Infectious Disease Epidemiology Section
Office of Public Health, Louisiana Dept of Health & Hospitals

GIARDIASIS

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Giardiasis is the gastrointestinal illness caused by the flagellated protozoan *Giardia intestinalis*, also known as *G. lamblia* or *G. duodenalis*.

Giardia has a two-stage life cycle: trophozoite and cyst. The life cycle begins with ingested cysts, which release trophozoites (10-20 µm x 5-15 µm) in the duodenum. These trophozoites attach to the surface of the intestinal epithelium by using a ventral sucking disk and then reproduce by binary fission. The trigger for encystment is unclear, but the process results in the inactive, environmentally resistant form of *Giardia* - a cyst (11-14 µm x 7-10 µm) that is excreted in feces.

Epidemiology

Giardia is spread from person to person and from animals to humans through fecal-oral transmission. Giardiasis occurs when cysts are ingested through person-to-person transmission or ingestion of fecally contaminated food or water.

Reservoir of infection: Giardia infects humans, domestic and wild animals (e.g., cats, dogs, cattle, deer, and beavers). Giardia cysts can be excreted in the stool intermittently for weeks or months, resulting in a protracted period of communicability.

The infectious dose is low: humans can be infected with as few as 10 cysts.

Giardia intestinalis, the organism that causes the gastrointestinal illness giardiasis, is the most commonly diagnosed intestinal parasite in public health laboratories in the United States. Giardia is one of the most frequently identified etiologic agent of outbreaks associated with drinking water in the US. In 1997, cases per 100,000 state population ranged from 0.9 to 42.3, with 10 states reporting >20.0 cases per 100,000 population and a national average of 9.5 cases per 100,000 population.

Giardiasis usually occurs sporadically, although outbreaks do occur. The prevalence of Giardia in stool specimens submitted for examination ranges from 2% to 5% in industrialized countries and from 20% to 30% in developing countries, and it can be as high as 35% among children attending day care centers in the United States in a non-outbreak setting.

The most common types of outbreaks are:

- Waterborne outbreaks, associated with ingestion of both drinking and recreational water (e.g., lakes, rivers, or swimming pools)
- Foodborne outbreaks
- Person-to-person outbreaks among men who have sex with men and among children and staff in day care centers

The relative contribution of waterborne, foodborne, and person-to-person transmission to sporadic giardiasis is unknown.

Persons at greatest risk of exposure to infection are children in day care, their close contacts, men who have sex with men, backpackers and campers (via ingestion of unfiltered, untreated drinking water), travelers to disease-endemic areas and persons drinking water from shallow wells.

The incidence of giardiasis was highest for children aged 0-5 years, followed by adults aged 31-40 years. These data correlate with reports of giardiasis prevalence being higher than average among children who attend day care centers as well as the family members and day care workers who care for these children.

Less commonly, community epidemics caused by contaminated drinking water occur. In such outbreaks, approximately 11 percent of the residents have become infected. Both human and animal (beaver) fecal contamination of stream water has been implicated as the source of Giardia cysts in waterborne outbreaks. Giardia species in dogs and possibly other animals are also considered infectious for humans.

The greatest number of reports of giardiasis are received during the late summer and early autumn.

The incubation period is of 3 to 25 days (median, 7 to10 days).

Clinical Description

Asymptomatic infections can occur, especially in children and in persons with prior infections.

Clinically, Giardia produces a broad spectrum of gastrointestinal symptoms, including one or more of the following symptoms: diarrhea, flatulence, bloating, weight loss, abdominal cramping, nausea, malabsorption, foul-smelling stools, steatorrhea, fatigue, anorexia and chills.

Laboratory Tests

The traditional method of diagnosis is a stool examination for trophozoites or cysts. In the stool ova and parasite examination, the stool should be examined fresh and after preservation. A saline wet mount of fresh liquid stool in the acute stages of illness may yield motile trophozoites. In semiformed stool, trophozoites are usually not found. The stool should be examined fresh for cysts after iodine staining or after preservation in 10% buffered formalin or polyvinyl alcohol and subsequent trichrome or iron hematoxylin staining. Examination of a purged sample does not increase the yield.

Formalin-ether or zinc sulfate flotation concentration techniques may increase the yield. Giardia should be identified 50% to 70% of the time after one stool, and some report over 90% identification after three stools.

Antigen detection assays are now available and have frequently become the tests of choice.

Antigen assays detect Giardia by immunofluorescence or enzyme-linked immunosorbent assay. They are most helpful when giardiasis is the leading diagnosis such as during an outbreak, when screening children in daycare, or when testing patients after the completion of treatment. They are comparable in cost to a stool ova and parasite examination and are 85% to 98% sensitive and 90% to 100% specific. One of the best-studied assays detects a 65-kD Giardia cyst wall glycoprotein by enzyme-linked immunosorbent assay (ProSpecT, Giardia Assay, Alexon, Inc., Mountain View, Calif. An immunofluorescence assay detecting Giardia and Cryptosporidium is also available (Merifluor, Meridian Diagnostics, Inc., Cincinnati, Ohio).

Stool specimens should be collected in stool containers that contain 5%-10% formalin solution or polyvinyl alcohol fixative (P.V.A.). Giardia organisms are passed intermittently and may, therefore, require multiple stool specimens (on successive days). Single stool examinations detect 50% to 75% of infections; sensitivity is increased to about 95% with three specimens.

The OPH does not routinely vary out diagnostic tests for giardiasis in non-outbreak situations.

Surveillance

Giardiasis is condition with reporting required within 5 business days.

Case Definition

Clinical description

An illness caused by the protozoan *Giardia lamblia* and characterized by diarrhea, abdominal cramps, bloating, weight loss, or malabsorption. Infected persons may be asymptomatic.

Laboratory criteria for diagnosis

- Demonstration of *G. lamblia* cysts in stool, or
- Demonstration of *G. lamblia* trophozoites in stool, duodenal fluid, or small-bowel biopsy, or
- Demonstration of *G. lamblia* antigen in stool by a specific immunodiagnostic test (e.g., enzyme-linked immunosorbent assay)

Case classification

Probable: a clinically compatible case that is epidemiologically linked to a confirmed case
Confirmed: a case that is laboratory confirmed

Investigation

The purpose of investigation is to identify cases, to determine the mode of transmission (whether from person to person or by common vehicle), to identify the population exposed to increased risk of infection and to institute disease control measures.

Upon receipt of a report of a case of giardiasis, contact the physician and/or hospital to confirm the diagnosis.

It is not necessary to follow-up on each individual, isolated case of giardiasis. Only under certain circumstances is further evaluation necessary, such as:

- If a physician requests family members be tested
- If the case appears to be associated with a child care center, institution, nursing home, etc.
- If follow-up is requested by the Infectious Disease Epidemiology Section
- If the case is suspected to be part of a waterborne outbreak

If the case is suspected to be part of a waterborne outbreak, the first concern would be to determine the source(s) of the infection. Questions regarding the need to test water systems should be referred to the Infectious Disease Epidemiology Section. OPH does not routinely test private wells. Water samples for coliform counts may be conducted when deemed necessary.

Treatment of asymptomatic carriers is not recommended, except to prevent household transmission to pregnant women and patients with other medical conditions.

If the case is associated with a child care center, contact the DCC owner/director to notify her of the case and to determine if any other cases have occurred. The normal procedure to follow includes testing symp-

tomatic individuals if a second case has been confirmed. Once the laboratory test results are available on those persons, a decision can be made regarding further testing and/or referral.

Treatment

Many effective treatment alternatives are available for patients with symptomatic giardiasis. Metronidazole is the treatment most often prescribed in the United States. Furazolidone is a less effective treatment option, but it is the only drug approved by the U.S. Food and Drug Administration (FDA) for treatment of giardiasis in the United States. Because furazolidone is available in liquid form, it is often used to treat children. Quinacrine, an effective and inexpensive treatment option, is not available from any U.S. manufacturer, although several compounding pharmacies have made it available. Tinidazole is widely used throughout the world; however, it is not approved for use in this country. Albendazole has been reported to be as effective as metronidazole with fewer side effects among children aged 2-12 years. Paromomycin, a nonabsorbed aminoglycoside, is less effective than other agents but is used for treatment among pregnant women because of potential teratogenic effects of the other agents. A combination of metronidazole and quinacrine has been used to treat refractory cases.

	Drug	Adult Dose	Pediatric dose
First Line	Metronidazole	250 mg tid × 5 days	15 mg/kg/day in 3 doses × 5 days
Alternatives	Quinacrine	100 mg PO tid × 5 days (max 300 mg/day)	2 mg/kg PO tid × 5 days (max 300 mg/day)
	Tinidazole	2 g once	50 mg/kg once (max 2 g)
	Furazolidone	100 mg qid × 7–10 days	6 mg/kg/day in 4 doses × 7–10 days
	Paromomycin	25–35 mg/kg/day in 3 doses × 7 days	25–35 mg/kg/day in 3 doses × 7 days

Prevention of transmission

Practice good hygiene.

- Wash hands thoroughly with soap and water.
- Wash hands after using the toilet and before handling food (especially for persons with diarrhea).
- Wash hands after every diaper change and when working with children, even if you are wearing gloves.
- Avoid swimming if experiencing diarrhea (essential for children in diapers).

Avoid food that might be contaminated.

Avoid fecal exposure during sex.

Avoid water that might be contaminated.

- Avoid swallowing recreational water (e.g., water in lakes, rivers, swimming pools, water parks).
- Avoid drinking untreated water from shallow wells, lakes, rivers, springs, ponds, and streams.
- Avoid drinking untreated water during community-wide outbreaks caused by contaminated drinking water.
- Avoid drinking untreated water when traveling in countries where the water supply might be unsafe.
- If you are unable to avoid water that might be contaminated, then treat the water.
- Heat water to a rolling boil for 1 minute.
  OR

Use a filter that has an absolute pore size of at least 1µm or that has been NSF-rated for cyst removal.

- Do not rely on cyst inactivation by chlorination or iodination, which are less effective than other methods because they are highly dependent on the temperature, pH and cloudiness of the water.
- Use uncontaminated water to wash all food that is to be eaten raw.
- Avoid eating uncooked foods when traveling in disease-endemic areas.

When to get well water tested?

If one of these criteria are met:

- **More than one person on the water supply with Giardias**
- **Well at bottom of hill or shallow well.** If so, runoff from rain or flood water may be draining directly into your well, causing contamination.
- **Well in a rural area where animals graze?** Well water can become contaminated with feces if animal waste seepage contaminates the ground water.

Tests used to specifically identify Giardia are often expensive, difficult and usually require hundreds of gallons of water to be pumped through a filter. Test well for fecal contamination by testing it for the presence of coliforms or *E. coli* instead of Giardia. Although tests for fecal coliforms or *E. coli* do not specifically tell you whether Giardia is present, these tests will show whether your well water has been contaminated by fecal matter.

These tests are only useful if a well is not routinely disinfected with chlorine, since chlorine kills fecal coliforms and *E. coli* . If the tests are positive, it is possible that the water may also be contaminated with Giardia or other harmful bacteria and viruses.

Municipal Water

Giardiasis epidemics have commonly resulted from contaminated drinking water. The long-term solution to waterborne outbreaks involving municipal water systems requires use of water filtration equipment in the water treatment process. Although most large U.S. cities use proper filtration methods, many towns and small cities rely solely on chlorination to disinfect drinking water; the amount of chlorine used often does not kill *G. lamblia* cysts.

How to treat drinking water for the removal of *G. lamblia* has become an important concern over the last few years as outbreaks of giardiasis have occurred. Designs appropriate for small water systems are particularly needed.

Because the cysts of *G. lambia* resist conventional disinfection, effective filtration must serve as an additional barrier to prevent disease transmission. Studies have shown that diatomaceous earth filtration is an effective process for the removal of *G. lamblia* cysts. Only diatomaceous earth filters approved by the National Sanitation Foundation for treatment of drinking water should be used.

A properly designed slow sand filtration system is also almost 100 % effective in removing *G. lamblia* cysts. However, proper construction operation, and sand size are critical to the efficiency of the slow sand filter. The sand should have an effective size of 0.25 - 0.35 mm with an ideal effective size of 0.30 mm and a uniformity coefficient of 1.4 to 1.8 with an ideal coefficient of 1.6.

Water Disinfection

Boiling - Except for water treatment methods that include filtration, boiling is the only technique that can be recommended with complete confidence for elimination of *G. lamblia* in polluted water. Boiling (at a rolling boil) for three minutes is adequate to kill *G. lamblia* as well as most other bacteria or other pathogens likely to be acquired from drinking polluted water.

Chemical Disinfection - Disinfection of water with chlorine or iodine is less reliable than boiling for killing *G. lamblia*. It is not possible to recommend a concentration of chlorine and a contact time that would be effective under all types of water conditions. Therefore, providing continuous chlorination of the water supply will not assure the destruction of the cysts. Chlorine concentrations ordinarily used to disinfect water supplies are ineffective in killing *G. lamblia* cysts.

Hospital precaution and isolation: Contact precaution should be used for the duration of the illness.