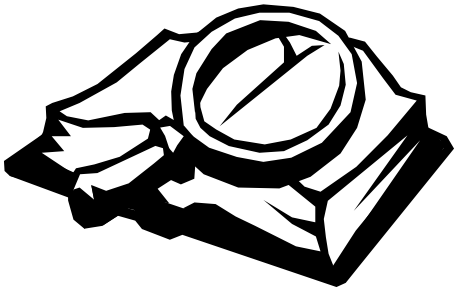


California Association for Medical Laboratory Technology

Distance Learning Program

GIARDIASIS

Course # DL-007

Adapted from Morbidity and Mortality Weekly Report, Vol 61/No. SS-5 Sept. 6, 2012
Giardiasis Surveillance-United States, 2009-2010,
Division of Foodborne, Waterborne, and Environmental Diseases,
National Center for Emerging and Zoonotic Infectious Diseases, CDC

by

Helen Sowers, MA, CLS
Dept. of Biological Science (Retired)
California State University East Bay

Approved for 1.0 CE
CAMLT is approved by the California Department of Public Health
as a CA CLS Accrediting Agency (#21)

Level of Difficulty: Basic

39656 Mission Blvd.
Fremont, CA 94539

Phone: 510-792-4441
FAX: 510-792-3045

Notification of Distance Learning Deadline
DON'T PUT YOUR LICENSE IN JEOPARDY!

This is a reminder that all the continuing education units required to renew your license/certificate must be earned no later than the expiration date printed on your license/certificate. If some of your units are made up of Distance Learning courses, please allow yourself enough time to retake the test in the event you do not pass on the first attempt. CAMLT urges you to earn your CE units early!

DISTANCE LEARNING ANSWER SHEET

Please circle the <u>one</u> best answer for each question.

COURSE NAME GIARDIASIS **COURSE #** DL-007

NAME _____ **CLS LIC. #** _____ **DATE** _____

SIGNATURE (REQUIRED) _____

ADDRESS _____

STREET **CITY** **STATE/ZIP**

1.0 CE – FEE: $12.00 (MEMBER) | $22.00 (NON-MEMBER)

PAYMENT METHOD: [ ] CHECK OR [ ] CREDIT CARD # _____ **TYPE – VISA OR MC**

EXP. DATE _____ **| SECURITY CODE:** ___ - ___ - ___

---

1. a b c d

2. a b c d

3. a b c d

4. a b c d

5. a b c d

6. a b c d

7. a b c d

8. a b c d

9. a b c d

10. a b c d

DISTANCE LEARNING EVALUATION FORM

According to state regulations, this form must be completed and returned in order to receive CE hours. Your comments help us to provide you with better continuing education materials in the distance learning format. Please circle the number that agrees with your assessment with, with **5 meaning you strongly agree and 1 meaning you strongly disagree.**

1. Overall, I was satisfied with the quality of this Distance Learning course.

   5 4 3 2 1

2. The objectives of this Distance Learning course were met.

   5 4 3 2 1

3. The difficulty of this Distance Learning course was consistent with the number of CE hours.

   5 4 3 2 1

4. I will use what I learned from this Distance Learning course.

   5 4 3 2 1

5. The time to complete this Distance Learning course was: _____ hours

6. Please comment on this Distance Learning course on the back of this sheet. What did you like or dislike?

GIARDIASIS

DL-007
1.0 CE
Level of Difficulty: Basic

Adapted from Morbidity and Mortality Weekly Report, Vol 61/No. SS-5 Sept. 6, 2012
Giardiasis Surveillance-United States, 2009-2010,
Division of Foodborne, Waterborne, and Environmental Diseases,
National Center for Emerging and Zoonotic Infectious Diseases, CDC

By: Helen M. Sowers, M.A., CLS
Dept. of Biological Science (Retired)
California State University, East Bay

OBJECTIVES:
At the end of this course the participant will be able to

1. Discuss the causative agent of giardiasis
2. Explain the mode of transmission of *Giardia intestinalis* infection
3. List the symptoms of giardiasis
4. Discuss the tests for *Giardia* infection
5. List methods of prevention of transmission of *Giardia*
6. Discuss problems in explaining epidemiology of giardiasis

INTRODUCTION:

Giardia intestinalis (also known as *G. lamblia* and *G. duodenalis*) is the most common intestinal parasite of humans identified in the United States. During 2009-2010 the number of reported cases of giardiasis in the U.S. increased slightly from 19,403 to 19,888. In California the number of cases decreased from 1,798 in 2009 to 1,783 in 2010, continuing a steady decrease over a 10-year period.

This flagellated protozoan causes a generally self-limited clinical illness typically characterized by diarrhea, abdominal cramps, bloating, weight loss, and malabsorption; asymptomatic infection also occurs frequently.

Giardia infection is transmitted through the fecal-oral route and results from the ingestion of *Giardi*a cysts through the consumption of fecally contaminated food or water or through person-to-person transmission. The cysts are infectious immediately upon being excreted in feces.

Giardiasis is often detected in travelers to areas where disease is endemic and among internationally adopted children. Participation in backpacking, camping, and swimming, having contact with some animal species, and certain sexual practices might increase the risk for giardiasis.

Because *Giardia* cysts can be excreted intermittently, multiple stool collections increase test sensitivity. Use of concentration methods and trichrome staining might not be sufficient to identify *Giardia* because variability in the concentration of organisms in stool can make this infection difficult to diagnose. For this reason, fecal immunoassays that are more sensitive and specific should be used. Direct fluorescent antibody testing is an extremely sensitive and specific detection method, and is considered the benchmark for accuracy by many laboratorians.

In 1992 the Council of State and Territorial Epidemiologists assigned a reporting number of giardiasis to facilitate transmission of reported giardiasis data to CDC. Reporting of giardiasis as a nationally notifiable disease began in 2002.

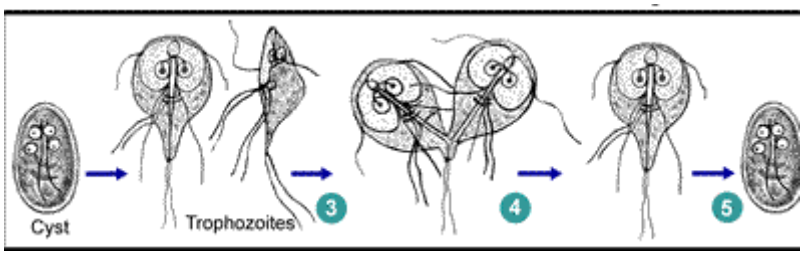
CLASSIFICATION:

Kingdom: Protista
Subkingdom: Protozoa
Physom: Sarcomastigophora
Subphylum: Mastigophora
Class: Zoomastigophora
Order: Diplomonadida
Family: Hexcamitidae
Genus: *Giardia*
Species: *intestinalis*

DESCRIPTON OF *GIARDIA INTESTINALIS*

Giardis intestinalis is a protozoan flagellate. This protozoan was initially named *Cercomonas intestinalis* by Lambl in 1859. It was renamed *Giardia lamblia* by Stiles in 1915 in honor of Professor A. Girard of Paris and Dr. F. Lambl of Prague. However many consider the name, *Giardia intestinalis*, to be the correct name for this protozoan.

Life cycle: the organism exists in two forms: trophozoite and cyst. Cysts are resistant forms and are responsible for transmission of giardiasis. Both cysts and trophozoites can be found in the feces (diagnostic stages). The cysts are hardy and can survive several months in cold water. Infection occurs by the ingestion of cysts in contaminated water, food, or by the fecal-oral route (hands or fomites). In the small intestine, excystation releases trophozoites (each cyst produces two trophozoites). Trophozoites multiply by longitudinal binary fission, remaining in the lumen of the proximal small bowel where they can be free or attached to the mucosa by a ventral sucking disc. Encystation occurs as the parasites transit toward the colon. The cyst is the stage found most commonly in nondiarrheal feces. Because the cysts are infectious when passed in the stool or shortly afterward, person-to-person transmission is possible. While animals are infected with *Giardia*, their importance as a reservoir is unclear.



Division of Parasitic Diseases, CDC (4)

EPIDEMIOLOGY

Giardia infection is transmitted through the fecal-oral route and results from the ingestion of *Giardia* cysts through the consumption of fecally contaminated food or water or through person-to-person (or, to a lesser extent, animal-to-person) transmission. The cysts are infectious immediately upon being excreted in feces. The infectious dose is low; ingestion of 10 cysts has

been reported to cause infection. Infected persons have been reported to shed 10^8-10^9 cysts in their stool per day and to excrete cysts for months.

Giardiasis is often detected in travelers to areas where disease is endemic and among internationally adopted children. Transmission can occur to close contacts of infected persons, including to children in childcare settings and their caregivers. Participation in backpacking, camping, and swimming, having contact with some animal species, and certain sexual practices might increase the risk for giardiasis.

National giardiasis surveillance data are used to assess the epidemiologic characteristics and disease burden of giardiasis in the United States. Following a gradual decline in case reports during 1996-2001 the number of cases reported and rates appears to have stabilized, coinciding with the disease becoming nationally notifiable in 2002. Although giardiasis is reported throughout the United States, the rates are highest in northern states and Vermont has reported the highest rate for each of the last 5 years. It is difficult to determine whether this finding is of biologic importance or if it reflects different surveillance capacities among states.

Drinking water is an important vehicle for *Giardia* transmission. *G. intestinalis* was the single most frequently identified pathogen in all drinking water outbreaks reported in the United States during 1971-2006, responsible for 121 (28%) of 432 outbreaks with an identified etiology. Untreated drinking water was identified as a risk factor for sporadic giardiasis in studies in the United States and New Zealand. Untreated groundwater appeared to be particularly risky if it was acquired from poorly constructed or maintained wells that might have been subject to surface water contamination.

Treated or untreated recreational water also has been implicated as a vehicle of giardiasis transmission. During 1999-2008, *Giardia* was identified as a causal agent of eight of 228 reported recreational water-associated gastroenteritis outbreaks. In studies of sporadic giardiasis, swallowing water while swimming and during other recreational contact with fresh water were both risk factors for contracting *Giardia.* Backpackers have contracted *Giardia* if they drink from streams that have run-off from cattle grazing areas or campers. *Giardia* can be frequently detected in fecal material in pools and transmission has been documented among diapered children who use swimming venues regularly.

Reported foodborne outbreaks of giardiasis have generally been caused by direct contamination by an infected food handler or by animal contamination of food. However foodborne outbreaks of giardiasis are infrequently reported in the United States; during 2000-2010 <1% of foodborne outbreaks with an identified etiology were attributed to *Giardia*. Infections from contamination of widely distributed foods (e.g., fresh produce) might be more difficult to detect. In a study of sporadic giardiasis in England, eating lettuce was associated with increased risk for giardiasis. Use of reclaimed wastewater for irrigation is associated with finding *Giardia* cysts on fresh produce, highlighting the necessity of using noncontaminated irrigation water to prevent foodborne disease.

Person-to-person transmission of *Giardia* also occurs. Persons attending or working in childcare settings or those who have close contact with persons with giardiasis are at increased risk for being infected. Exposure to feces through handling diapers and poor hygiene, particularly after toileting, in childcare settings might contribute to increased risk.

Although *G. intestinalis* infects both humans and animals, the importance of zoonotic transmission to humans and the rode of animal contamination of food and water are being reexamined as a result of advances in molecular epidemiology. *Giardia* has been detected in nearly all classes of vertebrates, including domestic animals and wildlife. However, molecular

characterization of *Giardia* has identified relatively species-specific genetic assemblages. Humans are primarily infected with assemblages A and B, although these assemblages are also found in other species. Animal contamination has been suspected of causing outbreaks associated with drinking water. In the United States and Australia, livestock are infected predominately with the bovine-specific genetic assemblage E. Although human-pathogenic assemblage A can be found in a small proportion of cattle, investigations of contaminated water supplies typically incriminate effluent from human waste as the source. Thus farm run-off and land application of animal waste might not be major contributions to human giardiasis as was previously thought.

Household pets represent a potential source of transmission; however, findings from molecular studies of human and animal *Giardia* species and assemblages suggest that the risk for *G. intestinalis* zoonotic transmission is not as high as previously believed. *Giardia* was identified in 9.4% of otherwise healthy pet dogs in Australia; however, assemblages C and D (rarely infectious to humans) were identified most frequently. Data implicating pets as a risk factor for giardiasis are limited, and additional epidemiology studies are needed to clarify this question. No molecular data are reported to CDC surveillance systems, limiting the ability to understand the role of zoonotic transmission.

The rate of giardiasis varies by age and sex. The rate of reported giardiasis is higher in males than in females in most age groups, particularly among adults aged 35-54 years. Although giardiasis affects persons in all age groups, the number of reported cases was highest among children aged 1-9 years. Data for younger age groups are consistent with reports published previously documenting higher rates of giardiasis among younger children. Higher rates in children might be related to increased recreational water exposures, poor sanitation and hygiene skills, and close contact with other potentially infected children in childcare settings. *Giardia* was identified as the cause of non-dysenteric diarrhea in 155 of children examined in outpatient clinics, and transmission from children who are ill to household contacts has been documented in outbreak investigations.

A marked increase in the number of giardiasis cases occurs during the summer, similar to the profile observed for other bacterial and parasitic enteric diseases. This seasonal variation also has been noted in state, Canadian provincial, and previous U.S. national surveillance data for giardiasis and cryptosporidiosis. This might be attributable to increased outdoor activities during the summer. Transmission associated with outdoor activities is facilitated by the substantial number of *Giardia* cysts that can be shed by a single person, the environmental hardiness of the organism, the extended periods of time that cysts can be shed, and the low infectious dose.

Its low infectious dose, protracted communicability, and moderate chlorine tolerance make *Giardia* ideally suited for transmission through drinking and recreational water, and person-to-person contact. Strategies to reduce the incidence of giardiasis have focused on reducing waterborne and person-to-person transmission. The U.S. Environmental Protection Agency (EPA) enacted the Surface Water Treatment Rule (SWTR) in 1989 and the Interim Enhanced SWTR in 1998. These regulations have decreased the number of giardiasis outbreaks associated with community drinking water systems. In 2006 EPA finalized the Ground Water Rule to address contamination of public ground water (well) systems, which might reduce the number of groundwater-associated outbreaks of giardiasis. For treated recreational water venues, conducting proper pool maintenance criteria (i.e., prohibiting persons with diarrhea from swimming) should decrease transmission of *Giardia* through treated recreational water. Person-to-person transmission of *Giardia* is difficult to interrupt in a systematic fashion, particularly in

childcare settings. Adherence to appropriate infection control (e.g., exclusion or separation of children ill with diarrhea, hand washing, and diaper changing) policies is recommended for controlling *Giardia* and other enteric pathogens in these group settings.

SYMPTOMS, DIAGNOSIS, AND TREATMENT

Symptoms

Signs and symptoms may vary and can last for 1 to 2 weeks or longer. In some cases people infected with *Giardia* have no symptoms.

Acute symptoms include:

1. Diarrhea
2. Gas
3. Greasy stools that tend to float
4. Stomach or abdominal cramps
5. Upset stomach or nausea/vomiting

Other less common symptoms include itchy skin, hives, and swelling of the eye and joints. Sometimes the symptoms of giardiasis might seem to resolve, only to come back again after several days or weeks. Giardiasis can cause weight loss and failure to absorb fat, lactose, vitamin A, and vitamin B12.

In children severe giardiasis might delay physical and mental growth, slow development, and cause malnutrition. Case reports and epidemiologic studies have associated giardiasis with the development of chronic enteric disorders, allergies, chronic fatigue, and reactive arthritis.

Diagnosis

Both cysts and trophozoites can be found in the feces of infected individuals. Because *Giardia* cysts can be excreted intermittently, multiple stool collections (i.e., three stool specimens collected on separate, preferably non-consecutive, days) increase test sensitivity. The Giardiasis organization (3) states that approximately 85-90% of cases may be detected when three separate stool samples are examined. However, in clinical practice, typically only a single stool exam is performed. Stool microscopy is relatively inexpensive, but does require a skilled technologist and may be a time consuming process. Thus the use of concentration methods and trichrome staining might not be sufficient to identify *Giardia*. For this reason, fecal immunoassays that are more sensitive and specific should be used in addition to routine ova and parasite examination. *Giardia* specific antigen may be detected in stool specimens even during an absence of cyst passage or visible signs of trophozoites.

Giardia specific antigen in stool specimens are detected by several different methods: EIA, indirect and direct immunofluorescent assays using monoclonal antibodies, and direct fluorescent assays. They are available from several different commercial sources, including Meridian, Alexon-Trend, Tech-lab, and Biosite.

These commercial companies have developed rapid diagnostic tests that are simple to perform and can be completed in less time than traditional methods. CDC compared one of these rapid tests, the ImmunoCard STAT! (Meridian Bioscience, Inc.) lateral-flow immunoassay with the MERIFLOUR direct fluorescent-antibody (DFA) test (Meridian), and the ProSpecT EZ microplate assay (Alexon-Trend, Inc.) using 246 specimens. The MERIFLUOR DFA test detected the largest number of case infections and was used to calculate the sensitivity and specificity of the other tests. For *Giardia* the sensitivities of the ImmunoCard STAT! and the ProSpecT Giardia EZ microplate assay were 81 and 91% respectively.

Treatment

Several drugs can be used to treat *Giardia* infection. Effective treatments include metronidazole, tinidazole, and nitazoanide. Alternatives to these medications include paromomycin, quinacrine, and furazolidone. Some of these drugs may not be routinely available in the Untied States.

Different factors may shape how effective a drug regimen will be, including medical history, nutritional status, and condition of the immune system. Therefore it is important to discuss treatment options with a health care provider.

PREVENTION

Its low infectious dose, protracted communicability, and moderate chlorine tolerance make *Giardia* ideally suited for transmission through drinking and recreational water, and person-to-person contact. Strategies to reduce the incidence of giardiasis have focused on reducing waterborne and person-to person transmission. The U.S. Environmental Protection Agency enacted Surface Water Treatment Rules in 1989 and 1998. These regulations have decreased the number of giardiasis outbreaks associated with community drinking water systems. For treated recreational water venues, conducting proper pool maintenance and implementing exclusion of swimmers with diarrhea should decrease transmission of *Giardia* through treated recreational water. Person-to-person transmission of *Giardia* is difficult to interrupt, particularly in childcare settings. Adherence to appropriate infection control policies is recommended for group settings. See Table I.

Table I

Always practice good hand hygiene.

- Wash hands with soap and water for at least 20 seconds, rubbing hands together vigorously and scrubbing all surfaces
    - after using the toilet,
    - before handling food,
    - after every diaper change (even if wearing gloves),
    - after direct contact with preschool-aged children, and
    - after any contact with animals or their feces.

Prevent contamination of recreational water (e.g., swimming pools, spas, interactive fountains, lakes, rivers, and oceans).

- Do not swim while experiencing diarrheal illness (e.g., swimming in or entering the water at pools, spas, interactive fountains, lakes, rivers, or oceans) or for 2 weeks after diarrhea or symptoms resolve if one has received a diagnosis of giardiasis or during an outbreak of giardiasis.
- Take children on frequent bathroom breaks and check their diapers often.
- Change diapers in the bathroom, not at the poolside.
- Wash children thoroughly (especially their bottoms) with soap and water after they use the toilet or their diapers are changed and before they enter the water.
- Shower before entering the water.

Information about recreational water illnesses and how to stop them from spreading is available from CDC at http://www.cdc.gov/healthyswimming.

Prevent infection and illness caused by water that might be contaminated.

- Do not swallow water in swimming pools, spas, or interactive fountains.
- Do not swallow untreated water from lakes, rivers, springs, ponds, streams, or shallow wells.
- Do not drink inadequately treated water during communitywide outbreaks caused by contaminated drinking water.
- Do not use or drink inadequately treated water when traveling in countries where the water supply might be unsafe.
- If the safety of drinking water is in doubt,
    - disinfect it by heating the water to a rolling boil for 1 minute,
    - use a filter that has been tested and rated by National Sanitation Foundation (NSF) Standard 54 or NSF Standard 58 for cyst reduction (filtered water will need additional treatment to kill or inactivate bacteria and viruses), or
    - treat it with chlorine or iodine; however, these chemical methods are less effective against *Giardia* than boiling or filtering because they are highly dependent on the temperature, pH, and cloudiness of the water.

Prevent infection and illness caused by eating food that might be contaminated.

- Use properly treated water to wash all food that will be eaten raw.
- Do not eat uncooked foods when traveling in areas where giardiasis is common.

Prevent contact and contamination with feces during sex.

- Use a barrier during oral-anal sex.
- Wash hands immediately after handling a condom used during anal sex and after touching the anus or rectal area.

SURVEILLANCE AND REPORTING

Giardiasis is a nationally notifiable disease. This means that health care providers and laboratories that diagnose cases of laboratory-confirmed giardiasis are required to report those cases to their local or state health departments, which in turn report the cases to CDC. Outbreaks of giardiasis affecting multiple people that are related to water, food, or person-to-person transmission should be reported to CDC by state health departments. It is important to inform local, state, and federal health authorities about cases of giardiasis so public health responses can be taken to help control the spread of disease.

CONCLUSION

Although giardiasis is the most common enteric parasitic infection in the United States, knowledge of its epidemiology is still lacking in public health research. The majority of data on giardiasis transmission comes from outbreak investigations; however, the overwhelming majority of reported giardiasis cases occur sporadically. Relative contributions of person-to-person, animal-to-person, foodborne, and waterborne transmission to sporadic human giardiasis in the U.S. are not well understood. It is unclear whether the geographic variability reflects true differences in transmission patterns and disease burden. Ecological studies could characterize the potential contributions of private wells, septic systems, land application of biosolids, and agricultural operations in giardiasis transmission. Infected persons can shed *Giardia* for several weeks, and symptomatology is variable; however, until recently, no reliable serologic assays for *Giardia* have been available, and no population studies of *Giardia* seroprevalence have been conducted. With recent laboratory advances, such studies might now be feasible and would contribute substantially to our understanding of the prevalence in the U.S. Enhanced genotyping methods would increase our knowledge of the molecular epidemiology of *Giardia*, including elucidating species-specific assemblages. These tools, combined with traditional epidemiology and surveillance, would improve understanding of giardiasis risk factors, identify outbreaks by linking cases currently classified as sporadic infections, and provide risk factor information needed to inform prevention strategies.

Although recent studies indicate a potential for chronic sequelae from giardiasis, additional research is needed to further improve understanding of the burden and scope of these conditions. The burden and cost of acute giardiasis in the U.S. continue to be substantial. An estimated 1.2 million cases occur annually. Each year hospitalizations resulting from giardiasis cost approximately $34 million; in addition ambulatory outpatients have an estimated $120-275 non-insurance-covered expense. Because giardiasis is the most commonly reported intestinal parasitic infection in the U.S. and no declines in incidence have occurred in recent years, new epidemiologic studies are needed to identify effective public health measures.

REFERENCES:

1. Yoder JS, Gargano JW, Wallace RM, Beach, MJ. Giardiasis Surveillance-United States, 2009-2010, *Morbidity and Mortality Weekly Report*, Vol 61/No. SS-5 Sept. 6, 2012
2. Centers for Disease Control and Prevention, Parasites – *Giardia*. www.cdc.gov/parasites/giardia/
3. Giardiasis Diagnosis. www.giardiasis.org/Diagnosis.aspx
4. Laboratory Identification of Parasites of Public Health Concern, Giardiasis. www.dpd.cdc.gov/dpdx/HMTL/Giardiasis.htm