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Gut-Brain Connection Series

**Part III - Replace - How to Identify & Address Low Stomach Acid,
Pancreatic Enzyme Insufficiency and Bile Salt Deficiency**

Cynthia Libert, M.D., ABFM, ABIHM, IFMCP



Cynthia Libert, M.D.

Caring for the Body, PLLC
1998 Hendersonville Rd
Suite 24
Asheville, NC 28803

(828)490-1545

caringforthebody.org

help@caringforthebody.org





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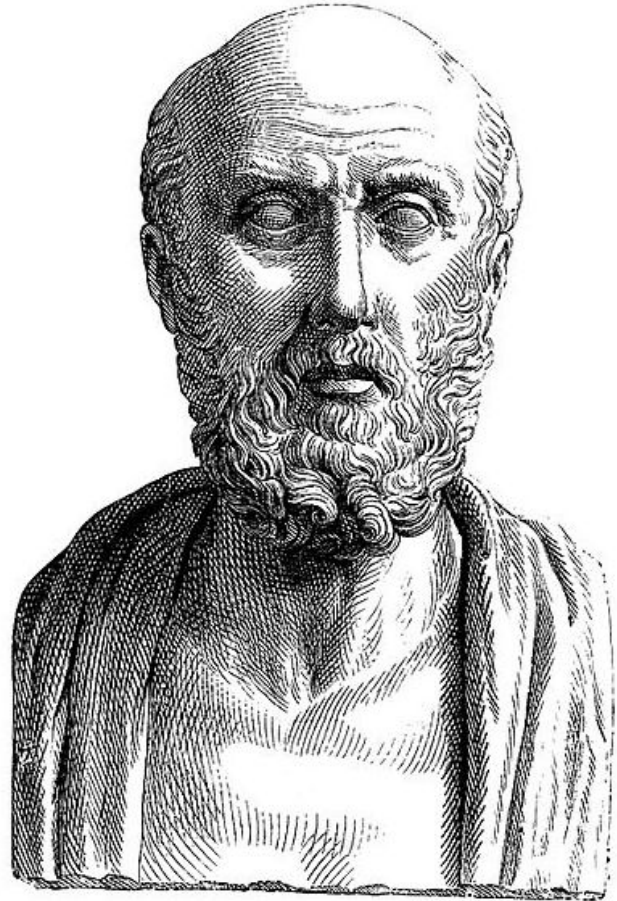


“All disease begins in the gut.”

Hippocrates

c.460 - c.370 BC

*Let food be thy medicine and medicine be thy food.
Life is short, the art long.
Wherever the art of medicine is loved, there is also a love of humanity.*





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< Previous Article Volume 361, No. 9356, p512-519, 8 February 2003 Next Article >

Review

Gut flora in health and disease

Dr Francisco Guarner, MD, PhD, Prof Juan-R Malagelada, MRCP

Altmetric 83

Article
Current Gastroenterology Reports
August 2008, Volume 10, Issue 4, pp 396-403
DOI: [http://dx.doi.org/10.1016/S1526-9892\(08\)00100-0](http://dx.doi.org/10.1016/S1526-9892(08)00100-0)
First online: 16 October 2008

Article Info

Summary Full Text

The human gut microbiome: for future health care

James M. Kinross, Alexander C. von Roon, Elaine Holmes, Aron D. Spector

The human gut is the largest part of these bacterial populations. Resident bacteria on a host's gut microflora influence nutrient metabolism, important for protection of the host and essential for the development of the immune system and inflammatory diseases.

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All About Flora: How Imp Health Really Is

Don't be grossed out – those little guys living in your gut are your friends.

aps American Physiological Society

Physiological Reviews

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Gut Microbiota in Health and Disease

Inna Sekirov, Shannon L. Russell, L. Caetano M. Antunes, B. Brett Finlay

Physiological Reviews Published 1 July 2010 Vol. 90 no. 3

Article Figures & Data Info

Abstract

Gut microbiota is an assortment of microorganisms inhabiting the mammalian gastrointestinal tract. The composition of this microflora evolves throughout an individual's lifetime and is susceptible to environmental modifications. Recent renewed interest in the structure and function of its central position in health and disease. The microbiota is intimately linked to normal host physiology, from nutritional status to behavior and can be a central or a contributing cause of many diseases, affecting various systems. The overall balance in the composition of the gut microbiota is essential for health and disease.

HUMAN MICROBIOME JOURNAL

2400 years later, we are still discovering of the importance of gut function

Abstract

In their intestine, humans possess an "extended genome" of millions of bacteria. Because this complex symbiosis influences host metabolism and gene expression, it has been proposed that humans are complex biological systems. Microbiologic analysis and systems biology are now beginning to implicate the etiology of localized intestinal diseases such as the irritable bowel syndrome, Crohn's disease, and colon cancer. These approaches also suggest possible links between previously unassociated systemic conditions such as type 2 diabetes and the intestinal microbiome. This review summarizes the research that is defining our understanding of the human microbiome, highlights future areas of research in gastroenterology and human health in which the intestinal microbiome will play a significant role.





The Gut has Many Different Functions

- 70% of our **immune** system
- Approximately 80% of the **neurotransmitters**
- **Absorptive surface area** of the gut is vast – similar in size to a tennis court
- The bacteria in the gut have about **100x more genetic information** than that of the entire human genome
- Microbiota in the gut is a complex **ecosystem** with effects on other body systems
 - These bacteria have the ability to synthesize:
 - Vitamins (B-vitamins, vitamin K)
 - Neurotransmitters (serotonin, GABA, dopamine)
 - Enzymes (beta-glucuronidase)

What we'll cover today...

- ✔ **What is Hypochlorhydria?**
 - ▽ **Potential Side Effects of PPIs**
 - ▽ **Strategies to Increase Stomach Acid**
 - ▽ **Empirical Testing Protocol for using Betaine HCl**
- ✔ **Bile Acid Insufficiency**
- ✔ **Pancreatic Exocrine Insufficiency**
- ✔ **Specialty Diagnostics for Gut Function**



What is Hypochlorhydria?



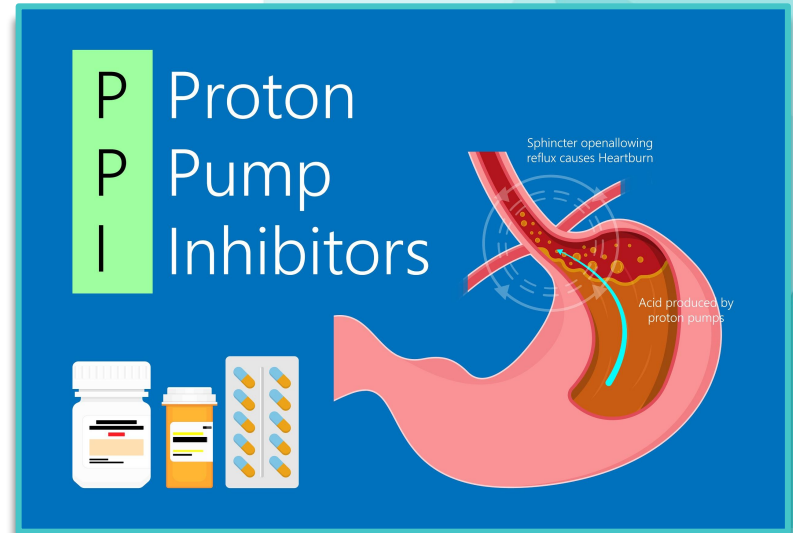
Hypochlorhydria/Achlorhydria

- ✔ Low stomach acid/Absence of stomach acid
- ✔ Gastric pH of <3.0 is normal
- ✔ Gastric pH of >7 is achlorhydria
- ✔ Linked to Proton Pump Inhibitor (PPI) and H₂ blocker use
- ✔ PPIs dysregulate the signaling mechanism behind HCl production



Potential Side Effects of PPIs

- ❑ Dementia
- ❑ Stroke
- ❑ Myocardial Infarction
- ❑ Chronic Kidney Disease
- ❑ Colitis - C diff, Salmonella, Campylobacter
- ❑ Microscopic colitis
- ❑ Osteoporosis and hip fractures
- ❑ SIBO
- ❑ Spontaneous bacterial peritonitis
- ❑ Anemia
- ❑ Hepatic encephalopathy
- ❑ Pneumonia



Targownik L. Discontinuing Long-Term PPI Therapy: Why, With Whom, and How? **Am J Gastroenterol.** 2018 Apr;113(4):519-528. doi: 10.1038/ajg.2018.29. Epub 2018 Mar 20. PMID: 29557943.



Causes of hypochlorhydria

- ✔ Long-term use of antacids
- ✔ Aging
- ✔ Chronic stress
- ✔ Hypothyroidism
- ✔ Pernicious anemia
- ✔ *Helicobacter pylori* infection
- ✔ Zinc deficiency
- ✔ Gastric bypass surgery



Consequences of hypochlorhydria

- ✔ An inadequate level of stomach acid (regardless of cause) is likely to result in a number of nutritional and digestive issues
- ✔ Decreased gastric acid prevents adequate protein breakdown → limits access to certain proteases → poor protein digestion and increased food allergies
- ✔ Low acid → reduced absorption of key micronutrients (e.g. calcium, iron, folic acid, vitamins B6, and B12)
- ✔ Gastric acid prevents growth of harmful ingested microorganisms and hinders SIBO



Symptoms of hypochlorhydria

- ✔ bloating and burping
- ✔ diarrhea
- ✔ gas
- ✔ hair loss
- ✔ heartburn and early satiety
- ✔ intestinal infections
- ✔ nausea while taking supplements
- ✔ nutrient deficiencies, including deficiencies in iron and vitamin B-12
- ✔ undigested food in the stool
- ✔ upset stomach
- ✔ weak fingernails



Hypochlorhydria is linked to other medical conditions

- ✔ allergies
- ✔ anemia
- ✔ asthma
- ✔ autoimmune disorders
- ✔ skin problems, including acne and psoriasis



Diagnosing achlorhydria

- Antiparietal and anti-intrinsic factor antibody
- Biopsy of stomach
- Gastric pH monitoring
- Serum pepsinogen level (a low serum pepsinogen level indicates achlorhydria)
- Serum gastrin levels (high serum gastrin levels greater than 500 to 1000 pg/mL may indicate achlorhydria)
- Tests for detecting *H. pylori* infection (urea breath test, stool antigen test, biopsy, polymerase chain reaction-PCR or fluorescent in situ hybridization [FISH])
- Hemoglobin level



Strategies to Increase Stomach Acid

- ✔ **Stress Management**
- ✔ **Address nutrient deficiencies**
- ✔ **Treat h pylori if present**
- ✔ **Digestive Bitters**
- ✔ **Apple Cider Vinegar**
- ✔ **Betaine HCl**



Empirical Testing Protocol for Using Betaine HCl



Special Considerations

- ✔ Patients experiencing burning, tingling, or other uncomfortable sensations can neutralize acid with 1 tsp aluminum-free baking soda in water or milk.
- ✔ Smaller meals require less betaine HCl
- ✔ Every time a warming sensation or discomfort occurs, this indicates weaning off the dose by one capsule until no supplementation is required.



Precautions

- ❑ Betaine HCl/pepsin is contraindicated in peptic ulcer disease
- ❑ Betaine HCl should not be taken on an empty stomach, only with meals
- ❑ Betaine HCl can irritate sensitive tissue and be corrosive to teeth; therefore, capsules should never be emptied into food or dissolved in beverages



Bile Acids

- ✔ Bile is an emulsifying agent that breaks fat into smaller molecules
- ✔ Bile is manufactured in the liver, stored in the gallbladder and secreted into the duodenum, particularly after high fat meals.



Bile has many functions

- ✔ Bile lubricates the small intestines and stool. Less lubrication can result in constipation and too much can lead to diarrhea.
- ✔ Bile also transports toxins out of the liver into the feces, and keeps everything flowing.
- ✔ If bile is not continually being produced and flowing, cholesterol stones can result.
- ✔ Fat soluble vitamins, like vitamins A, D, E and K can only be broken down in the body if there is adequate bile.



Bile Acid Insufficiency



Causes of Bile Acid Insufficiency

- ✔ Biliary obstructions
- ✔ Gallbladder surgery
- ✔ Liver disease
- ✔ Genetic mutations
- ✔ Bacterial overgrowth



Common Signs of Bile Acid Insufficiency

- ❑ Incomplete digestion/absorption of fats
- ❑ Fat soluble nutrient deficiencies
- ❑ Steatorrhea
- ❑ Diarrhea
- ❑ Abdominal discomfort, bloating and flatulence
- ❑ Edema
- ❑ Bleeding tendency (vitamin K deficiency)
- ❑ Weight loss
- ❑ Failure to thrive in children
- ❑ Burping a taste of bacon or onions 1-4 hours after ingestion
- ❑ Musculoskeletal pain mid-thoracic
- ❑ Heartburn



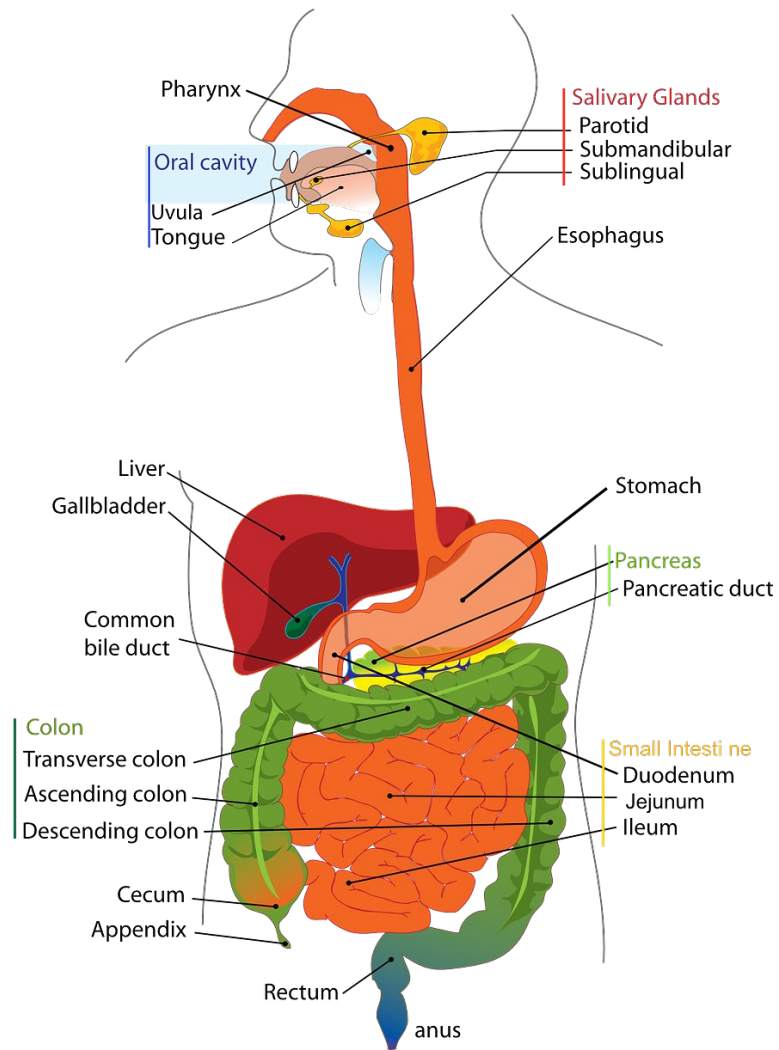
How to support healthy bile flow

- ✔ Proper hydration is essential for liver detoxification and bile production.
- ✔ Bitter foods are great at stimulating bile production - dark green leafy vegetables, beetroot, artichokes and pickles.
- ✔ Drinks such as roasted dandelion root tea, lemon tea, celery juice and coffee all stimulate bile production.
- ✔ Swedish bitters 10-15 minutes before each meal.
- ✔ Regular meal times and meals that contain fats will also insure your bile production is stimulated.
- ✔ Herbs & Spices: triphala, hibiscus, fenugreek seeds, cinnamon stick, turmeric, ginger
- ✔



Pancreatic Exocrine Insufficiency





Causes of Pancreatic Insufficiency

- ✓ Toxic burden
- ✓ Nutritional imbalances
- ✓ Gastric pH imbalances
- ✓ Bacterial overgrowth, parasitic infections
- ✓ Food allergies
- ✓ Chronic gut inflammation (IBD, celiac disease)
- ✓ Dysbiosis



Signs of Pancreatic Insufficiency

- ✓ Diarrhea
- ✓ Abdominal discomfort and distention
- ✓ Flatulence
- ✓ Weight loss
- ✓ Failure to thrive in children
- ✓ Glucose intolerance
- ✓ Steatorrhea (foul smelling and greasy stools)



Who's at Risk for PEI?

- ✔ Cystic fibrosis
- ✔ Pancreatic cancer
- ✔ Untreated celiac disease
- ✔ Diabetes
- ✔ Chronic pancreatitis or history of pancreatic surgery
- ✔ Inflammatory bowel disease
- ✔ Aging
- ✔ Obesity





GI *fx* **GI Effects**
Stool Profiles



Specialty Laboratory Diagnostics for Gut Function:

The GI Effects Comprehensive Stool Profile



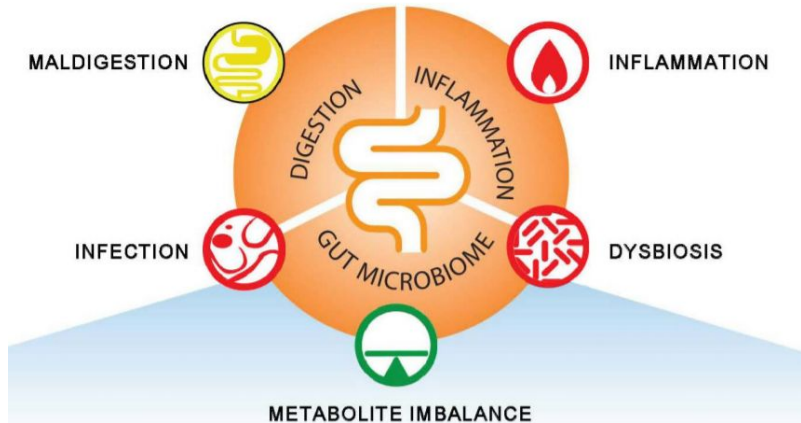
Overview

- The importance of gut function
- The D-I-G framework for gut health assessment
- Stool biomarker review



Assessment of Gut Function: D-I-G Provides the Framework

D	Digestion/Absorption
I	Inflammation/Immune response
G	Gut microbiome (infection, metabolic imbalance, dysbiosis)



GENOVA
DIAGNOSTICS

3425 Corporate Way
Duluth, GA 30096

GI Effects
Stool Profiles

Patient: **SAMPLE PATIENT**
DOB: _____
Sex: _____
MRN: _____

2200 GI Effects™ Comprehensive Profile - Stool Powered by Genova AI

Results Overview

Functional Imbalance Scores

Key <2 : Low Need for Support 2-3 : Optional Need for Support 4-6 : Moderate Need for Support 7-10 : High Need for Support

	Need for Digestive Support	Need for Inflammation Modulation	Need for Microbiome Support	Need for Prebiotic Support	Need for Antimicrobial Support
	5	10	10	0	10
Biomarkers	<ul style="list-style-type: none"> Pancreatic Elastase ▼ Products of Protein Breakdown Fecal Fats 	<ul style="list-style-type: none"> Calprotectin ▲ Eosinophil Protein X ▲ Secretory IgA ● Occult Blood ● 	<ul style="list-style-type: none"> A/D Methane Score ▲ PP Bacteria/Yeast ▲ Reference Variance ● Total Abundance ▲ 	<ul style="list-style-type: none"> Total SCFA's ● n-Butyrate Conc. ▲ SCFA (%) ▲ Beta-glucuronidase ● 	<ul style="list-style-type: none"> Parasitic Infection ▲ PP Bacteria/Yeast ▲ Total Abundance ▲ Pathogenic Bacteria ●
Therapeutic Support Options	<ul style="list-style-type: none"> Digestive Enzymes Betaine HCl Bile Salts Apple Cider Vinegar Mindful Eating Habits Digestive Bitters 	<ul style="list-style-type: none"> Elimination Diet/ Food Sensitivity Testing Mucosa Support: Slippery Elm, Alphas, Aloe, DGL, etc. Zinc Carnosine L-Glutamine Quercetin Turmeric Omega 3's GI Referral (if Calpro is Elevated) 	<ul style="list-style-type: none"> Pre-/Probiotics Increase Dietary Fiber Intake Consider SIBO Testing Increase Resistant Starches Increase Fermented Foods Metal Timing 	<ul style="list-style-type: none"> Pre-/Probiotics Increase Dietary Fiber Intake Increase Resistant Starches Increase Fermented Foods Calcium D-Glucarate (for high beta-glucuronidase) 	<ul style="list-style-type: none"> Antibiotics (if warranted) Antimicrobial Herbal Therapy Antiparasitic Herbal Therapy (if warranted) Saccharomyces boulardii

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New York Clinical Lab P# 89218 | Florida Clinical Lab L.C. #000089124

2200C.2

The GI Effects Comprehensive Stool Profile



3425 Corporate Way
Duluth, GA 30096



Patient: **SAMPLE PATIENT**

DOB:
Sex:
MRN:

2200 GI Effects™ Comprehensive Profile - Stool

Powered by Genova AI

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	MALDIGESTION	INFLAMMATION	DYSBIOSIS	METABOLIC IMBALANCE	INFECTION
	5	10	10	0	10
Biomarkers	<ul style="list-style-type: none"> Pancreatic Elastase Products of Protein Breakdown Fecal Fats Digestive Enzymes Betaine HCl Bile Salts Apple Cider Vinegar Mindful Eating Habits Digestive Bitters 	<ul style="list-style-type: none"> Calprotectin Eosinophil Protein X Secretory IgA Occult Blood Elimination Diet Food Sensitivity Testing Mucosa Support Slippery Elm, Athea, Aloe, DGL, etc. Zinc Carnosine L-Glutamine Quercetin Turmeric Omega-3s GI Referral (if Calprotectin is Elevated) 	<ul style="list-style-type: none"> ADI/Methane Score PP Bacteria/Yeast Reference Variance Total Abundance Pre-Probiotics Increase Dietary Fiber Intake Consider SIBO Testing Increase Resistant Starches Increase Fermented Foods Meal Timing 	<ul style="list-style-type: none"> Total SCFAs n-Butyrate Conc. SCFA (%) Beta-glucuronidase Pre-Probiotics Increase Dietary Fiber Intake Increase Resistant Starches Increase Fermented Foods Calcium D-Glucarate (for high beta-glucuronidase) 	<ul style="list-style-type: none"> Parasitic Infection PP Bacteria/Yeast Total Abundance Pathogenic Bacteria Antibiotics (if warranted) Antimicrobial Herbal Therapy Antiparasitic Herbal Therapy (if warranted) Saccharomyces boulardii

Page 2

You

Microbiome Overgrowth

compared to a healthy individual

distance may indicate

Notes: Genova's data analysis identifies the development of unique dysbiosis profiles as key physiologic disruptions, including dysregulation and inflammation. This may represent dysbiotic profiles that could pose clinical significance. Genova's published literature for *Helicobacter* and *Blautia* commensal profile in this zone with profiles associated with inflammation or immunosuppression. If biomarkers are present, other factors should be excluded, such as infection, immunosuppression, or more serious pathology.

Pattern of bacteria in this zone with profiles associated with inflammation or immunosuppression. If biomarkers are present, other factors should be excluded, such as infection, immunosuppression, or more serious pathology.

Results in this zone may have more clinical significance compared to those in zone 4. Mensural abundance is usually used for antimicrobial therapy. Patients in this zone may have pathogenic infections.

Page 3

all Bacteria (PCR) that are individual.

Pattern of bacteria in this zone with profiles associated with inflammation or immunosuppression. If biomarkers are present, other factors should be excluded, such as infection, immunosuppression, or more serious pathology.

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Page 4

Reference Range

- >200 mcg/g
- 1.8-9.9 micromol/g
- 3.2-38.6 mg/g
- 0.3-2.8 mg/g
- 1.2-29.1 mg/g
- 0.4-4.8 mg/g
- 0.2-6.9 mg/g

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Page 5

Reference Range

CRU/g stool

- 3.4E8-1.5E9
- <=2.2E9
- <=1.6E8
- <=8.0E7
- 1.4E5-1.6E7
- <=3.2E7
- 5.5E3-5.9E5
- 1.7E8-1.5E10
- <=1.2E8
- 5.8E7-4.7E9
- 8.3E6-5.2E9
- 4.2E5-1.3E8
- 1.3E8-1.2E10
- 0.5E7-1.6E9
- 1.2E5-5.5E7
- <=4.4E9
- <=7.2E8
- 1.4E7-1.9E9
- <=1.8E7
- 9.0E4-4.6E7
- <=5.5E7
- <=6.6E7
- <=2.4E5
- >=1.2E6

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Page 6

Category are those that are recognized as

category are considered in heavy growth. Category have a well literature and are present in the culture.

4+

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Page 7

Generation Sequencing

ected Result

- Detected
- Detected
- Detected
- Detected
- Detected
- Detected

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Page 9

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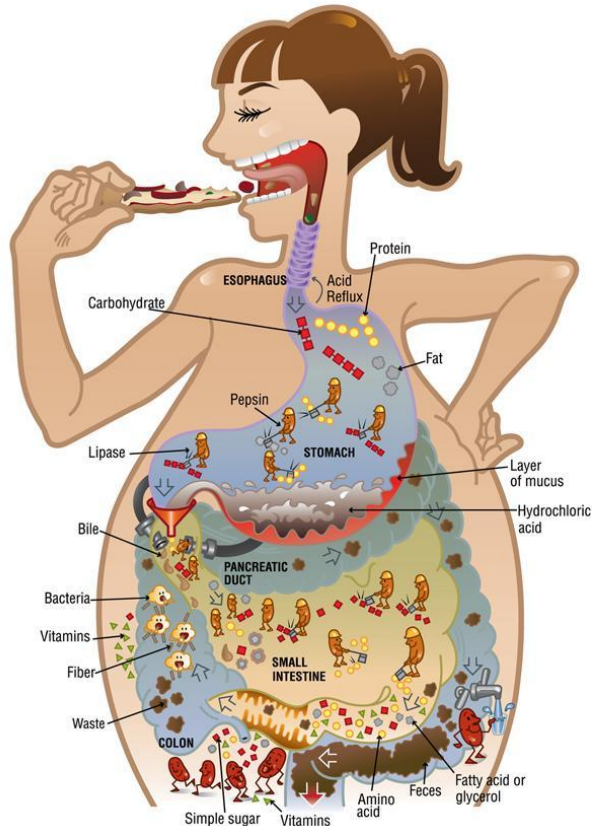


Functional Imbalance Scores

- A way of **prioritizing** results with the most significance
- “**Therapeutic Support Options**” are shown on the report

Functional Imbalance Scores					
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	Need for Digestive Support	Need for Inflammation Modulation	Need for Microbiome Support	Need for Prebiotic Support	Need for Antimicrobial Support
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D – Digestion and Absorption



Need for Digestive Support

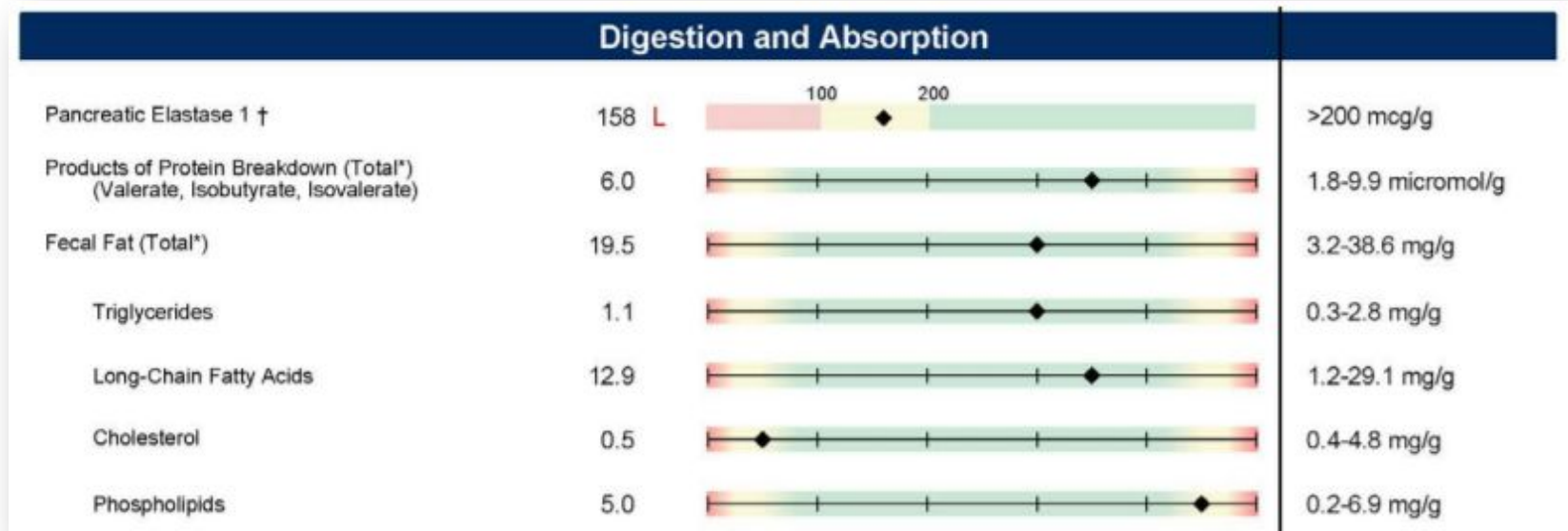
MALDIGESTION

5

Pancreatic Elastase ▼
Products of Protein Breakdown ●
Fecal Fats ●

- Digestive Enzymes
- Betaine HCl
- Bile Salts
- Apple Cider Vinegar
- Mindful Eating Habits
- Digestive Bitters

D – Digestion and Absorption



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Cynthia Libert, M.D.

Caring for the Body, PLLC
1998 Hendersonville Rd
Suite 24
Asheville, NC 28803

(828)490-1545

Caringforthebody.org

help@caringforthebody.org

