

# Pediatric Dehydration and Oral Rehydration

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- Volume Depletion (hypovolemia): refers to any condition in which the effective circulating volume is reduced. It can be produced by salt and water loss (as with vomiting, diarrhea, diuretics, bleeding, or third space sequestration) or by water loss alone (as with insensible water losses or diabetes insipidus).
- Dehydration -refers to water loss alone. The clinical manifestation of dehydration is often hypernatremia. The elevation in serum sodium concentration, and therefore serum osmolality, pulls water out of the cells into the extracellular fluid.

# Degree of Dehydration

- Volume depletion is most objectively measured as a change in weight from baseline. Acute loss of body weight reflects the loss of fluid, not lean body mass; thus, a 2 kg weight loss should reflect the loss of two liters of fluid.
- However, a previous recent weight is often not available. As a result, a number of findings on physical examination coupled with the pertinent clinical history are used to help assess the severity of hypovolemia. These findings include:

- History of increased thirst, decreased urine output, lethargy, or irritability.
- Pulse and respiratory rate – Pulse and respiratory rates increase with increasing volume depletion.
- Blood pressure – Low blood pressure is seen in children with severe hypovolemia and in some cases of moderate hypovolemia.
- Skin turgor – If the skin on the thigh, calf, or forearm is pinched in normal subjects, it will immediately return to its normally flat state when the pinch is released. This elastic property, called turgor, is partially dependent upon the interstitial volume of the skin and subcutaneous tissue. Interstitial fluid loss leads to diminished skin turgor, and the skin flattens more slowly after the pinch is released.

## Physical findings of volume depletion in infants and children

Finding	Mild (3 to 5%)	Moderate (6 to 9%)	Severe (≥10%)
Pulse	Full, normal rate	Rapid	Rapid and weak OR absent
Systolic pressure	Normal	Normal to low	Low
Respirations	Normal	Deep, rate may be increased	Deep, tachypnea OR decreased to absent
Buccal mucosa	Tacky or slightly dry	Dry	Parched
Anterior fontanelle	Normal	Sunken	Markedly sunken
Eyes	Normal	Sunken	Markedly sunken
Skin turgor	Normal	Reduced	Tenting
Skin	Normal	Cool	Cool, mottled, acrocyanosis
Urine output	Normal or mildly reduced	Markedly reduced	Anuria
Systemic signs	Increased thirst	Listlessness, irritability	Grunting, lethargy, coma

- In a systematic review of the literature, the most useful clinical signs that predicted 5 percent hypovolemia in children were delayed capillary refill time, reduced skin turgor, and deep respirations with or without an increase in absolute respiratory rate.
- However, a combination of signs and symptoms appear to be better than an individual finding at predicting hypovolemia. Clinical scales have been developed in the hopes of improving the assessment of dehydration, such as the four-item Clinical Dehydration and Gorelick scales.

**Figure 1: Dehydration Assessment Scales<sup>1</sup>**

<i>WHO scale for dehydration, 1 month–5 years old</i>			
	A	B	C
General condition	Well, alert	Restless, irritable	Lethargic or unconscious
Eyes	Normal	Sunken	Sunken
Thirst	Drinks normally, not thirsty	Thirsty, drinks eagerly	Drinks poorly or not able to drink
Skin pinch	Goes back quickly	Goes back slowly	Goes back very slowly

<i>Gorelick scale for dehydration, 1 month–5 years old</i>		
	No or minimal dehydration	Moderate to severe dehydration
General appearance	Alert	Restless, lethargic, unconscious
Capillary refill	Normal	Prolonged or minimal
Tears	Present	Absent
Mucous membranes	Moist	Dry to very dry
Eyes	Normal	Sunken to deeply sunken
Breathing	Present	Deep or deep and rapid
Quality of pulses	Normal	Thready, weak or impalpable
Skin elasticity	Instant recoil	Slow recoil (greater than 2 secs.)
Heart rate	Normal	Tachycardia
Urine output	Normal	Reduced; not passed in many hours

<i>Clinical Dehydration Scale, 1 month–3 years old</i>			
	0	1	2
General appearance	Normal	Thirsty, restless or lethargic, but irritable when touched	Drowsy, limp, cold, sweaty and/or comatose
Eyes	Normal	Slightly sunken	Very sunken
Mucous membranes	Moist	Sticky	Dry
Tears	Tears	Decreased tears	Absent tears

# Gorelick Score

- One point for each:
- Cap refill greater than 2 seconds
- Absence of tears
- Dry Mucus Membranes
- Ill general appearance

Score	% dehydrated	Degree of dehydration
<1	<5%	Mild
2	5-10%	Mod
>3	>10%	Severe

- Laboratory testing often reveals normal electrolytes and acid base balance in children with mild hypovolemia. As a result, measurement of serum electrolytes is typically limited to children with moderate to severe hypovolemia who require intravenous fluid repletion. These children are more severely volume depleted and are, therefore, at greater risk for electrolyte and acid-base abnormalities. Blood glucose should be measured in hypovolemic children who present with lethargy as hypoglycemia can be a concomitant finding.

- Laboratory testing is less useful for assessing the degree of volume depletion.

- ORT is based on the preserved co-transport of glucose and sodium in patients with diarrhea due to gastroenteritis. Studies from the 1960s showed an ORS formulation that is isotonic with equimolar concentrations of glucose and sodium is as effective as IV hydration in treating hypovolemia in patients with cholera. Subsequent formulations are based on this initial formulation.

- The following properties for ORS are recommended by the World Health Organization (WHO).
- Total osmolality between 200 and 310 mOsm/L
- Equimolar concentrations of glucose and sodium
- Glucose concentration <20 g/L (111 mmol/L)
- Sodium concentration between 60 and 90 mEq/L
- Potassium concentration between 15 and 25 mEq/L
- Citrate concentration between 8 and 12 mmol/L
- Chloride concentration between 50 and 80 mEq/L

## Composition of oral rehydration solutions (ORS) and commonly used beverages

	Carbohydrate (g/L)	mEq/L			Osmolarity (mOSM/kg H <sub>2</sub> O)
		Sodium	Potassium	Base (HCO <sub>3</sub> <sup>-</sup> )	
<b>Oral rehydration solutions</b>					
CeraLyte	40	70	20	10	235
Enfalyte	30	50	25	30	200
Pedialyte	25	45	20	30	250
Rehydralyte	25	75	20	30	310
WHO (1975)	20	90	30	30	310
WHO (2002)	13.5	75	20	30	245
<b>Commonly Used Beverages (not appropriate for repletion therapy)</b>					
Apple juice	100 to 150	3	20	0	700
Chicken broth	0	250	5	0	450
Colas	100 to 150	2	0.1	13	550
Gatorade	45	20	3	3	330
Ginger Ale	90	3.5	0.1	3.6	565
Tea	0	0	0	0	5

- Fluids with a molar ratio of glucose in excess of sodium (eg, fruit juices, soda, or sports beverages) will increase diarrheal losses because the higher unabsorbed glucose load will increase the osmolality in the lumen, resulting in decreased water absorption.
- Fluids with excess sodium concentration compared with glucose (eg, chicken broth) will increase diarrheal losses, as there is no organic solute for facilitated transport of sodium. Fluids with high sodium concentration also may result in hypernatremia.

# Setting

- Home – If care providers are properly instructed to recognize the appropriate clinical signs of dehydration, ORT can be given at home, leading to fewer outpatient and emergency department (ED) visits for hypovolemia. A standard commercially prepared and premixed oral rehydration solution (ORS) is recommended for use in nonmedical settings because major errors can occur when homemade solutions using sugar and sodium are administered. Care providers need to recognize signs of illness or treatment failure requiring medical attention.

- Medically supervised setting – Prior to initiation of ORT, the child who presents to a medical clinician's office, the ED, or an urgent care facility with diarrhea should be evaluated to determine the underlying etiology of diarrhea and whether further diagnostic testing and/or intervention is necessary.
- If there is evidence that rehydration is appropriate, ORT using a standard commercial formulation should be initiated if the patient has mild to moderate hypovolemia and there are no contraindications to enteral therapy.

- Rehydration phase – The fluid deficit is replaced quickly over three to four hours, returning the patient to a euvolemic state. ORS is administered in frequent, small amounts of fluid by spoon or syringe. A nasogastric tube can be used in the child who refuses to drink. Each aliquot given must be small enough to avoid accumulation of a large amount of fluid in the stomach that might trigger vomiting. Five mL (one teaspoon), administered every one to two minutes, allows as much as 150 to 300 mL/hour to be given. If the patient is breastfed, breastfeeding continues during this phase as well as during the maintenance phase.

- Maintenance phase – Maintenance calories and fluids are administered. Rapid realimentation begins after completion of the rehydration phase, with the goal to return the patient to an age-appropriate unrestricted diet.

- No dehydration — For patients with diarrhea but no evidence of dehydration, ORT is used to maintain hydration by replacement of stool losses. If the stool output is minimal, ORS may not be required. Regardless of stool output, age-appropriate feeding (including breastfeeding) should be continued along with supplemental fluids.

- Mild to moderate dehydration — Several experts in the field use the same management approach for patients with mild and moderate dehydration (range of 3 to 9 percent volume loss). While some individuals with lesser degrees of dehydration can be cared for at home once proper oral rehydration techniques have been taught, the care of patients with greater degrees of dehydration is best provided in a medically supervised setting.

- Repletion phase – Hydration should be restored by administering ORS at a volume of 50 to 100 mL/kg over four hours. Additional ORS is given to replace ongoing gastrointestinal losses (eg, stool or emesis). Reassessment of the patient's hydration status and replacement of ongoing losses should occur hourly.

- Maintenance phase – Once repletion is completed, feeding and fluids should be started as discussed previously. ORT is continued for ongoing gastrointestinal losses. The patient's hydration status and ongoing stool and emesis losses should be calculated, with the total hourly loss added to the amount to be given over the next hour.

- Discharge from medical setting and return to home management — Patients can be discharged from a medical setting and returned to home ORT management when the following end-points are achieved.

- A reasonable amount of ORT for the degree of dehydration has been successfully administered. Sufficient intake is reflected by normalization of vital signs, improved level of consciousness and activity, urine output (if there has been none for a prolonged period of time), and resolution of signs of dehydration. In addition, there is no evidence of intractable vomiting or ORS refusal.
- No concern for other possible illnesses that might complicate the clinical course.
- No social or logistical concerns that might prevent return evaluation, if necessary.
- Caregivers have been sufficiently educated regarding the use of ORT at home, and the criteria for return or need for further medical advice (eg, signs of dehydration).

- Contraindications to ORT — There are clinical settings when ORT should not be used. These include in children with the following conditions:
- Altered mental status with concern for aspiration
- Abdominal ileus
- Underlying disorder that limits intestinal absorption of ORT (eg, short gut, carbohydrate malabsorption)
- Severe dehydration.

- Once ORT has been initiated, intervention with IV hydration is indicated:
- If stool output continues to be excessive, and ORT is unable to adequately rehydrate the child
- If there is severe and persistent vomiting, and inadequate intake of ORS.

# Acute Childhood Vomiting & Diarrhea Pathway

## Inclusions:

- children >6 months and < 10 years with vomiting and/or diarrhea with or without accompanying nausea, fever or abdominal pain.

## Exclusions: Children with

- episodes of vomiting and/or diarrhea lasting longer than 7 days
- localized abdominal pain

- Chronic medical conditions such as diabetes, inborn errors of metabolism, immunodeficiency or those affecting major organ systems
- Signs suggested GI obstruction such as abdominal distention, bilious vomiting or absent bowel sounds.

## Assessment at Triage- including weight

### Gorelick Score\*\* 1 point for each sign listed below)

- capillary refill > 2 secs
- dry mucous membranes
- Absent tears
- ill general appearance

### Assess for shock

- vital signs – (HR, BP), LOC

VS stable and  
Gorelick score  
One or less points

VS Stable and  
Gorelick Score  
Two points

VS Stable  
Gorelick Score  
Three or four points

Abnormal VS / shock

### Maintain hydration (<5% dehydration)

- Place in waiting room until bed available
- Provide care giver with oral rehydration record + pen + offer fluids
- Encourage regular diet
- If BF continue with more frequent smaller feeds .
- If active vomiting, encourage frequent small volumes of fluids
- Encourage replacement if child vomits or has diarrhea (8ml/kg/episode)
- Repeat Gorelick Score (no need to reweigh) at discharge

### Needs Oral Rehydration (5-10% dehydration)

- ED bed as soon as possible
- VS q hour
- If active vomiting, give Ondansetron
- Oral rehydration with Pedialyte® 1cc/kg q5min target 50-100 cc/kg within 2-4 hrs
- If BF, continue along with ORS
- Document intake volume, # of episodes of V & D, & urination- hydration record
- Repeat weight & Gorelick Score qhourly x2 then q2h

### May require IV Rehydration (>10% dehydration)

\*No hypnotic fluids\*

- ED bed as soon as possible
- VS q 30 min x 2, then q hour
- IV bolus NS 20 ml/kg over 30 min
  - If can't obtain venous access, consider NG administration (ORS)
- Minimum Labs - Electrolytes, Urea, Creatinine, Glucose
  - If glucose and Na normal, start NS @ 20 ml/kg/hr and continue for 2 - 5 hrs (40 - 100 ml/kg) as needed
  - If Na <128 or >155 do not use rapid rehydration; consider consulting PICU/Nephrology before further rehydration
  - If glucose <4 use D5NS; monitor serum glucose q 1-2 hrs
- If active vomiting give ondansetron
- Document intake volume, # of episodes of V & D, & urination- hydration record
- Repeat weight & Gorelick Score qhourly x2 then q2h

### Needs Resuscitation

\*No hypnotic fluids!

- resuscitation room\*
- Nurse at bedside until patient's VS & LOC are normal
- IV bolus NS 20 ml/kg over 5 min
- Consider I.O if IV access cannot be obtained
- Accucheck
- Reassess HR, BP, CR, LOC
- Repeat bolus NS 20 ml/kg and reassess as needed
- Consider PICU consult
- Once VS & LOC normal, RLA and VS q hourly
- Minimum Labs - Electrolytes, Urea, Creatinine, Glucose, VBG/ABG, lactate, Ca
- If glucose and Na normal, start NS @ 20 ml/kg/hr and continue for 2 - 5 hrs (40 - 100 ml/kg) as needed
- If Na :5 128 or > 155 do not use rapid rehydration; consider consulting PICU/Nephrology before further rehydration
- Intake documented & output weighed and measure- nursing note
- Document urination – nursing note
- Repeat weight & Gorelick Score when stable qhourly x2 then q2h if improving

### Suggested Criteria for discharge home

- Hydration <5% BW (Gorelick score <1)
- Expect child can maintain hydration at home

### Suggested Criteria for Admission to hospital / or consult

- Continued significant vomiting and/or diarrhea
- Hypo or hypernatremia Significant social issues
- Diagnostic uncertainty
- Required resuscitation because of abnormal VS or decreased LDC
- Persistent metabolic acidosis

Ondansetron dosing per table from SOP

Ondansetron Dosing	
Weight (kg)	Dose (mg)
8-15	2
15-30	4
>30	8