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Citation: Rosengarten, Leah (2019) How to manage the care of the dehydrated child. British Journal of Nursing, 28 (21). pp. 1366-1368. ISSN 0966-0461

Published by: Mark Allen Publishing

URL: <https://doi.org/10.12968/bjon.2019.28.21.1366> <<https://doi.org/10.12968/bjon.2019.28.21.1366>>

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## How to manage the care of the dehydrated child

### Abstract

Caring for a child with dehydration is a common occurrence in acute paediatric settings and as such the ability to recognise and treat this condition is a vital skill for nurses who care for children. Failure to appropriately recognise dehydration when it occurs can lead to fast deterioration of the child's clinical condition and can be fatal. Children are more likely to become dehydrated than adults and often deteriorate quicker than adults when unwell so the nurse caring for this patient group is required to respond with speed and skill to provide the appropriate care at the right time.

### Dehydration in children how and why

The NHS defines dehydration as the body losing more fluid than it is taking in (2017). Dehydration in children is usually caused by diarrhoea and vomiting or systemic infection but can also be a result of a number of other underlying conditions (Forman et al, 2012). Nurses caring for children are likely to be required to treat numerous cases of dehydration throughout their careers as febrile illnesses and diarrhoea with or without vomiting are the second and third most commonly presented medical problems to Accident and Emergency Departments for children aged 0-15 years (Sands et al, 2012).

Inadequate treatment of dehydration in children can lead to acidosis, electrolyte disturbances, kidney damage or hypovolaemic shock (Pringle et al, 2011; Mecham, 2006). Hypovolaemic shock is the clinical state in which the loss of blood volume causes inadequate tissue perfusion in the body, it is the most common cause of shock in children and can be fatal if not detected early and treated appropriately (Nolan and Pullinger, 2014; Mecham, 2006).

Children are more likely to experience dehydration than adults because water constitutes a greater proportion of bodyweight in children than in adults (World Health Organization (WHO), 2009). Furthermore, the younger the child, the poorer the ability of their kidneys to conserve water, and children use more water over the course of 24 hours than adults due to their higher metabolic rates (WHO, 2009).

This 'at a glance' article will aid nurses caring for children with dehydration in recognising and treating dehydrated children.

### Recognition

Recognition of the dehydrated child is a key skill for nurses caring for this patient group. Assessment of all deteriorating or critically ill patients should always follow the ABCDE approach; Airway, Breathing, Circulation, Disability, Exposure (Resuscitation Council UK, 2019).

During ABCDE assessment, if the nurse suspects dehydration, they should consider whether the child; appears unwell, has altered responsiveness (for example is irritable or lethargic), has decreased urine output, has pale or mottled skin or has cold extremities (NICE, 2009). Recognition of the seriousness of the condition of a child with dehydration can sometimes be difficult on initial presentation as the child may at first appear to be quietly sleeping or undisturbed by assessment. Caution should be taken in these circumstances to ensure that the sleep is not a symptom of altered responsiveness and that the child receives a full thorough assessment.

Figure 1 displays the clinical features of dehydration and hypovolaemic shock which can be used to aid in the assessment and differentiation of these conditions (NICE, 2015).

Figure 1 (NICE, 2015).

No clinically detectable dehydration	Clinical dehydration	Hypovolaemic shock
Alert and responsive	Altered responsiveness (irritable, lethargic etc.)	Decreased level of consciousness
Appears well	Appears to be unwell or deteriorating	
Eyes not sunken	Sunken eyes	
Moist mucous membranes (except after drinking)	Dry mucous membranes (consider excluding children who are 'mouth breathers')	
Normal blood pressure	Normal blood pressure	Hypotension (decompensated shock)
Normal breathing pattern	Tachypnoea	Tachypnoea
Normal capillary refill time	Normal capillary refill time	Prolonged capillary refill time
Normal heart rate	Tachycardia	Tachycardia
Normal peripheral pulses	Normal peripheral pulses	Weak peripheral pulses
Normal skin turgor	Reduced skin turgor	
Normal urine output	Decreased urine output	
Skin colour unchanged	Skin colour unchanged	Pale or mottled skin
Warm extremities	Warm extremities	Cold extremities

The clinical features in red are 'red flags' for medical professionals and should prompt an escalation in treatment (NICE, 2015). When assessing dehydration it is important to note that the severity of the dehydration can be judged by an increased number of or an escalation in any of the clinical features (NICE, 2015).

#### Clinical considerations

A child or baby who 'appears unwell' due to dehydration may present with any of the following;

- Increased irritability, lethargy or a change in normal behaviour
- Sunken eyes or dark circles under the eyes
- Dry mouth and lips
- Low blood pressure
- High heart rate
- Weak peripheral pulses
- Reduced elasticity of skin
- Capillary refill time of more than 2 seconds
- Urine output less than 1ml per hour in children or 2mls per hour in infants
- Loss of skin colour or mottled skin
- Cooler than usual extremities

#### Clinical considerations

For nurses caring for children, it is important to recognise that the following groups are at increased risk of dehydration:

- Children younger than 1 year, particularly those younger than 6 months
- Infants who were of low birth weight
- Children who have had more than five episodes of diarrhoea in the previous 24 hours
- Children who have vomited more than twice in the past 24 hours

- Children who have not been offered or have not been able to tolerate supplementary fluids to maintain hydration (see figure 2)
- Infants who have stopped breast or bottle feeding during the illness
- Children with signs of malnutrition (NICE, 2009)

## Treatment

Treatment for dehydration in children is escalated according to the severity of the dehydration and may occur in one of the three following ways (NICE, 2015).

### *Clinical Consideration*

Any patient who requires treatment for dehydration should be monitored through the use of a fluid balance chart. This chart should include hourly documentation of the patients input and output with 12 hourly fluid balance subtotals and 24 hourly totals (NICE, 2015). Weight should be measured before treatment and every 24 hours, with any difference between the two calculated (NICE, 2015).

### Oral rehydration

Oral rehydration is advocated for use in all children showing signs of clinical dehydration as per Figure 1 (NICE, 2009). IV rehydration may be indicated as an alternative to oral rehydration in children who; have 'red flag' symptoms; are showing signs of clinical deterioration or who cannot tolerate oral rehydration (NICE, 2009; NICE, 2015).

In children who can tolerate oral rehydration, the use of an Oral Rehydration Solution (ORS) 240-250 mOsm/l is recommended (NICE, 2009). Children should be given 50ml/kg of ORS over 4 hours followed by ORS for maintenance in small, frequent volumes until reassessment shows an improvement in the signs of clinical deterioration (NICE, 2009). For example a 10kg child should be given an initial 500mls of ORS over 4 hours, then 42mls/hour of maintenance ORS and then reassessed hourly to ensure further deterioration is not missed.

### *Clinical Consideration*

The Oral Rehydration Solutions which meet the above recommended 240-250mOsm/l are Dioralyte, Dioralyte Relief, Electrolade and Rapolyte (NICE, 2009).

If children refuse to drink the ORS solution, supplementation of the ORS with normal fluids could be considered including milk or water but not fruit juice or carbonated drinks (NICE, 2009). Insertion of a nasogastric tube may also be considered for children who cannot tolerate the taste of the ORS as an alternative to the need for cannulation and IV fluids (NICE, 2009).

### Maintenance Fluids

For children who have any red flag symptoms (figure 1) or children who persistently vomit the ORS then IV rehydration is recommended (NICE, 2009). It is advised that IV rehydration should initially use isotonic crystalloids that contain sodium in the range of 131-154mmol/litre (NICE, 2009).

Routine maintenance IV fluid rates for children and young people can be calculated using the Holliday–Segar formula in Figure 2. It is important to be aware that over a 24-hour period, males rarely need more than 2500ml of fluid and females rarely need more than 2000 ml of fluid (NICE, 2009). When seeking to use IV fluids for rehydration in children, it is necessary to calculate their routine maintenance requirements, then add 50ml/kg to this total and deliver this volume over 24 hours (NICE, 2009). For example, a 15kg child would receive 1250mls maintenance volume then 750mls extra to counteract their dehydration so a total of 2000mls over 24 hours.

Figure 2. Holliday-Segar formula to calculate route maintenance fluids

- 100 ml/kg/day for the first 10 kg of weight
- 50 ml/kg/day for the next 10 kg
- And then 20 ml/kg/day for the remaining weight over 20 kg

Figure 3. Routine maintenance formula for term neonates (NICE, 2015)

- From birth to day 1: 50–60 ml/kg/day.
- Day 2: 70–80 ml/kg/day.
- Day 3: 80–100 ml/kg/day.
- Day 4: 100–120 ml/kg/day.
- Days 5–28: 120–150 ml/kg/day.

Children who require rehydration with IV hydration should have their urea, electrolytes and blood glucose monitored at the start of the hydration and every 24 hours thereafter (NICE, 2009). This monitoring will dictate whether the child requires an increase or decrease in fluid volumes or any additional treatment for altered electrolyte or glucose levels, **and therefore more frequent monitoring**. Following IV rehydration, the child's clinical condition should be reassessed and ORS or normal food and drink slowly introduced as tolerated (NICE, 2009).

#### *Clinical consideration*

The isotonic crystalloid with sodium in the range of 131-154mmol/l fluid of choice is usually sodium chloride 0.9% with glucose 5% but this may vary (NICE, 2009).

#### *Fluid resuscitation*

IV fluid resuscitation should be delivered in children who show signs of **hypovolemic** shock or children with red flag symptoms who show signs of clinical deterioration as per figure 1 (NICE, 2015).

Children and young people who require IV fluid resuscitation should be given 20ml/kg of glucose free crystalloids that contain sodium in the range of 131-154mmol/litre over less than 10 minutes (NICE, 2015; Moritz and Ayus, 2011). The most commonly used glucose free crystalloid is sodium chloride 0.9% but other solutions such as Hartmann's solution may be used (NICE, 2015).

#### *Clinical consideration*

The administration of IV fluids for fluid resuscitation over less than 10 minutes is usually referred to as a fluid bolus and delivered as quickly as the venous access device will allow.

It is important to consider whether the child has any pre-existing conditions such as cardiac or kidney disease as this may require reduced fluid volumes for resuscitation (NICE, 2015).

Once a child has received IV fluid resuscitation of 20ml/kg, their condition should be reassessed for clinical improvement, as they may require further fluid boluses (NICE, 2015). Children who no longer show clinical indication for the need for further fluid boluses should commence on maintenance fluids (calculated as per figure 2) with 100ml/kg extra volume added and continue to be monitored (NICE, 2009). Children who have not shown improvement in their condition, may have the fluid bolus repeated once or twice as required but it is vital to note that if 40-60 ml/kg or more IV fluid resuscitation is required then expert advice is needed to assess the child and for continuing fluid management advice (for example the Paediatric Intensive Care team) (NICE, 2015).

### *Clinical considerations*

In some practice settings, body surface area may be used to calculate fluid maintenance requirements for children. In this instance the calculation can occur through estimating insensible losses within the range of 300-400ml/m<sup>2</sup>/24 hours plus urine output (NICE, 2009).

### Summary

It is common for young children to show a decrease in normal fluid and dietary input when they are feeling unwell. Whilst this decrease in oral intake does not dictate that dehydration will always follow, this is a risk which should be considered in any children presenting to healthcare settings.

Recognition of dehydration in children is a necessary skill for nurses. Treatment of dehydration in children is tiered according to the severity of the dehydration and will consist of either oral rehydration, IV rehydration or IV fluid resuscitation. **Infants, children and young adults with conditions such as diabetic ketoacidosis or cardiac conditions will require altered management to that which this article outlines and management of these conditions should follow clinical guidance.** Early recognition of dehydration and effective treatment of the condition will prevent further clinical deterioration or additional complications.

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