



Figure 32-1 Compartments of total body water, expressed as percentage of body weight, in an older child or adult. (From Greenbaum LA: *Pathophysiology of body fluids and fluid therapy*. In Kliegman RM, Stanton, BF, St Geme JW, et al, editors: *Nelson Textbook of Pediatrics*, 19th ed. Philadelphia, 2011, Saunders, p 212.e1.)

It include direct stimulation of the proximal tubule to increase sodium reabsorption and stimulation of the adrenal gland to increase aldosterone secretion, which increases sodium reabsorption in the distal nephron. In contrast, volume expansion stimulates the synthesis of **atrial natriuretic peptide**, which increases urinary sodium excretion.

MAINTENANCE FLUIDS

Maintenance intravenous (IV) fluids are used in children who cannot be fed enterally. Along with maintenance fluids, children may require concurrent **replacement fluids** if they have excessive **ongoing losses**, such as may occur with drainage from a nasogastric tube. In addition, if dehydration is present, the patient also needs to receive deficit replacement (see Chapter 33).

Maintenance fluids are composed of a solution of water, glucose, sodium, potassium, and chloride. This solution replaces electrolyte losses from the urine and stool, as well as water losses from the urine, stool, skin, and lungs. The glucose in maintenance fluids provides approximately 20% of the normal caloric needs of the patient. This percentage is enough to prevent the development of starvation ketoacidosis and diminishes the protein degradation that would occur if the patient received no calories.

Maintenance fluids do not provide adequate calories, protein, fat, minerals, or vitamins. Patients should not remain on

Table 32-1 Body Weight Method for Calculating Maintenance Fluid Volume and Rate

BODY WEIGHT (KG)	VOLUME PER DAY	HOURLY RATE
0–10	100 mL/kg	4 mL/kg/h
11–20	1000 mL + 50 mL/kg for each 1 kg >10 kg	40 mL/h + 2 mL/kg/h × (wt – 10)
>20	1500 mL + 20 mL/kg for each 1 kg >20 kg*	60 mL/h + 1 mL/kg/h × (wt – 20)†

*The maximum total fluid per day is normally 2400 mL.

†The maximum fluid rate is normally 100 mL/hr.

maintenance therapy indefinitely; parenteral nutrition (see Chapter 34) should be used for children who cannot be fed enterally for more than a few days.

Daily water losses are measurable (urine and stool) and not measurable (*insensible losses* from the skin and lungs). Failure to replace these losses leads to a thirsty child and, ultimately, a dehydrated child. **Table 32-1** provides a system for calculating **24-hour maintenance water** needs based on the patient's weight. Sodium and potassium are given in maintenance fluids to replace losses from urine and stool.

After calculation of water needs and electrolyte needs, children typically receive either 5% dextrose (D5) in $\frac{1}{4}$ normal saline (NS) plus 20 mEq/L of potassium chloride (KCl) or D5 in $\frac{1}{2}$ NS plus 20 mEq/L of KCl. Children weighing less than 10 kg do best with the solution containing $\frac{1}{4}$ NS (38.5 mEq/L) because of their high water needs per kilogram. In contrast, larger children and adults may receive the solution with $\frac{1}{2}$ NS (77 mEq/L). These guidelines assume that there is no disease process present that would require an adjustment in either the volume or the electrolyte composition of maintenance fluids. Children with renal insufficiency may be hyperkalemic or unable to excrete potassium and may not tolerate 20 mEq/L of KCl. In children with complicated pathophysiologic derangements, it may be necessary to adjust the electrolyte composition and rate of maintenance fluids empirically based on electrolyte measurements and assessment of fluid balance.

Chapter 33

DEHYDRATION AND REPLACEMENT THERAPY

REPLACEMENT THERAPY

There are three sources of normal water loss—the components of maintenance water (see Chapter 32): urine (60%), **insensible losses** from the skin and lungs (35%), and stool (5%) (**Table 33-1**). Sweating is not insensible and, in contrast to evaporative losses, sweat contains water and electrolytes.