Maintenance fluids: compensate for ongoing losses

Losses

- Sensible losses (urine & feces)
  - Neonates: 2-4 mL/kg/h
  - Infants & child: 1-2 mL/kg/h
  - Teens & adults: 0.5-1 mL/kg/h
- Insensible losses (respiration, perspiration)
- ↑ metabolic rate → ↑ caloric expenditure → ↑fluid requirements

Hypoglycemia

- Decreased glycogen stores
- Decreased body fat
- High metabolic needs

Maintenance fluid requirement calculation

	Holiday-Segar	Estimate
First 10 kg	100 mL/kg/day	4 mL/kg/h
Second 10 kg	50 mL/kg/day	2 mL/kg/h
Every kg thereafter	20 mL/kg/day	1 mL/kg/h

Maintenance electrolytes

- Sodium: 3 mmok/kg/day
  - Sick children may need more (↑ADH secretion)
- Potassium: 2 mmol/kg/day
- Chloride: 5 mmol/kg/day (usually from NaCl & KCl)

Requirement calculation example: 3 yo who weighs 15 kg
Maintenance fluid: 40 mL/h + 10 mL/h = 50 mL/h
K = 2 mmol/kg/day x 15 kg = 30 mmol/day
50 mL/h x 24 h/day = 1200 mL/day
30 mmol/day KCl/ 1200mL x 1000 mL/l = 25 mmol/L
= D5NS + KCl 25 mmol/L at 50 mL/h

Deficit fluids: fluids lost prior to medical care (vomiting/diarrhea); inadequate fluid intake over period of time; trauma with blood loss

Assessment

Sign	Mild	Mod	Severe
Weight loss %	3-5	6-9	>10
Behavior	Normal	Normal to listless	Normal to lethargic or comatose
Thirst	Slight	Moderate	Intense
Mucus membranes	Maybe normal	Dry	Dry
Anterior fontanelle	Flat	Sunken	Sunken
Eyes	Normal	Sunken	Deeply sunken
Skin turgor	Normal	Decreased	Decreased
Blood pressure	Normal	Normal	Normal to decreased
Heart rate	Normal rate	Increased	Increased
Urine output	Decreased	Markedly decreased	Anuria

Assessment < 4 yo

	0	1	2
General	Normal	Thirsty, restless, lethargic, irritable	Drowsy, limp, cold, sweaty +/- comatose
Eyes	Normal	Slightly sunken	Very sunken
Tongue	Moist	Sticky	Dry
Tears	Tears	Decreased	Absent
0 = no dehydration; 1-4 = some; 5-8 = mod-severe dehydration			

Degree of dehydration: 1 kg weight loss = 1 L fluid loss
Pre-illness weight – illness weight x 100
Pre-illness weight

Degree of dehydration: should always be compared to clinical signs (1% = 1 mL/kg)

	Mild	Mod	Severe
Older	3%	6%	9%
Infant	5%	10%	15%

Type of dehydration: determined by serum Na

- Isonatermic: Na 135 – 145 mmol/L
- Hyponatremic: Na < 135 mmol/L
- Hypernatremic: Na > 145 mmol/L

Replacement fluids: fluids given to meet ongoing losses due to medical treatment

Patients with: chest tubes, uncontrolled vomiting, diarrhea, external CSF shunts

= maintenance + replacement of losses

Monitoring

- Oral intake
- Weight daily
- Urine output
- Urine specific gravity
- S/S of dehydration
- Serum electrolytes: at least OD on IV fluids

Mild dehydration management: oral rehydration therapy

50 mL/kg over 4 years

Moderate dehydration management: oral rehydration fluid

100 mL/kg over 4 hours

Severe dehydration: emergency

Isotonic or hypotonic: IV isotonic fluids 0.9% NaCl (NS), D5NS, D10NS

Phase I	20 mL/kg may repeat
Phase II (first 8 h)	1/2 remaining deficit + 1/3 daily maintenance
Phase III (first 16h)	1/2 remaining deficit + 2/3 daily maintenance

Hypernatremia

IV therapy: hypotonic fluid (D5-1/2NS)
→ deficit fluid volume + maintenance fluid volume
→ total amount infused over 48 h

- Prevents osmotic fluid shifts (cerebral edema, seizures)
- Serum sodium max increase 10 mmol/L per day

Severe hyponatremia or **clinical CNS signs of hyponatremia** (seizures, lethargy, coma)

IV therapy: 3% NaCl

Same process as adults