ORDER: 999999-9999
PATIENT: Sample Patient
ID: 999999
SEX: Female
AGE: 65
DOB:

CLIENT #: 999999
DOCTOR: Sample Doctor MD
Doctors Data Inc
123 Main St.
St. Charles, IL 60174 USA

CSA+P

DDI DOCTOR'S DATA INC

Comprehensive Stool Analysis + Parasitology

BACTERIOLOGY CULTURE

Expected/Beneficial flora	Commensal (Imbalanced) flora	Dysbiotic flora
3+ *Bacteroides* family	4+ *Kluyvera cryocrescens*	4+ *Klebsiella oxytoca*
4+ *Bifidobacterium* family	4+ *Streptococcus anginosus*	
4+ *Escherichia coli*		
4+ *Lactobacillus* family		
4+ *Enterococcus* family		
3+ *Clostridium* family		

MALDI-TOF

NG = No Growth

BACTERIA INFORMATION

Expected / Beneficial bacteria make up a significant portion of the total microflora in a healthy & balanced GI tract. These beneficial bacteria have many health-protecting effects in the GI tract including manufacturing vitamins, fermenting fibers, digesting proteins and carbohydrates, and propagating anti-tumor and anti-inflammatory factors.

Clostridia are prevalent flora in a healthy intestine. Clostridium spp. should be considered in the context of balance with other expected/beneficial flora. Absence of clostridia or over abundance relative to other expected/beneficial flora indicates bacterial imbalance. If C. difficile associated disease is suspected, review the Clostridium difficile toxin A/B results from the GI Pathogens PCR section of this report.

Commensal (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 known pathogenic bacteria and those that have the potential to cause disease in the GI tract. They can be present due to a number of factors including: consumption of contaminated water or food, 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. Aeromonas, Plesiomonas, Salmonella, Shigella, Vibrio, Yersinia, & Edwardsiella tarda have been specifically tested for and found absent unless reported.

YEAST CULTURE

Normal flora	Dysbiotic flora
No yeast isolated	

MALDI-TOF

YEAST INFORMATION

Yeast may normally be present in small quantities in the skin, mouth, and GI tract as a component of the resident microbiota. Their presence is generally benign. Recent studies, however, show that high levels of yeast colonization is associated with several inflammatory diseases of the GI tract. Animal models suggest that yeast colonization delays healing of inflammatory lesions and that inflammation promotes colonization. These effects may create a cycle in which low-level inflammation promotes fungal colonization and this colonization promotes further inflammation. Consideration of clinical intervention for yeast should be made in the context of other findings and presentation of symptoms.

SPECIMEN DATA

Comments:

Date Collected: 01/09/2023
Date Received: 01/13/2023
Date Reported: 01/23/2023
Specimens Collected: 3
Methodology: Culture and identification by MALDI-TOF and conventional biochemicals

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GI Pathogens; Multiplex PCR

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

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

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

SPECIMEN DATA

Comments:

Date Collected: 01/09/2023
Date Received: 01/13/2023
Date Reported: 01/23/2023
Methodology: Multiplex PCR

Specimens Collected: 3

ORDER: 999999-9999
PATIENT: Sample Patient
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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
Nematodes - Roundworms	
Ascaris lumbricoides	Not Detected
Capillaria hepatica	Not Detected
Capillaria philippinensis	Not Detected
Enterobius vermicularis	Not Detected
Strongyloides stercoralis	Not Detected
Trichuris trichiura	Not Detected
Hookworm	Not Detected
Cestodes - Tapeworms	
Diphyllobothrium latum	Not Detected
Dipylidium caninum	Not Detected
Hymenolepis diminuta	Not Detected
Hymenolepis nana	Not Detected
Taenia	Not Detected

SPECIMEN DATA

Comments:
Date Collected: 01/09/2023
Date Received: 01/13/2023
Date Reported: 01/23/2023
Methodology: Microscopy

Specimens Collected: 3

ORDER: 999999-9999
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Parasitology; Microscopy

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

Other Markers			Reference Interval
Yeast	Not Detected		None – Rare
RBC	Not Detected		None – Rare
WBC	Few		None – Rare
Muscle fibers	Not Detected		None – Rare
Vegetable fibers	Rare		None – Few
Charcot-Leyden Crystals	Not Detected		None
Pollen	Not Detected		None

Macroscopic Appearance	Result	
Mucus	Negative	

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.

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".

SPECIMEN DATA

Comments:
Date Collected: 01/09/2023
Date Received: 01/13/2023
Date Reported: 01/23/2023
Specimens Collected: 3
Methodology: Microscopy, Macroscopic Observation

ORDER: 999999-9999
PATIENT: Sample Patient
ID: 999999
SEX: Female
AGE: 65
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Parasitology; Microscopy

SPECIMEN DATA

Comments:

Date Collected: 01/09/2023
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Date Reported: 01/23/2023
Methodology:

Specimens Collected: 3

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Stool Chemistries

Digestion / Absorption	Result	Unit	Reference Interval
Elastase	>500	µg/g	> 200
Fat Stain	Not Detected		None – Moderate
Carbohydrates†	Negative		Negative

Inflammation	Result	Unit	Reference Interval
Lactoferrin	210	µg/mL	< 7.3
Calprotectin	1706	µg/g	< 80
Lysozyme*	753	ng/mL	≤ 500

Immunology	Result	Unit	Reference Interval
Secretory IgA*	508	mg/dL	30 – 275

Short Chain Fatty Acids	Result	Unit	Reference Interval
% Acetate‡	71	%	50 – 72
% Propionate‡	21	%	11 – 25
% Butyrate‡	6.8	%	11 – 32
% Valerate‡	1.2	%	0.8 – 5.0
Butyrate‡	0.46	mg/mL	0.8 – 4.0
Total SCFA's‡	6.7	mg/mL	5.0 – 16.0

Intestinal Health Markers	Result	Unit	Reference Interval
pH	6.2		5.8 – 7.0
Occult Blood	Negative		Negative

Macroscopic Appearance	Result	Unit	Reference Interval
Color	Brown		Brown
Consistency	Soft		Soft

Chemistry Information

Elastase findings can be used for assessing pancreatic exocrine function and insufficiency.

Fat Stain: Microscopic determination of fecal fat using Sudan IV staining is a qualitative procedure utilized to assess fat absorption and to detect steatorrhea.

SPECIMEN DATA

Comments:
Date Collected: 01/09/2023
Date Received: 01/13/2023
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Specimens Collected: 3
Methodology: Turbidimetric immunoassay, Microscopy, Colormetric, Elisa, Gas Chromotography, ph Electrode, Guaiac, Macroscopic Observation

RI= Reference Interval, Toggles: Green = within RI, Yellow = moderately outside RI, Red = outside RI

*This test 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 approved 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.

†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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Carbohydrates: The presence of reducing substances in stool specimens can indicate carbohydrate malabsorption.

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.

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.

Color: Stool is normally brown because of pigments formed by bacteria acting on bile introduced into the digestive system from the liver. While certain conditions can cause changes in stool color, many changes are harmless and are caused by pigments in foods or dietary supplements.

Consistency: Stool normally contains about 75% water and ideally should be formed and soft. Stool consistency can vary based upon transit time and water absorption.

SPECIMEN DATA

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Date Collected: 01/09/2023
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Date Reported: 01/23/2023
Methodology:

Specimens Collected: 3

ORDER: 999999-9999
PATIENT: Sample Patient
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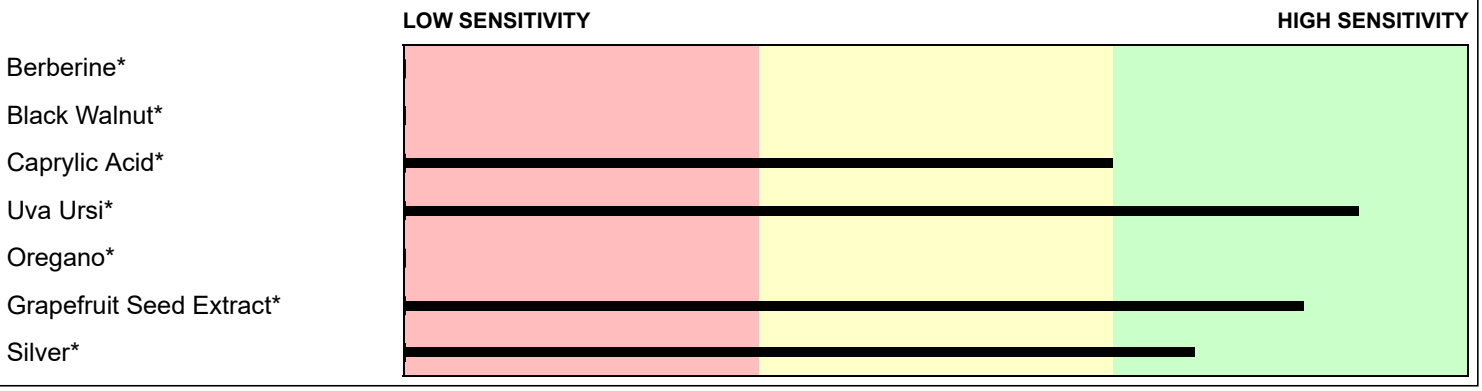
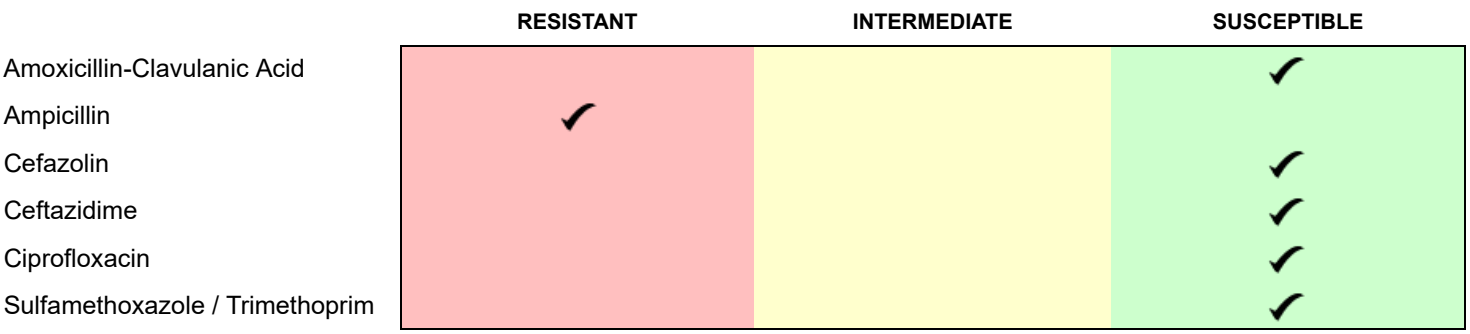
Bacterial Susceptibilities

Klebsiella oxytoca

NATURAL ANTIBACTERIALS



PRESCRIPTIVE AGENTS



Natural antibacterial agents may be useful for treatment of patients when organisms display in-vitro sensitivity to these agents. The test is performed by using standardized techniques and filter paper disks impregnated with the listed agent. Relative sensitivity 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 sensitivity 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.

SPECIMEN DATA

Comments:

Date Collected: 01/09/2023
Date Received: 01/13/2023
Date Reported: 01/23/2023
Methodology: Disk Diffusion

Specimens Collected: 3

*This test 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 approved 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.

Introduction

This analysis of the stool specimen provides fundamental information about the overall gastrointestinal health of the patient. When abnormal microflora or significant aberrations in intestinal health markers are detected, specific commentaries are presented. If no significant abnormalities are found, commentaries are not presented.

Microbiology

Clostridium spp

Clostridia are expected inhabitants of the human intestine. Although most clostridia in the intestine are not virulent, certain species have been associated with disease. Clostridium perfringens is a major cause of food poisoning and is also one cause of antibiotic-associated diarrhea. Clostridioides difficile is a causative agent in antibiotic-associated diarrhea and pseudomembranous colitis. Other species reported to be prevalent in high amounts in patients with Autistic Spectrum Disorder include Clostridium histolyticum group, Clostridium cluster I, Clostridium bolteae, and Clostridium tetani.

Imbalanced Flora

Imbalanced flora are those bacteria that reside in the host gastrointestinal tract and neither injure nor benefit the host. Certain dysbiotic bacteria may appear under the imbalanced category if found at low levels because they are not likely pathogenic at the levels detected. Imbalanced bacteria are commonly more abundant in association with insufficiency dysbiosis, and/or a fecal pH more towards the alkaline end of the reference range (5.8 - 7.0). Treatment with antimicrobial agents is unnecessary unless bacteria appear under the dysbiotic category.

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 (insufficiency dysbiosis) and an overgrowth of non-beneficial (imbalance) or even pathogenic microorganisms. 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.

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 may help restore healthy flora levels. Soluble fiber and polyphenols derived from chocolate, green tea, blackcurrant, red wine and grape seed extracts 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.

Klebsiella spp

Klebsiella spp. are gram-negative bacilli belonging to the *Enterobacteriaceae* family and closely related to the genera *Enterobacter* and *Serratia. Klebsiella* spp. are considered dysbiotic in the amount of 3 - 4 +. *Klebsiella* spp. are widely distributed in nature and in the gastrointestinal tract of humans. In humans, they may colonize the skin, oral cavity, pharynx, or gastrointestinal tract. Regarded as normal flora in many parts of the colon, intestinal tract and biliary tract, the gut is the main reservoir of opportunistic strains. This bacteria has the potential to cause intestinal, lung, urinary tract, and wound infections, but overgrowth of *Klebsiella* spp. is commonly asymptomatic. *K. pneumoniae*, in particular, may cause diarrhea and some strains are enterotoxigenic. Infection has been linked to ankylosing spondylitis as well as myasthenia gravis (antigenic cross-reactivity), and these patients usually carry larger numbers of the organism in their intestines than healthy individuals. *Klebsiella* oxytoca causes antibiotic associated hemorrhagic colitis. These strains have been shown to produce a cytotoxin that is capable of inducing cell death in various epithelial-cell cultures.

Klebsiella is a significant nosocomial infectious agent, partially due to the ability of organisms to spread rapidly. *Klebsiella* accounts for approximately 3-7% of all hospital-acquired infections, placing it among the top eight pathogens in hospitals. Extraintestinal infection typically involves the respiratory or urinary tracts, but may infect other areas such as the biliary tract and surgical wound sites. *K. pneumoniae* and *K. oxytoca* are the two members of this genus responsible for most extraintestinal human infections.

Microbiology continued...

Treatment of these organisms has become a major problem because of resistance to multiple antibiotics and potential transfer of plasmids to other organisms. Proper hand washing is crucial to prevent transmission from patient to patient via medical personnel. Contact isolation should be used for patients colonized or infected with highly antibiotic-resistant *Klebsiella* strains. *Klebsiella ozaenae* and *Klebsiella rhinoscleromatis* are infrequent isolates that are subspecies of *K. pneumoniae*; however, each is associated with at unique spectrum of disease. *K. ozaenae* is associated with atrophic rhinitis, a condition called ozena, and purulent infections of the nasal mucous membranes. *K. rhinoscleromatis* causes the granulomatous disease rhinoscleroma, an infection of the respiratory mucosa, oropharynx, nose, and paranasal sinuses.

Antibiotics may be indicated if symptoms are prolonged and in systemic infections. Refer to the antimicrobial susceptibilities for treatment.

GI Pathogens

Introduction

The GI Pathogen profile is performed using an FDA-cleared multiplex PCR system. It should be noted that PCR testing is much more sensitive than traditional techniques and allows for the detection of extremely low numbers of pathogens. PCR testing does not differentiate between viable and non-viable pathogens and should not be repeated until 21 days after completion of treatment or resolution to prevent false positives due to lingering traces of DNA. PCR testing can detect multiple pathogens in the patient's stool but does not differentiate the causative pathogen. All decisions regarding the need for treatment should take the patient's complete clinical history and presentation into account.

Clostridioides difficile

C. difficile may cause diarrhea following the production of two toxins, enterotoxin A and cytotoxin B. *C. difficile* is the most common cause of nosocomial infectious diarrhea in developed countries and is the major cause of antibiotic-associated pseudo-membranous colitis. *C. difficile* infection (CDI) symptoms vary from asymptomatic carriage (30% of young children) to mild/moderate watery diarrhea with fever and malaise to pseudomembranous colitis with bloody diarrhea, severe abdominal pain and fever. CDI occurs almost exclusively after broad-spectrum antibiotic use. No treatment is necessary for asymptomatic carriers. Anti-motility agents are contraindicated. CDI can be treated with vancomycin 125 mg given 4 times daily for 10 days, administered orally, and fidaxomicin 200 mg given twice daily for 10 days, as first-line options for both non-severe and severe initial CDI. Patients with fulminant CDI should receive vancomycin 500 mg 4 times per day in combination with IV metronidazole. In second or subsequent recurrences, patients can be treated with oral vancomycin, fidaxomicin, or a fecal transplant. Co-administration of *Saccharomyces boulardii* and *Lactobacillus rhamnosus* during antibiotic therapy may reduce the risk of infection relapse. Oral rehydration therapy is recommended to prevent dehydration.

Parasitology

White Blood Cells (WBCs)

The number of WBCs in this specimen is higher than expected. Elevated levels of WBCs in the stool are an indication of an inflammatory process resulting in the infiltration of leukocytes within the intestinal lumen. This could be the result of an inflammatory bowel conditions including ulcerative colitis (UC) or Crohn's disease (check fecal calprotectin and lactoferrin). Enteroinvasive bacteria such as *Campylobacter, Shigella, Salmonella*, and Enteropathogenic parasites such as *Giardia, Blastocystis, Cryptosporidium*, and *Entamoeba* can be a cause of inflammation to the mucosal lining. WBCs are often accompanied by mucus in the stool (macroscopic examination). Other conditions that may be associated with WBCs in the stool include localized abscesses and anal fistulas. A positive WBC result may warrant identification and eradication of the cause of inflammation and possible anti-inflammatory therapy.

Stool Chemistries

Lactoferrin

The level of fecal lactoferrin is elevated in this sample. Lactoferrin is a biomarker of serious gastrointestinal inflammation which may be associated is with inflammatory bowel disease (IBD) such as Ulcerative colitis (UC) or Crohn's disease (CD), but NOT Irritable bowel syndrome (IBS). Such distinction is critical because, although both IBD and IBS may share some common symptoms such as diarrhea, abdominal cramping and weight loss, the diseases are treated quite differently. IBD may become life threatening, requires lifelong treatment and possibly surgery. Very elevated lactoferrin should be reassessed in about four weeks, and if confirmed referral to a gastroenterologist should be considered. Lactoferrin is commonly high in breast-fed infants due to the high content in breast milk.

Patients with IBD oscillate between active and inactive disease states, and fecal lactoferrin levels increase 2-3 weeks prior to onset of clinical symptoms. During remission and effective treatment, fecal lactoferrin decreases significantly. Therefore, disease activity and efficacy of treatment can be monitored by following fecal lactoferrin levels. The test can be ordered separately to track disease activity in patients with IBD.

Moderately elevated levels of fecal lactoferrin can occur, often with fecal red and/or white blood cells, in association with invasive enteropathogens. Therefore, with moderately elevated levels of fecal lactoferrin, one should check for the presence of enteropathogens (eg. *Shigella*, *Campylobacter*, *Vibrio cholerae*, *Yersinia*).

Stool Chemistries continued...

Lysozyme

The level of lysozyme is elevated in this sample. Lysozyme is a biomarker of an inflammatory immune response in the gut. Moderate elevations in lysozyme are commonly associated with significant overgrowth of enteropathogens such as yeast, dysbiotic or pathogenic bacteria. Markedly elevated levels of lysozyme may occur with inflammatory bowel disease (IBD), such as Crohn's disease and Ulcerative colitis as well as other non-IBD intestinal diseases with diarrhea. If lysozyme is markedly elevated check the levels of calprotectin and lactoferrin. If either or both are very elevated reassess the levels in about four weeks. Lysozyme is commonly elevated for actively breast-feeding infants due to high maternal milk content.

Lysozyme is helpful in the determination of pathogen-induced inflammatory activity rather than IBD. Slightly-to moderately elevated levels of lysozyme may be remediated with elimination of an offending enteroinvasive microorganism and use of anti-inflammatory nutraceuticals.

Calprotectin (Very high)

The level of calprotectin is highly elevated in this specimen. Very high levels of calprotectin are associated with active IBD and gastrointestinal inflammation, colitis (not autoimmune), or sometimes cancer. Elevated fecal calprotectin levels indicate inflammation in the gastrointestinal mucosa. High levels of calprotectin have been highly correlated with inflammatory bowel disease (IBD). IBD includes autoimmune conditions such as Crohn's disease and ulcerative colitis (UC); these conditions may become life-threatening and require lifelong treatment.

Chronic inflammation of the gastrointestinal mucosa contributes to symptoms of IBD. Chronic stress is also known to contribute to symptom flare-ups and increased inflammation in IBD patients. Liver disease or the use of aspirin or nonsteroidal anti-inflammatory (NSAID) medications may variably elevate calprotectin levels.

Fecal Calprotectin should be reassessed after about 4 weeks for confirmation. A confirmatory finding warrants referral to a gastroenterologist for scoping.

Secretory IgA (sIgA) High

The concentration of sIgA is abnormally high in this fecal specimen. Secretory IgA represents the first line of defense of the gastrointestinal (GI) mucosa and is central to the normal function of the GI tract as an immune barrier. Elevated fecal sIgA is an appropriate response to antigens such as pathogenic bacteria, parasites, yeast, and viruses. Eradication of the pathogenic microorganisms will bring sIgA back down into the normal range. sIgA may remain elevated up to six weeks after a GI viral infection. Elevated fecal sIgA may also be associated with autoinflammatory conditions such as reactive arthritis and spondyloarthritis. Actively breast-feeding infants may exhibit high fecal sIgA due to high maternal milk content. Consumption of bovine colostrum does not artificially increase fecal sIgA because the assay is specific for human sIgA.

Short Chain Fatty Acids (SCFAs)

The total concentration and/or percentage distribution of the primary short chain fatty acids (SCFAs) are abnormal in this specimen. Beneficial bacteria that ferment non-digestible soluble fiber produce SCFAs that are pivotal in the regulation of intestinal health and function. Restoration of microbial abundance and diversity, and adequate daily consumption of soluble fiber and polyphenols can improve SCFA status.

The primary SCFAs butyrate, propionate and acetate are produced by predominant commensal bacteria via fermentation of soluble dietary fiber and intestinal mucus glycans. Key producers of SCFAs include *Faecalibacterium prausnitzii*, *Akkermansia muciniphila*, *Bacteroides fragilis*, *Bifidobacterium*, *Clostridium* and *Lactobacillus* spp. The SCFAs provide energy for intestinal cells, and regulate the actions of specialized mucosal cells that produce anti-inflammatory and antimicrobial factors, mucins that constitute the mucus barriers, and gut active peptides that facilitate appetite regulation and euglycemia. The SCFAs also contribute to a more acidic and anaerobic microenvironment that disfavors dysbiotic bacteria and yeast. Abnormal SCFAs may be associated with dysbiosis (including insufficiency dysbiosis), compromised intestinal barrier function (intestinal permeability) and inappropriate immune and inflammatory conditions.

"Seeding" with supplemental probiotics may contribute to improved production and status of SCFAs, but it is imperative to "feed" the beneficial microbes. Sources of soluble fiber that are available to the microbes include chick peas, beans, lentils, oat and rice bran, fructo- and galacto- oligosaccharides, and inulin.