

Total Parenteral Nutrition (TPN)

Total parenteral nutrition (TPN), also known as parenteral nutrition (PN) is a form of nutritional support given completely via the bloodstream, intravenously with an IV pump. TPN administers proteins, carbohydrates, fats, vitamins, and minerals.

Candidates for TPN are:

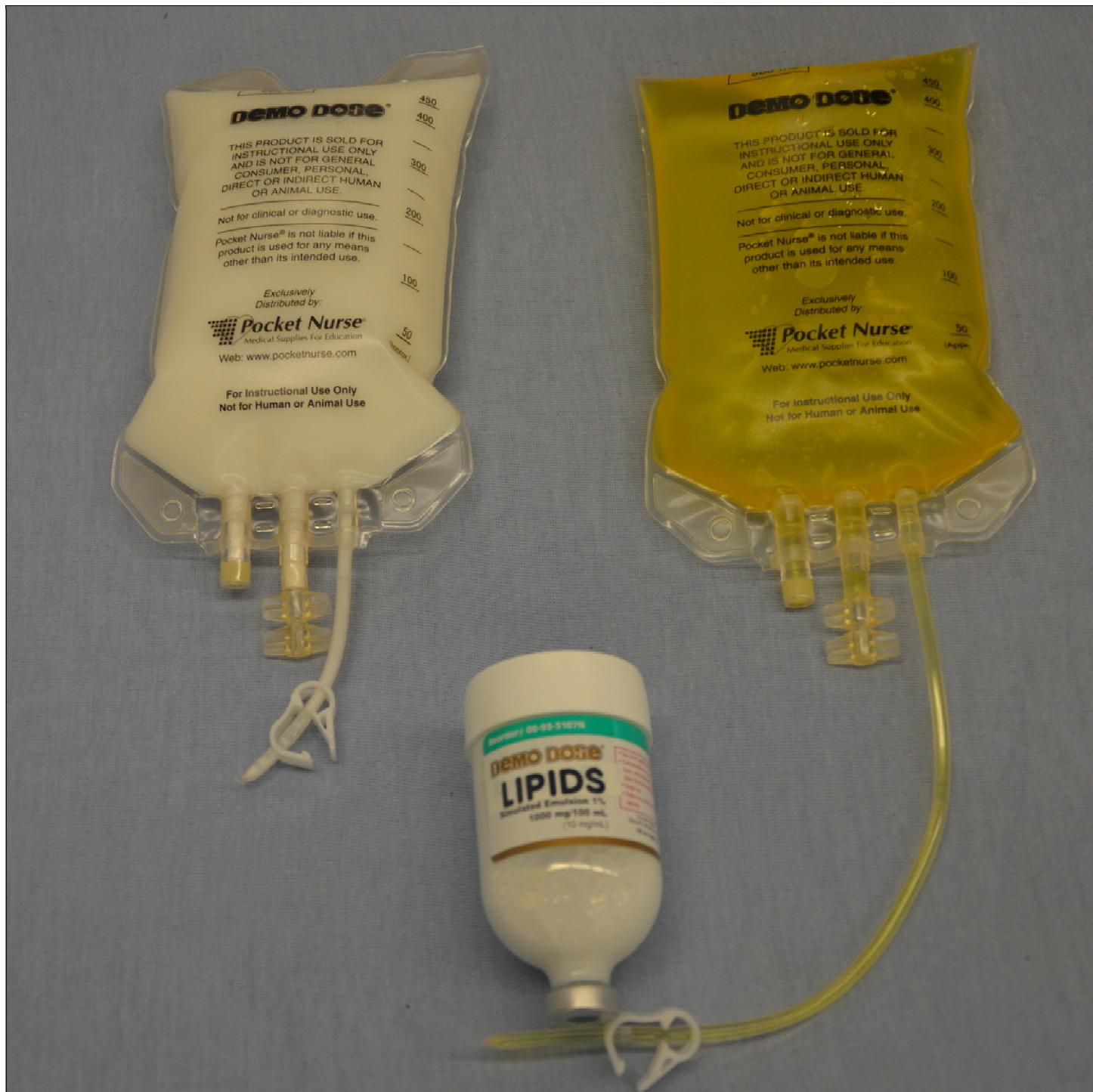
- Patients with paralyzed or nonfunctional GI tract, or conditions that require bowel rest, such as small bowel obstruction, ulcerative colitis, or pancreatitis
- Patients who have had nothing by mouth (NPO) for seven days or longer
- Critically ill patients
- Babies with an immature gastrointestinal system or congenital malformations
- Patients with chronic or extreme malnutrition, or chronic diarrhea or vomiting with a need for surgery or chemotherapy
- Patients in hyperabolic states, such as burns, sepsis, or trauma

TPN is made up of **two** components: **amino acid/dextrose solution** and **a lipid emulsion solution**. It is ordered by a physician, in consultation with a dietitian, depending on the patient's metabolic needs, clinical history, and blood report.

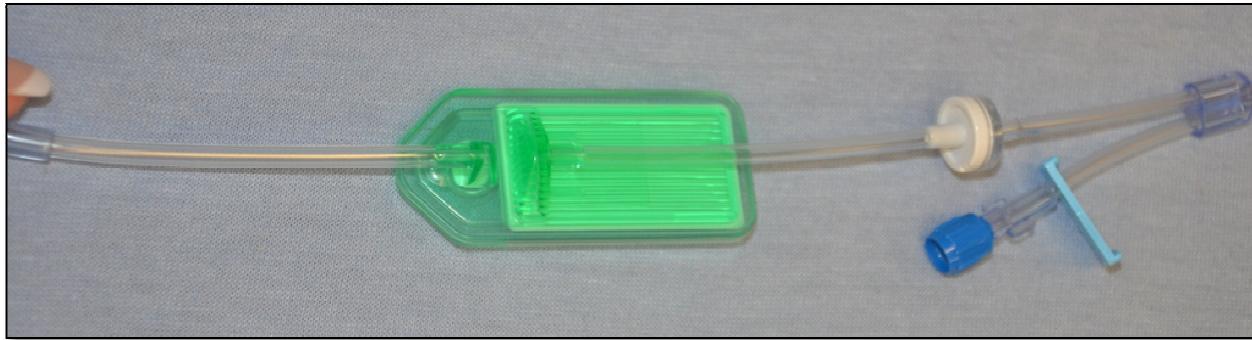
The amino acid/dextrose solution is usually in a large volume bag (1,000 to 2,000 ml), and can be standard or custom-made. It is often yellow in colour due to the multivitamins it contains. *The ingredients listed on the bag must be confirmed by the health care provider hanging the IV bag.*

The amino acid/dextrose solution is reviewed and adjusted each day based on the patient's blood report. Lipid emulsions are prepared in 100 to 250 ml bags or glass bottles and contain the essential fatty acids that are milky in appearance. At times, the lipid emulsion may be added to the amino acid/dextrose solution. It is then called *3 in 1* or *total nutrition admixture*

Various terms are used to describe the PN formulation, depending on whether lipid is included. If it contains lipid, it is called a 3-in-1, ternary or all-in-one admixture, if no lipid is present, the terms 2-in-1, binary or aqueous admixture are used.

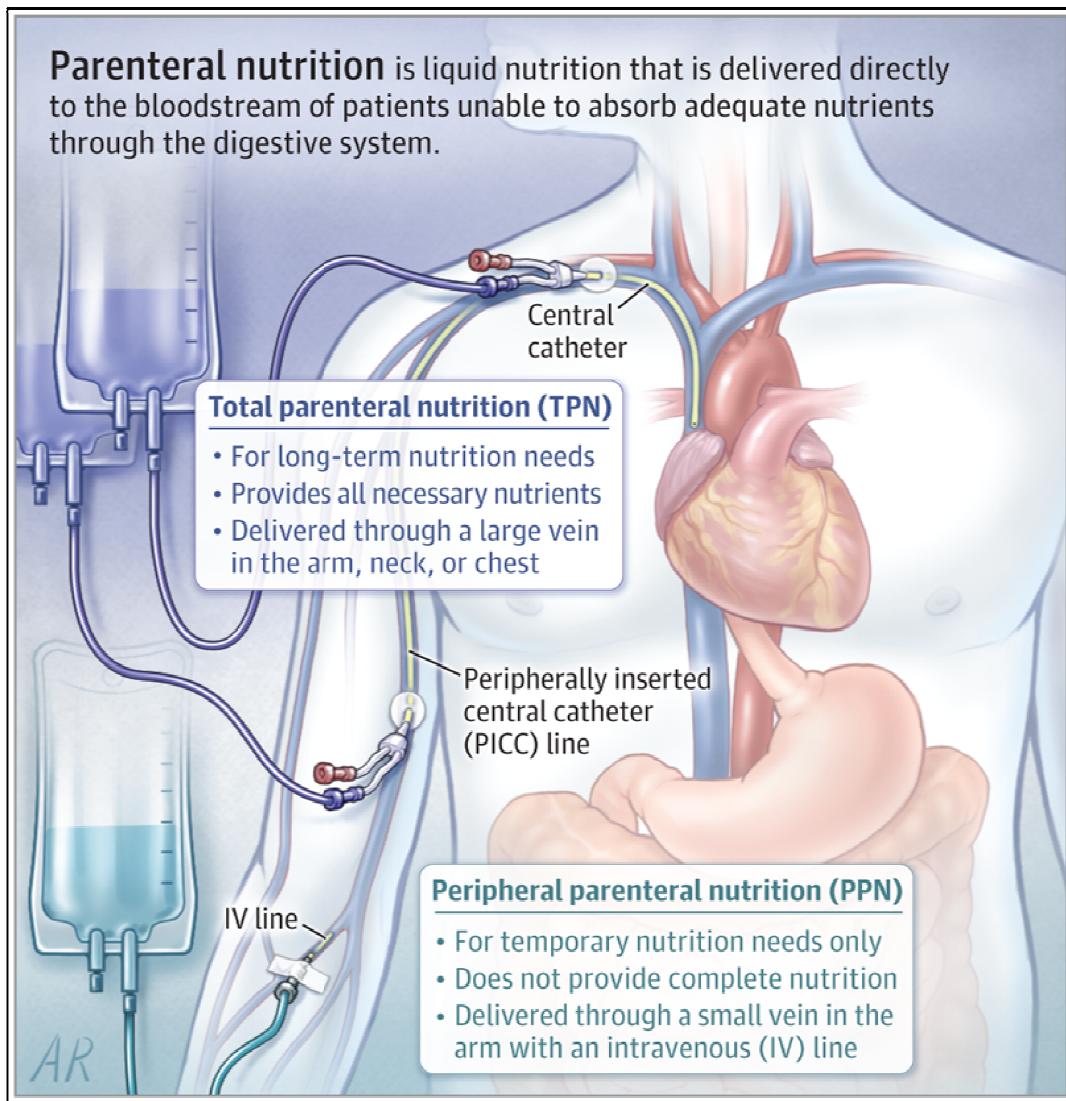


Types of TPN (amino acids and lipids)



TPN tubing with special filter

TPN is not compatible with any other type of IV solution or medication and must be administered by itself. TPN must be administered using an EID (IV pump), and requires special IV filter tubing for the amino acids and lipid emulsion to reduce the risk of particles entering the patient.



Composition of TPN based on PN source:

Oral and equivalent parenteral nutrition source	
Oral diet	Parenteral nutrition source
Water	Water
Protein	L-amino acids mixture
Carbohydrate	Glucose
Fat with essential fatty acids	Lipid emulsions with essential fatty acids
Vitamins	Vitamins
Minerals	Trace elements
Electrolytes	Electrolytes

In addition to water, six main groups of nutrients need to be incorporated in a PN regimen (see table above). The aim is to provide appropriate sources and amounts of all the equivalent building blocks in a single daily admixture.

Amino Acids: Twenty L-amino acids are required for protein synthesis and metabolism, and the majority of these can be synthesised endogenously. Eight are called ‘essential’ amino acids because they cannot be synthesised (isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine).

To balance the patient's amino acid requirements and the chemical characteristics of the amino acids (solubility, stability and compatibility), a range of commercially available licensed solutions has been formulated containing a range of amino acid profiles. **Aminoplasmal®**, **Aminoven**, **Synthamin®** and **Vamin®** are designed for adult patients.

The amino acid profiles of **Primene®** and **Vaminolact®** are specifically for **neonates, infants and children** (reflecting the amino acid profile of maternal cord blood and breast milk, respectively).

Glucose: Glucose is the recommended source of carbohydrate (1 g anhydrous glucose provides 4 kcal). Glucose 5% is regarded as isotonic with blood. **The glucose infusion rate should generally be between 2 and 4 mg/kg/min.** An infusion of 2 mg/kg/min (equating to approximately 200 g (800 kcal) per day for a 70 kg adult) represents the basal glucose requirement, whereas 4 mg/kg/day is regarded as the physiological optimal rate.

Lipid emulsions : Lipid emulsions are used as a source of energy and for the provision of the essential fatty acids, linoleic and alpha-linolenic acid. Supplying 10 kcal energy per gram of lipid, they are energy rich and can be infused directly into the peripheral veins since they are relatively isotonic with blood. **Typically, patients receive up to 2.5 g lipid/kg/day.**

Vitamins: There are two groups of vitamins: the water-soluble vitamins and the fat-soluble vitamins. Fat-soluble vitamins are stored in the body fat, whereas excess water-soluble vitamins are renally cleared; therefore, if there is inadequate provision, deficiency states for the water-soluble vitamins reveal themselves first. Commercially available preparations are Solivito® N (water soluble), Vitlipid® N Adult/Infant (fat soluble), Cernevit® (water and fat soluble).

Trace elements:

Trace elements are generally maintained at a relatively constant tissue concentration and are present to a level of less than 1 mg/kg body weight. They are essential; deficiency results in structural and physiological disorders which, if identified early enough, can be resolved by re-administration.

Ten essential trace elements are known: iron, copper, zinc, fluorine, manganese, iodine, cobalt (or as hydroxocobalamin), selenium, molybdenum and chromium.

Electrolytes:

Electrolytes are included to meet the patient's needs. Typical daily parenteral requirements are:

- **sodium** (1–1.5 mmol/kg)
- **potassium** (1–1.5 mmol/kg)
- **calcium** (0.1–0.15 mmol/kg)
- **magnesium** (0.1–0.2 mmol/kg)
- **phosphate** (0.5–0.7 mmol/kg).

Depending upon the stability of the patient's clinical state, they are kept relatively constant or adjusted on a near daily basis, reflecting changes in blood biochemistry.