



Patient Education: Stool Examination for Gastrointestinal Infections

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What Is Stool and How Is It Relevant for Diagnosis of Gastrointestinal Infections?

Stool or feces is not only a waste material, but also an important specimen that can be examined to identify any harmful bacteria, parasites, or viruses causing gastrointestinal (GI) infections. Visual examination, microscopy, microbial analysis, and molecular tests can be performed on stool samples to detect the cause. Stool tests provide useful information and evidence for the diagnosis of GI infections. When interpreted appropriately, they can prevent unnecessary investigations, and aid in early institution of targeted therapy.¹

What Are the Signs and Symptoms of Gastrointestinal Infections?

GI infections may cause loose stools, with or without blood and mucus, abdominal pain, cramps, nausea, vomiting, fever, and body-aches.²

What Are the Various Terms Used to Describe Gastrointestinal Infections?

Diarrhea: It is an increase in the frequency, volume, or liquidity of stools, when compared with the usual bowel habit of an individual. Usually, the passage of three or more stools per day is considered as diarrhea. It is caused by bacterial, viral, or parasitic infections spread through contaminated food or water.

Dysentery: It is the passage of loose stools with mucus and blood, along with abdominal cramps and tenesmus. It is typically caused by *Shigella spp.* (bacillary dysentery) and *Entamoeba histolytica* (amoebic dysentery).

Gastroenteritis: It is inflammation of the stomach and intestines, resulting in diarrhea and vomiting. It is usually caused by bacterial toxins or viral infections.²

Antibiotic-associated diarrhea: Diarrhea occurring after intake of antibiotics such as aminopenicillins, cephalosporins, amoxicillin-clavulanate, and clindamycin. It results from disruption of the normal microflora of gut by antibiotics. *Clostridioides difficile* is the most common enteropathogen reported to be associated with this condition.³

Who Needs a Stool Test?

Stool tests are recommended for people with symptoms of GI infection, and in cases of severe complications due to prolonged diarrhea, children, elderly, or people with decreased immunity, diarrhea after prolonged hospitalization or antibiotic use, and donors of fecal microbiota transplantation.⁴

Which Diseases Can be Detected by Stool Examination?

Stool examination can help in diagnosing infective (bacterial, viral, or parasitic) or noninfective etiologies (malabsorption syndrome and inflammatory bowel disease).

What Are the Normal Microorganisms Present in Stool?

Stool samples contain certain bacteria that inhabit the GI tract, called normal flora or commensals, which do not require treatment. They include *Escherichia coli*, *Klebsiella spp.*, *Enterobacter spp.*, *Pseudomonas spp.*, *Proteus spp.*, and anaerobic bacteria.⁵

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Which Pathogenic Microorganisms Can be Detected in a Stool Sample?

The pathogenic *bacteria* that may be detected in stool samples include nontyphoidal *Salmonella spp.*, *Shigella spp.*, *Vibrio cholerae*, *V. parahemolyticus*, *Escherichia coli* (enteroinvasive *E. coli*, enteroaggregative *E. coli*, enteropathogenic *E. coli* and enterotoxigenic *E. coli*) (other strains of *E. coli* are considered “normal”), *Campylobacter jejuni*, *Staphylococcus aureus*, *Bacillus cereus*, *Clostridium difficile*. Parasites that can be detected in stool include protozoa such as *Giardia lamblia*, *Entamoeba histolytica*, *Balantidium coli*, *Cryptosporidium parvum*, *Cyclospora cayetanensis*, and *Cystoisospora belli* and helminths like *Taenia solium*, *Hymenolepis nana* (tapeworms), *Enterobius vermicularis* (pinworm), *Ascaris* (roundworm), *Trichuris trichiura* (whipworm), *Ancylostoma duodenale* (hookworm), *Strongyloides stercoralis*, *Fasciola hepatica*, *Fasciolopsis buski* (flukes), and *Clonorchis sinensis*. Viruses like rotavirus, Norwalk virus, adenovirus, astrovirus, calicivirus, and coronavirus can also be detected in stool samples.²

What Preparation Is Needed Before Giving a Stool Sample?

In most cases, no special preparation is required. In some cases, the doctor may ask to avoid using certain products like laxatives, oil emulsions, antibiotics, antidiarrheal medications, and barium meal (used in imaging studies and X-ray), before collecting a stool sample.⁵⁻⁷

How to Collect the Specimen?

Freshly passed stool samples should be collected in a clean, dry, wide-mouthed plastic container that has a screw-cap or

tight-fitting lid. For routine examination, sample can even be collected in an empty, clean, dry matchbox. At least five to six spoonfuls of liquid or 20 to 40 g of solid stool sample must be collected, taking care to avoid contact with urine or water. The sample should not be collected from bed-pans that contain disinfectants, and should be submitted to the laboratory within 2 hours of collection. It is recommended to examine at least three consecutive stool samples when parasitic infection is suspected, as the diagnostic sensitivity increases from approximately 50% in a single sample to 80 to 90% in three samples.^{2,5-7}

How Are Stool Samples Analyzed?

Stool samples are examined macroscopically for color, consistency, odor, presence of blood, mucus, and adult worms. Microscopic examination of direct and concentrated stool specimens is used to identify cellular exudates, motile trophozoites, cysts, helminthic eggs, or segments. Leukocytes or cellular exudates are generally observed in inflammatory diarrhea and absent in toxin-mediated diarrheas. Red blood cells are observed in case of intestinal amoebiasis and bacillary dysentery. Hanging drop examination of watery stool samples can aid in provisional diagnosis of cholera. In immunosuppressed patients with diarrhea, *C. parvum*, *C. cayetanensis*, or *C. belli* oocysts may be detected by modified acid-fast staining (→Table 1).^{5,6}

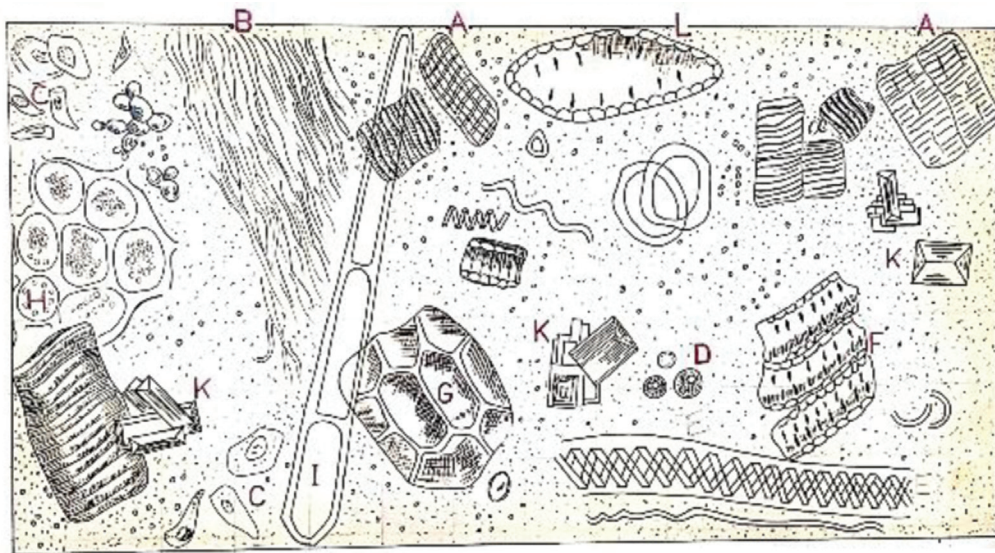
What Is Stool Culture and Where Is It Used?

In stool culture, bacteria present in the stool sample are identified. A part of the stool sample is put on special culture media that promote the growth of bacteria. The bacteria grown are identified by microscopy, biochemical, and serologic tests.

Table 1 Normal and abnormal findings on stool examination (original)

	Normal findings	Abnormal findings
Gross appearance	<ul style="list-style-type: none"> Does not contain blood, mucus 	<ul style="list-style-type: none"> Abundant mucus Mucus with scanty blood Bloody appearance
Color	<ul style="list-style-type: none"> Brown, dark brown, or yellow-brown, due to bile pigments 	<ul style="list-style-type: none"> Black and tarry stools due to bleeding from upper GI tract Bright red/ maroon color due to bleeding from lower GI tract Clay-colored stools due to biliary tract obstruction
Consistency	<ul style="list-style-type: none"> Soft, well-formed or semisolid 	<ul style="list-style-type: none"> Loose Watery or liquid
Parasites	<ul style="list-style-type: none"> Not seen 	<ul style="list-style-type: none"> Adult worms—roundworms, hookworm, tapeworms Tapeworm segments Larvae of <i>Strongyloides stercoralis</i>
Microscopic examination (→ Figs. 1, 2)	<ul style="list-style-type: none"> Vegetable matter Fat globules Epithelial cells Pollen grains Yeast cells Bacteria 	Saline & iodine mount examination: <ul style="list-style-type: none"> Cellular exudate (pus cells), RBCs and epithelial cells Charcot-Leyden crystals (eosinophil breakdown products) Parasites: motile trophozoites/ cysts of protozoa and ova/ larvae/ segments of helminths Hanging drop examination: <ul style="list-style-type: none"> Bacteria with darting motility (<i>Vibrio spp.</i>) Modified acid fast staining: <ul style="list-style-type: none"> Acid-fast oocysts of coccidian parasites

Abbreviations: GI, gastrointestinal; RBC, red blood cell.



A. Muscle fibers B. Connective tissue C. Epithelial cells D. Leukocytes
 E. Spiral vessels of plants F. G & H. Vegetable cells I. Plant hairs
 K. Triple Phosphate Crystals L. Stone cells. scattered among these elements
 are micro-organisms and debris.

Fig. 1 Microscopic elements of normal feces.

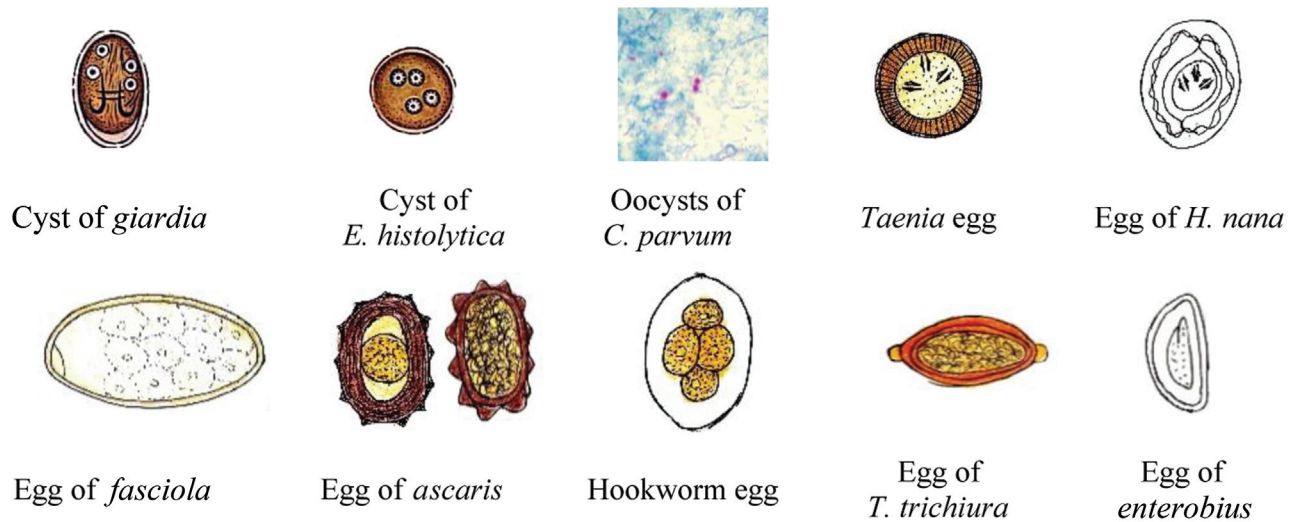


Fig. 2 Cysts and eggs of common parasites in stool.

Stool culture report, available in 72 to 96 hours, can help to identify the type of bacteria (pathogenic or commensal) and antibiotics that may be effective. If no pathogenic bacteria are found, the symptoms may be due to other causes like irritable bowel syndrome and parasitic infections.^{5,6}

What Are Fecal Antigen Tests?

Antigen detection in stool is useful in the diagnosis of *Helicobacter pylori*, *Giardia lamblia*, *Cryptosporidium parvum*, *Entamoeba histolytica/ dispar*, Rotavirus, adenovirus infections, etc. Enzyme immunoassays (enzyme-linked im-

munosorbent assay), latex agglutination, and rapid tests are the most commonly used tests. In cases of *C. difficile*-associated diarrhea, glutamate dehydrogenase enzyme and toxins A/B of *C. difficile* can be detected directly in stool specimens by rapid tests or enzyme-linked immunoassays.¹

What Are Molecular Tests?

Molecular tests help to detect GI pathogens in stool by polymerase chain reaction (PCR). PCR is a method of amplification and detection of specific gene sequences. Multiplex PCR systems are available that enable the detection of several

bacteria, viruses, and parasites in a short time (about 1 hour). This is a rapid and sensitive method for the diagnosis of infectious diarrheas, especially in cases of intractable diarrhea and screening of fecal microbiota transplant donors.¹

Ethical Statement

Not applicable.

Authors' Contribution

All authors contributed equally to the article.

Data Availability Statement

There is no data associated with this work.

Conflict of Interest

None declared.

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