Nordic Laboratories

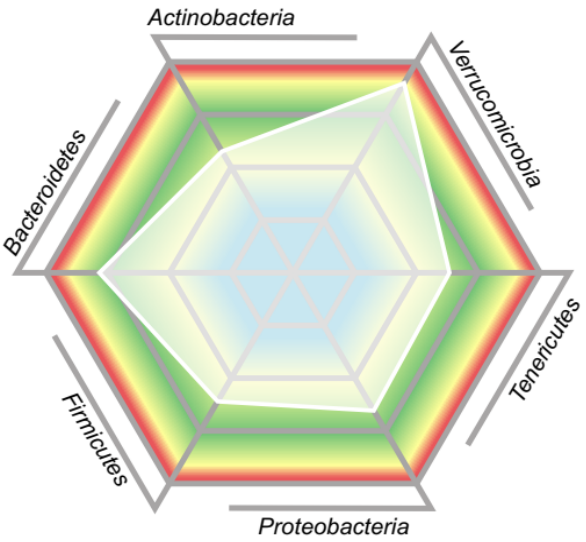
PATIENT:	**Sample Patient**			TEST REF:	**TST-NL-XXXXX**
TEST NUMBER:	T-NL-XXXXX (999999-9999)	COLLECTED:	09/23/2019	PRACTITIONER:	**Sample Doctor**
GENDER:	Male	RECEIVED:	09/26/2019		
AGE:	62	TESTED:	10/10/2019		Sample Clinic, 1234 Main St, Saint Charles, IL60174, U.S.A.

TEST NAME: GI360™

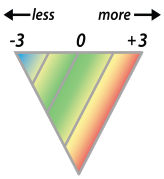
GI360™; stool

Microbiome Abundance and Diversity Summary

The abundance and diversity of gastrointestinal bacteria provide an indication of gastrointestinal health, and gut microbial imbalances can contribute to dysbiosis and other chronic disease states. The GI360™ Microbiome Profile is a gut microbiota DNA analysis tool that identifies and characterizes more than 45 targeted analytes across six Phyla using PCR and compares the patient results to a characterized normobiotic reference population. The web chart illustrates the degree to which an individual's microbiome profile deviates from normobiosis.



LEGEND



The web image shows the relative diversity and balance among bacteria belonging to the six primary Phyla. The white shaded area represents the patient's results compared to a normobiotic reference population. The center of the web represents less abundance while the outer edges represent more than normobiotic.

Dysbiosis Index

The Dysbiosis Index (DI) is a calculation with scores from 1 to 5 based on the overall bacterial abundance and profile within the patient's sample as compared to a reference population. Values above 2 indicate a microbiota profile that differs from the defined normobiotic reference population (i.e., dysbiosis). The higher the DI above 2, the more the sample is considered to deviate from normobiosis.

DI Score

5

Key Findings

Eubacterium siraeum, Very Low	↓	Vegetable fibers, Abnormal
Faecalibacterium prausnitzii, Very Low	↓	*Enterobacter cloacae* complex, Cultured
Phascolarctobacterium spp., Very High	↑	
Actinobacteria, Low	↓	
Alistipes onderdonkii, Low	↓	
Bacteroides zoogleoformans, High	↑	
Bacilli Class, Low	↓	
Akkermansia muciniphila, High	↑	

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Nordic Laboratories

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TEST REF: **TST-NL-XXXXX**
PRACTITIONER:
Sample Doctor

Sample Clinic, 1234 Main St, Saint Charles, IL60174, U.S.A.

TEST NAME: GI360™

Microbiome Bacterial Abundance;Multiplex PCR

LEGEND

-3	-2	-1	0	+1	+2	+3
Very Low	Low	Within Reference Interval			High	Very High

Results are graphed as deviations from a normobiotic population. Normobiosis or a normobiotic state characterizes a composition of the microbiota profile in which microorganisms with potential health benefits predominate in abundance and diversity over potentially harmful ones.

Actinobacteria	Result	Reference Interval
Actinobacteria	0	-1 to +1
Actinomycetales	0	0 to +1
Bifidobacterium spp.	0	-1 to +1

Bacteroidetes	Result	Reference Interval
Alistipes spp.	-1	-1 to +1
Alistipes onderdonkii	-1	-1 to +1
Bacteroides fragilis	+1	0 to +1
Bacteroides spp. & *Prevotella* spp.	0	-1 to +1
Bacteroides stercoris	0	0 to +1
Bacteroides zoogleoformans	0	0 to +1
Parabacteroides johnsonii	0	0 to +1
Parabacteroides spp.	0	-1 to +1

Firmicutes	Result	Reference Interval
Firmicutes	0	-1 to +1
Bacilli Class	-1	-1 to +1
Catenibacterium mitsuokai	0	-1 to +1
Clostridia Class	+1	-1 to +1
Clostridium L2-50	0	-1 to +1

The gray-shaded area of the bar graph represents reference values outside the reporting limits for this test.
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Notes:

Methodology: Multiplex PCR

Nordic Laboratories

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TEST NAME: GI360™

Microbiome Bacterial Abundance;Multiplex PCR

Firmicutes	Result	-3 -2 -1 0 +1 +2 +3	Reference Interval
Dialister invisus	0		0 to +1
Dialister invisus & Megasphaera micronuciformis	0		0 to +1
Dorea spp.	0		0 to +1
Eubacterium biforme	0		0 to +1
Eubacterium hallii	0		-1 to +1
Eubacterium rectale	0		0 to +1
Eubacterium siraeum	0		-1 to +1
Faecalibacterium prausnitzii	-2		-1 to +1
Lachnospiraceae	0		-1 to +1
Lactobacillus ruminis & Pediococcus acidilactici	0		0 to +1
Lactobacillus spp.	0		0 to +1
Phascolarctobacterium spp.	0		0 to +1
Ruminococcus albus & R. bromii	0		0 to +1
Ruminococcus gnavus	+3		0 to +1
Streptococcus agalactiae & Eubacterium rectale	0		0 to +1
Streptococcus salivarius ssp. *thermophilus & S. sanguinis*	0		-1 to +1
Streptococcus salivarius ssp. *thermophilus*	0		0 to +1
Streptococcus spp.	0		0 to +1
Veillonella spp.	0		-1 to +1

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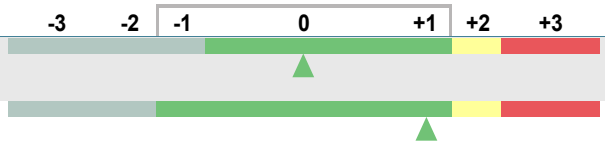
TEST NAME: GI360™

Microbiome Bacterial Abundance;Multiplex PCR

Proteobacteria	**Result**	**Reference Interval**
Proteobacteria	0	0 to +1
Escherichia spp.	+1	-1 to +1

Tenericutes	**Result**	**Reference Interval**
Mycoplasma hominis	-1	-1 to +1

Verrucomicrobia	**Result**	**Reference Interval**
Akkermansia muciniphila	0	0 to +1



Microbiome Abundance Information:

The GI360™ Microbiome Profile is a gut microbiota profiling test that characterizes patient results by determining deviation from a well-defined state of normobiosis using PCR. The profiling approach contrasts to direct diagnosis of a particular disease by detecting one organism. Characteristic sets of bacteria are required in a healthy normobiotic gut, and deviation will represent a potentially dysbiotic state. Measurement of deviation in bacterial microbiota makes it possible to characterize differences in the patient's results based on an established algorithm that defines normobiosis. By combining information from a well-defined set of predetermined PCR probes, this test enables highly reproducible and standardized information to be derived from the complex human microbiota. A summary web graphic chart is provided to represent bacterial abundance and diversity within a stool sample.

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Notes:

Methodology: Multiplex PCR

Nordic Laboratories

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TEST NAME: GI360™

GI Pathogens;Multiplex PCR

Viruses	Result
Adenovirus F40/41	Negative
Norovirus GI/GII	Negative
Rotavirus A	Negative

Pathogenic Bacteria	Result
Campylobacter (*C. jejuni*, *C. coli* and *C. lari*)	Negative
Clostridium difficile (Toxin A/B)	Negative
Escherichia coli O157	Negative
Enterotoxigenic *Escherichia coli* (ETEC) lt/st	Negative
Salmonella spp.	Positive
Shiga-like toxin-producing *Escherichia coli* (STEC) stx1/stx2	Negative
Shigella (*S. boydii*, *S. sonnei*, *S. flexneri* & *S. dysenteriae*)	Negative
Vibrio cholerae	Negative

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

Notes:
Methodology: Multiplex PCR

Nordic Laboratories

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TEST NAME: GI360™

Parasitology; Microscopy

Protozoa	Result
Balantidium coli	Not Detected
Blastocystis spp.	Not Detected
Chilomastix mesnili	Not Detected
Dientamoeba fragilis	Not Detected
Endolimax nana	Not Detected
Entamoeba coli	Not Detected
Entamoeba hartmanni	Not Detected
Entamoeba histolytica/Entamoeba dispar	Not Detected
Entamoeba polecki	Not Detected
Enteromonas hominis	Not Detected
Giardia duodenalis	Not Detected
Iodamoeba bütschlii	Not Detected
Isospora belli	Not Detected
Pentatrichomonas hominis	Not Detected
Retortamonas intestinalis	Not Detected

Cestodes - Tapeworms	Result
Diphyllobothrium latum	Not Detected
Dipylidium caninum	Not Detected
Hymenolepis diminuta	Not Detected
Hymenolepis nana	Not Detected
Taenia	Not Detected

Trematodes - Flukes	Result
Clonorchis sinensis	Not Detected
Fasciola hepatica/Fasciolopsis buski	Not Detected
Heterophyes heterophyes	Not Detected
Paragonimus westermani	Not Detected

Nematodes - Round Worms	Result
Ascaris lumbricoides	Not Detected

Notes:

Notes:
Methodology: Microscopy

Nordic Laboratories

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TEST NAME: GI360™

Parasitology; Microscopy

Nematodes - Round Worms	Result
Capillaria hepatica	Not Detected
Capillaria philippinensis	Not Detected
Enterobius vermicularis	Not Detected
Hookworm	Not Detected
Strongyloides stercoralis	Not Detected
Trichuris trichiura	Not Detected

Other Markers	Result	Reference Interval
Yeast	Many	Not Detected – Rare
RBC	Not Detected	Not Detected – Rare
WBC	Not Detected	Not Detected – Rare
Muscle fibers	Not Detected	Not Detected – Rare
Vegetable fibers	Rare	Not Detected – Few
Charcot-Leyden Crystals	Not Detected	Not Detected
Pollen	Not Detected	Not Detected

Macroscopic Appearance	Result	Reference Interval
Color	Brown	Brown
Consistency	Soft	Soft
Mucus	Negative	Negative

Parasitology Information:

- This test is not designed to detect *Cyclospora cayetanensis* or *Microsproridia* spp.

  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.

Notes:
Methodology: Microscopy,Macroscopic Observation

TEST NAME: GI360™

Parasitology; Microscopy

Parasitology Information:

- 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.
- **Red Blood Cells** (RBC) in the stool may be associated with a parasitic or bacterial infection, or an inflammatory bowel condition such as ulcerative colitis. Colorectal cancer, anal fistulas, and hemorrhoids should also be ruled out.
- **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
- **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".

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TEST NAME: GI360™

Microbiology

Pathogenic Bacteria	Result	NG 1+ 2+ 3+ 4+	Reference Interval
Aeromonas spp.	NG		No Growth
Edwardsiella tarda	NG		No Growth
Plesiomonas shigelloides	NG		No Growth
Salmonella group	2+		No Growth
Shigella spp.	NG		No Growth
Vibrio cholerae	NG		No Growth
Vibrio spp	NG		No Growth
Yersinia spp.	NG		No Growth

Imbalance Bacteria	Result	NG 1+ 2+ 3+ 4+	Reference Interval
Alpha *hemolytic strep*	4+		No Growth
Gamma *hemolytic strep*	3+		No Growth
Staphylococcus aureus	2+		No Growth

Dysbiotic Bacteria	Result	NG 1+ 2+ 3+ 4+	Reference Interval
Morganella morganii	4+		No Growth

Yeast	Result	NG 1+ 2+ 3+ 4+	Reference Interval
Candida albicans	2+		0+ – 1+

Microbiology Information:

- **Pathogenic bacteria** consist of known pathogenic bacteria that can cause disease in the GI tract. They are present due to the consumption of contaminated food or water, exposure to animals, fish, or amphibians known to harbor the organism. These organisms can be detected by either Multiplex PCR or microbiology culture.
- **Imbalanced bacteria** are usually neither pathogenic nor beneficial to the host GI tract. Imbalances can occur when there are insufficient levels of beneficial bacteria and increased levels of commensal bacteria. Certain commensal bacteria are reported as dysbiotic at higher levels.
- **Dysbiotic bacteria** consist of those bacteria that have the potential to cause disease in the GI tract. They can be present due to a number of factors including: exposure to chemicals that are toxic to beneficial bacteria; the use of antibiotics, oral contraceptives or other medications; poor fiber intake and high stress levels.

Notes:
Methodology: Culture and identification by MALDI-TOF and conventional biochemicals

MALDI-TOF

TEST NAME: GI360™

Microbiology

- **Yeast** may normally be present in small quantities in the skin, mouth, and intestine. When investigating the presence of yeast, disparity may exist between culturing and microscopic examination. Yeast are not uniformly dispersed throughout the stool and this may lead to undetectable or low levels of yeast identified by microscopy, despite culture and identified yeast species. Conversely, microscopic examination may reveal a significant amount of yeast present but no viable yeast cultured. Yeast may not always survive transit through the intestines. Nonviable diet-derived yeast may also be detected microscopically. Consideration of clinical intervention for yeast detected microscopically should be made in the context of other findings and presentation of symptoms.

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TEST NAME: GI360™

Stool Chemistries

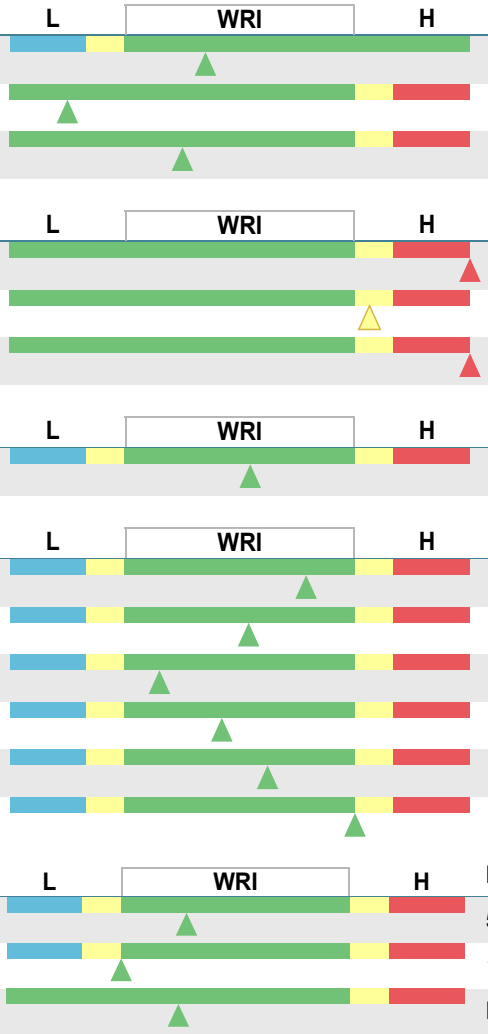
Digestion Absorption	Result	Unit	Reference Interval
Elastase	270	µg/mL	> 200
Fat Stain	None		None – Few
Carbohydrates	Negative		Negative

Inflammation	Result	Unit	Reference Interval
Lactoferrin	219	µg/mL	< 13
Lysozyme*	538	ng/mL	0 – 500
Calprotectin*	930	µg/g	< 50

Immunology	Result	Unit	Reference Interval
Secretory IgA*	163	mg/dL	30 – 275

Short Chain Fatty Acids	Result	Unit	Reference Interval
% Acetate	66.9	%	50 – 72
% Propionate	17.6	%	11 – 25
% Butyrate	13.1	%	11 – 32
% Valerate	2.4	%	0.8 – 5.0
Butyrate	2.1	mg/mL	0.8 – 4.0
Total SCFA's	16	mg/mL	5.0 – 16.0

Intestinal Health Markers	Result	Unit	Reference Interval
pH	6.2		5.8 – 7.0
β-glucuronidase*	100	U/L	100 – 1200
Occult Blood	Negative		Negative



Chemistry Information:

- **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.

Notes:
RI= Reference Interval, L (blue)= Low (below RI), WRI (green)= Within RI (optimal), WRI (yellow)= Within RI (not optimal), H (red)= High (above RI)

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†This test has been modified from the manufacturer's instructions and its performance characteristics determined by Doctor's Data Laboratories in a manner consistent with CLIA requirements.

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Methodology: Elisa,Microscopy,Colormetric,Gas Chromotography,ph Electrode

TEST NAME: GI360™

Stool Chemistries

- **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.
- **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.
- **Short chain fatty acids (SCFAs):** SCFAs are the end product of the bacterial fermentation process of dietary fiber by beneficial flora in the gut and play an important role in the health of the GI as well as protecting against intestinal dysbiosis. Lactobacilli and bifidobacteria produce large amounts of short chain fatty acids, which decrease the pH of the intestines and therefore make the environment unsuitable for pathogens, including bacteria and yeast. Studies have shown that SCFAs have numerous implications in maintaining gut physiology. SCFAs decrease inflammation, stimulate healing, and contribute to normal cell metabolism and differentiation. Levels of **Butyrate** and **Total SCFA** in mg/mL are important for assessing overall SCFA production, and are reflective of beneficial flora levels and/or adequate fiber intake.
- **Red Blood Cells** (RBC) in the stool may be associated with a parasitic or bacterial infection, or an inflammatory bowel condition such as ulcerative colitis. Colorectal cancer, anal fistulas, and hemorrhoids should also be ruled out.
- **pH:** Fecal pH is largely dependent on the fermentation of fiber by the beneficial flora of the gut.
- **Occult blood:** A positive occult blood indicates the presence of free hemoglobin found in the stool, which is released when red blood cells are lysed.
- **β-glucuronidase** is an enzyme that breaks the tight bond between glucuronic acid and toxins in the intestines. The binding of toxins in the gut is protective by way of blocking their absorption and facilitating excretion.

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Methodology:

Nordic Laboratories

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TEST NAME: GI360™

Bacterial Susceptibilities

Enterobacter cloacae complex

Natural Agents	Low Susceptibility	High Susceptibility
Berberine	▲	
Black Walnut	▲	
Caprylic Acid	△	
Grapefruit Seed Extract		▲
Oregano	▲	
Silver		▲
Uva Ursi		▲

Prescriptive Agents	Resistant	Intermediate	Susceptible
Ampicillin			●
Ciprofloxacin			●
Sulfamethoxazole / Trimethoprim			●

Susceptibility Information:

- **Natural antibacterial** agents may be useful for treatment of patients when organisms display in-vitro susceptibility to these agents. The test is performed by using standardized techniques and filter paper disks impregnated with the listed agent. Relative susceptibility is reported for each natural agent based upon the diameter of the zone of inhibition surrounding the disk. Data based on over 5000 individual observations were used to relate the zone size to the activity level of the agent. A scale of relative susceptibility is defined for the natural agents tested.
- **Susceptible** results imply that an infection due to the bacteria may be appropriately treated when the recommended dosage of the tested antimicrobial agent is used. **Intermediate** results imply that response rates may be lower than for susceptible bacteria when the tested antimicrobial agent is used. **Resistant** results imply that the bacteria will not be inhibited by normal dosage levels of the tested antimicrobial agent.

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TEST NAME: GI360™

Bacterial Susceptibilities

Morganella morganii

Natural Agents	Low Susceptibility	High Susceptibility
Berberine	▲	
Black Walnut	▲	
Caprylic Acid	▲	
Grapefruit Seed Extract		▲
Oregano	▲	
Silver		▲
Uva Ursi		▲

Prescriptive Agents	Resistant	Intermediate	Susceptible
Amoxicillin-Clavulanic Acid	●		
Ampicillin	●		
Cefazolin	●		
Ceftazidime			●
Ciprofloxacin			●
Sulfamethoxazole / Trimethoprim			●

Susceptibility Information:

- **Natural antibacterial** agents may be useful for treatment of patients when organisms display in-vitro susceptibility to these agents. The test is performed by using standardized techniques and filter paper disks impregnated with the listed agent. Relative susceptibility is reported for each natural agent based upon the diameter of the zone of inhibition surrounding the disk. Data based on over 5000 individual observations were used to relate the zone size to the activity level of the agent. A scale of relative susceptibility is defined for the natural agents tested.
- **Susceptible** results imply that an infection due to the bacteria may be appropriately treated when the recommended dosage of the tested antimicrobial agent is used. **Intermediate** results imply that response rates may be lower than for susceptible bacteria when the tested antimicrobial agent is used. **Resistant** results imply that the bacteria will not be inhibited by normal dosage levels of the tested antimicrobial agent.

*Natural antibacterial agent susceptibility testing was developed and its performance characteristics determined by Doctor's Data Laboratories in a manner consistent with CLIA requirements. The U. S. Food and Drug Administration (FDA) has not approve or cleared this test; however, FDA clearance is not currently required for clinical use. The results are not intended to be used as a sole means for clinical diagnosis or patient management decisions.

Notes:

Nordic Laboratories

PATIENT: **Sample Patient**
TEST NUMBER: T-NL-XXXXX (999999-9999)
GENDER: Male
AGE: 62

COLLECTED: 09/23/2019
RECEIVED: 09/26/2019
TESTED: 10/10/2019

TEST REF: **TST-NL-XXXXX**
PRACTITIONER:
Sample Doctor

Sample Clinic, 1234 Main St, Saint Charles, IL60174, U.S.A.

TEST NAME: GI360™

Bacterial Susceptibilities

Candida albicans

Natural Agents	Low Susceptibility	High Susceptibility
Berberine		
Caprylic Acid		
Grapefruit Seed Extract		
Oregano		
Plant Tannins		
Undecylenic Acid		
Uva Ursi		

Non-Absorbed Antifungals	Low Susceptibility	High Susceptibility
Nystatin		

Azole Antifungals	Resistant	S-DD	Susceptible
Fluconazole			●
Ketoconazole			●

Susceptibility Information:

- **Natural antifungal** agents may be useful for treatment of patients when organisms display in-vitro susceptibility to these agents. The test is performed by using standardized techniques and filter paper disks impregnated with the listed agent. Relative activity is reported for each natural agent based upon the diameter of the zone of inhibition or no growth zone surrounding the disk. Data based on over 5000 individual observations were used to relate the zone size to the activity level of the agent. A scale of relative activity is defined for the natural agents tested.
- **Non-absorbed antifungals** may be useful for treatment of patients when organisms display in-vitro susceptibility to these agents. The test is performed using standardized commercially prepared disks impregnated with Nystatin. Relative activity is reported based upon the diameter of the zone of inhibition or no growth zone surrounding the disk.
- **Susceptible** results imply that an infection due to the fungus may be appropriately treated when the recommended dosage of the tested antifungal agent is used. **Susceptible - Dose Dependent (S-DD)** results imply that an infection due to the fungus may be treated when the highest recommended dosage of the tested antifungal agent is used. **Resistant** results imply that the fungus will not be inhibited by normal dosage levels of the tested antifungal agent.

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Notes:

TEST NAME: GI360™

Commentary

Microbiome Abundance Information

Actinobacteria (phylum)

Actinobacteria is one of the largest bacterial phyla, comprised of Gram-positive bacteria. This phylum includes a wide range of species, with different morphological and physiological characteristics. Significant groups in the human colon include Actinomycetales and Bifidobacteriales. Actinomycetales were inversely associated with clinically significant depression in IBS patients, suggesting these bacteria may be depleted in depressed IBS patients. A strict vegetarian diet may increase the total count of Actinomyces spp. compared to following a Western diet.

Bacteriodetes (phylum)

Bacteroidetes make up approximately 28% of the gut microbiota in healthy human adults. They are early colonizers of the infant gut and are amongst the most stable, at a species and strain level, in the healthy host. A low Bacteroidetes to Firmicutes ratio has been associated with obesity, though this ratio can increase with weight loss and restricted calorie intake.

Firmicutes (phylum)

The phylum Firmicutes constitutes the most diverse and abundant group of gastrointestinal microbiota which are grouped into four classes, Bacilli, Clostridia, Erysipelotrichi, and Negativicutes. They make up approximately 39% of the gut microbiota, on average, in healthy adults, but can comprise as much as 80% of the community.

Faecalibacterium prausnitzii (species)

Faecalibacterium prausnitzii is one of the most abundant butyrate producing bacteria in a healthy gastrointestinal tract. As such, F. prausnitzii is a protective factor for the intestinal mucosa and supports very important intestinal barrier functions. F. prausnitzii exerts anti-inflammatory effects via metabolites such as short-chain fatty acids. F. prausnitzii is reduced in inflammatory bowel disease, irritable bowel syndrome, celiac disease and gastrointestinal inflammation in general. It is reduced in patients diagnosed with Parkinson's disease, bipolar disorder, colorectal cancer, diabetes and chronic idiopathic diarrhea. Diminished levels of F. prausnitzii were found in patients with major depressive disorder. The abundance of F. prausnitzii together with E. coli (F-E index) has been proposed as a discrimination tool between ulcerative colitis and Crohn's disease. F. prausnitzii has been correlated with pediatric obesity in instances of high consumption of foods that are rich in unabsorbed carbohydrate (banana, maize, rice). The prebiotic inulin has been shown to increase the proportion of F. prausnitzii in the human intestinal microbiota. Low FODMAP diets have been observed to reduce the abundance of F. prausnitzii and butyrate production.

Phascolarctobacterium (genus)

Phascolarctobacterium faecium can produce short-chain fatty acids, including acetate and propionate, and may be associated with metabolic effects and mental state of the host. Patients diagnosed with major depressive disorder had increased levels of these species. Decreased levels of Phascolarctobacterium were found to be associated with Crohn's disease, ulcerative colitis and Alzheimer's disease. Consumption of cruciferous vegetables, such as broccoli, increases the abundance of Phascolarctobacterium faecium in the gut.

Proteobacteria (phylum)

Proteobacteria include a wide variety of pathogens, including species within the Escherichia, Shigella Salmonella, Vibrio, and Helicobacter genera. The phylum includes a number of pathogenic species that are permanent residents of the microbiota and capable of inducing nonspecific inflammation and diarrhea when their presence is increased. Proteobacteria make up approximately 2% of the gut microbiota in healthy adults.

Tenericutes (phylum)

Tenericutes are cell wall-less bacteria that do not synthesize precursors of peptidoglycan. Tenericutes species consist of four main clades designated as the Acholeplasma, Spiroplasma, Pneumoniae and Hominis clusters. Tenericutes are typically parasites or commensals of eukaryotic hosts.

Verrucomicrobia (phylum)

Verrucomicrobia is a less common phylum in the human gut microbiota, but one with increasing recognition with regards to health. Verrucomicrobia includes Akkermansia muciniphila. The obligate anaerobe Akkermansia constitutes up 3-5% of total bacteria in a healthy microbiome, and has a protective or anti-inflammatory role in the intestine mucosa.

TEST NAME: GI360™

Commentary

Microbiome Abundance Information continued...

Akkermansia muciniphila (genus)

Several studies have shown a reduced abundance of Akkermansia muciniphila in people with various gastrointestinal disorders. Decreased levels of Akkermansia muciniphila have been found in patients with diabetes, obesity and inflammatory bowel disease. Higher abundance of Akkermansia muciniphila has been associated with a milder disease course in newly discovered ulcerative colitis patients. Archaea and Akkermansia were significantly more prevalent after weight reduction. A Low FODMAP diet has been shown to decrease the abundance of Akkermansia muciniphila leading to recommendations against long-term use of such a diet.

Parasitology

Vegetable Fibers

Excessive amounts of vegetable fibers were found in this stool specimen. This may be indicative of inadequate chewing, or eating "on the run". The presence of vegetable fibers must be considered in conjunction with other parameters such as muscle fibers, Elastase-1, and triglycerides for a proper assessment of maldigestion. A rapid transit time may also result in elevated levels of vegetable fibers.

Microscopic yeast

Microscopic examination has revealed yeast in this stool sample. The microscopic finding of yeast in the stool is helpful in identifying whether the proliferation of fungi, such as Candida albicans, is present. Yeast is normally found in very small amounts in a healthy intestinal tract. While small quantities of yeast (reported as none or rare) may be normal, yeast observed in higher amounts (few, moderate to many) is considered abnormal.

An overgrowth of intestinal yeast is prohibited by beneficial flora, intestinal immune defense (secretory IgA), and intestinal pH. Beneficial bacteria, such as Lactobacillus colonize in the intestines and create an environment unsuitable for yeast by producing acids, such as lactic acid, which lowers intestinal pH. Also, lactobacillus is capable of releasing antagonistic substances such as hydrogen peroxide, lactocidin, lactobacillin, and acidolin.

Many factors can lead to an overgrowth of yeast including frequent use of antibiotics (leading to insufficient beneficial bacteria), synthetic corticosteroids, oral contraceptives, and diets high in sugar. Although there is a wide range of symptoms which can result from intestinal yeast overgrowth, some of the most common include brain fog, fatigue, reccurring vaginal or bladder infections, sensitivity to smells (perfumes, chemicals, environment), mood swings/depression, sugar and carbohydrate cravings, gas/bloating, and constipation or loose stools.

A positive yeast culture (mycology) and sensitivity to prescriptive and natural agents is helpful in determining which anti-fungal agents to use as part of a therapeutic treatment plan for chronic colonic yeast. However, yeast are colonizers and do not appear to be dispersed uniformly throughout the stool. Yeast may therefore be observed microscopically, but not grow out on culture even when collected from the same bowel movement.

Microbiology

Pathogenic/Dysbiotic Flora

In a healthy balanced state of intestinal flora, the beneficial bacteria make up a significant proportion of the total microflora. However, in many individuals there is an imbalance or deficiency of beneficial flora and an overgrowth of non-beneficial (imbalance) or even pathogenic microorganisms (dysbiosis). This can be due to a number of factors including: consumption of contaminated water or food; daily exposure of chemicals that are toxic to beneficial bacteria; the use of antibiotics, oral contraceptives or other medications; poor fiber intake and high stress levels.

A number of toxic substances can be produced by the dysbiotic bacteria including amines, ammonia, hydrogen sulfide, phenols, and secondary bile acids which may cause inflammation or damage to the brush border of the intestinal lining. If left unchecked, long-term damage to the intestinal lining may result in leaky gut syndrome, allergies, autoimmune disease (e.g. rheumatoid arthritis), irritable bowel syndrome, fatigue, chronic headaches, and sensitivities to a variety of foods. In addition, pathogenic bacteria can cause acute symptoms such as abdominal pain, nausea, diarrhea, vomiting, and fever in cases of food poisoning.

TEST NAME: GI360™

Commentary

Microbiology continued...

Bacterial sensitivities to a variety of prescriptive and natural agents have been provided for the pathogenic bacteria that were cultured from this patient's specimen. This provides the practitioner with useful information to help plan an appropriate treatment regimen. Supplementation with probiotics or consumption of foods (yogurt, kefir, miso, tempeh, tamari sauce) containing strains of lactobacilli, bifidobacteria, and enterococci can help restore healthy flora levels. Polyphenols in green and ginseng tea have been found to increase the numbers of beneficial bacteria. Hypochlorhydria may also predispose an individual to bacterial overgrowth, particularly in the small intestine. Nutritional anti-inflammatories can aid in reversing irritation to the GI lining. These include quercetin, vitamin C, curcumin, gamma-linoleic acid, omega-3 fatty acids (EPA, DHA), and aloe vera. Other nutrients such as zinc, beta-carotene, pantothenic acid, and L-glutamine provide support for regeneration of the GI mucosa. A comprehensive program may be helpful in individuals in whom a dysbiotic condition has caused extensive GI damage.

Enterobacter cloacae

Enterobacter cloacae is part of the Enterobacteriaceae family. E. cloacae complex is a group of six closely related species with similar resistance patters, E. cloacae, E. asburiae, E. hormaechei, E. kobei, E. ludwigii, and E. nimipressuralis. This gram-negative bacterium is considered dysbiotic at levels of 3+ or greater. E. cloacae complex is considered an opportunistic pathogen associated with diarrhea in children. A Shiga-like toxin-producing E. cloacae was isolated from the feces of an infant with hemolytic-uremic syndrome. However, E. cloacae is most often involved in extraintestinal infections including the urinary tract, respiratory tract, and cutaneous wounds.

Widely distributed in the environment, Enterobacter is commonly isolated from both human and animal feces. Environmental strains of Enterobacter are capable of growth in foods at refrigeration temperature.

E. cloacae complex is known to possess inducible ß-lactamases. Isolates may become resistant to all cephalosporins after initiation of therapy. Avoid ß-lactam-inhibitor drugs such as: amoxicillin / clavulanate, ampicillin / sulbactam, and pipercillin / tazobactam. Antibiotics may be indicated if symptoms are prolonged and in systemic infections. Refer to the bacterial sensitivities to identify the most appropriate agent.

Imbalanced Flora

Most of the reported imbalanced flora are commensal bacteria that reside in the host gastrointestinal tract; they do not benefit nor harm the host. Certain dysbiotic bacteria may appear under the commensal/imbalanced category if found at low levels (<3+) because they are not likely pathogenic at the levels detected. When several species of imbalanced bacteria are present, it is common to find inadequate levels of one or more of the beneficial bacteria, and/or an alkaline fecal pH. Hemolytic or mucoid E. coli are often associated with a low level of beneficial E. coli and alkaline pH, secondary to a mutation of beneficial E. coli (DDI observations). Treatment with antimicrobial agents is unnecessary unless bacteria appear under the dysbiotic category.