# CASE 2.2
# Nutrition | Level 2

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**1. What is the subjective and objective evidence of dehydration in this patient?**

SUBJECTIVE FINDINGS: Decreased wet diapers and lethargy

OBJECTIVE FINDINGS: Decreased blood pressure, increased heart rate, decreased weight, lethargic, sunken fontanel, eyes sunken, dry mucous membranes, delayed capillary refill and skin turgor; BUN/SCr ratio of 35

**2. Determine the severity of dehydration and devise a treatment for the patient in the case.**

The patient has moderate dehydration as the patient has lost approximately 8% of her body weight and is presenting with symptoms consistent for moderate dehydration in infants including tachycardia, low systolic blood pressure, decreased urine output, dry mucous membranes, sunken fontanel and eyes, and delayed skin turgor. The percent dehydration is determined by amount of body weight loss from before the illness to after the illness [$(7.2 - 6.6)/7.2 \times 100 = 8.3\%$]. The likely cause for the patient's dehydration is decreased oral intake and increased output with vomiting over the past week.

Treatment of dehydration is divided into emergency management and replacement management. The type of dehydration is also important in the determination of IVF to administer. In this patient, her sodium is in the normal range, which indicates isonatremic dehydration indicating the amount of sodium and water loss is approximately the same. This is the most common type of dehydration in children.

Initially, if the patient is hemodynamically unstable, the administration of an intravenous bolus is necessary, which would be considered the emergency management of the patient. A bolus of 20 mL/kg (based on the pre-illness weight, in this patient would be 144 mL over 30 minutes) of normal saline or lactated Ringer's solution should be administered immediately. The use of normal saline is an appropriate choice in this patient. If the patient remains hemodynamically unstable, an additional bolus at the same dose can be repeated until circulation is stable. If a second bolus of 20 mL/kg is ineffective, 40 mL/kg can be administered. The goal of therapy with the IVF bolus is to restore intravascular volume in order to prevent hypoperfusion and damage to the organs.

After the initial IVF bolus(es), the replacement management begins. The remaining water deficits are calculated. In this patient, the total water deficit is 598 mL. Fluid deficit (in liters) is determined by multiplying the percent dehydration times the pre-illness weight. It is also necessary to calculate the maintenance intravenous fluid (MIVF), which equals 720 mL when using the Holliday-Segar method (100 mL/kg/day for first 10 kg based on the pre-illness weight). The total amount of fluid to administer over the next 24 hours is 1,318 mL. The rate of replacement should be ½ of remaining deficit (598 mL – 144 mL administered as bolus = 454 mL divided by two is equal to 227 mL) and ⅓ MIVF (720 mL divided by three is equal to 240 mL) in the first 8 hours (227 mL + 240 mL = 467 mL over 8 hours) and the remaining over the next 16 hours (227 mL + 480 mL = 707 mL over 16 hours), respectively. The rate of infusion of normal saline should be 58.4 mL/hr × 8 hours, followed by 44.2 mL/hr × 16 hours. This should be administered until the PN arrives.

### 3. Develop an initial PN formula with the same caloric content as her current dietary intake for administration via a peripheral line.

**a. Determine the fluid requirements for the infant:** Based on the Holliday-Segar formula, the MIVF is 720 mL per day.

**b. Determine the caloric needs:** The infant receives 1,032 mL (equivalent to 35 ounces) of formula with 20 kcal/ounce, which provides 700 kcal per day. The caloric requirements for an infant between 1 to 12 months are 80 to 105 kcal/kg. This patient had been receiving approximately 97 kcal/kg, which falls into the recommended caloric intake for the patient's age.

**c. Calculate the rate of infusion:** The total volume to be infused over 24 hours is 720 mL minus the volume of the intravenous lipids (see below, total of 108 mL). Therefore, the appropriate infusion rate equals 25.5 mL/hr (612 mL over 24 hours).

**d. Calculate carbohydrate requirements:** Because the patient only has a peripheral line, the concentration of carbohydrates cannot exceed 12.5%. The patient can start on a 10% dextrose formula to determine tolerance and advanced at 5 g/kg per day. With the insertion of a central line, the dextrose concentrations can be higher. The caloric intake can be determined by calculating the total number of grams in 24 hours (612 mL of 10% solution is equal to 61.2 g). Each gram of carbohydrate provides 3.4 kcal. The total caloric intake in this patient from carbohydrates is 208 kcal in 24 hours for a 10% solution.

**e. Calculate the protein intake:** The patient is currently receiving 21.7 g of protein through her enteral nutrition (each 100 calories of formula has 3.1 g of protein). This is equal to 3 g/kg of protein, which falls into the recommended protein intake of 2 to 3 g/kg for infants. As such, it is reasonable to provide the same amount of protein in the PN. The total caloric intake in this patient from protein is 87 kcal in 24 hours.

**f. Calculate the fat intake:** The patient is currently receiving 32.9 g of fat through her enteral nutrition (each 100 cal of formula has 4.7 g of fat). This is equal to 4.6 g/kg, which exceeds the recommended range of 1 to 3 g/kg for healthy children. However, this patient may require greater fat caloric intake in her TPN to ensure adequate growth and development due to underlying health conditions (i.e., cardiac abnormalities). The overall caloric percentage obtained from fat should be calculated to ensure it does not exceed 50%. It is reasonable to decrease the total grams to 21.6 g (= 3 g/kg × 7.2 kg) to determine tolerance to the lipid emulsion. The lipid emulsion is typically infused over 12 hours through a separate line. In this patient, administration of 9 mL/hr for 12 hours equals 3 g/kg/day. The total caloric intake in this patient from fat is 216 kcal in 12 hours (21.6 g × 10 kcal/g of 20% lipid emulsion). This is less than 50% of total caloric intake (42%).

**g. Total caloric intake:** The patient is receiving 511 kcal per day from TPN, which is below her required caloric intake. Increasing her dextrose to 12.5% would provide 260 kcal from carbohydrates and