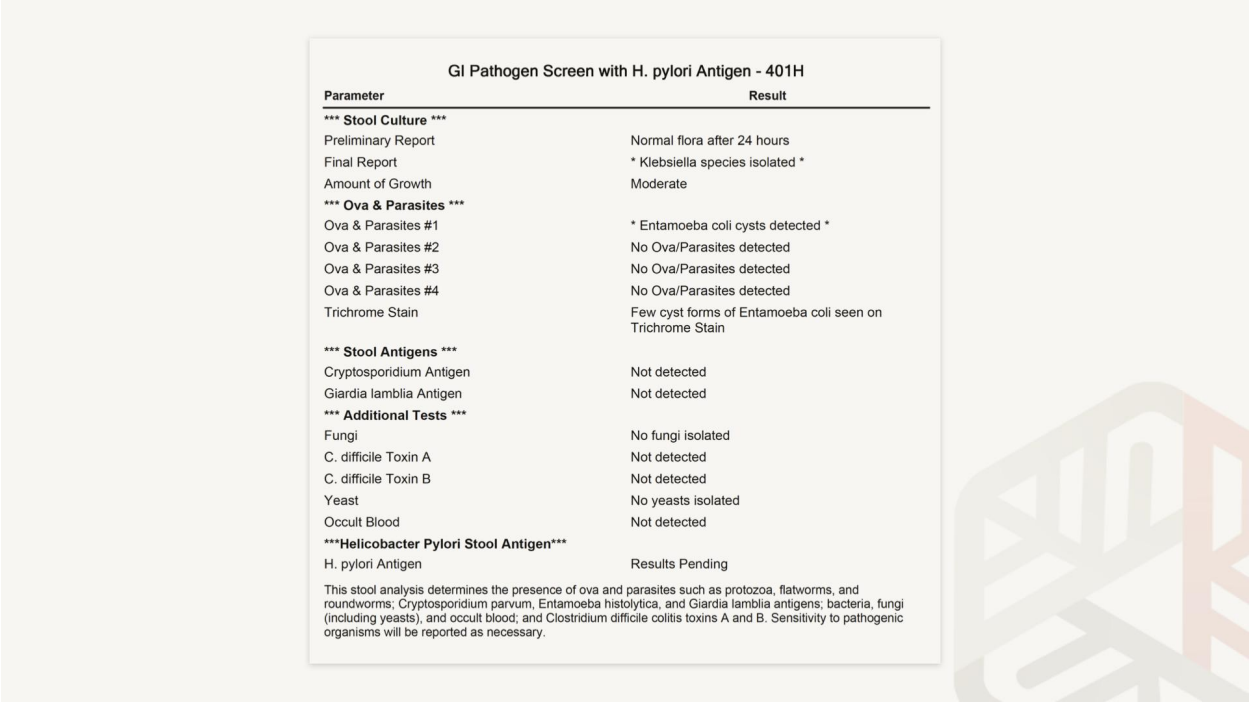
Gut: Stool Testing - Part 6

Tracey O'Shea: In the case where you are suspicious that there is another parasite or there [are] other pathogens that are being missed by a lab, then you may consider retesting with another lab like Parasitology Center in Scottsdale, Arizona. I think that's a good choice for follow-up parasite testing; [it's] run by Dr. Amin, the renowned parasitologist. Excellent methodology. We also use ParaWellness Research Center in Colorado for follow-up testing. So if I really am suspicious that something is missed, I will send it to one of these labs. And a number of times, more often I think that I can count, something has come back on this parasitology test that was missed by a previous lab.

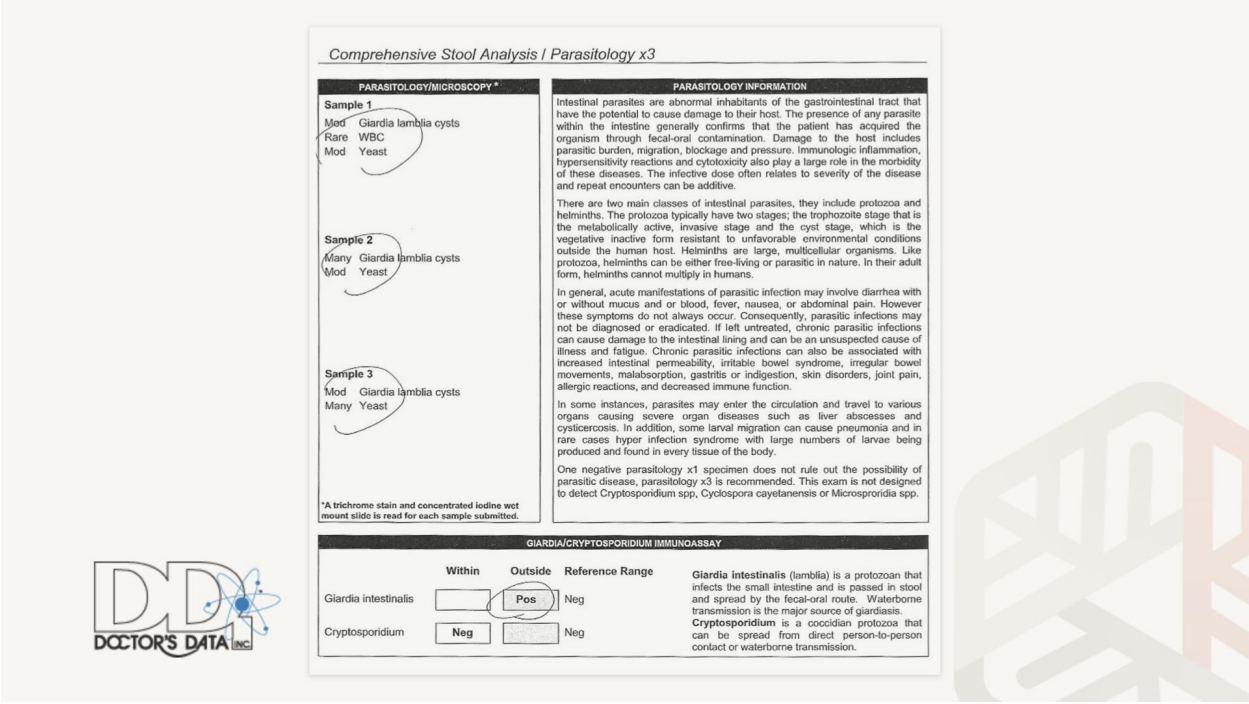


GI Pathogen Screen with H. pylori Antigen - 401H

Parameter	Result
***** Stool Culture *****	
Preliminary Report	Normal flora after 24 hours
Final Report	* Klebsiella species isolated *
Amount of Growth	Moderate
***** Ova & Parasites *****	
Ova & Parasites #1	* Entamoeba coli cysts detected *
Ova & Parasites #2	No Ova/Parasites detected
Ova & Parasites #3	No Ova/Parasites detected
Ova & Parasites #4	No Ova/Parasites detected
Trichrome Stain	Few cyst forms of Entamoeba coli seen on Trichrome Stain
***** Stool Antigens *****	
Cryptosporidium Antigen	Not detected
Giardia lamblia Antigen	Not detected
***** Additional Tests *****	
Fungi	No fungi isolated
C. difficile Toxin A	Not detected
C. difficile Toxin B	Not detected
Yeast	No yeasts isolated
Occult Blood	Not detected
*****Helicobacter Pylori Stool Antigen*****	
H. pylori Antigen	Results Pending

This stool analysis determines the presence of ova and parasites such as protozoa, flatworms, and roundworms; Cryptosporidium parvum, Entamoeba histolytica, and Giardia lamblia antigens; bacteria, fungi (including yeasts), and occult blood; and Clostridium difficile colitis toxins A and B. Sensitivity to pathogenic organisms will be reported as necessary.

While we're on the subject of parasites with controversial or uncertain pathogenicity, we should talk about *Entamoeba coli*. This is also considered by most organizations to be non-pathogenic and commensal. But there are two concerns when you see it. First, it often occurs with other pathogens. And so, like we were talking about with [*Endolimax nana*], you wonder if those pathogens were present, but were missed. And second, *Entamoeba coli* is sometimes confused with *Entamoeba histolytica*, which is a highly pathogenic parasite. So here, you'd follow the same procedure as you did with *Endolimax nana*. You'd consider following up with the Parasitology Center, for example, and retesting, especially if symptoms are consistent with parasite infection and treatment of other gut issues doesn't resolve the symptoms. So keep diving, keep looking.



Comprehensive Stool Analysis / Parasitology x3

PARASITOLOGY/MICROSCOPY *

Sample 1
Mod Giardia lamblia cysts
Rare WBC
Mod Yeast

Sample 2
Many Giardia lamblia cysts
Mod Yeast

Sample 3
Mod Giardia lamblia cysts
Many Yeast

*A trichrome stain and concentrated iodine wet mount slide is read for each sample submitted.

PARASITOLOGY INFORMATION

Intestinal parasites are abnormal inhabitants of the gastrointestinal tract that have the potential to cause damage to their host. The presence of any parasite within the intestine generally confirms that the patient has acquired the organism through fecal-oral contamination. Damage to the host includes parasitic burden, migration, blockage and pressure. Immunologic inflammation, hypersensitivity reactions and cytotoxicity also play a large role in the morbidity of these diseases. The infective dose often relates to severity of the disease and repeat encounters can be additive.

There are two main classes of intestinal parasites, they include protozoa and helminths. The protozoa typically have two stages; the trophozoite stage that is the metabolically active, invasive stage and the cyst stage, which is the vegetative inactive form resistant to unfavorable environmental conditions outside the human host. Helminths are large, multicellular organisms. Like protozoa, helminths can be either free-living or parasitic in nature. In their adult form, helminths cannot multiply in humans.

In general, acute manifestations of parasitic infection may involve diarrhea with or without mucus and or blood, fever, nausea, or abdominal pain. However these symptoms do not always occur. Consequently, parasitic infections may not be diagnosed or eradicated. If left untreated, chronic parasitic infections can cause damage to the intestinal lining and can be an unsuspected cause of illness and fatigue. Chronic parasitic infections can also be associated with increased intestinal permeability, irritable bowel syndrome, irregular bowel movements, malabsorption, gastritis or indigestion, skin disorders, joint pain, allergic reactions, and decreased immune function.

In some instances, parasites may enter the circulation and travel to various organs causing severe organ diseases such as liver abscesses and cysticercosis. In addition, some larval migration can cause pneumonia and in rare cases hyper infection syndrome with large numbers of larvae being produced and found in every tissue of the body.

One negative parasitology x1 specimen does not rule out the possibility of parasitic disease, parasitology x3 is recommended. This exam is not designed to detect Cryptosporidium spp, Cyclospora cayetanensis or Microsproridia spp.

GIARDIA/CRYPTOSPORIDIUM IMMUNOASSAY

	Within	Outside	Reference Range
Giardia intestinalis		Pos	Neg
Cryptosporidium	Neg		Neg

Giardia intestinalis (lamblia) is a protozoan that infects the small intestine and is passed in stool and spread by the fecal-oral route. Waterborne transmission is the major source of giardiasis.
Cryptosporidium is a coccidian protozoa that can be spread from direct person-to-person contact or waterborne transmission.

DOCTOR'S DATA INC

Giardia is another common parasite. It can be detected with standard ova and parasite stool techniques or by immunoassay, which detects antigens on the surface of the *Giardia* organism. So that's a stool antigen test, essentially. The immunoassay or antigen detection is preferred because of the variability and concentration of organisms in the stool. Now that we have [polymerase chain reaction] (PCR) testing, that can also be a preference over the culturing. *Giardia* can be difficult to diagnose with standard ova and parasite techniques because it could be patchy and the concentrations can be off. As you can see in this case, this is a Doctor's Data stool analysis, parasitology times three. Both the ova and parasite test under a microscope test and the antigen test were positive. So that's a pretty significant positive when you have multiple methodologies confirming [the] presence of that pathogen.

Giardia is found on surfaces or in soil, food, or water that has been contaminated with feces from infected humans or animals. It's protected by an outer shell that allows it to survive outside the body for long periods of time, and it makes it pretty tolerant to even chlorine disinfectant. It's [a] very similar route of transmission to *Blastocystis hominis,* and most infections with *Giardia* are typically self-limiting. But both reinfection and chronic infection do occur and can happen. The clinical presentation can range from asymptomatic to debilitating symptoms like severe diarrhea. Unlike Blasto, the pathogenicity of *Giardia* is not particularly controversial. Most authorities believe it should be treated when it's discovered.

List of **long-term complications**

Ocular pathologies
Choroiditis, retinal hemorrhage

Arthritis
Reactive arthritis, inflammatory osteoarthritis

Allergies
Food allergies (cow's milk), urticaria

Muscular complications
Myopathy

Nutritional deficiencies
Malabsorption, failure to thrive, stunted growth

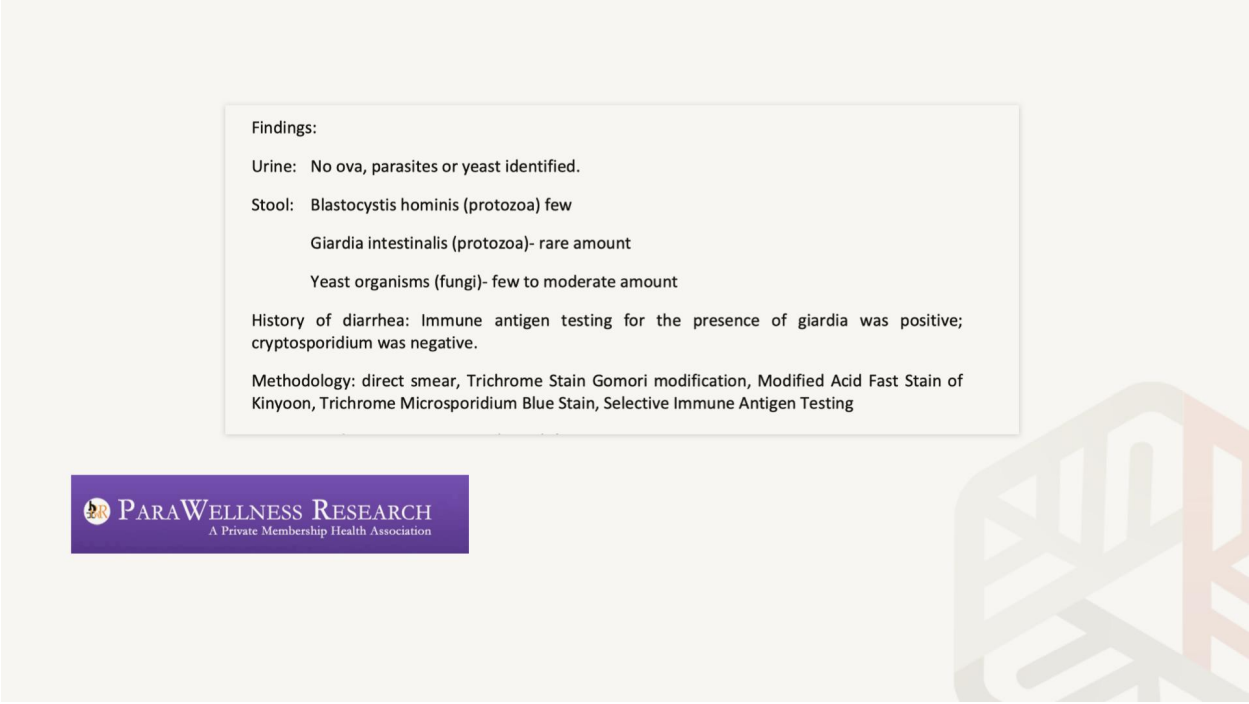
Chronic fatigue syndrome
Impaired cognitive function

Functional GI disorders
IBS, functional dyspepsia

Cancer
Associated by some reports

Recent research has shown that *Giardia* can cause long-term consequences even after it's been successfully treated. And this is also true of other gut pathogens, as we discovered earlier with *Campylobacter* and viruses that cause gastroenteritis. These include ocular or eye pathologies like corditis and retinal hemorrhage, arthritis, particularly reactive arthritis, which is an autoimmune form, but also inflammatory osteoarthritis allergies, including food allergies, particularly cow's milk, due to disruption of gut barrier function and [urticaria]. Muscular complications like myopathy, nutritional deficiencies, malabsorption, failure to thrive and stunted growth, chronic fatigue syndrome, impaired cognitive function, and functional GI disorders like IBS and functional dyspepsia [can also occur]. There are also some reports suggesting that parasite infection may be associated with cancer.

So one of the analogies I sometimes use is if a patient has a parasite, you first have to treat the parasite, but that's often just the beginning of what needs to be done. So it's like if someone gets stabbed, you don't have to just pull out the knife. There's still going to be a lot of work to be done in the healing process after the knife has been removed.



Findings:

Urine: No ova, parasites or yeast identified.

Stool: Blastocystis hominis (protozoa) few

Giardia intestinalis (protozoa)- rare amount

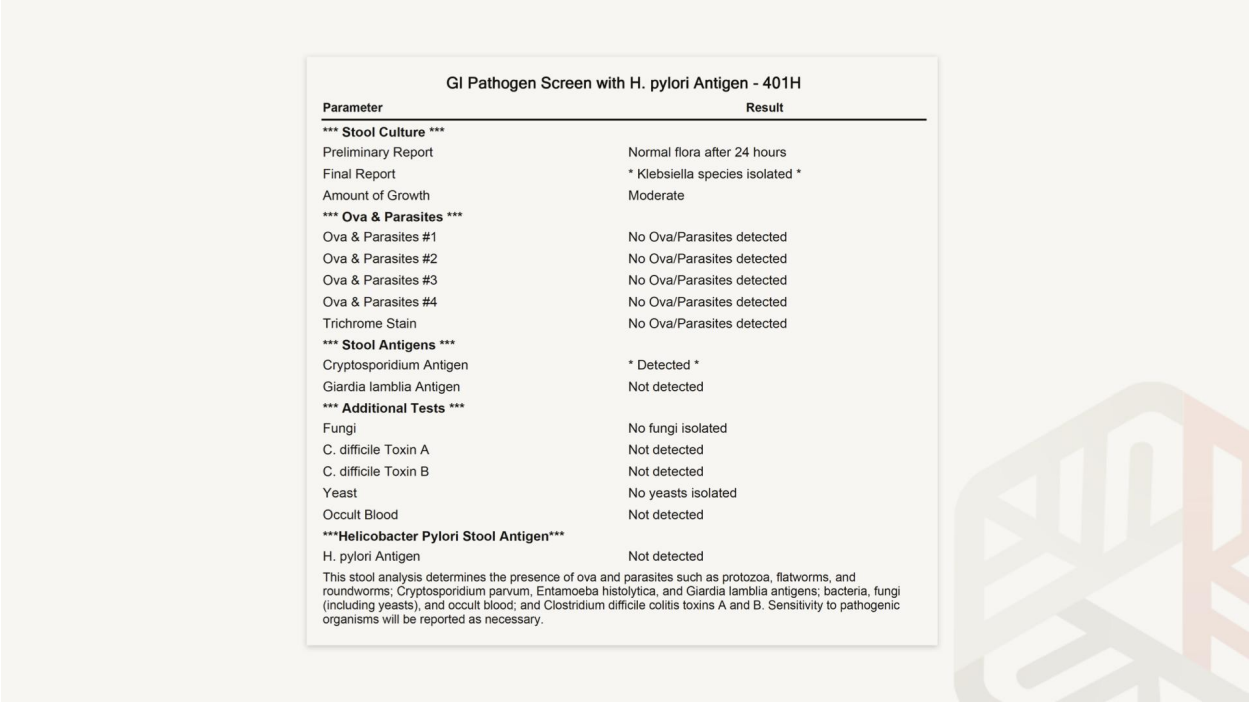
Yeast organisms (fungi)- few to moderate amount

History of diarrhea: Immune antigen testing for the presence of giardia was positive; cryptosporidium was negative.

Methodology: direct smear, Trichrome Stain Gomori modification, Modified Acid Fast Stain of Kinyoon, Trichrome Microsporidium Blue Stain, Selective Immune Antigen Testing

ParaWellness Research
A Private Membership Health Association

Here's an example from ParaWellness Research showing *Giardia*, *Blasto*, and yeast under microscopy with direct smear and trichrome stain. So this is just an example of what the ParaWellness Research looks like so you can see how they report it.



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Ova & Parasites #4	No Ova/Parasites detected
Trichrome Stain	No Ova/Parasites detected
***** Stool Antigens *****	
Cryptosporidium Antigen	* Detected *
Giardia lamblia Antigen	Not detected
***** Additional Tests *****	
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C. difficile Toxin A	Not detected
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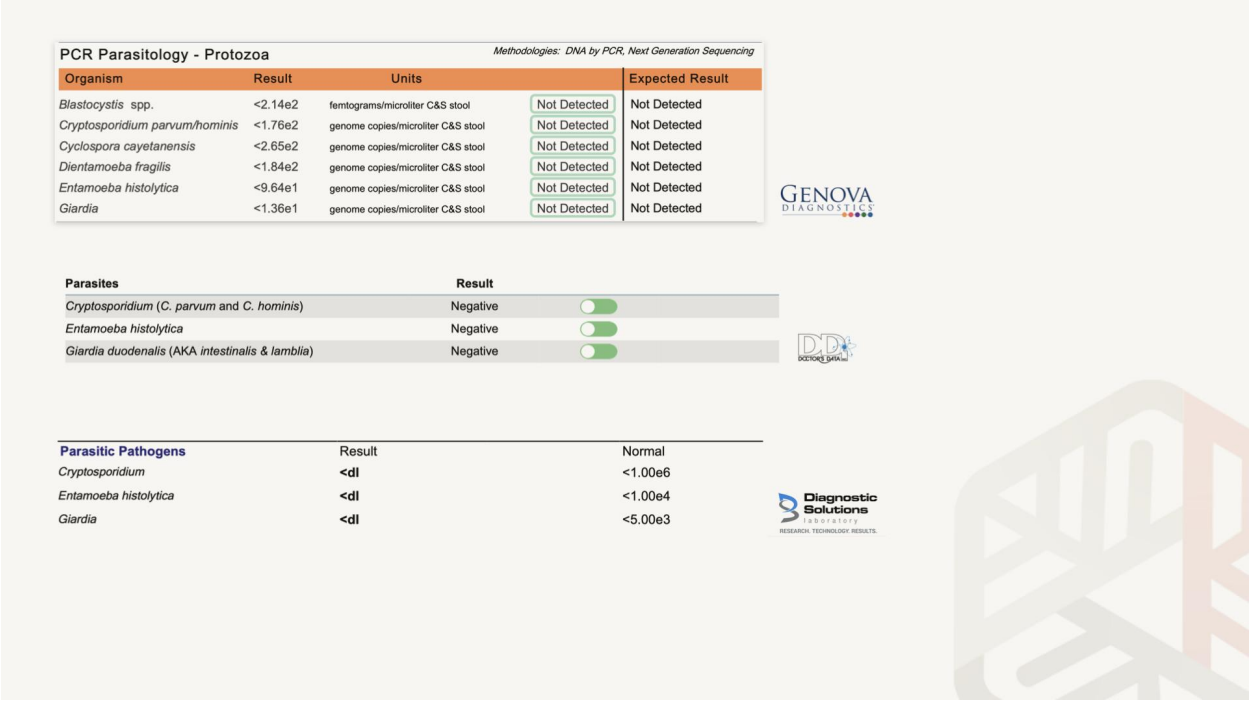
Next up is a parasite called *Cryptosporidium*; we'll call it Crypto for short. Many species of Crypto infect animals, and there are fewer that actually infect humans. *Cryptosporidium parvum* is the most common species that affects humans. It's protected by an outer shell that allows it to survive

outside the body for long periods of time and makes it tolerant to chlorine disinfectant. It can be spread in several different ways, including drinking water and recreational water being the most common, and it's the leading cause of waterborne diseases among humans in the [United States]. Symptoms are similar to other parasites. Watery diarrhea is common with Crypto in the acute phase, and it can be serious and even life-threatening in people that are immunocompromised.

[It's] often self-limiting, but reinfection and chronic infection are possible. It typically infects the small intestine, but it can also colonize areas of the digestive tract or the respiratory tract. Like other parasites, Crypto may be found in soil, food, water, or surfaces that can be contaminated with feces from infected humans or animals. And the type of Crypto that affects dogs and cats is not the same as the one that affects humans. But there is some evidence of transmission between dogs, cats, and humans and vice versa.



PCR Parasitology - Protozoa

Methodologies: DNA by PCR, Next Generation Sequencing

Organism	Result	Units		Expected Result
Blastocystis spp.	<2.14e2	femtograms/microliter C&S stool	Not Detected	Not Detected
Cryptosporidium parvum/hominis	<1.76e2	genome copies/microliter C&S stool	Not Detected	Not Detected
Cyclospora cayetanensis	<2.65e2	genome copies/microliter C&S stool	Not Detected	Not Detected
Dientamoeba fragilis	<1.84e2	genome copies/microliter C&S stool	Not Detected	Not Detected
Entamoeba histolytica	<9.64e1	genome copies/microliter C&S stool	Not Detected	Not Detected
Giardia	<1.36e1	genome copies/microliter C&S stool	Not Detected	Not Detected

GENOVA DIAGNOSTICS

Parasites	Result
Cryptosporidium (*C. parvum* and *C. hominis*)	Negative
Entamoeba histolytica	Negative
Giardia duodenalis (AKA *intestinalis* & *lamblia*)	Negative

D.D DOCTOR'S DATA

Parasitic Pathogens	Result	Normal
Cryptosporidium	**<dl**	<1.00e6
Entamoeba histolytica	**<dl**	<1.00e4
Giardia	**<dl**	<5.00e3

Diagnostic Solutions Laboratory
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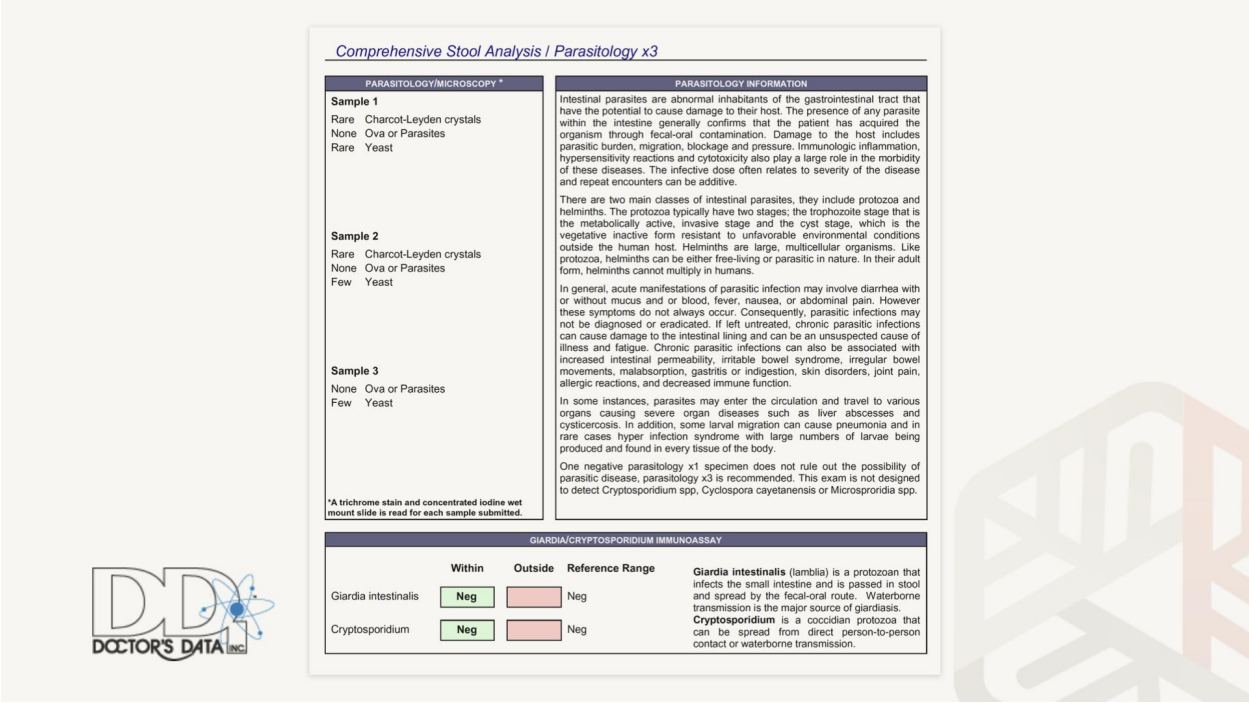
Let's talk about some test results and how Crypto is reported. So the immunoassay detection of antigen on [the] surface of Crypto was historically the most sensitive technique, and it was more reliable than acid-fast stain. In fact, the direct [fluorescent] antibody (DFA) technique was 99 percent sensitive, with almost no false negatives and 100 percent specific, no false positives. PCR testing is now the primary methodology for parasite testing by Doctor's Data, Genova, and [Diagnostic Solutions Laboratory] (DSL). Though Crypto is considered to be self-limiting in immunocompetent individuals, we're not 100 percent sure; I'm still a little suspicious when I see it chronically in people. I've seen patients with positive test results over a significant period of time.

So [it's] possible that they're being reinfected. It's also possible that it can take a chronic form. I usually will treat this when I see it. Again, taking in the whole picture, what [are] the patient's presentations, what else is going on in the stool test, but I usually opt to treat when I see this.



Comprehensive Stool Analysis / Parasitology x3

PARASITOLOGY/MICROSCOPY *
Sample 1
Rare Charcot-Leyden crystals
None Ova or Parasites
Rare Yeast
Sample 2
Rare Charcot-Leyden crystals
None Ova or Parasites
Few Yeast
Sample 3
None Ova or Parasites
Few Yeast
*A trichrome stain and concentrated iodine wet mount slide is read for each sample submitted.

PARASITOLOGY INFORMATION

Intestinal parasites are abnormal inhabitants of the gastrointestinal tract that have the potential to cause damage to their host. The presence of any parasite within the intestine generally confirms that the patient has acquired the organism through fecal-oral contamination. Damage to the host includes parasitic burden, migration, blockage and pressure. Immunologic inflammation, hypersensitivity reactions and cytotoxicity also play a large role in the morbidity of these diseases. The infective dose often relates to severity of the disease and repeat encounters can be additive.

There are two main classes of intestinal parasites, they include protozoa and helminths. The protozoa typically have two stages; the trophozoite stage that is the metabolically active, invasive stage and the cyst stage, which is the vegetative inactive form resistant to unfavorable environmental conditions outside the human host. Helminths are large, multicellular organisms. Like protozoa, helminths can be either free-living or parasitic in nature. In their adult form, helminths cannot multiply in humans.

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In some instances, parasites may enter the circulation and travel to various organs causing severe organ diseases such as liver abscesses and cysticercosis. In addition, some larval migration can cause pneumonia and in rare cases hyper infection syndrome with large numbers of larvae being produced and found in every tissue of the body.

One negative parasitology x1 specimen does not rule out the possibility of parasitic disease, parasitology x3 is recommended. This exam is not designed to detect Cryptosporidium spp, Cyclospora cayetanensis or Microsproridia spp.

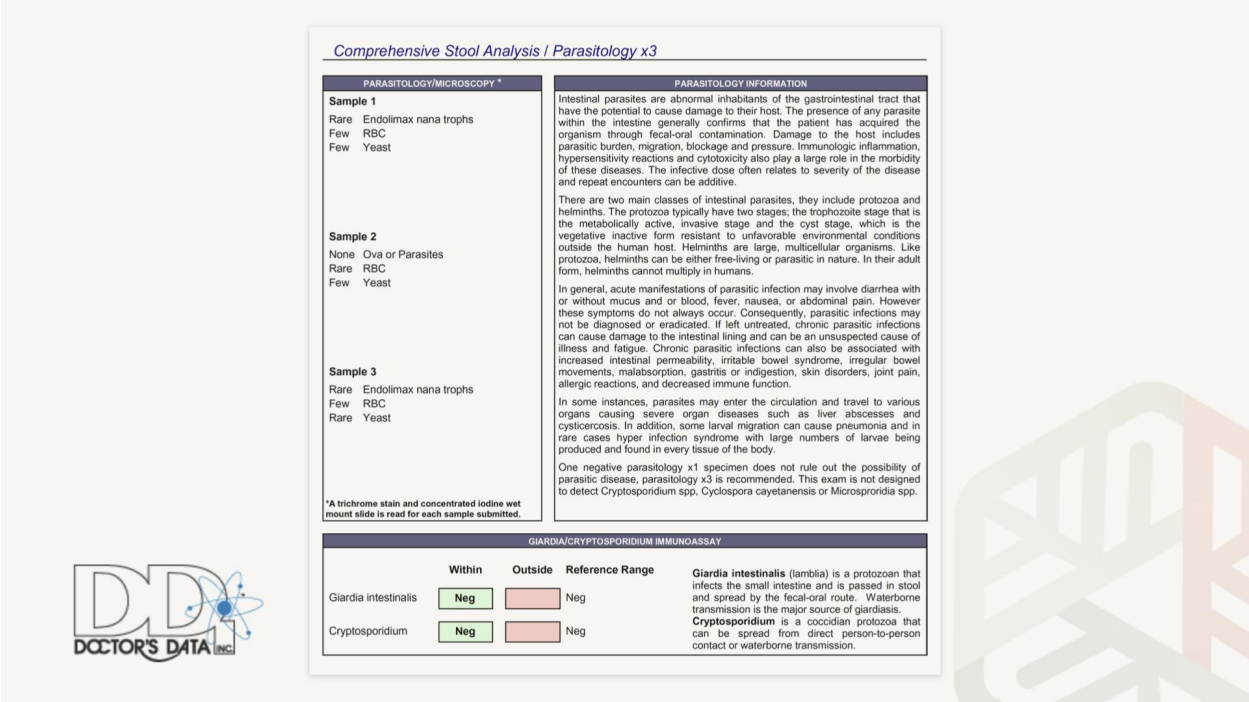
GIARDIA/CRYPTOSPORIDIUM IMMUNOASSAY

	Within	Outside	Reference Range
Giardia intestinalis	Neg		Neg
Cryptosporidium	Neg		Neg

Giardia intestinalis (lamblia) is a protozoan that infects the small intestine and is passed in stool and spread by the fecal-oral route. Waterborne transmission is the major source of giardiasis. **Cryptosporidium** is a coccidian protozoa that can be spread from direct person-to-person contact or waterborne transmission.

DOCTOR'S DATA INC

There are a lot of other parasites you may see beyond what we've covered here. There's lots of good information available online. You can ask me or any of the ADAPT faculty during a Q&A session. In most cases, the treatment is similar or the same for the ones we've discussed so far, and we're going to talk about treatment later in the gut unit. I did want to talk a little bit more about one thing you might see in the parasitology section, and that's Charcot-Leyden crystals. These are formed from the breakdown of eosinophils and may be seen in the stool of patients with parasitic disease. They only indicate an immune response, but the cause may or may not be a parasitic infection. So as you can see here on this test result, these are Charcot-Leyden crystals on two of the three stool samples, but there were no parasites found. So that could mean that there's a parasite present that was missed, or maybe that this is evidence of breakdown of eosinophils that's not caused by a parasite infection. So in this situation, you might want to consider a follow-up test with the specialized parasite labs that we talked about and see if they can find something that originally was missing on this lab.



Comprehensive Stool Analysis / Parasitology x3

PARASITOLOGY/MICROSCOPY *

Sample 1
Rare Endolimax nana trophs
Few RBC
Few Yeast

Sample 2
None Ova or Parasites
Rare RBC
Few Yeast

Sample 3
Rare Endolimax nana trophs
Few RBC
Rare Yeast

***A trichrome stain and concentrated iodine wet mount slide is read for each sample submitted.**

PARASITOLOGY INFORMATION

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Cryptosporidium is a coccidian protozoa that can be spread from direct person-to-person contact or waterborne transmission.

DOCTOR'S DATA INC

The next marker we're going to talk about is red blood cells in the stool. Red blood cells in [the] stool are associated with parasitic or bacterial infections. They're also associated with inflammatory bowel disease [(IBD)] like Crohn's [disease] and ulcerative colitis. So if you see red blood cells in the stool, you'd want to check for invasive gut pathogens like *Shigella*, *Campylobacter*, and *Yersinia*, which can often cause mucosal inflammation and bleeding. This particular result is from a 48-year-old female with ulcerative colitis. And as you can see, she's got red blood cells in all three stool samples and she also had elevated levels of lactoferrin and calprotectin, which we're going to discuss shortly.

Intestinal Health			
Digestion	Result		Normal
Steatocrit	**<dl**		<15 %
Elastase-1	**68**	**Low**	>200 ug/g
GI Markers	Result		Normal
b-Glucuronidase	**2341**		<2486 U/mL
Occult Blood - FIT	**0**		<10 ug/g
Immune Response	Result		Normal
Secretory IgA	**264**	**Low**	510 - 2010 ug/g
Anti-gliadin IgA	**143**		0 - 157 U/L
Inflammation	Result		Normal
Calprotectin	**113**		<173 ug/g

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Digestion and Absorption

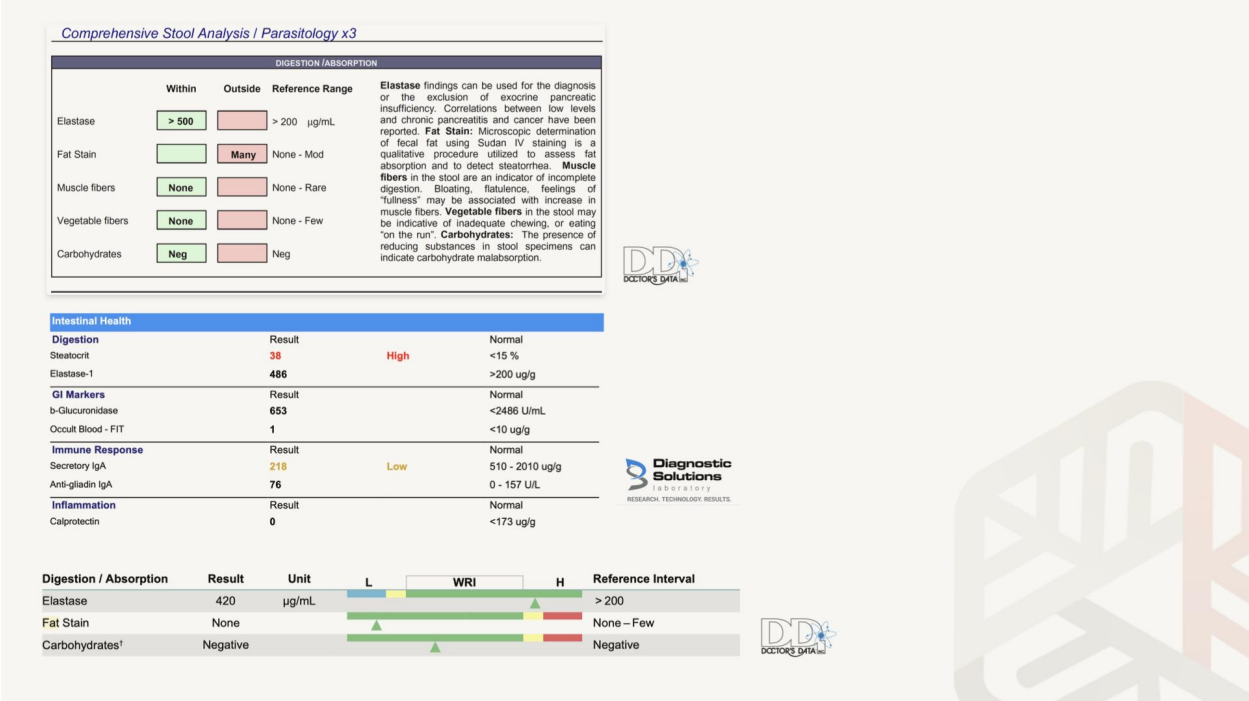
Pancreatic Elastase 1 †	197 L	100 / 200	>200 mcg/g
Products of Protein Breakdown (Total*) (Valerate, Isobutyrate, Isovalerate)	5.5		1.8-9.9 micromol/g
Fecal Fat (Total*)	9.4		3.2-38.6 mg/g
Triglycerides	0.8		0.3-2.8 mg/g
Long-Chain Fatty Acids	6.9		1.2-29.1 mg/g
Cholesterol	1.0		0.4-4.8 mg/g
Phospholipids	0.7		0.2-6.9 mg/g

GENOVA DIAGNOSTICS

The next marker I want to talk about is fecal elastase. Elastase is a pancreatic enzyme that digests and degrades a number of proteins. Low elastase is an indicator of pancreatic exocrine insufficiency. The ranges can vary depending on which test you're using, but I think a good rule of thumb is generally above 500 is representative of normal pancreatic output, 200 to 500 is generally decreased pancreatic output, and less than 200 is considered pancreatic insufficiency. If you have someone less than 100 with fecal elastase, I would really consider it severe impairment and follow up with some testing. A specific marker for pancreatic function, it has a pretty high specificity for small intestinal disease and pancreatic insufficiency caused by chronic pancreatitis, cystic fibrosis, pancreatic tumor, cholelithiasis, or diabetes mellitus. So there's a handful of other chronic conditions that can contribute to pancreatic insufficiency.

Also, we should consider that pancreatic insufficiency could be a risk factor for [small intestinal bacterial overgrowth] (SIBO) and even recurring recalcitrant difficult-to-treat SIBO. This patient with a fecal elastase of 68 is a 48-year-old male with chronic kidney disease, metabolic syndrome, obesity, and chronic reflux. We followed up with the Labcorp fecal elastase that came back in the 400s and amylase and lipase levels that all came back normal. His fecal elastase numbers continued to improve throughout treatment. We do use digestive enzymes, and [hydrochloric acid[support, I think would be important in this patient. But it's always important to rule out a more significant pancreatic disorder first, and I will usually opt with testing [through] Labcorp or Quest for fecal elastase.

The second patient [has] a pancreatic elastase of 197, so it was moderately impaired. She was a 50-year-old female with primary concerns of hypothyroidism and high cholesterol. She also had significant dysbiosis and infections that were being treated, and I would expect this elastase to improve once the underlying imbalances and infections are treated. I often see pancreatic elastase improve, especially if it's moderately to mildly decreased. I think that it does improve pretty quickly with gut treatments.



Comprehensive Stool Analysis / Parasitology x3

DIGESTION /ABSORPTION

	Within	Outside	Reference Range
Elastase	> 500		> 200 µg/mL
Fat Stain		Many	None - Mod
Muscle fibers	None		None - Rare
Vegetable fibers	None		None - Few
Carbohydrates	Neg		Neg

Elastase findings can be used for the diagnosis or the exclusion of exocrine pancreatic insufficiency. Correlations between low levels and chronic pancreatitis and cancer have been reported. **Fat Stain:** Microscopic determination of fecal fat using Sudan IV staining is a qualitative procedure utilized to assess fat absorption and to detect steatorrhea. **Muscle fibers** in the stool are an indicator of incomplete digestion. Bloating, flatulence, feelings of "fullness" may be associated with increase in muscle fibers. **Vegetable fibers** in the stool may be indicative of inadequate chewing, or eating "on the run". **Carbohydrates:** The presence of reducing substances in stool specimens can indicate carbohydrate malabsorption.

DOCTOR'S DATA

Intestinal Health			
Digestion	Result		Normal
Steatocrit	38	High	<15 %
Elastase-1	486		>200 ug/g
GI Markers	Result		Normal
b-Glucuronidase	653		<2486 U/mL
Occult Blood - FIT	1		<10 ug/g
Immune Response	Result		Normal
Secretory IgA	218	Low	510 - 2010 ug/g
Anti-gliadin IgA	76		0 - 157 U/L
Inflammation	Result		Normal
Calprotectin	0		<173 ug/g

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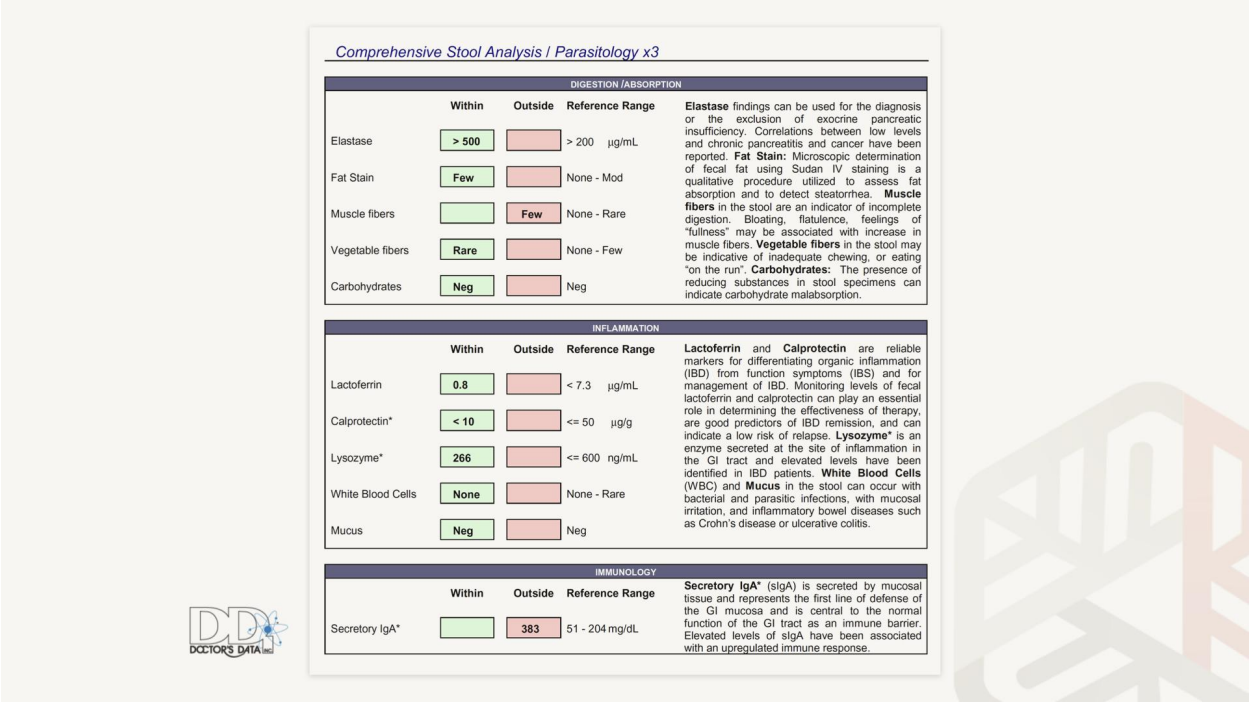
Digestion / Absorption	Result	Unit	L WRI H	Reference Interval
Elastase	420	µg/mL		> 200
Fat Stain	None			None – Few
Carbohydrates†	Negative			Negative

DOCTOR'S DATA

The next marker is the fat stain. This is an indicator of fat malabsorption, which is often secondary to pancreatic or biliary tract disease. So you want to consider the following mechanisms if you see positive fat stain: gastric surgery, pancreatic disease, biliary obstruction, liver disease, or intestinal permeability. Supplementation with pancreatic enzymes, hydrochloric acid, or bile might help. This particular patient is a 21-year-old male with fatigue and depression as the main complaint, and then additional testing revealed significant GI issues like [SIBO], *Cryptosporidium*, and fungal overgrowth. And there may be in fact a connection between bile insufficiency and SIBO. We've also added a few other examples of how this can be reported by other labs. So for example, DSL reports steatocrit levels. You can see in this patient the steatocrit levels are high. This is a 38-year-old female who came to us on a ketogenic diet with chronic fatigue and hormone regulation concerns. We adjusted her diet, supported her gut, and addressed other underlying imbalances and those numbers improved.



Comprehensive Stool Analysis / Parasitology x3

DIGESTION /ABSORPTION

	Within	Outside	Reference Range
Elastase	> 500		> 200 µg/mL
Fat Stain	Few		None - Mod
Muscle fibers		Few	None - Rare
Vegetable fibers	Rare		None - Few
Carbohydrates	Neg		Neg

Elastase findings can be used for the diagnosis or the exclusion of exocrine pancreatic insufficiency. Correlations between low levels and chronic pancreatitis and cancer have been reported. **Fat Stain:** Microscopic determination of fecal fat using Sudan IV staining is a qualitative procedure utilized to assess fat absorption and to detect steatorrhea. **Muscle fibers** in the stool are an indicator of incomplete digestion. Bloating, flatulence, feelings of "fullness" may be associated with increase in muscle fibers. **Vegetable fibers** in the stool may be indicative of inadequate chewing, or eating "on the run". **Carbohydrates:** The presence of reducing substances in stool specimens can indicate carbohydrate malabsorption.

INFLAMMATION

	Within	Outside	Reference Range
Lactoferrin	0.8		< 7.3 µg/mL
Calprotectin*	< 10		<= 50 µg/g
Lysozyme*	266		<= 600 ng/mL
White Blood Cells	None		None - Rare
Mucus	Neg		Neg

Lactoferrin and **Calprotectin** are reliable markers for differentiating organic inflammation (IBD) from function symptoms (IBS) and for management of IBD. Monitoring levels of fecal lactoferrin and calprotectin can play an essential role in determining the effectiveness of therapy, are good predictors of IBD remission, and can indicate a low risk of relapse. **Lysozyme*** is an enzyme secreted at the site of inflammation in the GI tract and elevated levels have been identified in IBD patients. **White Blood Cells** (WBC) and **Mucus** in the stool can occur with bacterial and parasitic infections, with mucosal irritation, and inflammatory bowel diseases such as Crohn's disease or ulcerative colitis.

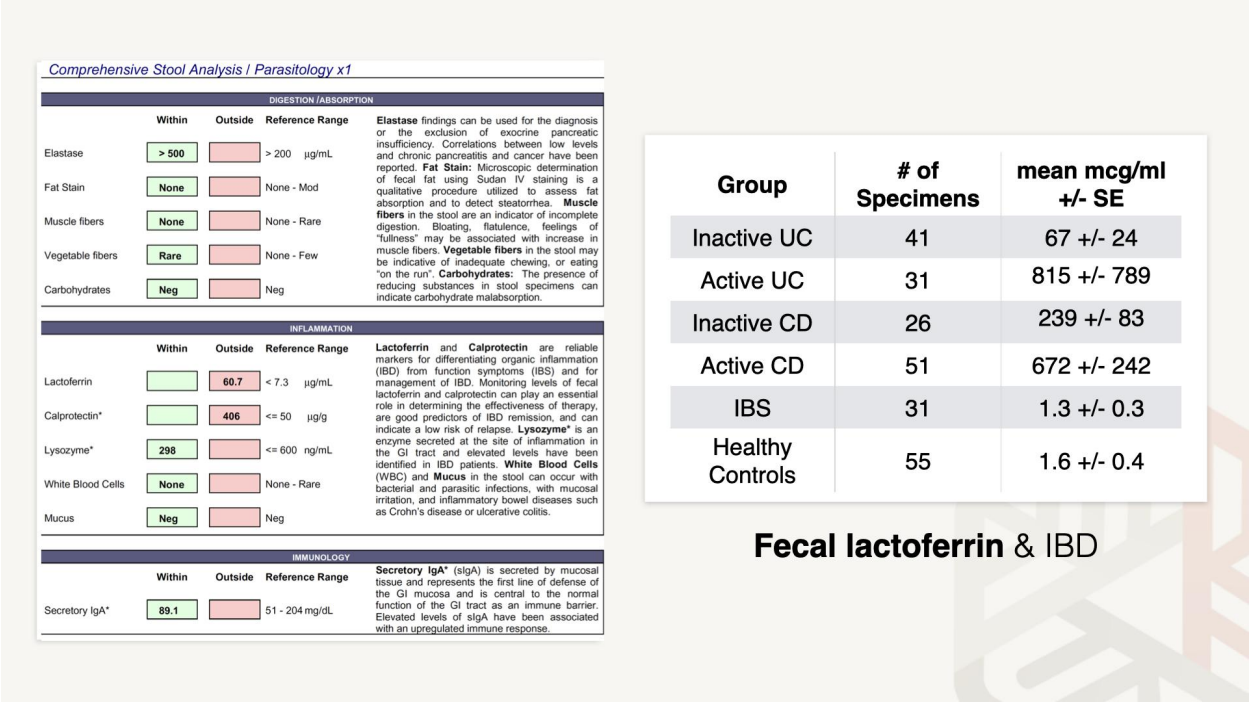
IMMUNOLOGY

	Within	Outside	Reference Range
Secretory IgA*		383	51 - 204 mg/dL

Secretory IgA* (sIgA) is secreted by mucosal tissue and represents the first line of defense of the GI mucosa and is central to the normal function of the GI tract as an immune barrier. Elevated levels of sIgA have been associated with an upregulated immune response.

DOCTOR'S DATA inc

Muscle fibers are an indication of incomplete digestion of protein or not chewing enough. This can suggest hypochlorhydria, which is low stomach acid. So you might want to check to see if the patient is on [proton-pump inhibitors] or acid-suppressing drugs or [has] insufficient digestive enzyme production. Vegetable fibers are also an indicator of inadequate digestion and in this case of carbohydrate, the same causes that we just talked about. And then the carbohydrate marker indicates carbohydrate malabsorption, which can be a risk factor for SIBO, but can also impact SIBO or be an effect of SIBO. In these cases, enzymes and hydrochloric acid are a good choice if it's not contraindicated. This result is a 32-year-old male with [the] main complaint of fatigue and hypothyroidism. So you can see muscle fibers indicating malabsorption, and then a high secretory [immunoglobulin A], among other things that we found within the stool.



Comprehensive Stool Analysis / Parasitology x1

DIGESTION /ABSORPTION

	Within	Outside	Reference Range
Elastase	> 500		> 200 µg/mL
Fat Stain	None		None - Mod
Muscle fibers	None		None - Rare
Vegetable fibers	Rare		None - Few
Carbohydrates	Neg		Neg

Elastase findings can be used for the diagnosis or the exclusion of exocrine pancreatic insufficiency. Correlations between low levels and chronic pancreatitis and cancer have been reported. **Fat Stain:** Microscopic determination of fecal fat using Sudan IV staining is a qualitative procedure utilized to assess fat absorption and to detect steatorrhea. **Muscle fibers** in the stool are an indicator of incomplete digestion. Bloating, flatulence, feelings of "fullness" may be associated with increase in muscle fibers. **Vegetable fibers** in the stool may be indicative of inadequate chewing, or eating "on the run". **Carbohydrates:** The presence of reducing substances in stool specimens can indicate carbohydrate malabsorption.

INFLAMMATION

	Within	Outside	Reference Range
Lactoferrin		60.7	< 7.3 µg/mL
Calprotectin*		406	<= 50 µg/g
Lysozyme*	298		<= 600 ng/mL
White Blood Cells	None		None - Rare
Mucus	Neg		Neg

Lactoferrin and **Calprotectin** are reliable markers for differentiating organic inflammation (IBD) from function symptoms (IBS) and for management of IBD. Monitoring levels of fecal lactoferrin and calprotectin can play an essential role in determining the effectiveness of therapy, are good predictors of IBD remission, and can indicate a low risk of relapse. **Lysozyme*** is an enzyme secreted at the site of inflammation in the GI tract and elevated levels have been identified in IBD patients. **White Blood Cells** (WBC) and **Mucus** in the stool can occur with bacterial and parasitic infections, with mucosal irritation, and inflammatory bowel diseases such as Crohn's disease or ulcerative colitis.

IMMUNOLOGY

	Within	Outside	Reference Range
Secretory IgA*	89.1		51 - 204 mg/dL

Secretory IgA* (sIgA) is secreted by mucosal tissue and represents the first line of defense of the GI mucosa and is central to the normal function of the GI tract as an immune barrier. Elevated levels of sIgA have been associated with an upregulated immune response.

Group	# of Specimens	mean mcg/ml +/- SE
Inactive UC	41	67 +/- 24
Active UC	31	815 +/- 789
Inactive CD	26	239 +/- 83
Active CD	51	672 +/- 242
IBS	31	1.3 +/- 0.3
Healthy Controls	55	1.6 +/- 0.4

Fecal lactoferrin & IBD

Next up in the presentation are inflammatory markers. Let's start with lactoferrin. It's a protein in the transferrin family that's expressed in activated neutrophils. Significantly elevated lactoferrin is a marker of IBD, like Crohn's and ulcerative colitis. So you can see the table on the right of the slide here shows the average level of lactoferrin and inactive ulcerative colitis at around 67. In active ulcerative colitis, it goes up to 815. In active Crohn's, it's around 240, 239. And specifically in active Crohn's disease, it goes up to 672. And then you compare that with functional bowel conditions like IBS, where it's only 1.3. In healthy controls, it's actually 1.6. So you wouldn't expect to see lactoferrin elevated in functional bowel disorders or healthy controls. And when you do see it elevated, it's a pretty specific indicator of [IBD] when it's that high. Remember, these numbers are just averages, so you have to use your critical thinking skills. But really, we're just indicating the major gap in [the] difference between the values.

Its average sensitivity is 80 percent and specificity is 82 percent. One thing to be aware of, though, is that moderately elevated levels of lactoferrin below the levels indicated for the active [IBD] can be a sign of either IBD in remission, or it can just be a general marker for gut inflammation and gut infections. So which one that it points to will depend on other markers, whether calprotectin is also positive or lysozyme [is] positive, and whether you see evidence of gut infections. And I'm going to suggest a treatment or diagnostic algorithm for how to figure this out shortly. But it's important to note that many of the lab companies offer lactoferrin as an add-on. So make sure to double-check the markers that are included in the comprehensive blood test so you can add the lactoferrin if you suspect or know that your patient has IBD. A lot of times,

just calprotectin will come with the standard panel, and you'll want to follow up with lactoferrin or even consider using Labcorp or Quest if you want to try to use insurance.