SECTION 3: Drug and fluid administration (IMEESC 13.3 and 13.4 and WHO Pregnancy S-55, C-23 and C-34)

Fluid requirements

Dehydration: see Sections 9 and 12

Oral fluid requirements: see Sections 9 and 12

Fluid replacement

Oral rehydration solutions – used in gastro-enteritis to maintain electrolyte balance. Prepare by adding **1 sachet to 7 oz (210 ml)** clean water. **One ounce = 30ml**

Importance of enteral fluids:

- Best method of maintaining caloric intake is through enteral feeding
- If patient is unable to drink then pass gastric tube.
- When commencing feed fill syringe to required amount with feed, draw plunger back as far as possible and then attach syringe to tube. Kink tube and remove plunger. Allow feed to pass into stomach using gravity.
- Observe patient's colour and respiratory rate for any signs of aspiration.

- Breast milk is the best food for infants. It is always available at the correct temperature, no preparation is required and no sterilising equipment involved.
  - If the infant is too ill to suck and is fed through a gastric tube, encourage mother to express milk into sterile receptacle. To encourage release of milk and ease of expression encourage mother to express whilst holding the baby. Store excess milk in a freezer. Defrost the quantity needed for 4 hours of feeding at a time.

IV fluids

IV fluids must only be used when essential and enteral feeds not available or absorbed.
Always check before use: seal is not broken, expiry date, solution is clear and free of visible particles
Dextrose/glucose solutions unless in Ringer-Lactate or Hartmann's are not appropriate for replacing fluid losses
Never infuse plain water IV: causes haemolysis and will be fatal

Always specify concentrations of dextrose and Ringer-Lactate or Hartmann's **solutions to be infused.**

Maintenance requirement of electrolytes:

Sodium (Na^+)	3-4 mmol/kg/24 hour in child	150mmol/24hour in mother
Potassium (K^+)	2-3 mmol/kg/24 hour in child	100 mmol/24hour in mother

Crystalloids containing a similar concentration of sodium to plasma (Ringer-Lactate or Hartmann's) are used to replace vascular compartment losses. When infused IV only ¼ remains inside the vascular compartment, the rest passes into the extra-cellular space.

All fluids should be prepared and given using an aseptic technique. It is important to observe cannula site (directly by removing dressing) for redness and swelling before each IV injection. Observe patient for pain or discomfort at drip site. If any signs of inflammation, stop fluids, reassess need for continuing IV fluid drugs and resite cannula.

Record fluid intake/hour on a fluid balance chart.

Fluids can be calculated in drops/minute as follows: (standard giving sets) 20 drops = 1ml and ml/hour divided by 3 = drops/minute.

Ensure that site is kept clean

Flush cannula with 0.9% saline 4-hourly if continuous fluids are not being given

Section 3 **Self assess 1**

1) ***Enteral fluids are preferred whenever tolerated to IV fluids for the following reasons***
   (a) safer
   (b) can contain more calories
2) ***When giving IV fluids the following are true***
   (a) sterile water is one of the fluids that can be given IV in shock
   (b) the daily requirement of sodium in a child is 3 – 4 mmol/kg/24 hours
   (c) a septic technique is not necessary when placing IV cannula
   (d) 0.9% saline contains a similar concentration of sodium to that in plasma and can be used to replace vascular losses

ANSWERS
1) a b 2) b d [(a) sterile water is fatal if given IV, c) strict asepsis is essential]

Prescribing practice and minimising drug errors

Introduction - general

- oral administration is safer and less expensive, if tolerated
- the following antibiotics are as effective orally as IV:
  - amoxycillin, ampicillin, chloramphenicol, ciprofloxacin, co-trimoxazole, erythromycin, flucloxacillin, fluconazole, metronidazole, sodium fusidate,
- if a drug is given down an oro/nasogastric tube, flush through
- rectal drugs are less reliably absorbed than oral drugs
- liquid formulations are better than suppositories for rectal treatment in infants

Prescribing

- use block capitals
- use approved names
- dosages should be in grams (g) milligrams (mg) or micrograms **ALWAYS WRITE MICROGRAMS IN FULL**
- volumes should be in milliliters (ml)

- avoid decimal places when possible (eg write 500mg not 0.5g) if used, prefaced by a zero (eg write 0.5ml not .5ml)
- write times using 24 hour clock
- routes of administration can be abbreviated to: IV (intravenous), IM (intramuscular), PO (orally), SC (subcutaneous) NEB (nebuliser), PR (rectally)
- 'as required' prescriptions must be specific as to how much, how often and for what purpose (indicate maximum 24 hour dose)
- 'stop dates' for short course treatments should be recorded when first prescribed

Measuring Drugs

- multiple sampling from drug vials risks introducing infection: they do not contain preservatives or antiseptic
- dilute drugs so that volumes can accurately be measured eg do not use doses <0.1ml for a 1 ml syringe
- do not forget to consider the dead space in the hub of the syringe for small volumes
- for dilutions >10 fold, use a small syringe to inject the active drug connected by a sterile 3 way tap to a larger syringe and then add diluent to the large syringe to reach desired volume

Delivery

- MUST BE GIVEN IN AN ASEPTIC MANNER
- give IV drugs slowly in all cases
- after injection into line (eg through a 3 way tap), use the usual rate of the IV infusion to drive the drug slowly into the patient
- if there is no background infusion, give sufficient follow-up (flush) of 0.9% saline or 5% dextrose to clear the drug from the cannula or T piece
- repeat flushes of 0.9% saline can result in excess sodium intake in infants - use 0.45% saline if possible
- flush over 2 minutes to avoid sudden surge of drug (remember the hub)

Infusions

- MUST BE GIVEN IN AN ASEPTIC MANNER
- adjust total 24 hour IV fluid intake
- never put more drug or background IV into syringe or burette than is needed over a defined period of time
- check and chart rate of infusion and confirm this by examining amount left every hour
- Use cannula NOT butterfly needles for infusions if available
- DO NOT mix incompatible fluids IV

- do not add drugs to any line containing blood or blood products
- infusions of glucose >10%, and adrenaline, can cause problems if outside the vein
- most IV drugs can be given into an infusion containing 0.9% saline, Ringer-Lactate or Hartmann's or up to 10% glucose (exceptions include phenytoin and erythromycin)

- if using only one line wait 10 minutes between each drug infused, or separate by 1 ml of 0.9% saline or sterile water

Safe IV infusions where no burettes are available

Mark the infusion bottle with tape for each hour of fluid to be given and label each hour.

Or

Empty until only the necessary amount of fluid to be given is left in bottle

Intravenous Lines

Placement

- always place cannula aseptically and keep the site clean
- use **sterile** bungs, NOT syringes, for closing off cannula/butterfly needles between IV injections

Care

- change giving sets every 3 or 4 days
- change the giving set after blood transfusion, or if a column of blood has entered the infusion tubing from the vein (site of potential bacterial colonization)
- always inspect the cannula tip before and whilst injecting any drug IV - never give a drug into a drip that has started to tissue - severe scarring can occur, for example from calcium solutions.
- always use luer lock connections to minimize extravasations

Sampling

- clear the dead space first (by 3x its volume)
- glucose levels cannot be accurately measured from any line through which a glucose solution is infused
- blood cultures should always be taken from a separate, fresh, venous needle or stab sample
- after sampling, flush the line - beware that repeat flushes of 0.9% saline can result in excess sodium intake in infants

Complications

- infection
    - local infection can become systemic, especially in neonates or the immunosuppressed (eg HIV)
    - if there is erythema in tissue, remove the cannula
    - if lymphangitis is present, remove cannula, take a blood culture from a separate vein and start IV antibiotics
- air embolism
    - umbilical or other central venous lines are particularly high risk
    - another source of air embolus is through the giving set, especially when pumps are used
    - always use a tap or syringe on the catheter, especially during insertion
    - if air reaches the heart it can block the circulation and cause death

- haemorrhage
    - in neonates this can occur from the umbilical stump
    - all connections must be luer locked
    - the connections to the cannula and its entry must be visualized at all times

Minimising Errors with IV infusions

- prescribe or change infusion rates as infrequently as possible
- have the minimum number of IV infusions running at the same time
- use a burette in which no more than the prescribed volume is present (especially in infants and young children, or with drugs like quinine)
- record hourly the amount given (from burette, syringe or infusion bag) and the amount left
- check the infusion site hourly to ensure fluid outside the vein has not occurred
- ensure that flushes are only used when essential and are given slowly over at least 2 minutes
- be careful with potassium solutions given IV (use enteral route when possible)
- check and double check the following:
    - is it the right drug? Check ampoule as well as box
    - is it the right concentration?
    - is shelf life within expiry date?
    - has it been constituted and diluted correctly?
    - is it for the right patient?
    - is the dose right (2 health workers ideally to check the prescription chart)
    - is it the correct syringe? (deal with one patient at a time)
    - is the IV line patent?
    - is a separate flush needed? If so has the flush been checked?
    - are sharps disposed of (including glass ampoules)?
    - has it been signed off as completed (ideally countersigned)?
    - If not received is reason given?

Intramuscular injections

- IM injections are unsafe in shock, especially with opiates
  eg a high dose can be released once recovery of the circulation occurs
- to avoid nerve damage, only the anterior aspect of the quadriceps muscle in the thigh is safe in infants
- alternate between legs if multiple injections are needed
- do not give IM injections if a bleeding tendency is present
- draw back the plunger to ensure that the needle is not in a vein before injecting (especially adrenaline or lidocaine)

  In very poorly resourced situations the IM route might be preferred because the drug might reach the patient sooner than if the patient had to wait in a queue to have an IV sited. It also
- requires less nursing time
- less expensive: venous cannula are often in short supply

- as effective as IV injections in many situations

Section 3 **Self assess 2**

1) ***When prescribing drugs the following statements are true***

a) IV administration is safer and less expensive
b) Flucloxacillin is as effective orally as IV
c) if given down a nasogastric tube drugs do not need flushing in
d) are more reliably absorbed rectally than orally

2) ***For safe prescribing the following statements are true***

a) use decimal places
b) IM means intramuscularly
c) Micrograms should be spelt in full
d) Stop dates should be included when first prescribed

ANSWERS

1) b 2) b c d

Section 3 **Self Assess 3**

1) ***When preparing for IV or IM injections of drugs the following statements are true***

a) multiple sampling from a drug vial is good practice
b) asepsis is essential
c) give drugs rapidly IV
d) there is no need to flush in drugs IV if there is a background infusion

2) ***When an IV infusion is being given the following statements are true***

a) never put more drug into syringe or burette than is needed over a defined time period
b) glucose solution > 10% are safe if they go outside the vein
c) change giving set after blood transfusion or if column of blood has entered IV tubing from vein

ANSWERS

1) b d 2) a c

Section 3 **Self Assess 4**

1) ***To minimise errors with IV infusion the following statements are true***

a) use a burette in which no more than prescribed volume is present especially if drug is dangerous e.g. quinine
b) be very careful with potassium solution which should ideally be given orally
c) change the infusion rates frequently

2) ***Regarding IM injections the following statements are true***

a) IM opiates are safe to give in shock
b) must not be given if a bleeding tendency is present
c) if essential to draw back on the plunger to ensure needle is not in vein

ANSWERS

1) a b 2) b c

Blood and blood transfusion and techniques to avoid transfusion wherever possible.

(IMEESC 12.3, 14.7, 13.4 and 13.8 and WHO Pregnancy C-23 and C-34)

Blood must be stored safely, or a bank of adequately screened donors be available 24 hours a day, especially for obstetric emergencies or major trauma.

If giving a blood transfusion, care must be taken to ensure the blood is compatible with the recipient, is infection free and is given safely.

Normal Hb (after the neonatal period) is around 12G/dl.

The WHO defines anaemia as any Hb below 11G/dl but in pregnancy haemodilution means that a figure of <10g/dl is more appropriate.

Severe anaemia in a child is Hb 5G/dl or less. Hb 5G/dl is the widely accepted level at which transfusion might be indicated and < 4G/dl if severe malnutrition. In a pregnant woman, transfusion may be considered at a Hb level of 6 – 7 G/dL taking into account other factors.

Factors other than the Hb level must be taken into account when considering transfusion:

- What is the heart rate? If rapid this will favour the decision to transfuse
- What is the respiration rate? If rapid this will favour the decision to transfuse
- Is a patient grunting? If so this will favour the decision to transfuse
- Is the patient already in circulatory collapse (shock)? ***Transfusion is very urgent***

Some patients will not show any of these features, and it might then be justifiable to delay transfusion and use haematinics – iron and folic acid. Some patients may show the above features and have a Hb of more than 5G. It will also be necessary to transfuse such patients.

Who needs blood?

- Mothers with obstetric emergencies eg APH, PPH
- Children with severe malaria. Usually under 2 years old
- Patients involved in major trauma or surgery
- Children with severe burns

A child's body contains 80ml blood for every kg body weight; hence a 3 year old weighing 12kg will have 960ml blood.

A pregnant mother's body contains 100ml/Kg of blood.

Administration

During initial transfusion give 20ml/kg body weight in a child; i.e. increase the blood volume by 25% (in severe malnutrition give 15ml/Kg and watch carefully for heart failure) and in the **pregnant mother give 2 units (1000 ml) with frusemide 40mg IV after each 500ml.**

The transfusion should ideally take 4 hours except in cases of shock when blood must be given as quickly as possible. Each unit of blood transfused should never take longer than 6 hours. Blood left out of the fridge longer than 6 hours should be discarded.

A trained person must monitor the patient as frequently as possible during a transfusion (T,P,R,BP, urine output)

Blood should be warm before it is infused. This can be achieved by passing the coiled delivery tube through a bowl of lukewarm water by the patient's side (be careful of the risk from electricity at this time) or by warming the transfusion pack under a relative's clothes.

For blood there are 20 drops per ml; in changing ml per hour into drops per minute you divide by 3.

Eg a 10kg child require 10 x 20ml blood for transfusion = 200ml

200ml in 4 hours = 50ml per hour

50ml per hour divided by 3 = 17 drops per minute

Any rate between 16-18 drops per minute would be acceptable for this transfusion

Special issues when transfusing children

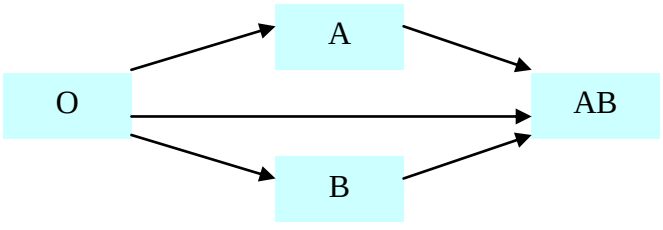
If the drip goes at the correct rate throughout the transfusion, you can use the **time** to know when the right amount of blood has been delivered. Eg, the 10kg child with a 500ml bag of blood up, will require only 200ml of it. If you run your transfusion at 16-18 drops per minute as calculated above, you know that the 200ml will have gone through in 4 hours. So, if your transfusion started at 2.00pm, and your drip rate stays at 16-18 drops per minute – your 200ml will have gone in at 6.00pm. **This is more accurate than guessing the amount remaining in the bag.**

The volume delivered can also be derived by weighing the infusion bag and giving set using scales from which the bag/giving set is suspended.

The safest way of giving blood when there is a danger of fluid overload is by using an IV giving set with an in-line burette.

Blood Groups

There are 4 major blood groups - A, B, AB and O. To avoid ABO incompatibility, the blood group of the donor and the receiver must be known. Blood can only be donated in the direction of the arrows:



Donors with blood group O can donate to patients (receivers) with blood group A, B, AB or O

Donors with blood group A can donate to patients with blood group A or AB

Donors with blood group B can donate to patients with blood group B or AB

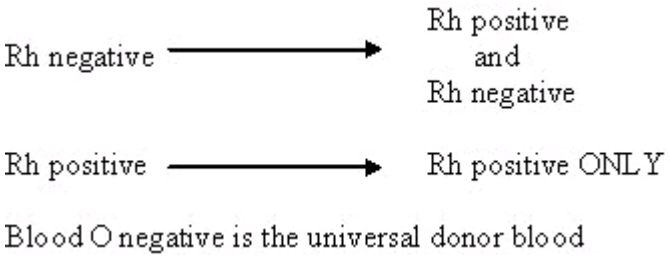
Donors with blood group AB can donate only to patients with blood group AB

Blood is also categorized according to its rhesus status. Therefore:

Rhesus negative donors can give to rhesus +ve and –ve patients

Rhesus positive donors can only give to rhesus +ve patients

(just thought that needed clarifying)



Blood O negative is the universal donor blood

If blood group unknown and blood is required before a cross-match can be performed, give O Rhesus negative blood if available.

Is the blood safe?

When possible and regionally appropriate, HIV, syphilis, Hepatitis B and C, malaria and Chagas disease should be screened for. It may be appropriate to give prophylactic anti malarial drugs.

Blood transfusion reactions

Blood transfusion can be life-saving and provides great clinical benefit to many patients but it is not without risks.

- Immunological complications.
- Errors and 'wrong blood' episodes
- Infections (bacterial and viral).

Causes of acute complications of transfusion

Acute haemolytic transfusion reaction

- Incompatible transfused red cells react with the patient's own anti-A or anti-B antibodies or other alloantibodies (e.g. anti-rhesus (Rh) D) to red cell antigens. Complement can be activated and may lead to *disseminated intravascular coagulation* (DIC).
- Infusion of ABO incompatible blood almost always arises from errors in labelling sample tubes/request forms or from inadequate checks at the time of transfusion. Where red cells are mistakenly administered, there is about a 1 in 3 risk of ABO incompatibility and 10% mortality with the severest reaction seen in a group O individual receiving group A red cells.
- Non-ABO red cell antibody haemolytic reactions tend to be less severe.

Infective shock

- Bacterial contamination can be fatal.
- Acute onset of hypertension or hypotension, rigors and collapse rapidly follows the transfusion.

Transfusion-related acute lung injury (TRALI)

- TRALI is a form of acute respiratory distress due to donor plasma containing antibodies against the patient's leukocytes.
- Transfusion is followed within 6 hours of transfusion by the development of prominent nonproductive cough, breathlessness, hypoxia and frothy sputum. Fever and rigors may be present.
- CXR if available shows multiple perihilar nodules with infiltration of the lower lung fields.

Fluid overload

- This occurs when too much fluid is transfused or too quickly, leading to *pulmonary oedema* and *acute respiratory failure*.
- Patients at particular risk are those with severe or chronic anaemia, severe malnutrition and who have normal blood volumes (that is not bleeding) and those with symptoms of *cardiac failure* prior to transfusion.
- These patients should receive packed cells rather than whole blood via slow transfusion, with diuretics if required.

Non-haemolytic febrile reactions to transfusion of platelets and red cells

- Fevers (>1°C above baseline) and rigors may develop during transfusion due to patient antibodies to transfused white cells.
- This type of reaction affects 1-2% of patients.
- Multiparous women and those who have received multiple previous transfusions are most at risk. Reactions are unpleasant but not life-threatening. Usually symptoms develop towards the end of a transfusion or in the subsequent two hours. Most febrile reactions can be managed by slowing or stopping the transfusion and giving paracetamol.

Severe allergic reaction or anaphylaxis

- Allergic reactions occur when patients have antibodies that react with proteins in transfused blood components.
- Anaphylaxis occurs where an individual has previously been sensitised to an allergen present in the blood and on re-exposure, releases immunoglobulin E (IgE), or IgG, antibodies. Patients with anaphylaxis become acutely dyspnoeic due to bronchospasm and laryngeal oedema and may complain of chest pain, abdominal pain and nausea.
- Urticaria and itching are common within minutes of starting a transfusion.
- Symptoms are usually controlled by slowing the transfusion and giving antihistamine and the transfusion may be continued if there is no progression at 30 minutes.
- Pre-treatment with an antihistamine should be given when a patient has experienced repeated allergic reactions to transfusion.
- *See* chapters 2.7.C and 5.1.B for treatment of anaphylaxis

Presentation

Symptoms or signs may occur after only 5-10 mL of transfusion of incompatible blood so patients should be **observed very closely at the start of each blood unit transfused**.

Symptoms:

- Feeling of apprehension or 'something wrong'
- Flushing
- Chills
- Pain at the vene-puncture site
- Muscle aches
- Nausea
- Pain in the abdomen, loins or chest.
- Shortness of breath

Signs:

- Fever (rise of 1.5°C or more) and rigors
- Hypotension or hypertension
- Tachycardia
- Respiratory distress
- Oozing from wounds or puncture sites
- *Haemoglobinaemia*
- *Haemoglobinuria*

Investigations and management

- Where a serious acute transfusion reaction is suspected, **stop the transfusion** and take down the donor blood bag and giving set and send back to the blood bank with notification of event. Set up a new IV line with Ringer-Lactate or Hartmann's.
- To detect a haemolytic reaction, send post-transfusion blood (for FBC and clotting, repeat type and crossmatch, antibody screen and direct Coombs' test) and urine specimen (for detection of urinary haemoglobinuria: if available) from the transfusion recipient.
- Where bacterial contamination is suspected, send blood cultures from patient and bag remnants.
- If the patient is dyspnoeic, obtain CXR if possible and check for fluid overload and pulmonary oedema.
- Give treatment as for anaphylaxis: IM adrenaline, IV hydrocortisone, promethazine or chlorphenamine
- Record ID of blood given
- Send specimens of venous blood and samples of the transfused blood to the lab. Take blood cultures if risk of contaminated transfusion.

Section 3 **Self Assess 5**

1) ***Severe anaemia as defined by WHO and the level at which transfusion is widely accepted is:***
   a) Hb < 5g/dl
   b) Hb < 8g/dl
   c) Hb < 10g/dl
2) ***Total blood volume in a child is:***
   a) 40 ml/kg body weight
   b) 60 ml/kg body weight
   c) 80 ml/kg body weight
3) ***Initial transfusion of blood in an un-shocked child is:***
   a) 20 ml/kg over 8 hours
   b) 40 ml/kg over 4 hours
   c) 20 ml/kg over 4 hours

ANSWERS

1) a 2) c 3) c

Section 3 **Self Assess 6**

1) ***Which of the following is true:***

a) O rhesus –ve blood can be given to all patients in an emergency when there is no time for X match

b) Patients of blood group AB rhesus –ve are able to receive in an emergency all types of blood

2) ***If a major transfusion reaction occurs:***

a) take down the blood bag, leave the giving set as it is and transfuse IV Ringer-Lactate or Hartmann's

b) take down the bag and replace the giving set with a new one and transfuse IV Ringer Lactate or Hartmann's

c) leave the blood going but give IV hydrocortisone and an antihistamine