

Simulation Scenario:

In-text Chapter 25: Fluid, Electrolytes, and Nutrition;
Chapter 26: Gastrointestinal Disorders
Acute Gastroenteritis and Dehydration

I. Scenario Objectives

During the scenario, the health care provider (HCP) will be able to

1. Recognize the neonate with 10% dehydration and initiate appropriate therapy.
2. Perform a comprehensive history and physical examination.
3. Identify pertinent differential diagnoses.
4. Outline the plan of care, including diagnostic studies, therapeutic management, and consultation.
5. Perform serial physical examinations to assess for management effectiveness or illness progression.
6. Effectively communicate a plan of care to the family and health care team.

II. Simulation Milieu

An 18-day-old carried into the emergency department

III. Simulator, Equipment, and Participant Requirements

1. Simulation center setup
 - Pediatric emergency department
2. Manikin setup
 - Infant simulator
3. Equipment
 - Cardiorespiratory monitor and blood pressure equipment
 - Pulse oximetry
 - Emergency bedside equipment
 - Oxygen
 - Self-inflating bag
 - Face mask
 - Suction equipment
 - Isolation equipment
 - Hand sanitizer
 - Gloves
 - Medications

- Normal saline (NS) infusion
 - Intravenous (IV) infusions per institutional protocol
 - Peripheral IV catheter insertion supplies
 - IV equipment: tubing, pump
 - Venipuncture supplies for laboratory analysis
 - Supplies to obtain stool culture and urinalysis
4. Participants
- HCP team
 - Patient's family

IV. Expected Duration of Simulation Exercise

30 minutes

V. Description of the Scenario

An 18-day-old arrives who was referred to the emergency department by the primary care provider (PCP). The patient was seen this morning due to a 4-day history of watery diarrhea and symptoms of increased sleepiness and decreased oral intake.

VI. Primary Survey: Objective Data

Minutes 0–5

A sleeping infant lying in the caregiver's arms awakens and cries with examination but is easily consolable. The HCP introduces himself or herself to the patient's family and begins to perform a general assessment. The patient's weight is 3.3 kg.

Airway

Nasopharynx and oropharynx patent. No nasal congestion or rhinorrhea.

Breathing

RR 56. Chest symmetrical without deformities; equal rise and fall. Bilateral breath sounds clear in all lung fields with good aeration; no wheezing, crackles, or rhonchi noted. No retractions or nasal flaring. Oxygen saturation 99% on room air.

Circulation

HR 182 bpm; no murmurs, rubs, or gallops. Hyperdynamic precordium. BP 62/38 mmHg. Bilateral radial, femoral, and dorsalis pedis pulses +1; capillary refill time

(CRT) 3 seconds. Skin warm, pink, and dry with tented skin turgor. Dry mucous membranes; dry lips without fissures. Anterior fontanel flat.

Disability

Glasgow Coma Scale (GCS) 13 (eye: 3; verbal: 4; movement: 6) with pupils equally round, briskly reactive to light (PERRL). Normotonic with normal muscle bulk. Normal Moro, palmar grasp, sucking, and plantar reflexes.

Exposure

Axillary (or rectal) temperature 36.9°C (98.4°F). Abdomen is soft, nondistended, and nontender. No rashes or lesions present.

Elicit AMPLE History

A: allergies; M: medications; P: past medical history; L: last meal; E: events leading to presentation

A: No allergies.

M: No medications.

P: No hospitalizations.

L: Attempted to breastfeed this morning but patient refuses the breast.

E: As per above. Watery diarrhea with every diaper for the past 4 days. Increased sleepiness and decreased oral intake; no emesis or fever.

Or Elicit CIAMPEDS History

C: chief complaint; I: immunizations/infectious exposures; A: allergies; M: medications or over-the-counter products; P: past medical history/caregiver perception; E: events surrounding illness/injury; D: diet/diapers—last output of urine and stool; S: symptoms associated with the illness/injury

Expected Impression/Differential Diagnosis

1. Dehydration and percentage
 - Isonatremic
 - Hyponatremic
 - Hypernatremic
2. Gastroenteritis
 - Viral
 - Bacterial
3. Viral gastritis
4. Milk protein allergy

Expected Plan/Transition

Minutes 5–10

The HCP should recognize that the patient is moderately dehydrated (10%) and unable to take in oral fluids; the HCP should state the most pertinent differential diagnoses to determine the etiology of the dehydration.

Diagnostic Studies

- Rapid bedside glucose
- Consider metabolic panel (electrolytes, creatinine, BUN, calcium, magnesium, phosphate, liver function tests)
- Consider complete blood count (CBC) with differential
- Stool studies (rotavirus, guaiac)
- Consider urinalysis

Therapeutic Management

- Placement of IV catheter
- Administer a 20 mL/kg normal saline fluid bolus

Past Medical History (PMH)

Birth History

Born at 39 1/7 weeks' gestation to a G2P2 mother. The mother received prenatal care and had no complications. All prenatal labs evaluating for infection were negative. Birth weight was 3.2 kg (7 lb). Apgar scores were 8 and 9 at minutes 1 and 5 after birth. Discharged to home with mother and was breastfeeding without complications.

Chronic Medical Problems

None

Surgeries

None

Immunizations

Hepatitis B given at birth

Social History

Lives with her mother, father, 4-year-old sister, and an inside dog. Does not attend a daycare program, but her sister does.

Family History

Noncontributory

ROS

Negative for fever. Recent weight loss; her weight at the PCP's office last week was 3.7 kg (8 lb 2.5 oz). The caregiver reports the patient has been breastfeeding regularly, about every 3 hours until this morning, but is unsure of how much patient has been taking. Caregiver reports diarrhea for approximately 4 days and is unable to quantify how many wet diapers the patient has had because there has been watery diarrhea with almost every diaper. No emesis, rhinorrhea, cough, difficulty breathing, or change in color. The patient's sister had diarrhea for 2 days prior to the start of her illness.

Therapeutic Management

Minutes 10–20

- Initial laboratory studies are evaluated as available
- NS infusion continues
- Ongoing monitoring and assessment of therapeutic interventions

VII. Data Following Initial Management

Physical Examination Findings

Across-the-Room Assessment

Awake dehydrated infant lying in caregiver's arms

Airway

Nasopharynx and oropharynx are patent.

Breathing

RR 48. Breath sounds clear in all lung fields with good aeration; no wheezing, crackles, or rhonchi noted. No retractions or nasal flaring. Oxygen saturation 99% on room air.

Circulation

HR 160 bpm. Hyperdynamic precordium. BP 70/48 mmHg. Bilateral radial, femoral, and dorsalis pedis pulses +2; CRT 2 seconds. Skin warm, pink, dry with tented skin turgor. Moist buccal mucosa.

Disability

Awake, calm infant. GCS 15.

Exposure

Axillary (or rectal) temperature 36.9°C (98.4°F). Abdomen is soft, nondistended, and nontender.

Diagnostic Study Results

| | |
|-----------------------------------|---------------------------|
| Initial laboratory data | |
| Point-of-care glucose | 115 mg/dL |
| Basic metabolic panel | |
| Sodium | 138 mEq/L |
| Potassium | 4.0 mEq/L |
| Chloride | 100 mEq/L |
| Carbon dioxide (CO ₂) | 17 mEq/L |
| Blood urea nitrogen (BUN) | 25 mg/dL |
| Creatinine | 0.5 mg/dL |
| Glucose | 89 mg/dL |
| Calcium | 7.2 mg/dL |
| Magnesium | 2.1 mEq/L |
| Phosphorus | 4.8 mg/dL |
| Aspartate aminotransferase | 40 unit/L |
| Alanine aminotransferase | 37 unit/L |
| Alkaline phosphate | 146 unit/L |
| Total bilirubin | 0.4 mg/dL |
| Total protein | 5.5 gm/dL |
| Albumin | 3.0 gm/dL |
| White blood count | 6.5 × 10 ³ /μL |
| Segmented neutrophils | 45 |
| Bands | 0 |
| Lymphocytes | 51 |
| Monocytes | 4 |
| Eosinophils | 0 |
| Hemoglobin | 17.8 gm/dL |
| Hematocrit | 53.4% |
| Platelets | 211 × 10 ³ /μL |
| Rotavirus | Pending |
| Stool culture and Gram stain | Pending |
| Fecal leukocytes | Negative |

Guaiac

Negative

Describe Follow-up to Therapeutic Management/Disposition and Patient/Family Teaching

Minutes 20–30

- Delineate fluid management plan for isonatremic dehydration including
 - Calculation of repletion and maintenance requirements
 - Treatment of ongoing losses
- The HCP should recognize that management is specific to the type of dehydration:
 - Replace fluid losses over 24 hr: $\frac{1}{3}$ of maintenance + $\frac{1}{2}$ of replacement over first 8 hr
 - $\frac{2}{3}$ of maintenance + $\frac{1}{2}$ replacement over next 16 hr
- The HCP also recognizes that potassium is not added to IV fluids until after adequate urine output has been established
- Determine plan for assessment and treatment of ongoing losses:
 - Measure at least every 4–6 hr
 - Replace with solution similar to body fluid
- Communicate with the family regarding the therapeutic management plan.
- Provide ongoing monitoring and assessment of therapeutic interventions.
- Prepare for patient admission.

VII. Debriefing

Review of Objectives

During the scenario, the HCP will be able to

1. Recognize the neonate with 10% dehydration and initiate appropriate therapy.
2. Perform a comprehensive history and physical examination.
3. Identify pertinent differential diagnoses.
4. Outline the plan of care, including diagnostic studies, therapeutic management, and consultation.
5. Perform serial physical examinations to assess for management effectiveness or illness progression.
6. Effectively communicate a plan of care to the family and health care team.

Evaluation of Cognitive, Technical, and Behavioral Skills

Cognitive

1. Identification of physical examination findings and history supporting impression.
2. Discussion of isonatremic dehydration and the associated etiologies. Review positive and negative findings on physical examination and diagnostic data to support or refute the differentials.
3. Knowledge of the evidence-based therapeutic plan. Briefly discuss evidence supporting therapeutic interventions.

Technical

Skill competencies (based on HCP): physical examination, IV infusion, medication and fluid calculations.

Behavioral

1. Clear direction to the health care team
2. Developmentally appropriate care of the infant
3. Clear, compassionate communication to the family

Team Dynamics

- Closed-loop communication using the SBAR (S: situation, B: background, A: assessment, R: recommendation) technique
- Clear roles and responsibilities
- Acknowledgment of self-limitations
- Knowledge sharing
- Mutual respect

Team Leader Effectiveness

- Constructive intervention
- Reevaluation
- Summarizing
- Mutual respect

Lessons Learned

- What went well
- What did not go well

Technical/Scenario Difficulties

VIII. Simulation Flowchart for Programmer

| Time | Scenario Flow | Action |
|-----------------------------|---|--|
| <p>0–5 minutes</p> | <p>HR 182 RR 56 BP 62/38 SpO₂ 99% on RA Temp 36.9°C (98.4°F)</p> <p>Bilateral clear breath sounds.</p> <p>CRT 3 seconds; warm, pink skin; pulses +1; fontanel flat; mucous membranes dry</p> <p>PERRL Sleeping infant, awakens and cries with examination, but consolable GCS 13 (E-3, V-4, M-6)</p> | <p>HCP introduces himself or herself to the patient’s family</p> <p>Perform a primary survey of patient</p> <p>Begin to elicit a brief medical history using AMPLE/CIAMPEDS</p> |
| <p>5– 10 minutes</p> | | <p>Recognize that patient is 10% dehydrated and unable to take oral fluids</p> <p>Obtain peripheral IV access</p> <p>Administer a 20 mL/kg NS bolus</p> <p>Begin to formulate differential diagnoses</p> <p>Obtain PMH</p> |

| | | |
|----------------------|---|--|
| | | <p>Consider diagnostic studies</p> <p>Rapid bedside glucose</p> |
| 10–20 minutes | <p>HR 160</p> <p>RR 48</p> <p>BP 70/48</p> <p>SpO₂ 99% on room air</p> <p>Temp 37.0°C (98.6°F)</p> <p>CRT 2 seconds; pulses +2; fontanel flat; mucous membranes moist</p> <p>PERRL</p> <p>Awake, calm infant</p> <p>GCS 15 (E-4, V-5, M-6)</p> | <p>Diagnostic studies are evaluated as available</p> <p>NS infusion continues</p> <p>Ongoing monitoring and assessment of therapeutic interventions</p> |
| 20–30 minutes | | <p>Calculate fluid repletion and maintenance requirement and appropriate rate of replacement</p> <p>Order appropriate IV fluids based on the isonatremic dehydration calculations</p> <p>Communicate with the family and health care team regarding the therapeutic management plan</p> <p>Prepare for patient admission</p> |

Reference Calculations

Total fluid deficit (L) = pre-illness weight (kg) – illness weight (kg)

Percent dehydration = (pre-illness weight – illness weight)/pre-illness weight × 100%

Fluid/electrolyte deficit:

Fluid deficit (mL) = % dehydration × wt (kg) × 1,000 mL/kg

Na deficit (mEq) = fluid deficit (L) × proportion from ECF × Na concentration (mEq/L) in ECF

K deficit (mEq) = fluid deficit (L) × proportion from ICF × K concentration (mEq/L) in ICF

Maintenance fluids/electrolytes:

H₂O (mL) = wt × 100 mL/kg/day

Na (mEq) = maintenance × 3 mEq/100 mL

K (mEq) = maintenance × 2 mEq/100 mL

24-hour rehydration schedule:

First 8 hours: 1/3 maintenance + 1/2 deficit

Next 16 hours: 2/3 maintenance + 1/2 deficit

Example Patient

Pre-illness weight = 3.7 kg, illness weight = 3.3 kg, Na 138 mEq/L

Percent dehydration = (pre-illness weight – illness weight)/pre-illness weight × 100% = 10.8% dehydration

Administer a 20 mL/kg bolus for initial fluid resuscitation (*subtract this if administered from the deficit calculated below*)

Fluid deficit:

Fluid deficit = % dehydration × wt (kg) = 10% × 3.7 kg × 1,000 mL/kg = 370 mL

Na deficit = fluid deficit (L) × proportion from ECF × Na concentration (mEq/L) in ECF = 0.37 × 0.6 × 145 = 32.2 mEq

K deficit = fluid deficit (L) × proportion from ICF × K concentration
(mEq/L) in ICF = $0.37 \times 0.4 \times 150 = 22.2$ mEq

Maintenance fluids:

H₂O = (wt × 100 mL/kg/day) = 3.7×100 mL/kg/day = 370 mL

Na = 370 mL/day × 3mEq/100 mL = 11.1 mEq

K = 370 mL/day × 2 mEq/100 mL = 7.4 mEq

24-hour rehydration schedule

| | | H ₂ O | Na | K |
|-------------------------|-----------------|------------------|------|------|
| First 8 hours: | 1/3 maintenance | 123 | 3.7 | |
| 2.5 | | | | |
| 1/2 deficit | | 185 | 16 | 11 |
| <i>First 8 hr total</i> | | 308 | 19.7 | 13.5 |
| Next 16 hours: | 2/3 maintenance | 246 | 7.4 | 5 |
| | 1/2 deficit | 185 | 16 | 11 |
| <i>Next 16 hr total</i> | | 431 | 23.4 | 16 |

Summary: for the first 8 hours

Rate: 308 mL/8 hr = 38.5 mL/hr

Na: 19.7 mEq/0.308 L = 64 mEq

K: 13.5 mEq/0.308 L = 44 mEq

IV fluids = D₁₀W 0.45 NS at 38.5 mL/hr

IV fluids changed to: D₁₀W 0.45 NS with 40 mEq of KCL at 38.5 mL/hr

when adequate urine output is established

Summary: for the following 16 hours

Rate: 431 mL/16 hr = 27 mL/hr

Na: 23.4 mEq/.431 L = 54 mEq

K: 16 mEq/.431 L = 37 mEq

IV fluids = D₁₀W 0.45 NS with 40 mEq of KCL at 27 mL/hr