



The Ins and Outs of Dehydration

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Background Information



- 1940 – oral solutions were developed
 - K⁺ replacement recognized for reducing mortality
- 1950's – IV fluid became widespread treatment for epidemics of infectious diarrhea
- 1992 CDC prepared the first national guidelines for managing childhood diarrhea
 - Rehydration
 - Maintenance
 - Nutritional therapy

- United States
 - >1.5 million outpatient visits
 - 200,000 hospitalizations
 - 300 deaths/year
 - \$1 billion/year in total costs for rotavirus alone
- Worldwide
 - Diarrhea is leading cause of morbidity and mortality
 - 1.5 billion episodes and 1.5-2.5 million deaths occur annually in children <5 years of age

Are We Making Any Progress?

- Worldwide mortality decreased
 - 1982 **5 million** deaths/year
 - 1992 **3 million** deaths/year
- Decreased mortality is attributable to worldwide campaigns to treat acute diarrhea with oral rehydration therapy



Causes of Dehydration

Diarrhea/Vomiting

- Most common reason for loss of excess water

Sweat

- Intense exercising, hot environment, fever

Diabetes

- Sugar spills into urine – water follows

Chronic renal failure

- polyuria

Burns

- Water moves into damaged skin

Inability to drink fluids

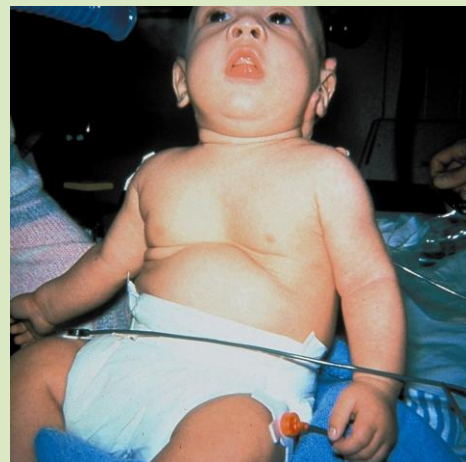


Decreased intake

- Voluntary/involuntary
- Anatomical (pharyngitis, facial dysmorphism)
- Neurological (brain tumor)
- Febrile illness

Increased Output

- Insensible loss (fever, respiratory)
- GI loss
- Renal
- Systemic (burns)



Daily Requirements

- Average daily requirements of **water**

- First year: 130-150ml/kg
- 2-4 years: 100-130 ml/kg
- 4-10 years: 70-100 ml/kg
- 10-18 years: 50-70 ml/kg

- Average daily requirements of **Sodium/Potassium**

- 1st 6 months: 120/500 mg/day
- 7-12 months 200/700 mg/day
- 1-3 years 225/1000 mg/day
- 4-8 years: 300/1400 mg/day

Categorizing Dehydration

- **Mild**
 - 3-5% fluid deficit/loss of body weight
 - Encourage use of ORT
 - Nutrition should not be restricted
- **Moderate**
 - 6-9% fluid deficit/loss of body weight
 - ORT including NG rehydration
- **Severe**
 - >10% fluid deficit/loss of body weight (shock/near shock state)
 - IV rehydration, switch to oral route once LOC normal

Dehydration Categories

- Dehydration can also be categorized in relation to Serum Na levels:
- **Hyponatremic** <130 mEq/L
- **Isonatremic** 130-150 mEq/L
- **Hypernatremic** >150mEq/L

Lab test results **DO NOT** predict dehydration severity.

Indications for Medical Evaluation

**Young age
<6 months or weight <8 kg**

History of premature birth

**Chronic medical conditions
or concurrent illness**

Fever $>38^{\circ}\text{C}$ <3 months
 $>39^{\circ}\text{C}$ 3-36 months

Visible blood in stool

High output (urine or
diarrhea)

Persistent vomiting

Caregiver's report of signs
consistent with
dehydration (decreased
tears, decreased UO, dry
mucous membranes)

Change in mental status
(irritability, apathy,
lethargy)

Suboptimal response to
oral rehydration

Caregiver inability to
administer oral rehydration

12 Clinical symptoms/manifestations of dehydration:

1. Mental status
2. Thirst
3. Heart rate
4. Quality of pulses
5. Breathing
6. Eyes
7. Tears
8. Mouth/tongue (mucous membranes)
9. Skin fold
10. Capillary refill
11. Extremities
12. Urine output



Minimal or no dehydration ($<3\%$ loss of body weight)

Symptom	Minimal or no dehydration ($<3\%$)
Mental status	Well, alert
Thirst	Drinks normally, might refuse liquids
Heart rate	Normal
Quality of pulses	Normal
Breathing	Normal
Eyes	Normal
Tears	Present
Mouth and tongue	Moist
Skin fold	Instant recoil
Capillary refill	Normal
Extremities	Warm
Urine output	Normal to decreased

Mild to Moderate dehydration (3-9% loss of body weight)

Symptom	Mild to Moderate dehydration
Mental status	Normal, fatigues or restless, irritable
Thirst	Thirsty, eager to drink
Heart rate	Normal to increased
Quality of pulses	Normal to decreased
Breathing	Normal; fast
Eyes	Slightly sunken
Tears	Decreased
Mouth and tongue	Dry
Skin fold	Recoil in <2 seconds
Capillary refill	Prolonged
Extremities	Cool
Urine output	Decreased

Severe dehydration (>9% loss of body weight)

Symptom	Severe Dehydration
Mental status	Apathetic, lethargic, unconscious
Thirst	Drinks poorly; unable to drink
Heart rate	Tachycardia, with bradycardia in most severe cases
Quality of pulses	Weak, thready, or impalpable
Breathing	Deep
Eyes	Deeply sunken
Tears	Absent
Mouth and tongue	Parched
Skin fold	Recoil >2 seconds
Capillary refill	Prolonged; minimal
Extremities	Cold; mottled, cyanotic
Urine output	Minimal

Treatment Options

ORT

Reverse technology transfer

Protocols originally implemented in developing countries which changed the standard of care in industrialized countries

Can any liquid be used as ORT?

Ondansetron prior to ORT

- 6 mo - 4 years 0.15 mg/kg
- 4-11 years of age 4 mg
- >11 years of age 8 mg



10 Minute Rule

- Oral Rehydration Guidelines

Weight (kg)	10-minute volume (mls)
5	7
6	8
7	9
8	11
9	12
10	14
12	15
14	17
16	19
18	20
20	22
25	24
30	27
35	30
40	32
45	35
50	38



IF ORT Fails

- NG
- IV fluids



Barriers to Both

ORT

- Ingrained use of IV therapy
- Reduced appeal of a technologically simple solution
- 30% of practicing pediatricians withhold ORT for children with vomiting or moderate dehydration
- Practice of continued feeding during diarrhea episodes has been difficult to establish as soc.
- Time consuming in a “hot and now” world

IV Therapy

- Invasive
- Expensive
- Risk of infection/complications
- Time consuming
- Often requires transfer to ED or overnight admission

Two Phases of Treatment



Rehydration phase

- Water and electrolytes are administered as ORT/IV to replace existing losses

Maintenance phase

- Includes both replacement of ongoing fluid and electrolyte losses and adequate dietary intake

Types of IV fluid

Initial Resuscitation: isotonic crystalloid (NS/LR)

IV Fluid (meq/L)	Na	Cl	K	Glu	Bicarb
D5W	0	0	0	50g/L	0
D5W ¼ NS	34	34	0	50g/L	0
D5W ½ NS	77	77	0	50g/L	0
LR	130	109	4	0	28
D5LR	130	109	4	50g/L	28
D5 0.9% NS	154	154	0	50g/L	0

↓ Na ↓ Volume

Signs and symptoms depend on Na levels and rate of falling

- CNS changes
- Nausea, vomiting, HA, MS changes
- Weakness/cramps

Treatment

20 ml/kg bolus, repeat if needed

Maintenance for ongoing loss

↑ Na ↓ Volume

Signs and symptoms result from cellular dehydration

- MS changes, weakness, ataxia, tremors

Treatment

20 ml/kg bolus, repeat if needed

maintenance D5 ½ and ¼
come into play
dialysis

Risk Factors:

- Prematurity
- Young maternal age
- African American race
- Rural residence

When is hospitalization indicated?

- Severe dehydration
- Social or logistical concerns that might prevent return evaluation
- Factors such as age, unusual irritability or drowsiness, uncertainty of diagnosis, progression of symptoms

7 principles of treatment



1. Oral rehydration solutions (ORT) should be used for rehydration
2. Oral rehydration should be performed “rapidly” – within 3-4 hours
3. Age-appropriate, unrestricted diet is recommended as soon as dehydration is corrected
4. Nursing should continue for breastfed infants
5. If formula-fed, diluted formula or special formula is not recommended
6. Additional ORT should be administered for ongoing losses through diarrhea
7. No unnecessary laboratory tests or medications should be administered

What's on the Horizon?

BRAT diet is out

unnecessarily restrictive and provides suboptimal nutrition

Severe malnutrition can occur if prolonged gut rest or clear fluids are prescribed

Zinc

trials are supporting zinc supplements as an effective agent in treating and preventing diarrheal disease

Probiotics

live microorganisms in fermented foods help establish improved balance in intestinal microflora

Prebiotics

complex carbohydrates used to preferentially stimulate growth of health-promoting intestinal flora (whole grains, barley, flax)

Case Studies



General appearance?

looks good/looks bad

Quick visual assessment?

12 clinical signs

Severity of dehydration?

mild/moderate/severe

Plan?

ORT/NG/IV

Fluid type/amount?

Case Study



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Sent from clinic by private vehicle

HR 178, RR 28, BP 86/56 T 38.1

Vomited bottle of pedialyte at clinic, 4
episodes of diarrhea in clinic

2 older siblings also home sick with similar
symptoms earlier this week

Case Studies



General appearance?

looks good/looks bad

Quick visual assessment?

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Case Study



Questions?

