Guide to Crystalloid Intravenous Fluids

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Objectives:

The learner will be able to:

- Differentiate the various types of IV fluids
- Understand the distribution of IV fluids after infusion
- Apply this knowledge to determine the optimal fluid type, rate and quantity for an individual patient

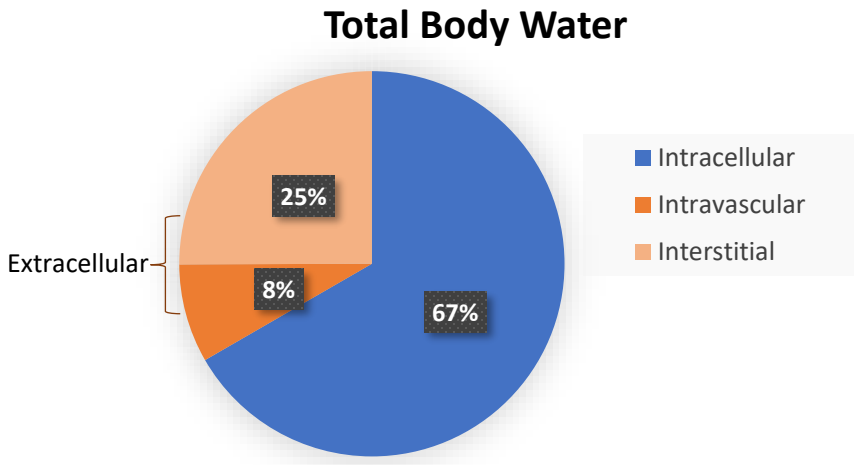
What is in IV fluids?

- Isotonic:
  - 0.9% "Normal" Saline – 154 mEq Na, 154 mEq Cl
  - Lactated Ringers – 130 mEq Na, 109 mEq Cl, small amounts of potassium, calcium, lactate
- Hypotonic
  - 0.45% "Half normal" Saline – 77 mEq Na, 77 mEq Cl
  - 5% Dextrose/Water (D5W) – 50g glucose in water
- Hypertonic
  - 3% Saline – 513meq Na, 513 mEq Cl

**Highlights:

- Normal Saline has much higher chloride than plasma
- LR is isotonic, but with lower chloride load than normal saline
- D5W contains 50g of dextrose per bag, which equals 200kCal per liter bag

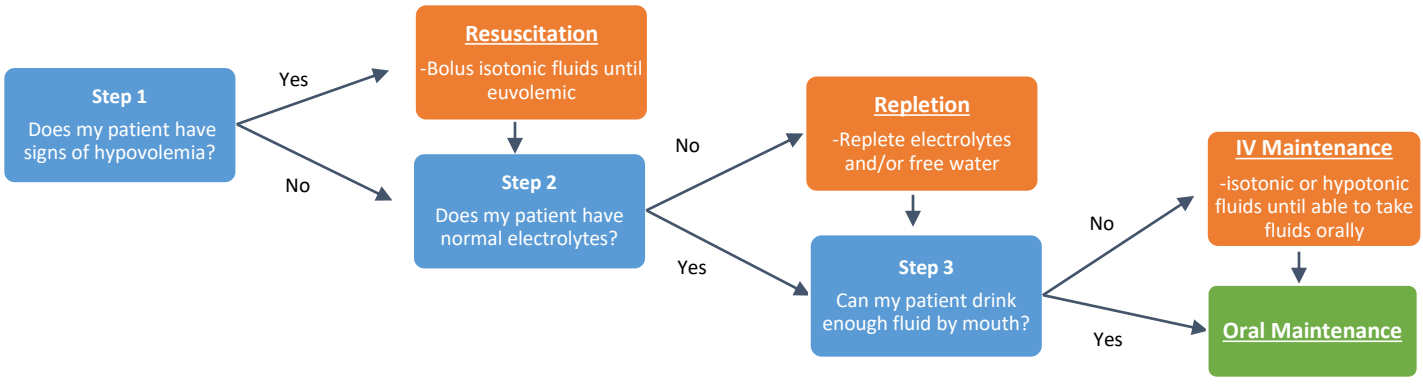
Where do fluids distribute after infusion?



- Isotoninc fluids → Extracellular compartments
- D5W → Total body water
- Half-normal saline → some to extracellular, some to total body water

Indications for IV Fluids and How to Choose

1. **Maintenance**
    - **When to use:** Replace expected daily losses and *maintain euvolemic state*. The patient has normal vital signs, normal volume status on physical exam, and normal electrolytes, but cannot take enough fluid by mouth
    - **Ideal Fluid:** 0.45% Saline (With K+ and/or Dextrose if needed)
      *It is important to give IV fluids that will reach all water compartments. Isotonic fluids are not a good choice over the long term because the intracellular compartment is missed
    - **How much to give:** Use "4-2-1" Rule to calculate hourly rate. 4ml/kg for the first 10kg, 2ml/kg for the next 10kg, 1ml/kg for the rest of the body weight. 70kg person would receive 110ml/hour. Consider using ideal body weight in obese patients, and reducing dose in elderly patients or those with heart, renal, or liver failure
2. **Resuscitation**
    - **When to use:** when there are signs of intravascular volume depletion (hypovolemia on exam, hypotension, sepsis, etc.)
    - **Ideal Fluid**: Isotonic fluids (0.9% NaCl or LR)
      *Isotonic or hypertonic fluids give the most intravascular volume expansion
    - **How much to give:** Estimate volume of losses if possible. If sepsis, Surviving Sepsis Campaign Guidelines recommend 30ml/kg bolus, adjusted based on clinical picture.[2] Fluids for resuscitation should be given as a bolus (500-1000ml/hour)
3. **Replacement**
    - **When to use:** Replace water and/or electrolyte deficits (ex: hypernatremia, increased GI losses, etc.)
    - Ideal Fluid and volume/rate will depend on type and severity of deficit
    - Examples:
        - Hypernatremia – calculate free water deficit and replace with D5%/Water.
        - Hypokalemia – add KCl to IV fluids
        - Acidemia – add Bicarbonate to IV fluids. 3 ampules of sodium bicarbonate (150meq $NaHCO_3$) in water is isotonic to plasma
        - Symptomatic hyponatremia or cerebral edema – consider 3% NaCl



References

1. Lobo D, Lewington A, Allison S. 2013. *Basic Concepts of Fluid and Electrolyte Balance.* Germany: Bibliomed
2. Evans L, Rhodes A, Alhazzani W, et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021. *Crit Care Med*. 2021;49(11):e1063-e1143. doi: 10.1097/CCM.0000000000005337