

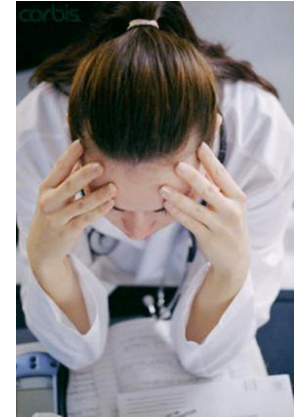
# Fluid Management



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# Learning outcomes

- Calculate maintenance fluids
- Identify the types of dehydration
- Manage dehydration appropriately
- List the signs of a shocked child
- Treat a shocked child with appropriate fluids and volume
- Discuss fluid management in neonatal care



# Fluid basics

# Fluid composition

IV Fluid	Na <sup>+</sup> mmol/l	K <sup>+</sup> mmol/l	Cl <sup>-</sup> mmol/l	Ca <sup>+</sup> mmol/l	Lactate mmol/l	Glucose g/l	Calories / l
Ringers lactate (Hartmann's)	130	5.4	112	1.8	27	-	-
Normal saline (0.9% saline)	154	-	154	-	-	-	-
5% dextrose	-	-	-	-	-	50	200
Half-strength Darrow's with 5% dextrose	61	17	52	-	27	50	200

	Na <sup>+</sup> mmol/l	K <sup>+</sup> mmol/l	Cl <sup>-</sup> mmol/l	Bicarbonate mmol/l	Glucose g/l	Magnesium mmol/l
WHO ORS	90	20	80	30	111	-
ReSoMal	45	40	-	-	125	3

# Maintenance fluids

- Assuming no dehydration and no extra losses a child will require over 24 hours
  - 100 ml/kg for the first 10 kg of body weight
  - 50 ml/kg for the second 10 kg of body weight
  - 20 ml/kg for every kg thereafter
- This is the same for PO / NG / IV fluids

# Maintenance fluids

## A 17 kg boy will need

- $100 \text{ ml} \times 10 \text{ kg} = 1000 \text{ ml}$
- $50 \text{ ml} \times 7 \text{ kg} = 350 \text{ ml}$
- Total of 1350 ml in 24 hrs
- Which = **56 ml / hr**

## A 35 kg girl will need

- $100 \text{ ml} \times 10 \text{ kg} = 1000 \text{ ml}$
- $50 \text{ ml} \times 10 \text{ kg} = 500 \text{ ml}$
- $20 \text{ ml} \times 15 \text{ kg} = 300 \text{ ml}$
- Total of 1800 ml in 24 hrs
- Which = **75 ml / hr**

# How fast should the IVI should 'drip'

- Standard paediatric giving sets 60 drops = 1 ml
  - So if trying to give 10 ml / hr
  - This is 10 ml x 60 drops = 600 drops per hr
  - Which is 600 drops per 60 minutes = 10 drops per minute
  - So the IVI should be dropping 10 drops per minute
  - This is 1 drop every 6 seconds
- Alternatively 1 drop every 1 second delivers 60 ml / hr
  - So you can divide 60 by the amount you want to give to work out how many seconds to wait between drops

# How fast should the IVI should 'drip'

## For a 7.2 kg boy?

- Maintenance fluids are  $7.2 \text{ kg} \times 100 \text{ ml} = 720 \text{ ml} / 24\text{hrs}$
- **= 30 ml/hr**
- $30 \text{ ml} \times 60 = 1800 \text{ drops per hour}$
- Which is 1800 drops per 60 minutes
- So the IVI should be dripping at 30 drops per minute
  - This is 1 drop every 2 seconds
- $60 / 30 = 2$ ; so give 1 drop every 2 seconds



# How fast should the IVI should 'drip'

## For a 53kg girl?

- Maintenance fluids are
  - $10 \text{ kg} \times 100 \text{ ml} = 1000 \text{ ml}$
  - $10 \text{ kg} \times 50 \text{ ml} = 500 \text{ ml}$
  - $33 \text{ kg} \times 20 \text{ ml} = 660 \text{ ml}$
  - Total fluid / 24hrs = 2160 ml
  - = **90 ml / hr**
- This means the drip should be dripping at 90 drops per minute
- This is roughly 1.5 drops per second
- Or  $60 / 90 = 0.66$ ; so give 1 drop every 0.6 second

# How to make a dextrose solution

## To make a fluid with 10% dextrose

- Dilute at a ratio of 1:4
- For example take 200 ml 50% dextrose and add to 800 ml of 0.9% saline
- Another way of thinking about it is
  - 100 ml of 50% dextrose contains 50 gram of glucose
  - To make a 10% solution you need to add 100 gram of dextrose to 1000 ml of fluid
  - Therefore you would need to add 200 ml of 50% dextrose

## To make a fluid with 5% dextrose

- Dilute at a ratio of 1:9
- For example take 100 ml 50% dextrose and add to 900 ml 0.9% saline
- Or
  - To make a 5% solution you need to add 50 gram of dextrose 1000 ml of fluid
  - Therefore you would need to add 100 ml of 50% dextrose

# Dehydration

# Dehydration

- Hydration status must be assessed in all children with diarrhoea

Classification	Signs / symptoms
Severe dehydration	Two or more of the following signs:- <ul style="list-style-type: none"><li>Lethargy / unconsciousness</li><li>Sunken eyes</li><li>Unable to drink / drinks poorly</li><li>Skin pinch goes back very slowly (<math>\geq 2</math> seconds)</li></ul>
Some dehydration	Two or more of the following signs: - <ul style="list-style-type: none"><li>Restlessness / irritability</li><li>Sunken eyes</li><li>Drinks eagerly, thirsty</li><li>Skin pinch goes back slowly</li></ul>
No dehydration	No signs of dehydration

# Dehydration

## Severe dehydration

- Rapid IV rehydration with Ringer's lactate or 0.9% saline

	First give 30ml/kg in:	Then give 70ml/kg in:
< 12 months old	1 hour *	5 hours
≥ 12 months old	30 minutes*	2 ½ hours
* Repeat again if radial pulse is still very weak or not detectable		

# Dehydration

## Severe dehydration

- Reassess every 15-30 minutes
- Hydration status not improving → give drip more rapidly
- As soon as the child can drink give ORS (~5 ml/kg/hr)
  - Usually after 3 - 4 hours in infants or 1 - 2 hours in children
- If normally breastfed encourage the mother to continue frequently
- Reassess
  - Infant after 6 hours
  - Child after 3 hours
- Then chose the appropriate management plan
  - Severe / some / no dehydration

# Dehydration

## Some dehydration

- Give recommended amount of ORS over a 4 hour period

Age	< 4 months	4 – 12 months	12 – 2 years	2 – 5 years	5 – 15 years
Weight	<5 kg	5 - 8 kg	8 - 11 kg	11 - 16 kg	16 - 50 kg
In ml	200 - 400	400 - 600	600 - 800	800 - 1200	1200 - 2000

# Dehydration

## Some dehydration

- Show the mother how to give the ORS
  - < 2 years a teaspoonful every 1-2 minutes
  - > 2 years frequent sips from a cup
- If the child vomits
  - Wait 10 minutes, then resume ORS more slowly
- Advise breastfeeding mothers to continue
- Reassess after 4 hours, checking for signs of dehydration



# Dehydration

## No dehydration

- Give extra fluid
- Breastfeed frequently and for longer at each feed
- If being exclusively breastfed, give ORS in addition
- In non-exclusively breastfed children give ORS / food based fluids (soup, rice water, yoghurt drinks) / clean water
- **To prevent dehydration from developing, advise the mother to give extra fluids – as much as the child will take:**
  - For children <2 years, about 50-100ml after each loose stool
  - For children >2 years, about 100-200ml after each loose stool

# Dehydration

## No dehydration

- Tell the mother to give small sips from a cup
- If the child vomits, wait 10 minutes and then give more slowly
- She should continue giving extra fluid until the diarrhoea stops
- Teach the mother how to mix and give ORS solution and give her two packets of ORS to take home
- Advise the mother to return if the child:
  - Is more sick
  - Is unable to drink / breastfeed
  - Drinks poorly
  - Develops a fever
  - Develops blood in the stool
- If the child has not improved after 5 days they should return for further review

# Dehydration

**Teach this mother how to use ORS**

# Dehydration

## Malnutrition and dehydration

- Tends to be over diagnosed
- Do not use IV fluids unless the child is shocked
- Give ReSoMal rehydration fluid orally or by NG
  - 5 ml/kg every 30 minutes for the first 2 hours
  - Then 5 – 10 ml/kg/hr for the next 4-10 hours

## Hypoglycaemia and dehydration

- Always check the blood sugar
- If  $< 3$  mmol give 1 ml/kg of 50% dextrose IV / PO

**Shock**

# Shock

- Commonest cause in children is fluid loss
  - Due to severe diarrhoea
  - Due to bleeding
  - Due to capillary leak in sepsis / severe infection
- It is important to replace this fluid quickly
- Amount and type of fluid given depends on:
  - Age / weight of child
  - Child's nutritional status

# Assessing for Shock

- Signs of shock include:
- **Cold hands**
- **Capillary refill > 3 seconds**
  - Apply pressure to nail bed for 5 seconds
  - Release and observe time for pink colour to return
- **Weak pulse and tachycardia**

**= SHOCK**

# Managing shock

- Give oxygen
- Stop bleeding by applying firm direct pressure
- Make sure the child is warm
- Establish IV / IO access
- Give fluids



# Managing shock WITHOUT malnutrition

**20 ml / kg Ringer's Lactate or 0.9% Saline as fast as possible**

Reassess circulation

No improvement



**Repeat 20 ml / kg Ringer's / Saline**

Reassess circulation

No improvement



**Repeat 20 ml / kg Ringer's / Saline**

Reassess circulation

No improvement



**Give 20 ml / kg blood over 30 minutes**

If improvement commence maintenance fluids / PO fluids as soon as able

## Chart 7. **How to give IV fluids rapidly for shock (child not severely malnourished)**

- Check that the child is not severely malnourished (in the child with severe malnutrition see section 1.4, page 4 and Chart 8)
- Insert an intravenous line (and draw blood for emergency laboratory investigations).
- Attach Ringer's lactate or normal saline—make sure the infusion is running well.
- Infuse 20 ml/kg as rapidly as possible.

<b>Age/weight</b>	<b>Volume of Ringer's lactate or normal saline solution (20 ml/kg)</b>
2 months (<4 kg)	75 ml
2–<4 months (4–<6 kg)	100 ml
4–<12 months (6–<10 kg)	150 ml
1–<3 years (10–<14 kg)	250 ml
3–<5 years (14–19 kg)	350 ml

### **Reassess child after appropriate volume has run in**

- Reassess after first infusion:* If no improvement, repeat 20 ml/kg as rapidly as possible.
- Reassess after second infusion:* If no improvement, repeat 20 ml/kg as rapidly as possible.
- Reassess after third infusion:* If no improvement, give blood 20 ml/kg over 30 minutes.
- Reassess after fourth infusion:* If no improvement, see treatment guidelines.

After improvement at any stage (pulse slows, faster capillary refill), go to Chart 11, page 14.

**If the child is severely malnourished, the fluid volume and rate are different—see Chart 8.**

# Shock WITH malnutrition

- Children with severe malnutrition:
  - Are difficult assess
  - Are at risk of cardiac failure
  - Are at risk of hypoglycaemia
  - Need more cautious fluid management with different fluids
  - Need very close monitoring
- The malnourished child usually has shock because of dehydration / sepsis

# Assessing for malnutrition

## Marasmus

- Look at arms, legs, chest, buttocks
- Appears to be 'skin and bone'
- Skin looks too large for body
- Head may appear large



# Assessing for malnutrition

## Kwashiorkor

- Oedema of both feet
  - Press top of foot gently with thumb
  - Look for a definite dent in tissues



## Other signs

- Thin, sparse, depigmented hair
- Peeling skin rash ('flaky paint')

# Managing shock WITH malnutrition

- General principles
  - Weigh the child
  - Monitor for hypoglycaemia
  - Avoid IV fluid if possible
  - Monitor closely for signs of cardiac failure/ increasing respiratory distress/ worsening oedema
- 
- If able to drink/ tolerate NG give oral fluid as in severe dehydration
    - ReSoMal:
      - 5ml/kg every 30 mins for 2 hours, then
      - 5-10ml/kg/hour for 4-10 hours

# Managing shock WITH malnutrition

- If unconscious or vomiting all fluids then use IV fluids
  - Half strength Darrow's with 5% dextrose
  - Ringer's Lactate with 5% dextrose
  - 0.9% saline with 5% dextrose
- Give 15 ml/kg over 1 hr – observe RR and HR
- If RR and HR improve child probably has dehydration and needs more fluid
- Give another 15 ml/kg over 1 hr
- Start oral fluids and F75 when able (10 ml /kg/hr for up to 10 hrs)

# Managing shock WITH malnutrition

- If no improvement after first 15 ml/kg the child is probably septic rather than dehydrated
- THIS child needs blood 10 ml/kg over 3 hrs
- If blood not available run IV VERY slowly (4ml/kg/hour) until it arrives
- Give oral fluids and F75 as soon as able
- Start antibiotics



## Chart 8. **How to give IV fluids for shock in a child with severe malnutrition**

Give this treatment only if the child has signs of shock **and is lethargic or has lost consciousness**:

- Insert an IV line (and draw blood for emergency laboratory investigations)
- Weigh the child (or estimate the weight) to calculate the volume of fluid to be given
- Give IV fluid 15 ml/kg over 1 hour. Use one of the following solutions (in order of preference):
  - Ringer's lactate with 5% glucose (dextrose); or
  - half-normal saline with 5% glucose (dextrose); or
  - half-strength Darrow's solution with 5% glucose (dextrose); or, if these are unavailable,
  - Ringer's lactate.

Weight	Volume IV fluid	Weight	Volume IV fluid
Give over 1 hour (15 ml/kg)		Give over 1 hour (15 ml/kg)	
4 kg	60 ml	12 kg	180 ml
6 kg	90 ml	14 kg	210 ml
8 kg	120 ml	16 kg	240 ml
10 kg	150 ml	18 kg	270 ml

- Measure the pulse and breathing rate at the start and every 5–10 minutes.

*If there are signs of improvement (pulse and breathing rates fall):*

- give repeat IV 15 ml/kg over 1 hour; then
- switch to oral or nasogastric rehydration with ReSoMal (see page 83), 10 ml/kg/h up to 10 hours;
- initiate refeeding with starter F-75 (see page 85).

*If the child fails to improve after the first 15 ml/kg IV, assume the child has septic shock:*

- give maintenance IV fluid (4 ml/kg/h) while waiting for blood;
- when blood is available, transfuse fresh whole blood at 10 ml/kg *slowly* over 3 hours (use packed cells if in cardiac failure); then
- initiate refeeding with starter F-75 (see page 85).

*If the child deteriorates during the IV rehydration (breathing increases by 5 breaths/min or pulse by 25 beats/min), stop the infusion because IV fluid can worsen the child's condition.*

# Neonates

# Fluid management in neonates

- Encourage breastfeeding frequently to prevent hypoglycaemia
- If unable to feed give EBM via NGT
- If IV fluids are given, reduce the IV fluids as the volume of milk feeds increases
- Babies over 3 days of age need sodium added to their IV fluids
- **Increase the amount of fluid given over the first 3-5 days (total amount oral and IV)**
  - Day 1 60ml/kg/day
  - Day 2 90ml/kg/day
  - Day 3 120ml/kg/day
  - Then increase to 150ml/kg/day

# Scenario 1

- 30 kg girl presented with a history suggestive of acute gastroenteritis
- On examination
  - Lethargic
  - Sunken eyed
  - Skin turgor = 3 seconds

# Scenario 1

- What type of dehydration?
  - **Severe dehydration**
- What type of fluid are you going to give?
  - **Ringer's lactate / 0.9% Saline**
- How much fluid are you going to give and over what time frame?
  - **30ml x 30 kg = 900 ml over 30 minutes**
- On reassessing the child has improved, how much fluid are you now going to give?
  - **70 ml x 30 kg = 2100ml over 2.5 hrs = 840 ml/hr**

## Scenario 2

- 1 year old boy = 6.5 kg
- History of diarrhoea and vomiting for 2 days
- On assessment
  - Lethargic and unresponsive
  - Icy cold
  - CRT 4 seconds
  - Unable to feel radial pulse
  - RR 60, HR 180

## Scenario 2

- What is the diagnosis in this child?
  - **Marasmus with shock**
- Should the child have IV fluids?
  - **Yes**
- What type of IV fluids are you going to use?
  - **Half strength Darrow's with 5% dextrose**
- How much fluid are you going to give and over what time frame?
  - **15 ml x 6.5 kg = ~100 ml over 1 hr**

## Scenario 2

- After 1 hour you reassess
  - The child is more awake
  - The hands are warmer
  - The CRT is 2 seconds
  - The radial pulse is palpable
  - RR 40, HR 150
- What is your next plan?
  - **Start oral fluids / F75 10 ml x 6.5 kg = 65 ml every hr for 10 hrs**



# Scenario 3

- 12 kg boy
- Needs IV maintenance fluids as NBM
- Set up the IV fluids
- Run the fluids at the correct rate
  - **Total of 1100 ml in 24 hours**
  - **$\approx 46 \text{ ml / hr}$**
  - **$46 \text{ ml} \times 60 = 2760 \text{ drops per hour}$**
  - **Which is 2760 drops per 60 minutes**
  - **So the IVI should be dripping at 46 drops per minute**
  - **This is 1 drop every 1.3 seconds**
- Label the fluid appropriately

# Thank you

