Nutritional Management for Short Bowel Syndrome

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What is SBS?

- Specific type of intestinal failure that occurs because of loss of a significant portion of the small bowel's absorptive area
- Less than 200 cm (6.5 ft) of jejunum-ileum in continuity after bowel resection
- Can occur in adults and children

Byrne et al; Short Bowel Syndrome; Encyclopedia of Gastroenterology, 2004.

Causes of SBS

Extensive small bowel resection:

- Infarction of the mesenteric vessels
- Intestinal volvulus
- Abdominal trauma
- Malignancy
- Congenital abnormalities
- Repeated resections due to Crohn's disease

Functional defect:

- Radiation enteritis
- Severe inflammatory bowel disease

Byrne et al; Short Bowel Syndrome; Encyclopedia of Gastroenterology, 2004.

Short-Term Consequences of SBS

Diarrhea leading to major fluid and nutrient losses, incomplete digestion and absorption of food

Dehydration, electrolyte abnormalities, vitamin and mineral deficiencies, and progressive weight loss/malnutrition

The need for nutrition support to prevent dehydration, stabilize electrolytes, avoid weight loss or restore weight, and/or to provide vitamins and minerals

Byrne et al; Short Bowel Syndrome; Encyclopedia of Gastroenterology, 2004.

What is the spectrum of nutrition support options for consumers with SBS?

Diet Therapy	Diet manipulations to help optimize the absorption of calories and nutrients through the GI tract
Enteral Nutrition	Fluid and nutrients administered through a tube into the GI tract
IV Hydration	Fluid and electrolytes administered intravenously
Parenteral Nutrition	Fluid and nutrients administered intravenously

Any combination of the above therapies

First Intestinal Rehabilitation (IR) Model

The “bowel rehabilitation” concept was initiated by Drs. Wilmore and Byrne at the Nutritional Restart Center (NRC)

The NRC’s regimen consisted of a specific diet with supplements, medications and a behavior modification program

The primary goal of bowel rehabilitation was to eliminate, reduce or prevent the need for long-term dependency on TPN

Byrne et al; Bowel Rehabilitation: An Alternative to Long-term Parenteral Nutrition and Intestinal Transplantation for Some Patients with Short Bowel Syndrome; Transplantation Proceedings, 34, 887-890, 2002.

Role of an Appropriate Diet in SBS Management

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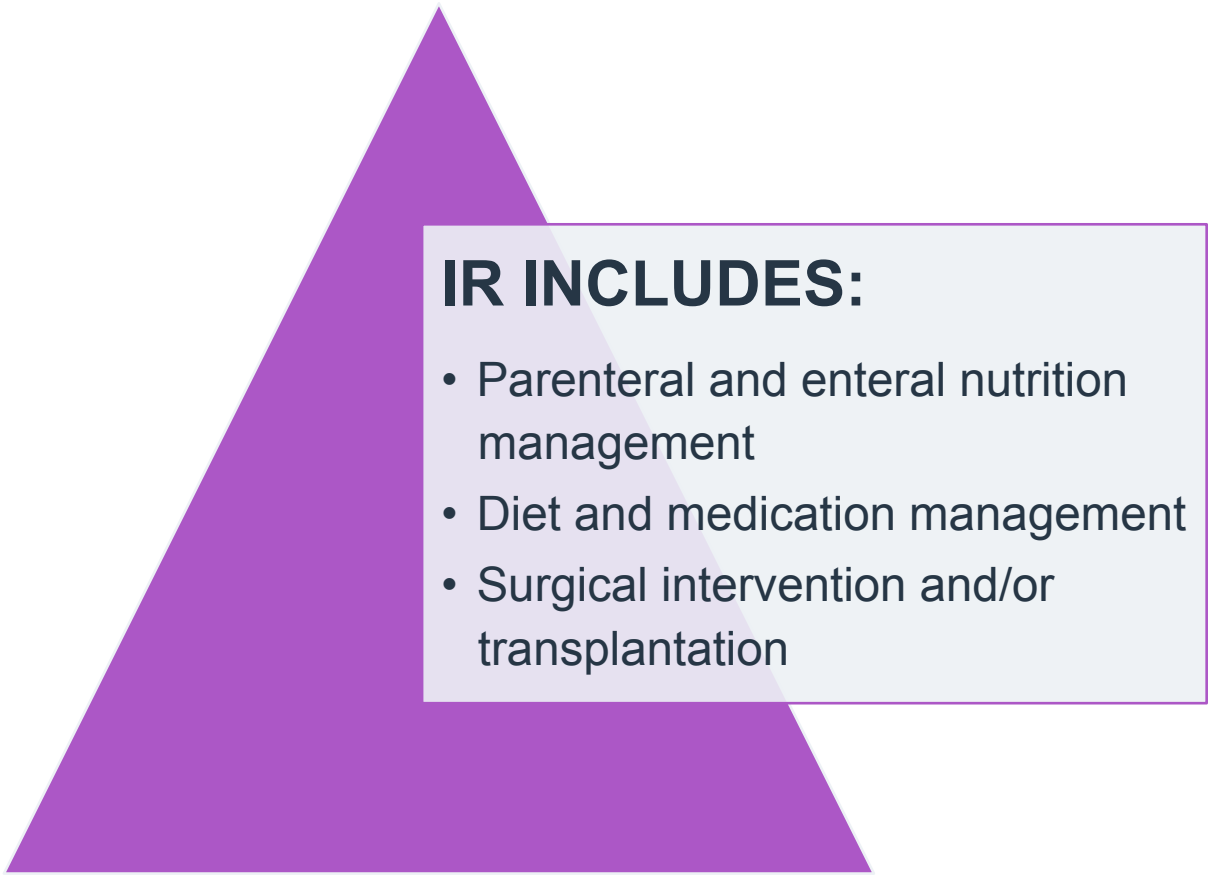
In caring for nearly 400 patients with SBS over a 10-year period, the NRC:

- Recognized the significant adverse effect of an inappropriate diet on nutrient absorption and stool output
- Designed a specific diet for each patient according to the presence or absence of colon
- Identified the importance of educating the patient on how to translate the diet prescription into appropriate foods, fluids and meals

Byrne, T. et al; Beyond the Prescription: Optimizing the Diet of Patients with SBS; NCP 15:306-311, 2000.

Current
Intestinal Rehabilitation (IR) Model



What is the Current Role of Diet in IR?

Evidence of the Importance of Diet/Enteral Nutrition:

"Clinical experience confirms the important role that diet plays in the successful management of these patients, particularly those with colon, and in addition, suggests that with appropriate follow-up and compliance, this can result in the long-term reduction of PN needs."
–DiBaise et al., Am J Gastroenterol, 2004

"Nutrition is an integral component of the care of these very complex and heterogeneous patients and forms the foundation for treatment ."
–Matarese LE et al., NCP, 2005

"There is currently no clinical consensus as to if or when to administer therapies such as growth hormone, glutamine or glucagon-peptide 2 in the intestinal failure population. However, one therapy is currently employed to enhance intestinal adaptation central to IR efforts, the provision of enteral nutrition."
–Rudolph, JA et al., Curr Opin Organ Transplant, 2010

Diet: Colon vs. No Colon

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Comparison of the two diet prescriptions:

	Colon	No Colon
Carbohydrate	50–60% of total calories (limit simple sugars)	40–50% of total calories (restrict simple sugars)
Protein	20–30% of total calories	20–30% of total calories
Fat	20–30% of total calories (primarily essential fats)	30–40% of total calories (primarily essential fats)
Fluid	Isotonic fluids or Hypoosmolar fluids	Isotonic, high sodium oral rehydration solution
Soluble Fiber	5–10 grams per day (if stool output is > 3L/day)	5–10 grams per day (if stool output is > 3L/day)
Oxalates	Limit intake	
Meals	5–6 meals per day	4–6 meals per day

Byrne, T. et al; Beyond the Prescription: Optimizing the Diet of Patients with SBS; NCP 15:306-311, 2000.

Types of Fluids

Hyper-osmolar	• Contain many particles of glucose and little to no sodium • Cause fluid to be pulled into the intestinal tract to dilute the concentration of the drink, therefore causing watery diarrhea
Hypo-osmolar	• Contain little to no particles of glucose and sodium (not concentrated) • Are not always absorbed entirely, known as free fluids • Water, decaffeinated and sugar-free beverages
Iso-osmolar	• Contain sodium, potassium and glucose in same concentration as blood and extracellular fluid • Will not cause fluid to shift into the GI tract • Oral rehydration solution, Cera-Lyte, Pedialyte®, G2®

Matarese et al; Short Bowel Syndrome: Clinical Guidelines for Nutrition Management; NCP, 20:493-502, 2005.

Iso-osmolar Drinks

Iso-osmolar drinks are the beverage of choice for SBS consumers.

Fluid Comparison

Beverage	Osmolarity (m0sm/L)	Type of Fluid
Prune Juice	1265	Hyper-osmolar
Grape Juice	863	Hyper-osmolar
Apple Juice	680	Hyper-osmolar
Orange Juice	614	Hyper-osmolar
Regular Soda	550–700	Hyper-osmolar
Popsicle	720	Hyper-osmolar
Jell-o®	730	Hyper-osmolar
Diet Soda	0	Hypo-osmolar
Water	0–18	Hypo-osmolar
Tea	18	Hypo-osmolar
ORS salts	300	Iso-osmolar
CeraLyte	220–260	Iso-osmolar
Pedialyte®	250	Iso-osmolar
Gatorade®	330–380	Iso-osmolar

Parrish, C; The Clinician's Guide to Short Bowel Syndrome; Practical Gastroenterology, 2005.

Carbohydrates

There are two major types: COMPLEX and SIMPLE

Complex carbohydrates (starches & fiber)

- Complex carbohydrates are polysaccharides, containing many glucose units. They include starch and dietary fiber.
- Complex carbohydrates (starches) should make up the bulk of the daily calories.
- Fiber is the non-starch component of plant cells that cannot be digested or absorbed and is usually limited in the SBS diet

Simple carbohydrates (sugars)

- The simplest form of carbohydrate is the monosaccharide, one sugar unit..
- Simple carbohydrates (sugars) should be avoided due to their small particle size and affect on the concentration in the intestine.

Guthrie, HA. Introductory Nutrition, 7th Edition, 1 Times Mirror/Mosby College Publishing 989.

Examples of Simple & Complex CHOs

Simple CHOs	Complex CHOs
• Sugar	• Pasta
• Candy	• Potato
• Cakes, cookies, pies	• Breads
• Regular soda, pop	• Cereals
• Jelly, jam, syrup	• Whole grains as tolerated
• Ice cream, sherbet, sorbet	• Fruits and vegetables as tolerated

Matarese, L. et al; Dietary and Medical Management of Short Bowel Syndrome in Adult Patients; J Clin Gastroent 40(Supp 2):S85-S93, 2006.

Digestion and Absorption of Dietary CHO

DIGESTION IN SBS CONSUMERS

- The amount and type of CHO consumed becomes critical to achieving and maintaining good nutrition
- Simple sugars cause an increase in the concentration of intestinal fluids due to their very small particle size. The result is an increase in diarrhea, malabsorption, and loss of fluids, electrolytes, and vital nutrients
- Limiting intake of simple sugars to less than 10 grams per meal/snack and instead choosing complex CHOs will help to reduce diarrhea
- Those with a colon appear to benefit further from a high complex carbohydrate diet due to the energy derived from the fermentation of malabsorbed carbohydrates

Byrne, T. et al; Beyond the Prescription: Optimizing the Diet of Patients with SBS; NCP 15:306-311, 2000.

Alternatives to Sugar

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Non-nutritive Sweeteners

Non-nutritive sweeteners are intense, very low-calorie sweeteners that do not have an adverse effect on stool output since they do not contribute to osmolality in the GI tract. These sweeteners can be used as an alternative in order to reduce simple sugars in the diet.

The sweeteners currently approved by the FDA are:

- **Aspartame** (Nutrasweet®, Sugar Twin®, Equal®)
- **Saccaharin** (Sweet'N Low® and Sweet Twin)
- **Sucralose** (Splenda®)
- **Acesulfame K** (Sunett®, Sweet & Safe, Sweet One®)
- **Neotame** (used by manufacturers in combination with other nutritive and non-nutritive sweeteners to enhance the flavor of food and beverages)
- **Stevia-based sweeteners** (Truvia®, Pure Via®)

U.S. Food & Drug Administration. http://www.fda.gov/food/ingredientspackaginglabeling/foodadditivesingredients/ucm397725.htm

Alternatives to Sugar

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Sugar Alcohols

Sugar alcohols are also used as low-calorie sweeteners. Unlike the non-nutritive sweeteners, they are designed to be malabsorbed and therefore *cause uncomfortable side effects like abdominal gas, bloating and diarrhea*.

- Sugar alcohols can be found in the ingredient list on food labels as sorbitol mannitol, xylitol.
- A product labeled “sugar-free” must contain a separate line for sugar alcohols under the carbohydrate section on the food label.

Nutrition Facts

Serving Size 3 oz. (85g)

Amount Per Serving	As Served
Calories 38	**Calories from Fat** 0
	% Daily Value
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0g	0%
Sodium 0g	2%
Total Carbohydrate 0g	3%
Sugars 0g	
Sorbitol Mannitol, Xylitol 1g	
Protein 0g	

Vitamin A 270%	¥	**Vitamin C** 10%	
Calcium 2%	¥	**Iron** 0%	

Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	80g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

U.S. Food & Drug Administration. http://www.fda.gov/food/ingredientspackaginglabeling/foodadditivesingredients/ucm397725.htm

Function of Fiber in the SBS Diet

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SOLUBLE FIBER:	INSOLUBLE FIBER:
• Increases the viscosity or the thickness of food mass which delays stomach emptying • Slows movement (or transit time) in the small intestine thereby allowing more time for food and fluid to be absorbed • Passes through the small intestine undigested and enters the colon where it is broken down by bacteria in the colon. Additional calories are made available from this fermentation process just as they are with other malabsorbed carbohydrates • Large amounts may cause increased fat malabsorption and gas and bloating	• Does not dissolve in water, but traps water • Increases stool bulk and volume • Speeds up movement or transit time in the small intestine • Can contribute to bowel blockages in those consumers with narrowed areas of small intestine

Byrne, T. et al; Beyond the Prescription: Optimizing the Diet of Patients with SBS; NCP 15:306-311, 2000.

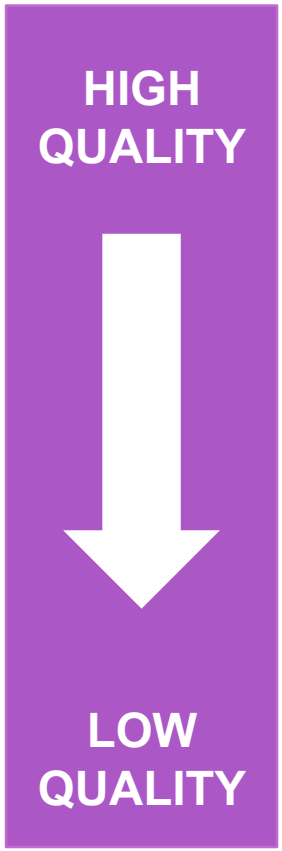
The Best Fiber Choices for SBS

CHOOSE	LIMIT
Soluble Fiber	Insoluble Fiber
Oatmeal cereals and breads	Whole wheat cereals and breads
Oatbran cereals and breads	Wheat bran cereals and breads
Apple (without skin), applesauce, banana, orange, grapefruit, tangerine without seeds, membranous tissues and peelings (strawberries are allowed)	Grapes, blueberries, cherries, rhubarb, figs, blackberries, raspberries
Cooked, peeled and/or seedless vegetables such as carrots, butternut squash, asparagus tips, canned green beans	Corn, celery, cucumber, mushroom, cauliflower, lettuce, cabbage, peppers, eggplant, broccoli & asparagus stems, spinach, turnip greens, kale, Brussels sprouts
Refried low-fat beans, shelled beans (i.e., garbanzo beans, black beans)	Nuts, large seeds (pumpkin, sunflower), lentils, peas

United States Departure of Agriculture. Center for Nutrition Policy and Promotion.
http://www.cnpp.usda.gov/sites/default/files/dietary_guidelines_for_americans/PolicyDoc.pdf

Types of Dietary Protein

FOOD
Egg
Cow's Milk
Fish
Beef
Unpolished Rice
Peanuts
Oats
Polished Rice
Whole Wheat
Corn
Soy Beans
Sesame Seeds
Peas



William's Basic Nutrition and Diet Therapy. 13th Ed; Staci Nix, ed; p.57, 2009.

Fat

- Fat is a very important part of the diet but not all fats are alike
- Foods high in animal fat and saturated fat should be limited.
- Essential fats or essential fatty acids (EFAs) should be the focus since the body cannot make EFAs on its own. EFAs are found in polyunsaturated fats

Essential vs. Non-Essential Fats

Essential Fat	Non-Essential Fat
Safflower oil	Butter
Sunflower Oil	Cocoa Butter
Soybean Oil	Whole Milk & Cheeses
Flaxseed Oil	Red Meat
Fish Oil	Palm Oil
Cold Water Fish (Salmon, Trout, Mackerel, Sardines)	Coconut Oil
Margarine	Olive Oil
Mayonnaise	Canola Oil
Oil-Based Dressings & Marinades	Peanut Oil

Preventing an EFA Deficiency

WAYS TO INCREASE ESSENTIAL FATS:

At breakfast:

- Drizzle 1 tsp of “S” oil over cooked eggs.
- Use margarine on toast, muffins, pancakes, waffles and biscuits.
- Add lox to a bagel and cream cheese.
- Add 1 tsp. of “S” oil to oatmeal or cream of wheat.

At lunch:

- Add 1 tsp. of margarine to a sandwich.
- Add extra mayonnaise to tuna, chicken, ham or egg and potato salads.
- Use mayonnaise instead of mustard on sandwiches.

At dinner:

- Add 1 tsp. of “S” oil to a serving of pasta.
- Eat 3–4 oz of salmon, trout or mackerel.
- Warm an “S” oil and fresh garlic. Serve with crusty bread.
- Marinate lean meat, chicken and pork in “S” oil and spices.
- Use margarine on vegetables and potatoes

“Appropriate” & “Less Appropriate” Meal Patterns

Diet #1: “Appropriate”	Diet #2: “Less Appropriate”
BREAKFAST 1 cup oatmeal 2 oz lactose-free milk 1 egg 1 English Muffin or 2 slices of toast 2 tsp margarine 1 tsp diet jelly 4 oz of coffee	**BREAKFAST** 8 oz orange juice 1 cheese and fruit-filled Danish
MORNING SNACK 1 bagel ½ oz cheese 1 tsp margarine 4 oz water	
LUNCH 3 oz baked ham ½ cup rice ½ cup carrots 2 small dinner rolls 2 tsp margarine 4 oz water or diet soda	**LUNCH** 1 thin slice cheese pizza 12 oz regular soda

Byrne, T. et al; Beyond the Prescription: Optimizing the Diet of Patients with SBS; NCP 15:306-311, 2000.

“Appropriate” & “Less Appropriate” Meal Patterns

Diet #1: “Appropriate”	Diet #2: “Less Appropriate”
Dinner 4 oz roasted chicken 1 large baked potato 2 dinner rolls 2 tsp margarine 4 oz water or diet soda	**Dinner** 12 oz T-bone steak 1 large baked potato 1 cup spinach 12 oz beer
Evening Snack 1 roast beef sandwich: 2 slices bread 1 oz of meat 1 tsp mayonnaise 1 tsp mustard 1 oz pretzels 4 oz water or diet soda	**Evening Snack** 3–4 cups popcorn 1 cup raspberry sorbet 12 oz diet soda
Additional Fluid 1.5–2.0 L oral rehydration solution	**Additional Fluid** 1.5–2 L water

Byrne, T. et al; Beyond the Prescription: Optimizing the Diet of Patients with SBS; NCP 15:306-311, 2000.

Best Practice Eating

- Contains a source of complex carbohydrate, protein and fat (especially essential fat) at each meal and snack
- Emphasizes complex carbohydrates and restricts simple sugars
- Distributes food throughout the day
- Restricts fluids to 4 oz. per meal, and fluids are either hypo-osmolar or isotonic

Impact of the SBS Diet

Adhering to the SBS diet can reduce stool output and lead to:

- Better absorption
- Improved hydration
- Fewer PN/hydration needs
- Improved quality of life

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