



SHORT BOWEL SYNDROME AND INTESTINAL REHABILITATION

**A Handbook for
Patients, and their
Caregivers, with Short
Bowel Syndrome**



Transplant
UNWRAPPED

TABLE OF CONTENTS

Purpose	1
Introduction to SBS	2-3
Digestive System	4-9
SBS Signs and Symptoms	10
SBS Diagnosis	11
SBS Complications	12-20
Basics of Intestinal Rehab	21-25
Diet and Nutrition	26-38
Oral Rehydration Therapy	39-41
Intestinal Rehab Medications	42-45
Surgical Options	46-48

Purpose: Transplant Unwrapped hopes to provide educational information on short bowel syndrome and the different options for intestinal rehabilitation, including dietary, medical, and surgical options. This material is by no means all-inclusive; instead, it provides a snapshot of the topic.

Further reading can be found on our website or in reputable medical journals.

Short Bowel Syndrome (SBS)

- Short bowel syndrome is one of the most common reasons an individual may require intestinal rehabilitation or intestinal transplantation.
- **Short Bowel Syndrome** is a condition in which your body cannot absorb enough nutrients from the foods you eat because you do not have enough of your small intestine.
- SBS may result in **intestinal failure (IF)**: This is when the small intestine does not provide the necessary long term nutrition needed to sustain a normal life. This results in the need for additional long term nutrition to be delivered through large veins in the body, "Total Parenteral Nutrition" or "TPN."

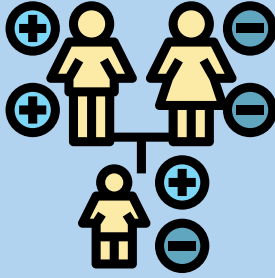
In **adults**, short bowel syndrome results from **surgical resection** (removal) of the small bowel.

Common causes in adults include:

- Mesenteric ischemia
- Thrombosis (blood clots)
- Volvulus (twisting of the intestine)
- Bowel Obstruction
- Complications from Crohn's Disease
- Motility disorders, such as Chronic Intestinal Pseudo Obstruction (CIPO)
- Invasive Tumors
- Intestinal Trauma or Injury
- *Internal hernia*, which occurs when the small intestine is displaced into pockets in the abdominal lining.
- *Intussusception*, one section of either the large or small intestine folds into itself, like a collapsible telescope.

Short Bowel Syndrome (SBS)

Short bowel syndrome **in children** can be broken up into **two categories**:



Congenital causes or when a child is born with short bowel syndrome:

- *Intestinal atresia*, which occurs when a part of the intestine does not form completely.
- *Gastroschisis*, which happens when the intestines stick out of the body through one side of the umbilical cord.
- Volvulus and Malrotation
- Hirschsprung's Disease
- Other congenital conditions

Complications from a disorder leading to bowel resection:

- Necrotizing Enterocolitis (NEC)
- Radiation Enteritis
- Trauma
- Crohn's Disease



To read more about the causes of short bowel syndrome and intestinal failure, please visit our page for [adults here](#) and [pediatric patients here](#).

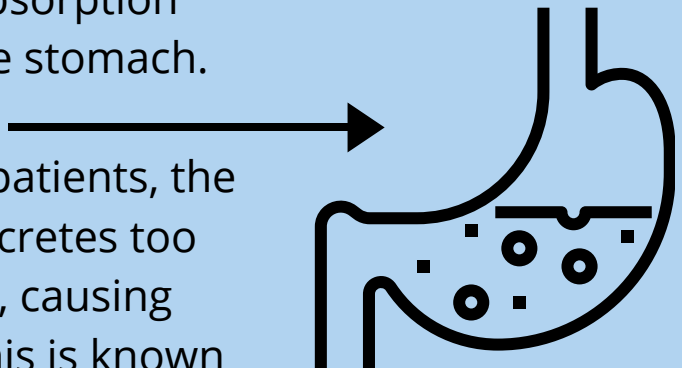
How the Digestive System Relates to Short Bowel Syndrome

The Stomach

- The stomach is the first destination for food after breaking it down into pieces in your mouth.
- The stomach begins the digestive process by releasing enzymes and stomach acid that further break the food into a partially digested food called **chyme**.
- The chyme moves from the stomach into the first part of the small intestine, the **duodenum**.

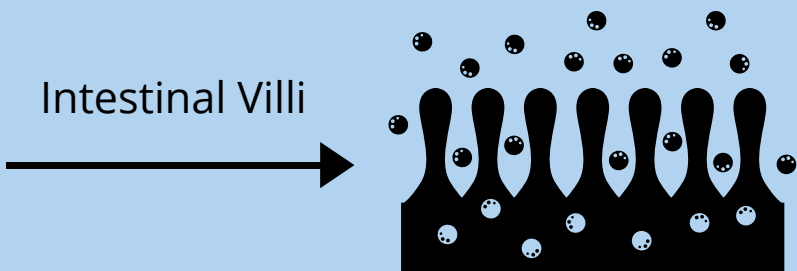
Minimal absorption occurs in the stomach.

In some SBS patients, the stomach secretes too much acid, causing problems. This is known as gastric hypersecretion.



The Small Intestine

- Once your food breaks down as chyme, it moves into the small intestine, where most nutrient absorption occurs.
- The length of the small intestine is usually ~12-20 ft. The small intestine's interior surface area is expanded by microscopic finger-like projections known as **villi**.
- The average length of a small intestine and the villi allows ample time for food to contact the intestinal wall, allowing for nutrient absorption.
- However, in people with short bowel syndrome, there is not enough functional small intestine to allow for nutrient absorption.
- Additionally, the location of the bowel resection determines which nutritional deficiencies short bowel patients may experience.



The Small Intestine: The Duodenum

The first portion of the small intestine (~25-30 cm, 10 inches in length) absorbs **many**

nutrients:

- Fats
- Sugars
- Peptides and Amino Acids
- Iron* (primary site)
- Folate* (primary site)
- Calcium
- Water
- Magnesium
- Electrolytes (i.e. Potassium, Sodium etc.)

Duodenum:

Pancreatic enzymes and bile salts empty into the duodenum to aid in digestion.



What are bile salts? Bile salts are made by the liver and are required for the digestion and absorption of fats and fat-soluble vitamins A, D, E, and K. In some SBS patients with >100 cm of ileum removed, bile salt malabsorption can lead to increased diarrhea and fatty stool (steatorrhea).

The Small Intestine: The Jejunum and Ileum

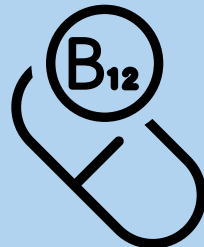
The second portion of the small intestine, the jejunum (200-300 cm, 6-10 ft.), is a **primary site** of nutrient absorption, mainly:

- Sugars
- Fats
- Peptides and amino acid
- Calcium
- Water
- Magnesium
- Electrolytes (i.e. Potassium, Sodium etc.)

The third portion of the small intestine, the **ileum** (300-400 cm, 10-13 ft.), absorbs **many nutrients**:

- Water
- Bile acids* (lack of ileum may lead to fat malabsorption. See steatorrhea and bile problems)
- Electrolytes
- Vitamin B12* (exclusively absorbed in the terminal ileum)

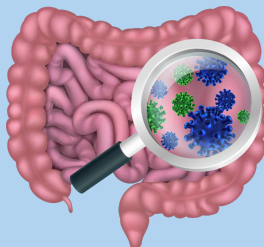
Vitamin B12: If >60 cm of the ileum is resected, particularly the terminal ileum, vitamin B12 absorption can be impaired.



The Small Intestine: The Ileum and The Colon

Ileocecal Valve:

- This is a valve between your terminal ileum and the first part of your colon, the cecum.
- It helps to prevent the backflow of contents once they leave the ileum.
- It also helps slow down intestinal motility, increasing nutrient and fluid contact time with the intestinal wall, increasing absorption.
- In some patients with short bowel syndrome, resection of the intestine results in loss of the ileocecal valve.
- This can lead to problems with the backflow of contents and bacteria into the small intestine, leading to small intestinal bacterial overgrowth (SIBO).

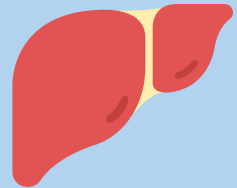


The Small Intestine: The Colon

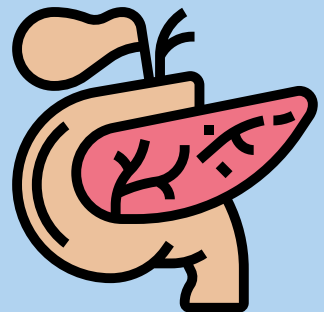
- Approximately 160 cm. or 5 ft. in length
- The main function is to reabsorb leftover fluids and electrolytes.
- The colon also can utilize short-chain fatty acids (SCFAs) produced by colonic bacteria from dietary fibers as energy.

Other Important Organs for Digestion:

1. **Liver:** Produces bile required for fat absorption.



2. **Gallbladder:** Stores bile and releases when signaled by the intestine. Some SBS patients are at risk for gallstones.



3. **Pancreas:** Produces pancreatic enzymes required for digestion of food.

Signs and Symptoms of Short Bowel Syndrome

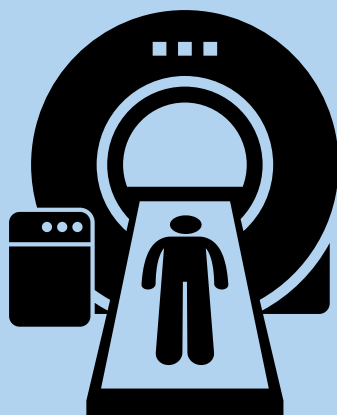
Signs and symptoms associated with short bowel syndrome stem from the bowel's inability to absorb enough nutrients and fluids from the individual's diet.

- **Diarrhea:** Most common symptom.
 - Long-term and in large amounts.
 - It can quickly lead to dehydration and electrolyte imbalances.
- **Dehydration**
 - Dehydration may present with excessive thirst, dark urine, infrequent urination, lethargy, and/or dark skin.
 - Dehydration may present in infants and young children as a dry tongue or skin, sunken eyes or cheeks, cranky or drowsy personality, and lack of tears when crying.
- Malnutrition
- Vomiting
- Weakness and fatigue
- Bloating
- Heartburn or cramping
- Oily or foul-smelling stool

How is short bowel syndrome diagnosed?

1. **Bloodwork:** This can look at electrolyte abnormalities, vitamin and mineral deficiencies. It can also look for anemia, or low red blood cells, which can indicate nutrition deficiency.
2. **Physical exam:** Certain characteristics, such as loss of muscle mass or dry skin, may indicate certain nutrient deficiencies.
3. **Stool tests:** This can check for fat in the stool.
4. **Imaging:** Your team may recommend imaging, such as an x-ray, Upper GI series, or CT scan to investigate the cause of short bowel syndrome further.

To read more about possible diagnostic testing, visit [this page](#).



What are possible complications associated with Short Bowel Syndrome?

1. Malnutrition: A person's diet does not supply enough nutrients to maintain nutritional status.
2. Dehydration and Electrolyte Imbalances
3. Kidney stones
4. Small Intestinal Bacterial Overgrowth (SIBO)
5. Vitamin and Mineral Deficiencies
6. Gastric Acid Hypersecretion
7. Steatorrhea, Bile Problems, and Gall stones
8. Long-term Complications from Total Parenteral Nutrition (TPN)

“It is health that is the real wealth, and not pieces of gold and silver.”

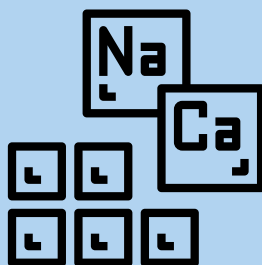
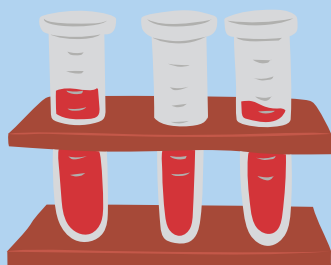
Breaking it Down Complications: Electrolyte Abnormalities

What are electrolytes?

Electrolytes are electrically charged minerals and compounds that help your body do much of its work.

Why should a short bowel syndrome patient be familiar with electrolytes?

Electrolyte imbalances occur very quickly with excessive diarrhea and can quickly turn into a serious medical situation. As a SBS patient, it is essential to regularly receive bloodwork to have key electrolytes checked to ensure everything remains stable and balanced.



Breaking it Down

Electrolyte Abnormalities

Electrolyte	Normal Range (may vary per lab)	Symptoms if too Low	Additional Comments
Sodium Na⁺ Hyponatremia (low) Hypernatremia (high)	135-145 mEq/L	<ul style="list-style-type: none"> • Nausea and vomiting • Headache • Confusion • Muscle weakness, spasms, or cramps • Seizures, coma (extreme) 	Sodium is essential in maintaining the balance of fluid and blood volume.
Potassium K⁺ Hypokalemia Hyperkalemia	3.5-5.5 mEq/L	<ul style="list-style-type: none"> • Weakness, tiredness, or cramping in arm or leg muscles • Tingling or numbness • Nausea or vomiting • Heart palpitations • Fainting from low blood pressure 	<p>Works with sodium to maintain water balance and acid/base balance.</p> <p>With calcium, it regulates nerve and muscle activity.</p>
Chloride Cl⁻ Hypochloremia Hyperchloremia	96-106 mEq/L	<ul style="list-style-type: none"> • Many people do not notice any symptoms, unless they are experiencing very high or very low levels of chloride in their blood. 	

Breaking it Down

Electrolyte Abnormalities

<p>Calcium Ca⁺² Hypocalcemia Hypercalcemia</p>	<p>8.5-10.2 mg/dL</p>	<ul style="list-style-type: none"> • Confusion • Muscle spasms or cramps • Numbness or tingling 	<p>Calcium in the blood helps to regulate cell function, heart rate, and blood clotting.</p> <p>The body needs vitamin D to absorb calcium</p>
<p>Magnesium Mg⁺² Hypomagnesemia Hypermagnesemia</p>	<p>1.7-2.2 mg/dL</p>	<ul style="list-style-type: none"> • Numbness • Tingling • Muscle cramps • Seizures • Muscle spasticity • Personality changes • Abnormal heart rhythms 	<p>Mostly in bones, with about 1% in <i>extracellular fluid</i> (body fluid outside the cells)</p>
<p>Phosphate/Phosphorus PO₄⁻ Hypophosphatemia Hyperphosphatemia</p>	<p>2.5-4.5 mg/dL</p>	<ul style="list-style-type: none"> • Bone pain • Loss of appetite • Joint stiffness • Numbness • Weakness 	<p>Helps build/repair bones and teeth, stores energy, contracts muscles and enables nerve function.</p> <p>The body needs vitamin D to absorb phosphorus.</p>

Breaking it Down Complications: Kidney Stones

What is oxalate?

Oxalate is a substance that is found in plant-based foods. When these foods are broken down, oxalate is released as a by-product. Normally, oxalate binds to calcium in the intestine and is pooped out.

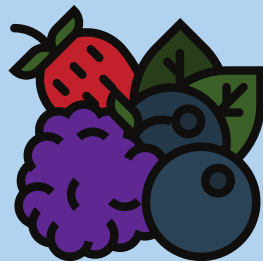
Why should a short bowel syndrome patient be concerned with oxalate?

In some individuals with short bowel who have fat malabsorption, the fat binds with the calcium, leaving the oxalate free in the colon, where it is reabsorbed into the bloodstream. Back in the body, the oxalate reaches the kidney, binds with calcium, and **can form kidney stones.**

How do you prevent oxalate kidney stones?

Try to avoid foods high in oxalate, such as:

- Tea
- Chocolate
- Nuts
- Leafy green vegetables
- Berries
- Wheat germ/bran



You also should stay well-hydrated and have adequate

Breaking it Down Complications: Small Intestinal Bacterial Overgrowth (SIBO)

What is small intestinal bacterial overgrowth (SIBO)?

Small Intestinal Bacterial Overgrowth (SIBO) occurs when there are excess bacteria in the intestine.

Why are short bowel patients at risk for developing SIBO?

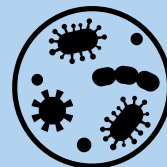
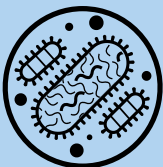
Usually, the balance of bacteria in the intestine is regulated by stomach acid, intestinal motility, and the ileocecal valve. In short bowel patients, these three things may be altered and result in SIBO.

What are the signs and symptoms of SIBO?

- Nausea
- Gas and bloating
- Malabsorption
- Increased diarrhea or ostomy output

What is the treatment for SIBO?

SIBO is usually treated with an antibiotic regimen. Your team will determine the best treatment for you.



Breaking it Down Complications: Vitamin and Mineral Deficiencies

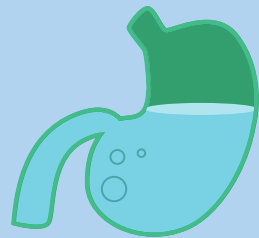
What determines vitamin and mineral deficiencies in a short bowel patient?

Vitamin and mineral deficiencies will vary depending on the length and location of intestinal resection/ portion of the intestine that is missing.

In particular, if the ileum is missing, the absorption of fat-soluble vitamins A, D, E, and K, are often insufficient. Additionally, the body will not absorb vitamin B12, which will need to be supplemented.

Gastric Acid Hypersecretion

The stomach relies on signals from certain areas of the small intestine to control the release of stomach acid. In some with short bowel, the missing portion of intestine results in an impaired signal. Without the proper signal, there is an **excessive release of stomach acid**.



Why is this a problem? The excess acid can increase diarrhea and inactivate digestive enzymes leading to impaired digestion.



Treatment is with anti-acid medications.

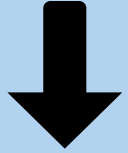
Breaking it Down Complications: Steatorrhea and Bile Problems

What is steatorrhea?

Steatorrhea is when dietary fat remains in your stool after passing through the small intestine unabsorbed.

Why might this occur in a short bowel patient?

A large portion of the ileum is gone or resected (>100 cm). The ileum is responsible for recycling and reabsorbing bile salts which are necessary for fat digestion and absorption.



This results in a **decrease** in **bile reabsorption**.



There is then an **increase** in **bile salt loss**.



This **decreases fat** digestion and fat **absorption**.



There is an **increase** of **fat in stool**.



Results in oily, foul smelling stool.



Breaking it Down Complications: Steatorrhea and Gall stones

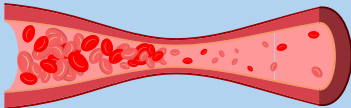
How might steatorrhea be treated?

- Your team may recommend a low-fat diet. If you have severe diarrhea, a bile acid sequestrant medication may be recommended.
- An example of this type of medication is cholestyramine. It reduces bile salt diarrhea by increasing the removal of bile acids from the body.
- The downside of these medications is that they can interfere with the absorption of essential things, like fat-soluble vitamins and essential fatty acids.

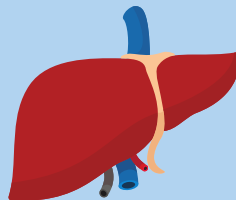
Gallstones: Common in patients with short bowel due to decrease in the contractions of the gallbladder and slow movement of bile creating "biliary sludge." Bile concentrates and forms stones.

Long-Term Complications from Total Parenteral Nutrition

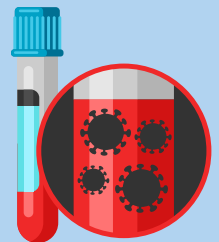
Thrombus



Blood clots: Can occur in the large veins where your central line is placed.



Liver Damage: A range of damage from fatty liver to cirrhosis and parenteral nutrition associate liver disease (PNALD).



Infection: Can lead to sepsis and can be life-threatening.

Diagnosed with Short Bowel Syndrome (SBS), Now What?

Main Goal: Obtain Optimal Nutritional Status

Parenteral Nutrition (PN)

- Initially, most patients with short bowel syndrome will be placed on IV nutrition, also known as parenteral nutrition (PN), to achieve full nutritional status.
- PN is the delivery of nutrients through the large veins of a person's body.
- While this efficiently delivers the nutrients a person needs, it is also associated with many complications, including infections, blood clots, and liver disease; thus, it is not ideal for long-term nutrition.
- Also, for the intestine to adapt, it requires stimulation by food intake. Regular, whole foods are the best at stimulating the bowel to adapt.

Did you know it was only in **1968** that PN became a treatment option for babies with intestinal failure.



Obtaining Optimal Nutrition: Enteral Nutrition

- "Enteral" means by way of the intestine.
- Enteral nutrition is when nutrients and fluids are delivered via a feeding tube.
- There are many types of feeding tubes, but the 3 most commonly used include:
 - **Nasogastric (NG) tube:** This tube goes from the nose down into the stomach. They are commonly used for short-term needs.
 - **Gastrostomy tube (G-tube):** This tube is inserted surgically through the skin and into the stomach. They are commonly placed for long-term use.
 - **Jejunal tube (J-tube):** This tube is inserted surgically and directly into the second portion of the small intestine, the jejunum.
- After initial stabilization on parenteral nutrition (PN), many children will be placed on enteral nutrition (tube feeds) to help kickstart the process of intestinal adaptation, even if oral intake is not tolerated. Enteral nutrition may also be used in stabilized adults who cannot tolerate oral intake.
- Many different formulas exist for all different tolerance levels, sensitivities, and allergies.

For more information on feeding tubes, visit the Feeding Tube Awareness Foundation at:
www.feedingtubeawareness.org



Diagnosed with Short Bowel Syndrome (SBS), Now What?

Main Goal: Obtain Optimal Nutritional Status- Off of TPN and onto Oral Nutrition

Purpose of Intestinal Rehabilitation:

Intestinal rehabilitation is the process of restoring nutritional autonomy in patients with short bowel syndrome and intestinal failure. This means weaning from TPN and onto oral feedings to the point in which one can live life without TPN and the associated complications.

Intestinal rehabilitation relies on the physiologic process of **intestinal adaptation**: This is when the remaining small intestine goes through a period of adaptation and grows to increase its ability to absorb nutrients. This process can take years to complete.

Diagnosed with Short Bowel Syndrome (SBS), Now What?

Factors that help determine if a patient may successfully wean from TPN with intestinal rehabilitation and restore nutritional autonomy include:

- Length of the remaining bowel (for adults)
 - As a general rule, a person with <60-65 cm of ileum with a colon can wean from TPN.
 - <100-115 cm ileum without a colon usually can wean from TPN.
 - To see a visual of this concept, please visit **[this article.](#)**
- Section of the remaining bowel that remains.
- Presence or absence of an anatomical unit known as the *ileocecal valve*.
- Presence of colon or ileum.
- Functional ability of the remaining intestinal cells (i.e. is there an inflammatory process occurring).
- Age and health status of the patient before weaning.

Intestinal Rehabilitation: Possible Options

1. **Diet Modification:** First-Line Therapy

2. **Oral Rehydration Therapy:** Maintain hydration status.

3. **Vitamin and Mineral Supplements**

4. **Pharmacological Therapy**

a. **Anti-Diarrheal agents:** These help slow transit time and increase absorption.

b. **Proton-pump inhibitors:** These help decrease stomach acid secretion.

c. **Probiotics or antibiotics:** These help treat small bowel bacterial overgrowth.

d. **Exogenous bile salts:** These help with fat and calcium absorption.

e. **Teduglutide (GLP-2 analog)** also known as Gattex®: Used to increase nutrient absorption in short bowel syndrome patients.

f. **Human Growth Hormone (aka Somatropin):** Helps to enhance intestinal adaptation processes.

5. **Surgical Interventions:** These include autologous reconstruction and bowel lengthening techniques such as the Bianchi and Serial Transverse Enteroplasty Procedure (STEP).

Step One: Diet Modification

- Maintaining nutrition and hydration status can be difficult for a short bowel patient.
- Dietary modifications focus on increasing the amount of time food and nutrients spend in contact with the intestinal wall, reducing diarrhea, decreasing motility, and maximizing nutrient and fluid absorption.
- A short bowel patient needs to have both a gastroenterologist and nutritionist as part of their medical team to develop a proper diet.
- Every individual has a specific diet regimen to meet their needs; however, we will present the basic premises and overview of the optimal diet for a short bowel patient.

Why is it important for Short Bowel Patient to Know the Location of Fluid and Nutrient Absorption?

- Before deciding on the best diet for an individual, your team must determine the remaining anatomy/ section of the intestine This is because certain nutrients are only absorbed in specific areas of the intestine.
- For example, the ileum is the only portion of the small intestine that absorbs vitamin B12.
- If a person with short bowel does not have the ileum, they will be deficient in vitamin B12 and require alternative supplementation methods.
- Similarly, if an individual is missing the duodenum, they may be deficient in iron or folate, as that is where the nutrients are mainly absorbed.



Why is it important for Short Bowel Patient to Know the Location of Fluid and Nutrient Absorption?

- Maintaining hydration is also a challenge for short bowel patients.
- Reduced bowel length limits the amount of time fluids spend in contact with the intestinal wall, thus, reducing the amount of fluid reabsorption.
- Maintaining hydration status can be incredibly difficult if an individual no longer has a colon, a portion of the digestive tract where a large amount of fluid reabsorption occurs.



A Quick Review of Section Specific Nutrients



Duodenum



Calcium,
Magnesium,
Iron, Folate,
Electrolytes,
Sugars,
Peptides



Jejunum



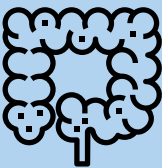
Sodium,
Magnesium,
Calcium, Fluids,
Sugars



Ileum



Vitamin B12, E,
D, K, bile salts
to help absorb
fats, water



Colon



Remaining
fluids and
electrolytes

General Diet Tips for Short Bowel Syndrome

- Eat small, frequent meals 6-8 times per day.
- Chew food well, which helps to increase digestion and absorption of nutrients.
- Include **soluble fiber** in your diet.
 - Include soluble fiber in your diet.
 - Soluble fiber helps to slow movement through the intestine.
 - Soluble fiber passes from the small intestine undigested into the colon, where colonic bacteria ferment it.
 - One of the byproducts of fermentation is butyric acid which is a valuable source of calories, improves the integrity of lining cells and enhances absorption of water and salt.
 - If consumed excessively, it may contribute to gas, bloating, and malabsorption.
 - Examples: Metamucil®, Benefiber®, Nutrisource®, pectin, guar gum, oatmeal, barley, legumes.
- Avoid **insoluble fiber**, which tends to hold water in the intestine, increasing diarrhea.
 - Insoluble fiber increases transit time and movement of stool through the intestine.
 - Examples: vegetable stems, fruit and vegetable skins, seeds.



To read more about the types of fiber, [visit this article](#) from Columbia's Center for Liver Disease and Transplantation.

General Diet Tips for Short Bowel Syndrome

- An individual with short bowel syndrome may need to limit **oxalate absorption**.
 - Oxalate is found in many foods. When our bodies breakdown foods, oxalate is created as a by-product.
 - When the ileum is removed, but the colon remains, some short bowel patients will **absorb too much oxalate**.
 - **Excess** oxalate can lead to the **formation of kidney stones**.
 - **Reduce oxalate absorption by** eating calcium-rich foods and foods with probiotics. Both help eliminate oxalate from the body.
 - **Avoid oxalate-rich foods**, including tea, alcohol, coffee, chocolate, nuts, soy, leafy green vegetables, berries, wheat germ/bran.
- **Supplemental vitamins and minerals**
 - The **amount** of intestine and the **section** that remains determines the vitamins and minerals that must be supplemented (see section specific vitamins and minerals above).
 - Usually, it is recommended to take a **daily multivitamin**.
 - **Example:** A short bowel patient without the last portion of the ileum will require a shot of vitamin B12 as that is the only location of absorption in the digestive tract.

General Diet Tips for Short Bowel Syndrome

- **Limit fluids** at mealtime because fluids can increase output, push food through the bowel faster, and hinder nutrients' absorption.
 - A general rule is to limit fluids to 1/2 cup (4 oz) during a meal.
 - Consume the rest of your fluids in between meals throughout the day, with at least a one hour buffer from food.
- **Avoid high sugar drinks and desserts**, which draws more water into the intestine and increases diarrhea. Consider using oral rehydration solutions (contains the proper balance of salt and sugar for hydration) to stay hydrated.
- In general, short bowel patients benefit from a diet that is:
 - **High in protein**
 - At least six times a day
 - Ex: meat, fish, poultry, eggs, legumes, dairy (if tolerated)
 - **Moderate in fat**
 - With a jejunostomy or high output ileostomy, a higher fat diet is often recommended.
 - Include oils with essential fatty acids (e.g. sunflower, soy, walnut)
 - Other fats: butter, margarine, oils
 - **High in low-fiber, complex carbohydrates**
 - With a colon, a high complex carbohydrate diet is commonly recommended.
 - Ex: white bread, cereal, pasta, potatoes, white rice
 - **Low in concentrated sweets**
 - Ex: honey, soda, fruit juices, corn syrup

Breaking it Down:

Carbohydrates

- Avoid simple sugars, such as those in fruit juice, as these draw water into the intestine and increase diarrhea.
- 50-60% of the diet should be in the form of complex carbohydrates if someone has a colon and 40-50% of total intake without a colon (3).

Complex Carbohydrates: Good Choices

- White bread and rice
- Plain waffles or pancakes
- White bagels, English muffins
- Unsweetened cereals, such as Cheerios®, Corn Flakes®, Rice Krispies®, Corn Chex®, Special K®, Kix®
- Crackers
- Pretzels
- Potatoes, sweet potatoes
- Plain banana, carrots, butternut squash

Carbohydrates to Avoid:

- Donuts
- Sweet rolls, pastries
- Cake, cookies
- Sugary cereals, such as Honey Nut Cheerios®, Frosted Flakes®, Cocoa Puffs®, Fruit Loops®,
- Fruit juices
- Fruit in cans/syrups
- Dried fruit



Breaking it Down: Artificial Sweeteners

- Avoid adding simple sugars to foods which can increase diarrhea and output.
- An alternative is to use artificial sweeteners.
- You still must use in moderation as low-calorie sweeteners are osmotic agents. These can increase output and diarrhea.



Some artificial sweeteners that may be helpful include:

- Aspartame: Equal®, Nutrasweet®
- Sucralose: Splenda®
- Saccharin (Sweet'N Low®)
- Stevia-based Sweeteners: Truvia®, Pure Via®

It is important to be wary of *sugar alcohols* (i.e. xylitol, sorbitol, mannitol) which can cause gas, bloating, and increased diarrhea. Often times these are found in things like sugar-free gum and other sugar-free food products.

Breaking it Down: Fats

- If someone has a colon, usually fat intake should be 20-30% of total calories (low-fat diet).
- In an individual without a colon, fat intake should be about 30-40% total calories, or as tolerated.
- Short bowel patients should prioritize polyunsaturated fats as these contain *essential fatty acids (EFAs)*, or fatty acids that the body cannot make.

Fats Good Choices:

- Oils: Sunflower, Soybean, Fish, Flaxseed (good source of EFAs)
- Full-fat salad dressing (good source of EFAs)
- Margarine
- Avocado
- Olives
- Cheese, cream cheese
- Bacon
- Shredded coconut
- Mayonnaise

Fats to Avoid:

- Sweetened cream cheeses (strawberry, honey nut, etc.)
- Cream, half and half
- Honey butter, flavored nut butter
- Butter



Breaking it Down: Protein

- 20-30% of total dietary calories should be from protein.

Three Major Categories for Good Sources of Protein

Meat, Fish Poultry

Good Choices:

- Chicken or turkey
- Beef
- Pork
- Fresh Fish

Avoid:

- Fried fish, meats, poultry
- Raw fish, poultry, meat

Dairy and Soy

Good Choices:

- Regular cheeses
- Cow, soy, or rice milk
- Tofu
- Unsweetened yogurt

Avoid:

- Fried fish, meats, poultry
- Raw fish, poultry, meat

Nuts and Nut Butters

Good Choices:

- CHEW WELL: Peanuts etc.
- Nut butters, like peanut, almond

Avoid:

- Nutella
- Flavored nut butters with jelly mixed in

Breaking it Down: Example Daily Menu for Short Bowel Patient

Breakfast 6:30 am

- Scrambled egg
- Slice of toast
- Sugar free jelly
- 1/4 c orange juice mixed with 1/4 c water

Drink Break 8:00 am

- Oral Rehydration Solution, such as DripDrop® or homemade

Snack 10:00 am

- 1 oz cheese
- 6-8 crackers

Lunch 12:30 pm

- 1 slice of bread
- 2 oz ham
- 1 tsp. mustard
- 1/2 c lactose free milk

Drink Break 2:00 pm

- Oral Rehydration Solution, such as DripDrop® or homemade

Snack 4:00 pm

- 1 tbsp. peanut butter
- 10 pretzels

Dinner 6:30 pm

- 1/2 c mashed potatoes
- 1/2 c cooked green beans
- 2 oz grilled chicken
- 1/2 c lactose free milk

Drink Break 8:30 pm

- Oral Rehydration Solution

Late Night Snack 10:00 pm

- 1/2 Cheerios®

Diet Progression In Young Children

The entire intestinal adaptation process, and weaning a child completely from PN and enteral feeds, can take months to years.

Phase 1:

- First few weeks of life
- Initial stabilization phase
- Infant is started on parenteral nutrition (PN): nutrition through the veins to stabilize fluids and electrolytes
- Often high output and diarrhea
- Goal is to meet the needs for growth and development

Phase 2:

- Start the child on enteral feeds (tube feeding), usually continuous, to stimulate intestinal adaptation
- Begin weaning off of TPN, if tolerated
- Supplement the appropriate vitamins, minerals, and electrolytes

Phase 3:

- Intestinal adaptation is near completion
- Start on age-appropriate oral foods, generally food that is high-protein, low-fat
- Try to avoid carbohydrates because of their osmotic effect (cause increase in diarrhea)
- If the child has an oral aversion to food, consider seeing an occupational therapist or speech-language pathologist
- Try to wean off of enteral feeds (tube feeds)

Step Two: Oral Rehydration Therapy (ORT) and Solutions (ORS)

Three Types of Fluids:

Hyper-Osmolar

- These are fluids that contain sugar (glucose) and minimal salt (sodium).
- These types of fluids cause water to be drawn into the intestine, causing watery diarrhea.
- Examples: Juice, sugary soda drinks.
- Should be avoided by short bowel patients to prevent dehydration.

Iso-Osmolar

- These are fluids that contain electrolytes (sodium, potassium) and glucose in the same concentration as the body's extracellular fluid.
- These types of fluids do not cause water to be drawn into the GI tract- *ideal for short bowel patients.*
- Examples are oral rehydration solutions like Pedialyte® or G2®

Hypo-Osmolar

- These are fluids that contain little to no sugar (glucose) and salt (sodium).
- These types of fluids are partially absorbed by the GI tract.
- Examples: Water, sugar-free drinks

Step Two:

Oral Rehydration Therapy (ORT) and Solutions (ORS)

- In addition to maintaining nutrient intake, you must also maintain hydration status.
- To maintain hydration status there must be an equal amount of input and output of fluids.
- Fluid imbalance occurs when there is either a fluid deficit, such as losing fluid with diarrhea, or fluid surplus, such as retaining water with heart failure.
- Short bowel patients are at high risk for fluid deficits and electrolyte abnormalities due to their large amounts of diarrhea, causing a significant loss of water and sodium.
- Rehydration with just water and/or water+sodium will result in the continued loss of fluids.
- The use of **oral rehydration solutions** can help solve this problem.
 - Oral rehydration solutions are a mixture of water, sodium (possibly other salts), and glucose (sugar) that utilize a unique sodium-glucose transport mechanism across the intestinal cell wall.
 - This results in the absorption of Na^+ , creating a gradient, and water follows.
- There are numerous formulations, flavors, and types of ORS.

Breaking it Down: Oral Rehydration Therapy (ORT) and Solutions (ORS)

- ORS solutions may be purchased or can be homemade.
 - Commercial examples include: Pedialyte,[®] DripDrop, Ceralyte,[®] or Liquilyte[®].
- The solutions contain the proper amount of salt, sugar, and fluid to restore the fluid, potassium, and sodium that is lost from the excessive diarrhea (i.e. iso-osmolar as described above).

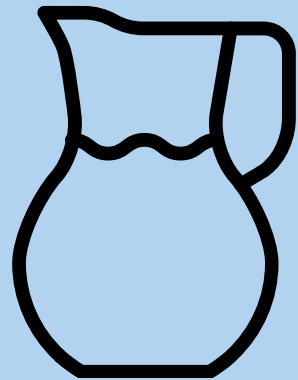
ORS Recipe Examples:

Gatorade 2[®] Based

- 4 cups Gatorade 2[®] (G2)
- 3/4 teaspoon salt

Water Based

- 1 quart water
- 3/4 teaspoon salt
- 2 tbsp. sugar
- Add sugar free drink mix, like Kool aid, for flavor

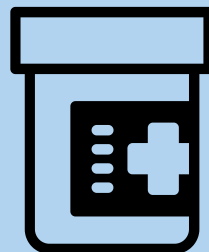


Medications for Short Bowel Syndrome and Intestinal Rehabilitation

Medications are an important component of intestinal rehabilitation for short bowel patients.

What needs to be considered when selecting medications for short bowel patients?

- Due to malabsorption in short bowel, the full amount of a medication may not be absorbed.
- The dose, frequency, formulation, and timing of administration in relation to meals are necessary.
- IV formulations may be required.
- **Avoid extended-release** medications.



Medications for Short Bowel Syndrome and Intestinal Rehabilitation

Anti-Motility Agents: These are medications that help slow down food movement through the small intestine, giving more time to absorb fluid and nutrients.

- Loperamide (Imodium®)
- Diphenoxylate/atropine (Lomotil®)
- Codeine
- Tincture of Opium
- Somatostatin (Octreotide): Hormone works to slow down the small intestine's action by reducing the secretion of gastric acid and small intestine secretions. May help to increase the absorption of fluids and salts.

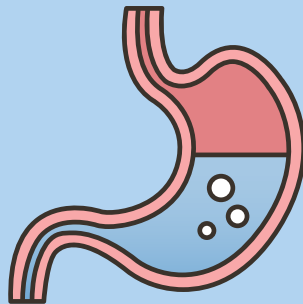


Medications for Short Bowel Syndrome and Intestinal Rehabilitation

Gastric hypersecretion occurs when there is extensive bowel resection (>50%). Hypersecretion increases the acidic fluid that reaches the bowel, leading to increased diarrhea and malabsorption.

Anti-Secretory Agents: These are medications that decrease the amount of acid that the stomach secretes with gastric hypersecretion.

- Histamine-2 receptor antagonists: Cimetidine, Famotidine (Pepcid®), Nizatidine and Ranitidine (Zantac®)
- Proton Pump Inhibitors: Pantoprazole, Omeprazole (Prilosec,® Losec®)
- Octreotide
- Clonidine



Medications for Short Bowel Syndrome and Intestinal Rehabilitation

Antimicrobials: Broad-spectrum is used to treat small intestinal bacterial overgrowth (SBBO), a common complication for SBS patients.

Bile acid/salt resin: These function to bind excess bile salts, which can worsen short bowel syndrome malabsorption. They can help with bile salt diarrhea, but must be taken carefully because they can also affect your ability to absorb fat-soluble vitamins and nutrients. An example is cholestyramine.

Growth Hormone: In SBS patients, growth hormone has been shown to enhance the intestinal adaptation process and increase absorption.

Glucagon-Like Peptide-2 (GLP-2)

(Teduglutide, Gattex®): Improves absorption of fluids and electrolytes by increasing the absorptive surface of the small intestine.

Surgery for Short Bowel Syndrome and Intestinal Rehabilitation

The last component of intestinal rehabilitation is reconstructing an individual's native bowel via various surgical techniques. The methods either try to optimize the function by lengthening or tapering the dilated bowel or slowing the transit, increasing the time the food and fluid comes in contact with the bowel wall, hopefully increasing absorption of nutrients.

Surgery may involve procedures which:

- Narrow a dilated segment of the small intestine.
- Slow the time it takes for food to travel through the small intestine.
- Lengthen the small intestine.
- Prevent blockage and preserve the length of the small intestine.

Surgery for Short Bowel Syndrome and Intestinal Rehabilitation

Bianchi Procedure: The dilated short bowel is divided in half and sewed one end to the other, therefore, creating a longer, narrower tube with a smaller diameter.

Serial Transverse Enteroplasty

Procedure (STEP): This involves lengthening dilated small bowel by creating a row of alternating slits in the small intestine and stapling the V-shaped cuts shut, creating a zig-zag like tube. The benefit of the STEP is that it can nearly double the bowel's length, greatly enhancing the amount of time nutrients spend in contact with the absorptive intestinal surface.



Surgery for Short Bowel Syndrome: Intestinal Transplant

- In some instances, all intestinal rehabilitation options have been exhausted, and the intestine still has not fully adapted to allow freedom from TPN.
- In cases like these, an intestinal transplant may be recommended.
- It is important to note that intestinal failure alone does not qualify an individual for intestinal transplant; a person must also suffer a TPN complication and meet other rigorous evaluation criteria.
- To learn more about an intestinal transplant, please visit our website at [**www.transplantunwrapped.org**](http://www.transplantunwrapped.org) to learn about every step of the journey.

More Info? Contact or Visit us.



info@transplantunwrapped.org



www.transplantunwrapped.org



(469)-389-0692

References

1. Matarese LE, O'Keefe SJ, Kandil HM, Bond G, Costa G, Abu-Elmagd K. Short bowel syndrome: clinical guidelines for nutrition management. *Nutr Clin Pract.* 2005;20(5):493-502. doi:10.1177/0115426505020005493
2. Tappenden, K.A. (2014), Pathophysiology of Short Bowel Syndrome. *Journal of Parenteral and Enteral Nutrition*, 38: 14S-22S. doi:10.1177/0148607113520005
3. Shatnawei, A. (2010). Intestinal Failure Management at the Cleveland Clinic. *Archives of Surgery*, 145(6), 521. doi:10.1001/archsurg.2010.103
4. Cuffari, C., & Ziegler, T. (2015, July 01). Short Bowel Syndrome. Retrieved September 27, 2020, from <https://www.niddk.nih.gov/health-information/digestive-diseases/short-bowel-syndrome>
5. Parrish CR, DiBaise JK. Managing the Adult Patient With Short Bowel Syndrome. *Gastroenterol Hepatol (N Y)*. 2017;13(10):600-608.



Transplant UNWRAPPED

© 2020 Transplant Unwrapped. All rights reserved.

Disclaimer: This booklet is not intended to be used as medical advice or to diagnose, treat, cure or prevent any disease, nor should it be used for therapeutic purposes or as a substitute for a health professional's advice. Transplant Unwrapped does not accept any liability for any injury, loss or damage incurred by use of or reliance on the information presented.