 250mLs in 20minutes

In 1 hour there are 60 minutes. Within 60 minutes, there are 3 lots of 20 minutes (60 / 20 = 3)

250 mL x 3 = 750mL/hr

*** Your go ***

You need to administer 1500mls of 0.9% Sodium Chloride over 24 hours, what rate do you set the pump at?

You need to administer an antibiotic over 15 minutes. You have made up the required dose in 50mL. What rate do you set the pump at?

You need to administer an drug over 1.5 hours. You have made up the required dose in 30mL. What rate do you set the pump at?