Fluid management in children

Dr Mikey

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Introduction:

- Fluid management in children is more complex than first appears.
- Very important to know why fluid is being given before giving.
- Be aware of the dangers of over-hydrating patients – pulmonary oedema etc.
- Children need to be treated with caution.
- Constant re-assessment is extremely important to avoid sudden changes in condition.

Starting point: Assessing for shock:

- Shock in a child requires 3 clinical signs:

- 1. Fast and weak pulse (could also be slow if in severe shock).
- 2. Cold and clammy peripheries.
- 3. CRT > 3 seconds.

What is shock ?

- Shock: not getting blood carrying glucose and oxygen to important organs
- Organs don´t work well without oxygen and glucose, and can be permanently damaged in shock
  - Heart reduced pumping function
  - Brain lethargy, irritability, coma, convulsion
  - Kidneys stop producing urine

Other helpful fluid management parameters:

- Observe for signs of dehydration – obvious ones such as skin turgor, sunken eyes and lethargy.
- Urine output very important to monitor: this will tell you what is happening earlier than anything else.
- Beware history is not always accurate with a urine output.
- But should be monitored on the ward, forms a part of the history.

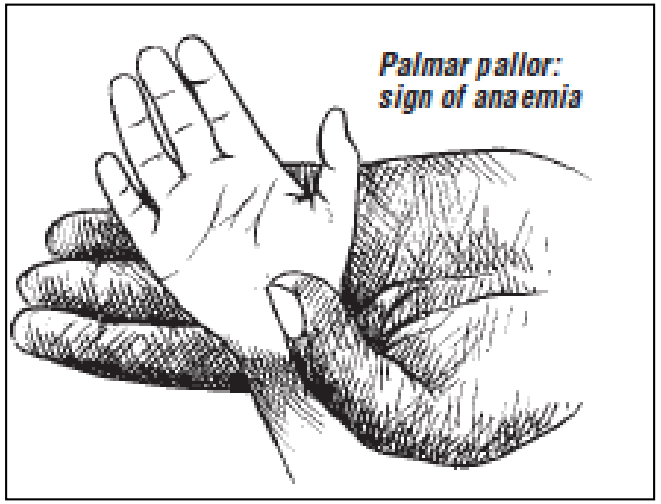
Having established shock – 3 questions:

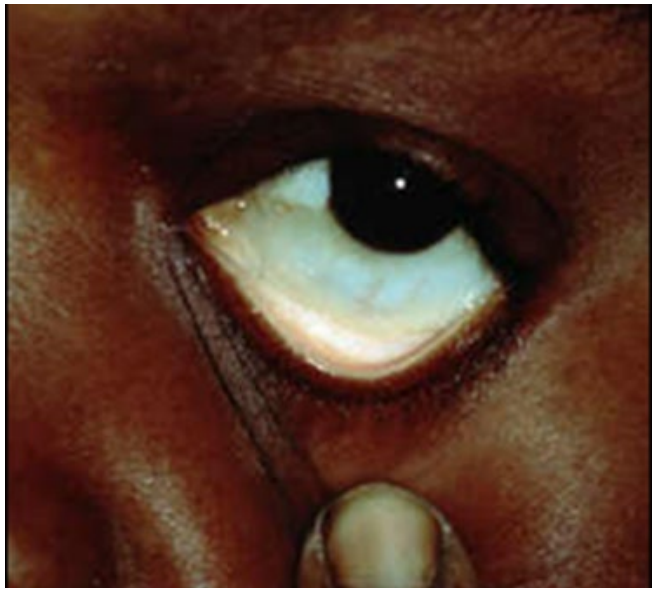
1. Is the child anaemic?
2. Is the child malnourished?
3. Is the child dehydrated?

We are trying to establish a cause for the shock as well as looking at ways to treat.

Assessing Severe Anaemia

- Common
- Often in children with malaria (Malaria parasites destroy red blood cells rapidly)
- Beware children bleeding slowly via GIT.
- Severe pallor
- Low HB
- May cause cardiogenic shock





Management of children with shock AND severe anaemia (Hb<6)

- **Give blood as soon as possible**
- No malnutrition: 20 ml/kg over 3-4 hours
- Severe acute malnutrition: 10 ml/kg over 3-4 hours

- Give maintenance fluid while waiting for blood

Giving a blood transfusion

When? Hb < **6 g/dl** if child in shock or has signs of heart failure
Hb **< 5 g/dL** for all other children

What? Whole blood or packed red cells

How much? 20ml/kg whole blood or 10-15ml/kg packed red cells
Half of this volume in severely malnourished children

How fast? 3-4 hrs

Assess for malnutrition: Look

Marasmus

- Old person's face
- Irritable
- Extreme wasting and low weight

Kwashiorkor

- Apathy
- Oedema of legs, arms, face
- Pale, spare hair, weak roots
- Moon face
- Pale, thin, peeling skin
- Hepatomegaly

Assess for dehydration – fluid resuscitation is different

What is your assessment?

- **Normal circulation**: proceed to assess **Disability**

- **Signs of impaired circulation**:
- 1. Is the child in shock? (ALL of cold hands and feet; CRT >3 secs; weak+rapid pulse)
- 2. What is the cause of the circulatory problem?
  - Is the child **anaemic**?
  - Does the child have watery diarrhoea, and are they **dehydrated**?
- 3. Does the child have **severe acute malnutrition**?

Different causes for shock

Cause	Mechanism	Name
Severe dehydration Severe bleeding	Because of fluid loss through vomiting and diarrhoea or blood loss through bleeding, there **is too little blood volume**	Hypovolaemic shock
Severe infection bacterial (Septic shock) viral (Ebola, Dengue)	Infection can damage **blood vessels** and make them **leaky.** Fluid leaks out of the vessels into the tissue (oedema) and there is too little fluid left in the blood vessels **(too little blood volume).** Infection can also damage the heart muscle.	Distributive shock
Severe anaemia (Other diseases of the heart)	**Heart failure** (too little oxygen in the heart muscle), the heart can´t pump the blood. There are too few red blood cells to deliver oxygen.	Cardiogenic shock (weak heart)
Severe allergic reaction (anaphylaxis)	Severe allergic reactions can also make blood vessles leaky. Fluid leaks into the tissue (oedema), and there is too little fluid left in the blood vessels (**too little blood volume**)	Anaphylactic shock (leaky vessels)

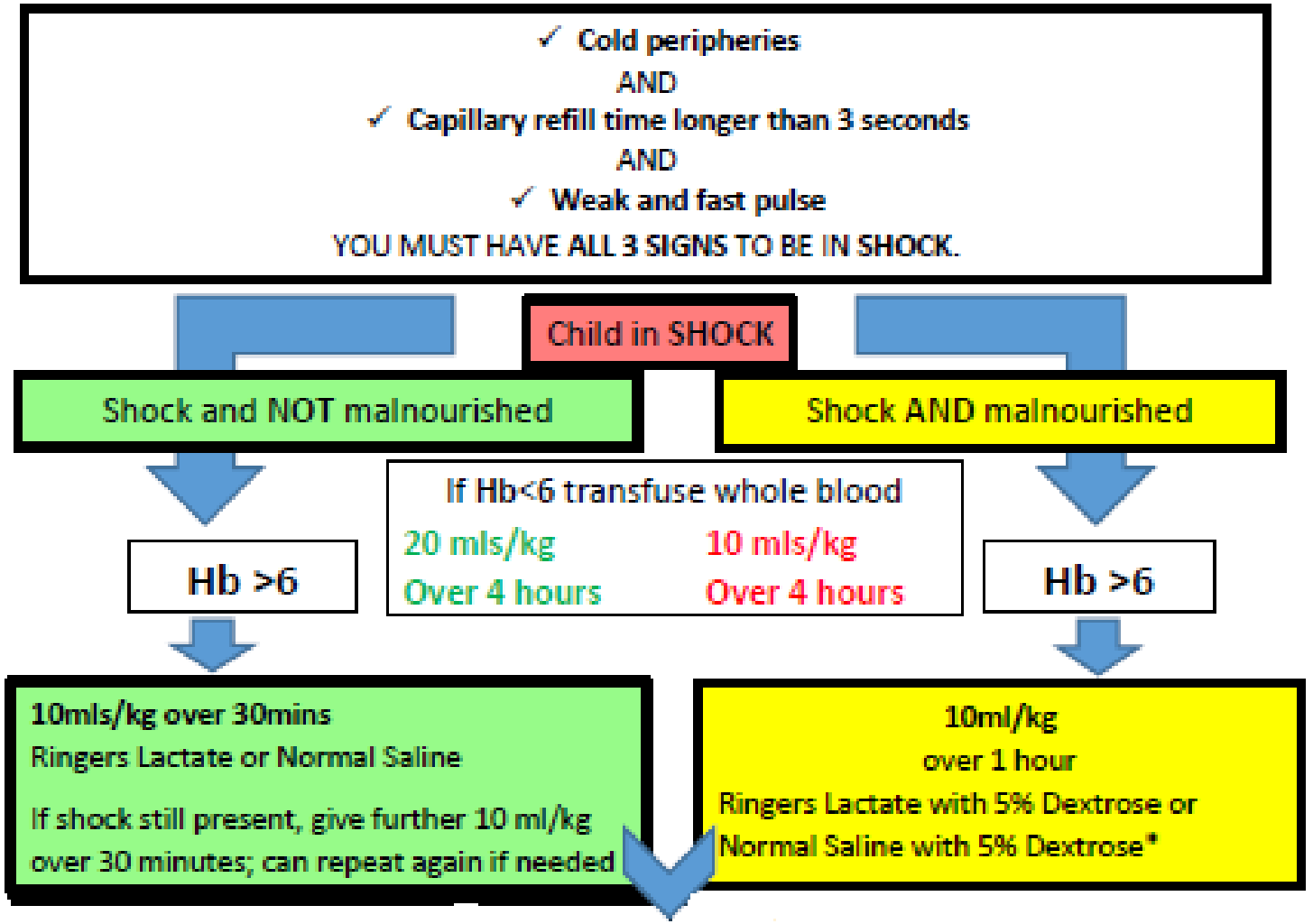
What would you see if a child is in shock?

- **Airway:** The patient may be unconscious, in which case they are at risk of aspiration and obstruction
- **Breathing:** The patient may be hypoxic: poor blood supply to lungs to pick up oxygen
- **Circulation:**
  - The heart beats faster: trying to increase the blood supply to the body
  - The pulses become weaker
  - Hands and feet become cold: what level does it stop? Wrist? Elbow?
  - CRT > 3 sec
  - Pale
- **Coma/Convulsion:**
  - Decreased level of conciousness, irritable, convulsion: decreased oxygen and sugar to the brain
  - Blood sugar might be low
- **Dehydration**
  - Very severe diarrhoea and dehydration will eventually cause shock

Shock treatment – cause determined:

- Dehydration – more aggressive fluid management to be discussed later.
- Distributive – boluses as below.
- Cardiogenic – need for blood to improve oxygen to heart.
- Anaphylactic – similar plan to distributive but address the cause with anti-inflammatories.

Treatment of Shock: distributive/anaphylactic



Shock and NOT Malnourished with Hb >6

- Bolus: 10mls/kg over 30 mins
- Fluid: RL or NS
- Reassess after each bolus
- Can be repeated 2x if shock not resolved

Shock and **Malnourished** with Hb >6

- Bolus: 10mls/kg over 1 hour
- Fluid: RL+D5 or NS+D5
- Reassess after the bolus
- The bolus should not be repeated

After the initial treatment of Shock

NO MALNUTRITION	SEVERE MALNUTRITION
If shock not secondary to diarrhoea: **SHOCK RESOLVED:** Give maintenance fluids or feeds following the protocol below **SHOCK PERSISTS:** Give maintenance fluids **AND** Consider blood transfusion	**If shock not secondary to diarrhoea:** **SHOCK RESOLVED:** Start NG/oral ReSoMal following Step 2 for malnourished children **SHOCK PERSISTS:** Start NG/oral ReSoMal following Step 2 for malnourished children **AND** Consider blood transfusion

SHOCK SECONDARY TO DIARRHOEA
NO MALNUTRITION: Follow Severe Dehydration Step 2
SEVERE MALNUTRITION: Start NG/oral ReSoMal following Step 2 for malnourished children

After the initial treatment:
Shock not secondary to dehydration

- **Child not malnourished:**

<u>Shock resolved</u>:

- **Give IV maintenance fluid or NG/PO feeds**

- **<u>Shock not resolved</u>:**
- **Give maintenance fluid**
- **AND**
- **Consider blood transfusion**

After the initial treatment:
Shock not secondary to dehydration

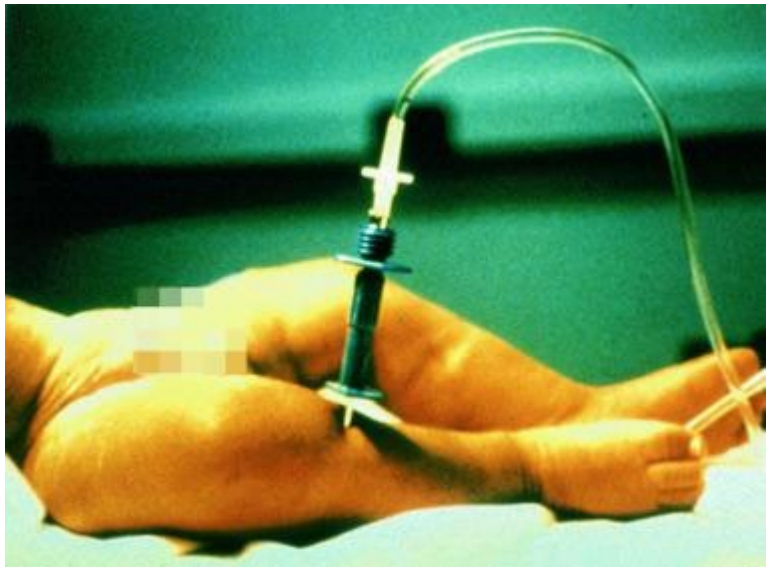
- **Child Malnourished**

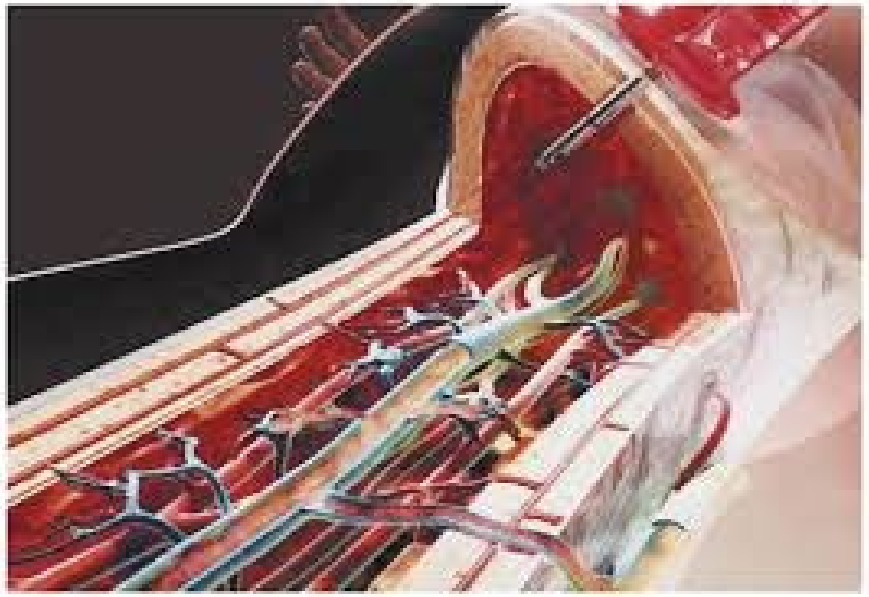
- **Shock resolved:**
- **Give NG/PO ReSoMal following step 2 for the child with SAM**

- **Shock not resolved:**
- **Give NG/PO ReSoMal following step 2 for the child with SAM**
- **AND**
- **Consider blood transfusion**

What is IO cannulation?

Inserting a line into the marrow cavity providing access to non-collapsible venous plexus



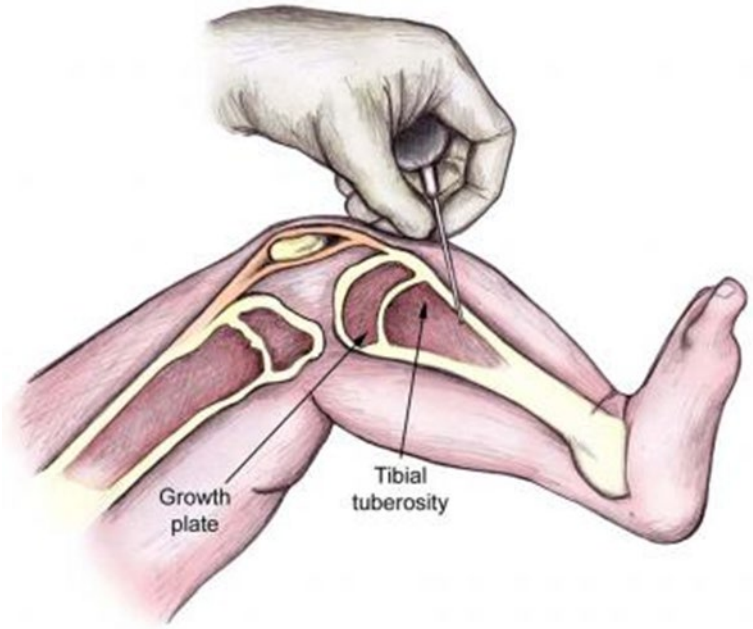


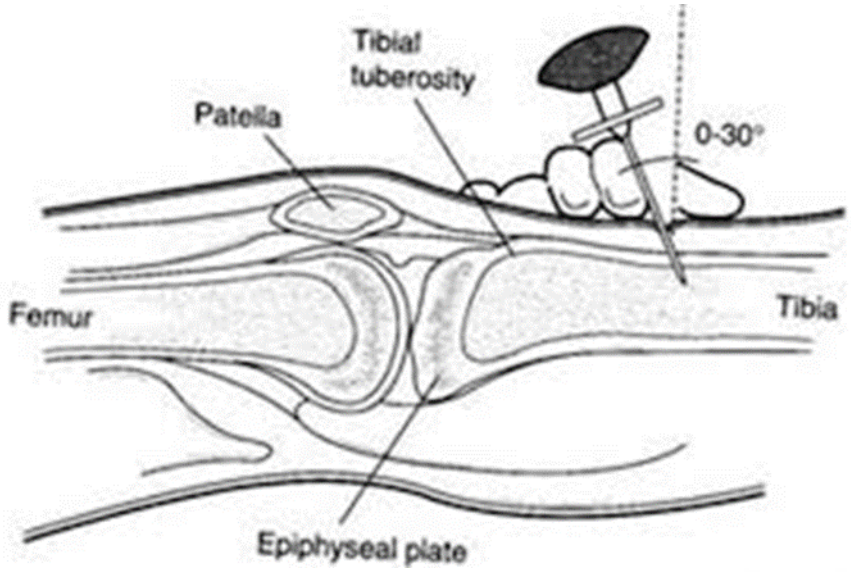
Site

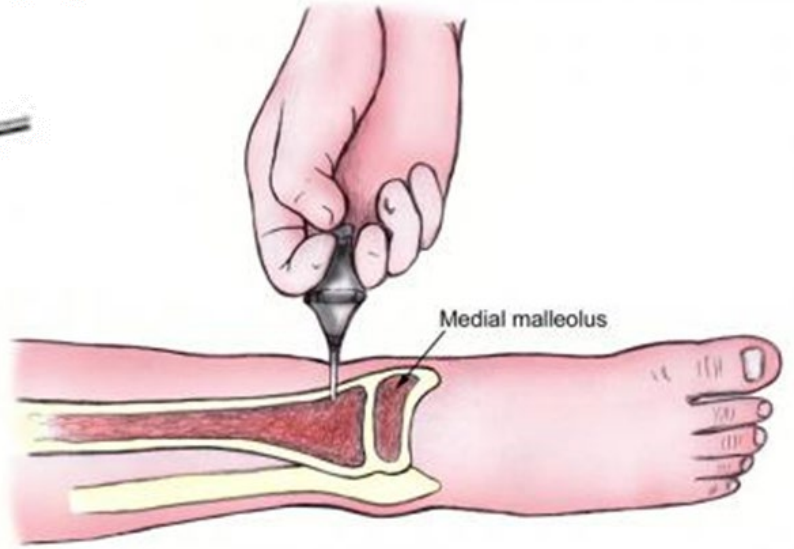
- Sternum
- **Humerus**
- **Femur**
- **Tibia- proximal and distal**
- Ilium

Tibia

- Proximal or distal

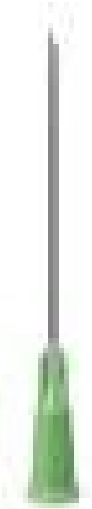






Types of IO


Jamshidi Bone Marrow Aspiration Needle
Illinois Sternal/Iliac Aspiration Needle
Jamshidi Disposable Sternal/Iliac Aspiration Needle
Cook IO Needle
Sur-Fast Needle



Contraindications

- Distal trauma (fracture on the same side)
- Infection
- Previous attempt on the same site
- Osteogenesis imperfecta
- Bleeding problems (relative contraindication)

Reason for failure

- Incorrect identification of landmarks
- A bent needle
- Clogging of the needle with marrow
- Through-and-through penetration of both anterior and posterior cortices
- Fractures caused by excess force or by fragile bones
- Penetration of the mediastinal structures or space with the potential for pneumothorax, vascular injury, lung injury, in the case of a sternal needle

Complications

- Local infection
- Compartment syndrome secondary to fluid extravasation
- Local hematoma
- Pain
- Potential for growth plate
- Fat embolus
- Bone embolus (though this has not been reported in humans)
- Mediastinitis after sternal IO puncture

Watery Diarrhoea

- In small children, diarrhoea is usually caused by viruses, and not by bacteria

- These viruses are highly infectious, and easily spread between people

Watery Diarrhoea

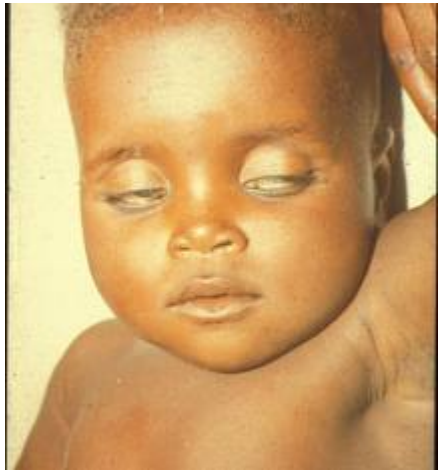
- Diarrhoea (frequent watery stool)
- Vomiting (not always)
- Might be unable to drink
- Low grade fever

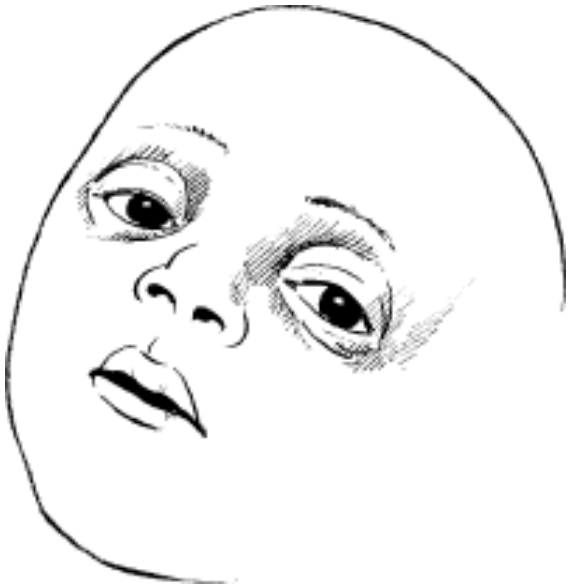
Fluid loss

Treatment:

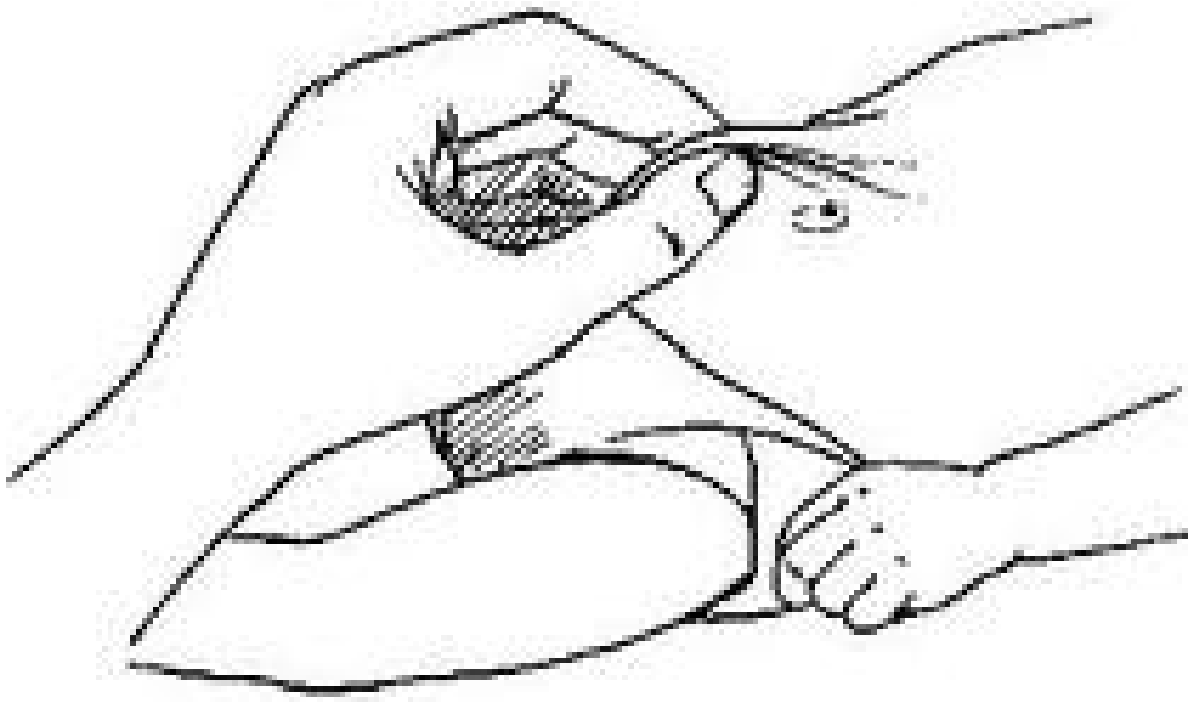
- **Rehydration** (PO,NG or IV)
- **Zinc**
- **Advise to feed continuously**
- **ANTIBIOTICS ONLY IF BLOODY DIARRHOEA**

How to assess dehydration
Look; Feel: signs of dehydration





Skin pinch

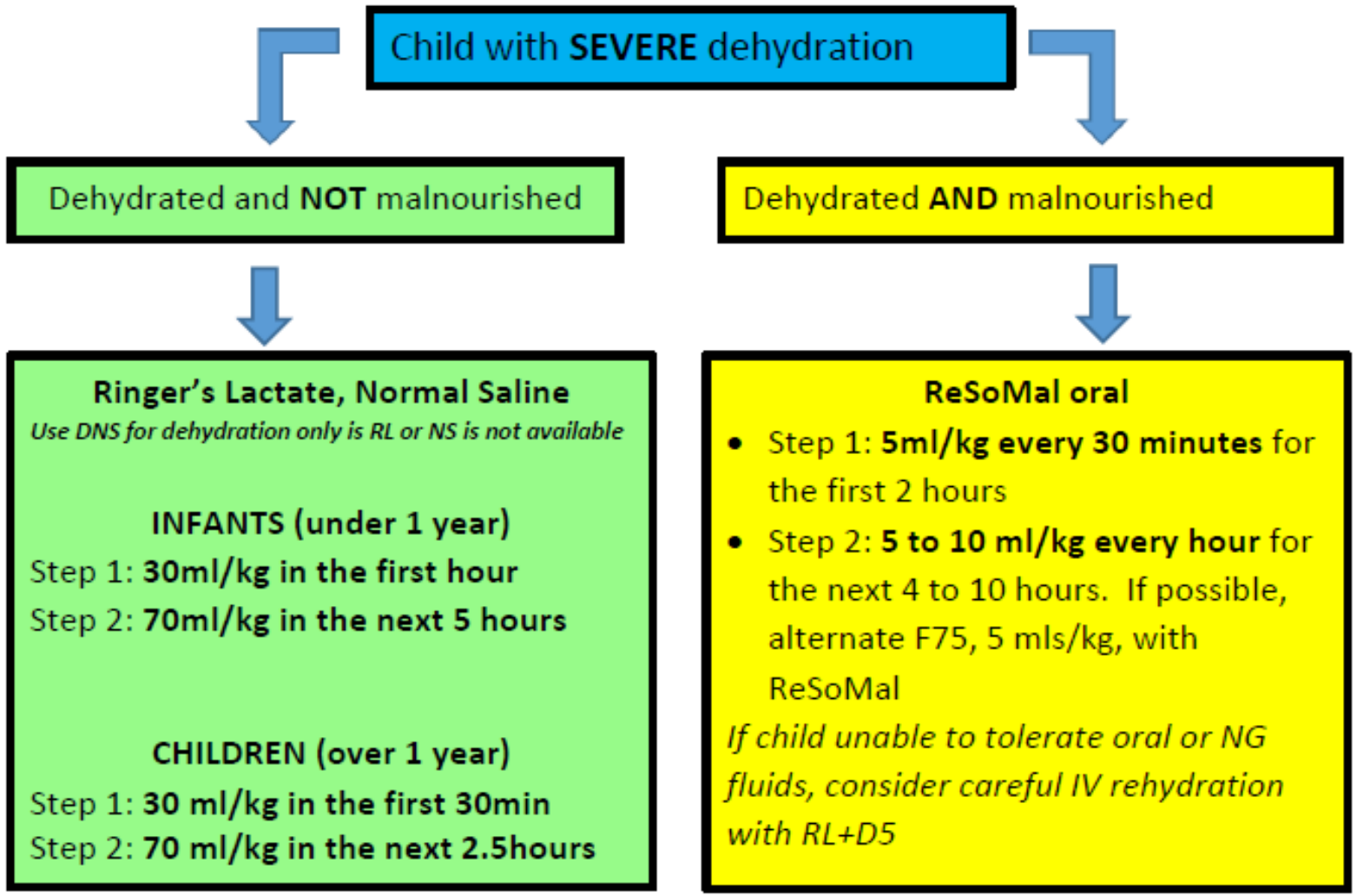


Grades of Dehydration

- No Dehydration (no signs of dehydration)
- Some Dehydration
- Severe Dehydration

Emergency signs for severe dehydration

- Watery diarrhoea ***and***
- 2 out of the 4:
  - Lethargy
  - Sunken eyes
  - Very slow skin pinch
  - Unable to drink


Child with **SEVERE** dehydration
Dehydrated and **NOT** malnourished
Dehydrated **AND** malnourished
Ringer's Lactate, Normal Saline
Use DNS for dehydration only is RL or NS is not available
INFANTS (under 1 year)
Step 1: **30ml/kg in the first hour**
Step 2: **70ml/kg in the next 5 hours**
CHILDREN (over 1 year)
Step 1: **30 ml/kg in the first 30min**
Step 2: **70 ml/kg in the next 2.5hours**
ReSoMal oral
• Step 1: **5ml/kg every 30 minutes** for the first 2 hours
• Step 2: **5 to 10 ml/kg every hour** for the next 4 to 10 hours. If possible, alternate F75, 5 mls/kg, with ReSoMal
If child unable to tolerate oral or NG fluids, consider careful IV rehydration with RL+D5

Dehydrated and **NOT** malnourished

Ringer's Lactate, Normal Saline

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Step 1: **30 ml/kg in the first 30min**

Step 2: **70 ml/kg in the next 2.5hours**

Treatment of severe dehydration (**not in shock**) in **malnourished** children

- Signs of dehydration are difficult to assess in malnourished children
- The heart muscle is weak and wasted, so giving IV fluids in large amounts is dangerous
- Oral rehydration with ReSoMal:
  - 5 ml/kg for every 30min for the first 2 hours
  - 5-10 ml/kg per hour for the next 4 to 10 hours (in between F75, every 2 hours
- Every child with SAM and diarrhoea should receive ReSoMal (treatment or prevention of dehydration)

Dehydrated **AND** malnourished

ReSoMal oral

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Dehydration

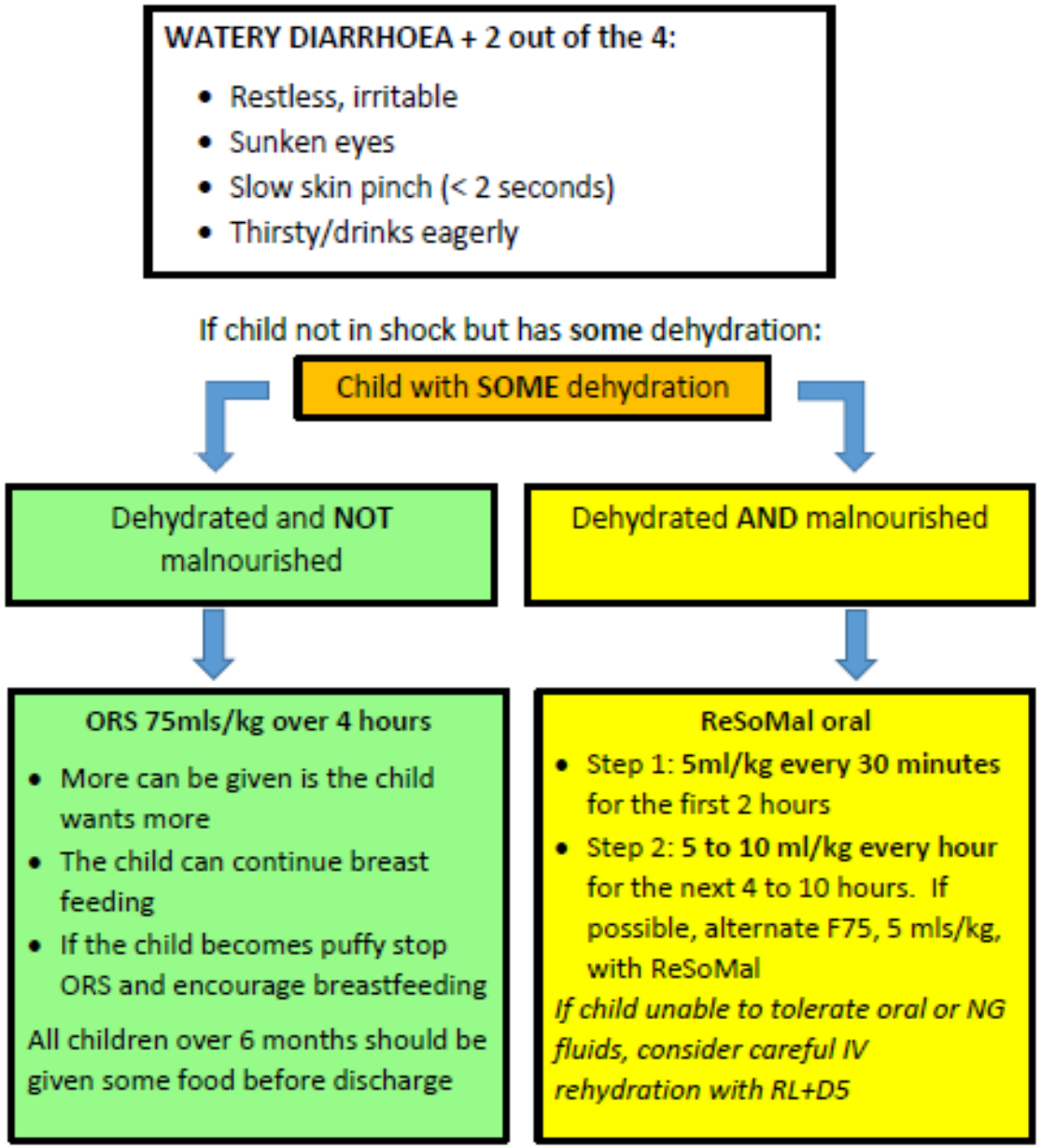
Watery diarrhoea + 2 of the following:

SEVERE

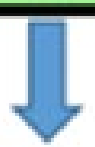
- Sunken eyes
- Lethargic
- **Very** slow skin pinch (>2sec)
- Unable to drink

SOME

- Sunken eyes
- Restless
- Slow skin pinch (<2 sec)
- Thirsty


WATERY DIARRHOEA + 2 out of the 4:
Restless, irritable
Sunken eyes
Slow skin pinch (< 2 seconds)
Thirsty/drinks eagerly
If child not in shock but has some dehydration:
Child with SOME dehydration
Dehydrated and NOT malnourished
Dehydrated AND malnourished
ORS 75mls/kg over 4 hours
More can be given is the child wants more
The child can continue breast feeding
If the child becomes puffy stop ORS and encourage breastfeeding
All children over 6 months should be given some food before discharge
ReSoMal oral
Step 1: 5ml/kg every 30 minutes for the first 2 hours
Step 2: 5 to 10 ml/kg every hour for the next 4 to 10 hours. If possible, alternate F75, 5 mls/kg, with ReSoMal
If child unable to tolerate oral or NG fluids, consider careful IV rehydration with RL+D5

Dehydrated and **NOT** malnourished



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Dehydrated **AND** malnourished

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If child unable to tolerate oral or NG fluids, consider careful IV rehydration with RL+D5

Fluid management: summary

	Not malnourished	Malnourished
Shock (all 3 features)	**IV** 10-20mls/kg RL/NS over 1 hour (10mls/kg over 30mins can be repeated 2x)	**IV** RL+D5% 10-15mls/kg over 1hr
Severe dehydration	**IV** 30mls/kg RL/NS/DNS: < 1yr over 1 hr, >1yr over 30mins 70mls/kg RL/NS/DNS : < 1yr over 5 hrs, >1yr over2.5hrs	**PO/NG** ReSoMal 5mls/kg every 30min
Some dehydration	**PO/NG** ORS 75mls/kg over 4 hours	**PO/NG** ReSoMal 5mls/kg every 30min
Impaired circulation (some but <3 features of shock)	**IV** Maintenance	**PO/NG** ReSoMal 5mls/kg every 30min

Maintenance Fluid and Feeds

Which children need maintenance fluid?

- Any child who is nil by mouth (NPO):
  - Severe respiratory distress
  - Bowel obstruction (perforation, septic ileus….)
  - AVP**U** and at high risk of aspiration
- Well nourished children with impaired circulation (some, but not all 3 features of shock)

What fluid to give?

- Most children should receive fluid containing dextrose
- Normally Dextrose Normal Saline (DNS)
- or
- Ringer Lactate with 5% Dextrose

- For short periods, it is possible to use Ringer's Lactate: make sure to check the blood glucose level!
- YOU MUST NEVER GIVE ONLY D5%

How much fluid to give?

- In order to calculate the child's IV maintenance fluids over 24 hours:

- Use the weight of the child
- 1st 10 kg: 100 ml/kg
- 2nd 10 kg: 50 ml/kg
- Any further kg: 25 ml/kg

Calculating how much fluid/feed to give over 24 hours

- 12kg child:
- 10kg x 100ml = 1000ml
- 2kg x 50ml = 100ml
- Total over 24 hours = 1100ml

Calculating how much fluid/feed to give over 24 hours

- 24kg child
- 10kg x 100ml = 1000ml
- 10kg x 50ml = 500ml
- 4kg x 25ml = 100ml
- Total over 24 hours = 1600ml

Calculating 3 hourly feeds

- 24kg child: 1600ml in 24 hours
- 3 hourly feeds = 8 feeds in 24 hours
- 1600/8 feeds = 200ml per feed

Hypoglycaemia:

- Ideally less than 70 mg/dl should be treated.
- Avoid further hypoglycaemic events by managing fluids and feeds effectively.
- Consider hypoglycaemia to be a sign of either malnutrition, sepsis or another serious underlying condition.

- Treat with D10% 5mls per kg.

Summary

- Fluid loss from diarrhoeal disease can kill if the fluid is not replaced
- It is important to make a careful assessment of the degree of dehydration, using the most reliable signs
- Severe dehydration is an emergency sign, and requires immediate action
- Treatment will differ, depending on whether or not the child is malnourished
- It is important to make a plan for the child's ongoing fluid requirements, and to calculate and prescribe the fluids for the first 24 hours of admission