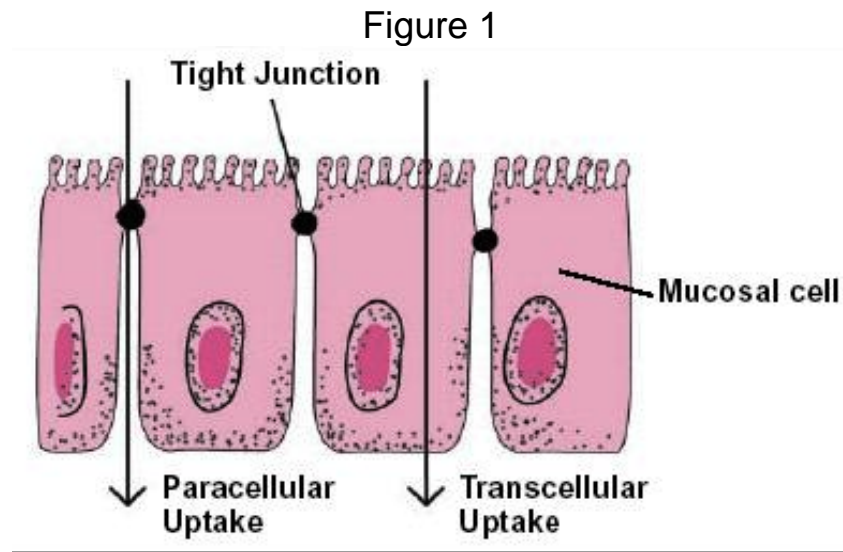




The gut “tube” is the interface between the outside and inside of the body. The digestive tract is over 30 feet long in an adult. This lining or gastrointestinal (GI) epithelium is the body's greatest barrier and defense against microbes and other invaders. It is no wonder that 70% of our immune system resides in the gut. Intestinal epithelium have the fastest cell turnover in the body. New epithelium replaces the cells that are lost through digestion every 3-6 days.

The GI epithelium also functions as a semi-permeable surface to absorb nutrients from food. Normally, the cells lining the gut are impermeable, forming tight junctions (see diagram). Digested food particles are actively carried through cellular pathways into the smaller blood vessels that lead to the liver and then to the tissues throughout the body. A compromised epithelium causes a breakdown of the intestinal barrier and disruption of these tight junctions. This leads to the passage of food particles, and pathogens such as bacteria and viruses, between the cells. What follows is inflammation, poor absorption of nutrients, immune dysfunction and disease.



There are numerous causes of abnormal intestinal permeability (IP). The most common triggers are infectious agents (bacteria, viruses, parasites), auto-immune dysfunction and non-steroidal anti-inflammatory drugs such as ibuprofen and prescription pain killers. Antibiotic use and alcohol consumption also affect permeability. Even aspirin has been shown to increase gut permeability after just one dose.

Dehydration during prolonged exercise or as a result of chronic dehydration from not drinking enough water has been shown to increase leaky gut.

Nutritional deficiencies, food allergy or intolerance, such as sensitivity to gluten, are also associated with leaky gut.

Certain patients with celiac disease show a drastic change in gut permeability after consuming gluten. This disruption of the gut lining leads to a vicious cycle of dysfunction. Let's examine a typical case, gluten sensitivity. Indigestible pieces of gluten irritate the epithelial lining which begins to loosen the tight junctions between the cells. Fragments of gluten, small proteins cross the gut lining and cause the release of enzymes that modify the gluten, leading to the immune system recognizing the gluten as a foreign invader has attacked. The immune system causes a cascade of reactions that attack the modified gluten and increase inflammation. The resultant inflammation then attacks the epithelial cells as well, damaging them and further destroying the tight junctions between the cells. The result may lead to the autoimmune response (the body attacking itself) called celiac disease, in which the cells responsible for digestion are destroyed.



Diseases associated with leaky gut include:

- Irritable bowel syndrome: a group of symptoms ranging from bloating, indigestion, and GERD (gastro-esophageal reflux disease) reflux
- Autism
- Inflammatory bowel disease (IBD), such as Crohn's and ulcerative colitis. Defective function of the absorptive gut lining has been shown to be an important factor in causing increased inflammation when gut bacteria come in contact with the immune system.
- Celiac disease: Gluten triggers chemical changes that increase the destruction of many tight junctions, leading to increased autoimmune reactions in organs and tissues throughout the body.
- Eczema and Psoriasis
- Fibromyalgia
- Chronic fatigue syndrome
- Arthritis
- Asthma
- Heart failure: Increased permeability allows bacterial biofilms to travel from the gut to the heart. (Gum disease causes similar heart disease.)
- Liver disease: Toxins, bacteria and viruses that get past the gut barrier pass through the liver, increasing the toxic load and leading to nutritional imbalance, increased viral disease (hepatitis) and changes in liver function.
- Food allergy: When particles of partially digested food pass through a leaky gut lining between the cells, a cascade of reactions occurs, leading to autoimmune responses, allergy and sensitivity.

## Testing

Laboratory assessment of leaky gut involves the intake of two sugars: mannitol and lactulose. This test involves measuring the amount of each of these sugars recovered in the urine after drinking a premeasured solution of each. Mannitol, a monosaccharide, is normally absorbed through the cells lining the gut. Lactulose, a disaccharide (a more complex sugar), would not normally be absorbed and passes through to the urine. However, if there is increased permeability between the cells in the gut, lactulose will pass into the blood. Measuring what remains in the urine is a good indicator of gut permeability.

A comprehensive digestive stool analysis (Genova Diagnostics) is an excellent way to test for pathology due to parasitic infection, as well as bacterial and yeast overgrowth. Chemical analysis of the products of digestion indicates how well you are digesting, and quantitative analysis of the amount of good vs. bad bacteria makes this an invaluable tool for analysis of the gut. This is not a direct measurement of permeability of the gut lining, but provides information as to the overall health of the intestines.

Food allergy panels and gluten sensitivity tests allow for identification of allergens and sensitivities that cause gut inflammation.

## Treatment:

1. Remove the source of damage
  - Medications known to affect permeability (only through medical supervision), alcohol, sugar, NSAIDS, food allergens and sensitivities.
2. Replace needed aids to digestion that are lacking
  - Pancreatic or plant enzymes, betaine, HCl (an acid that helps regulate pH of the gut, bile salts if fat digestion is poor, herbal digestive aids.



### 3. Re-inoculate

- Good bacteria. Probiotics help balance the normal flora and rebuild intestinal integrity. Prebiotics and enzymes are often necessary to re-establish helpful bacteria. Healthy microbial balance is essential to digestive health. (Please refer to Probiotics, in the next article.)

### 4. Repair mucosal lining

- Essential fatty acids - EPA/DHA and krill oil
- Vitamins - pantothenic acid (B6), C, A and especially vitamin D which helps repair the tight junctions that control permeability
- Antioxidants, such as C, E, beta-carotene, grape seed extract, milk thistle (silymarin), and R-alpha lipoic acid
- Quercetin deserves special note as an antioxidant. It stabilizes mast cells that lead to allergic reactions, quells inflammation of the gut and helps to stabilize the tight junctions between cells.
- Minerals such as zinc act as the spark plugs for all enzymatic reactions and restore cell membranes.
- L-glutamine is the primary amino acid food source for the epithelial cells lining the gut.
- Glutathione - an antioxidant defense against free radical tissue damage. It is the most common antioxidant made by the body itself. It is poorly absorbed when taken orally, so it is best to use the precursor N-acetyl cysteine and/or methionine.
- N-acetyl glucosamine (NAG) promotes the repair of the gut lining.
- Fiber, in many forms, acts as a substrate for probiotic growth and adhesion. Fiber acts as a prebiotic, providing nutrition for various probiotic species.
- Low-allergy protein provides the full complement of amino acids needed for the repair and rebuilding of gut tissue.
- Consider an **alkaline diet** of 80% vegetables and fruits to provide the balance of nutrients needed for healing the gut. Remember that enzymes may be needed to enhance the digestion of food. All foods that may create allergic or sensitivity reactions should be eliminated (**elimination diet**) for at least 6-10 weeks and then re-introduced slowly to self-test for sensitivity to a specific food group. An elimination diet is the most accurate way to determine how foods affect your digestion, mood and energy associated with diet.