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Risk factors for sporadic *Giardia* infection in the United States: a case-control study in two FoodNet sites

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University of Michigan
2014

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Abstract

Risk factors for sporadic *Giardia* infection in the United States: a case-control study in two FoodNet sites

By Hannah Reses

Background: *Giardia intestinalis* is the most common intestinal parasite of humans in the United States, with an estimated 1.2 million cases of giardiasis occurring annually. Over 99% of cases in the United States are sporadic (i.e., not associated with a known outbreak), but the risk factors for sporadic giardiasis are not well described.

Methods: The Colorado and Minnesota sites of the Foodborne Diseases Active Surveillance Network (FoodNet) conducted a case-control study in 2003 and 2004 to assess risk factors for sporadic giardiasis. Cases were patients with non-outbreak-associated laboratory-confirmed *Giardia* infection reported to the FoodNet sites, and controls were matched by age and site. We used bivariate and multivariable logistic regression models to estimate the association between *Giardia* infection and exposures during the two week period prior to illness onset in case-patients. Population attributable fractions (PAF) were also calculated.

Results: Overall, 199 case-patients and 381 controls were enrolled. In the multivariable analysis, risk factors for *Giardia* infection included international travel (OR=13.7; 95% CI=4.7, 39.6; PAF=11.2%), drinking water from a river, lake, stream, or spring (OR=6.3; 95% CI=2.0, 19.9; PAF=9.3%), swimming in a natural body of water (OR=3.2; 95% CI=1.5, 6.8; PAF=10.4%), having high-risk sexual contact (OR=5.4; 95% CI=2.5, 11.5; PAF=10.2%), taking antibiotics (OR=2.6; 95% CI=1.3, 5.2; PAF=6.5%), and having a chronic gastrointestinal condition (OR=1.9; 95% CI=1.2, 3.1; PAF=13.3%). Eating raw vegetables or fruit was inversely associated with infection (OR=0.3; 95% CI=0.1, 0.8). Among individuals without a history of international travel during the exposure period, contact with children in diapers was a risk factor for giardiasis (OR=1.7; 95% CI=1.0, 2.7; PAF=17.9%).

Conclusions: This study provides additional evidence supporting previously reported protective and risk factors and identifies novel risk factors and host-level characteristics that deserve attention. Our results also highlight the importance of domestic exposures for sporadic giardiasis, as less than 12% of the illness was attributable to international travel. *Giardia* control measures should focus on decreasing exposure to unsafe drinking and recreational water and preventing person-to-person transmission via contact with children in diapers and sexual contact.

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Manuscript

Introduction

Giardia intestinalis, a flagellated protozoan, is a major cause of diarrheal illness worldwide (1). *Giardia* is endemic in both developed and developing countries. In the United States, *Giardia* is the most commonly identified parasite of humans (2), with an estimated 1.2 million cases occurring annually (3) and *Giardia* identified in 4%-7% of stool specimens from patients with diarrheal illness tested by state diagnostic laboratories (2, 4-6). Cases of giardiasis, the gastrointestinal illness caused by the parasite *Giardia*, are estimated to result in 3,581 hospitalizations and $34 million in hospitalization costs annually in the United States (7).

Giardia infection typically results in self-limited gastrointestinal illness characterized by diarrhea, abdominal cramps, bloating, malaise, nausea, weight loss, and malabsorption (1, 8). Asymptomatic infection also occurs frequently (1, 8). Additionally, giardiasis has been associated with the development of chronic diarrhea, fatigue, reactive arthritis, and allergies (9-13). Effective therapies for patients with symptomatic giardiasis include metronidazole, tinidazole, nitazoxanide, paromomycin, furazolidone, albendazole, and quinacrine (14).

Giardia infection is transmitted through the fecal-oral route and results from the ingestion of *Giardia* cysts through the consumption of fecally contaminated water or food, or through person-to-person or, to a lesser extent, animal-to-person transmission (15). The infectious dose is low, with ingestion of as few as 10 cysts needed to cause

infection (16). Cysts are immediately infectious upon being excreted in feces (16), and infected individuals have been reported to shed one hundred million to one billion cysts in their stool each day for several months (16-18). *Giardia* cysts are environmentally hardy and moderately chlorine tolerant, and can therefore survive in water, food, or on surfaces for long periods of time (1, 15).

The transmission of *Giardia* frequently occurs directly from person-to-person, especially among certain high-risk groups, including children attending daycare centers (19), individuals living in homes for the mentally handicapped (20), men who have sex with men (MSM) (21), individuals living in poor sanitation conditions, and families with young children (22, 23). Parents of young children, nursing mothers, and individuals who change diapers have been found to experience an elevated risk of giardiasis, indicating that contact with children may be an important determinant of infection transmission (24). *Giardia* has frequently been reported among MSM, and oral-anal sex has been hypothesized to be associated with infection (21, 25-27). Other behavioral factors such as anal sex, digital-anal contact, and shared penetrative sex toys could also lead to *Giardia* transmission (25). However, evidence of sexual transmission is limited, and epidemiologic studies have not assessed the association between specific sexual behaviors and giardiasis.

Giardia is a common enteric parasite of wildlife (28) and domestic animals including dogs, cats, and livestock (29, 30), but few epidemiologic studies have assessed the importance of animal-to-person transmission of giardiasis (31). *Giardia* is diversified into eight genetic assemblage (A-H), with assemblages A and B infecting humans (31). Assemblages C-H infect other mammals and are relatively species-specific (29). Within

assemblage A, there are three major sub-assemblages: AI, AII, and AIII (32). Epidemiologic surveys have indicated that humans are mostly infected with AII parasites, whereas pets, livestock, and wildlife are primarily infected by AI and AIII parasites (33). Although sub-assemblage AI is most frequently reported in dogs, AII parasites are also commonly reported (33). A study in Malaysia found evidence for assemblage-specific risk factors, with assemblage A infection associated with contact with household pets (34). Similarly, Minetti et al. (2015) found that assemblage A infection was associated with dog ownership, suggesting the presence of a potential zoonotic reservoir for this assemblage (32). Other case-control studies did not take into account the genetic diversity of *Giardia*; a study in eastern England reported a positive association between giardiasis and pigs, dogs, and cats (15), and studies in New Zealand identified contact with farm animals as a risk factor for adults (35, 36). Similarly, a study in the United Kingdom reported farm visitation as a risk factor (37). Other studies in the United Kingdom, Canada, and the United States did not identify an association between giardiasis and animal contact (15).

Indirect transmission of *Giardia* largely occurs through consumption of contaminated water and ingestion of contaminated food. It has been suggested that waterborne transmission is common in North America (38). Drinking water is an efficient vehicle for transmitting giardiasis, as cysts remain infective for long periods of time and are moderately chlorine-tolerant (39). Water may also become contaminated by domestic and wild animal species (40). *Giardia* is a common cause of outbreaks associated with untreated surface and groundwater (39, 41), and outbreaks of giardiasis due to contaminated community water systems have been the subject of most epidemiologic

reports on giardiasis in the United States (39, 42-44). *Giardia* was the most frequently identified pathogen in all drinking water outbreaks reported in the United States during 1971-2006 (39). *Giardia* infection has also been associated with swimming pools (45, 46), untreated recreational water (23, 47), and drinking well water (22, 48).

Poor hygiene practices by food handlers are the likely cause of most foodborne outbreaks of giardiasis in the United States (49, 50). However, foodborne outbreaks of giardiasis are infrequently reported in the United States and accounted for 15.7% of reported giardiasis outbreaks during 1971-2011 (51). Studies have identified eating lettuce and raw vegetables as risk factors for sporadic giardiasis (37, 52, 53). In contrast, a negative association between sporadic giardiasis and the consumption of lettuce and raw vegetables has also been reported (32). Produce may become contaminated with *Giardia* by water used during processing, irrigation water or runoff in the field, or by unwashed hands during harvesting, processing, transport, or at point-of-use (51, 54, 55).

Outdoor activities including camping, hiking, and picnicking have also been associated with *Giardia* outbreaks. In these settings, *Giardia* might be transmitted by consumption of untreated water or contaminated food (56). Studies of sporadic giardiasis have identified camping as a risk factor for infection (32, 47, 48, 57). Traveling abroad to countries with higher *Giardia* prevalence is a known risk factor for giardiasis (23, 24, 31-33, 38, 47), and domestic travel has also been implicated as a risk factor (36).

In addition to risk factors involving direct and indirect fecal contact, host-level factors might affect the risk of acquiring giardiasis (58) as the immune status of the host influences susceptibility to *Giardia* infection (59). An increased incidence of giardiasis has been previously reported among the immunocompromised (60, 61), including

patients with human immunodeficiency virus (HIV) (25). Additional immunocompromising conditions (e.g., cancer) and autoimmune diseases (e.g., Crohn's disease) have been investigated (60). Few studies have considered associations between *Giardia* and medications that may influence host susceptibility. Antacid use was examined in a case-control study in Germany (60), but other medications that may affect the gut microbiota or immunocompetence have not been studied. Antibiotic use may lead to increased *Giardia* infection vulnerability as disruption of the microbiota with antibiotics has been shown to precede the emergence of several enteric pathogens (62, 63). Finally, psychoactive medications can affect the composition of the gut microbiota and could lead to increased vulnerability to *Giardia* infection (64-67).

In the United States, reported cases of giardiasis gradually decreased from 1996 to 2001 and remained relatively stable from 2002 to 2010, coinciding with *Giardia* becoming a nationally notifiable disease in 2002 (68). From 1971-2011, 242 giardiasis outbreaks were reported to the Centers for Disease Control and Prevention (CDC). These outbreaks resulted from waterborne (74.8%), foodborne (15.7%), person-to-person (2.5%), and zoonotic (1.2%) transmission (51). Outbreak investigations in the United States have identified specific domestic risk factors including contaminated tap water (45, 69) due to untreated groundwater and distribution system deficiencies (51), recreational exposure to water in lakes, swimming pools, and kiddie pools (46, 51), person-to-person spread in daycare centers, nursing homes, and among men who have sex with men (21, 70-74), contact with animals at farms and petting zoos (51), and consumption of contaminated produce (51, 75).

Most information on risk factors for domestically-acquired giardiasis has come from outbreak investigations (37), but <1% of cases are associated with a recognized outbreak (76). While the majority of domestic giardiasis cases are sporadic (i.e., not outbreak-associated), the risk factors for sporadic giardiasis transmission are not well described and have been investigated in only three case-control studies in the United States (9). These studies, along with case-reports, have identified risk factors for sporadic giardiasis including drinking untreated water from rivers or streams (23, 57, 77), consumption of unfiltered municipal water (22), swimming in fresh water (23), contact with persons thought to have giardiasis (23), contact with a child in day care (23), having a shallow dug well (23) or any private well as a residential water source (22), camping (57), and international travel (48).

Given that giardiasis is the most commonly reported intestinal parasitic infection in the United States and most infections are not associated with known outbreaks, a better understanding of the epidemiology and risk factors for sporadic giardiasis is needed. The identification of risk factors for sporadic giardiasis, especially those that can be modified, may help in developing effective prevention measures. To address this ongoing public health problem, the CDC collaborated with Colorado and Minnesota to identify giardiasis cases and controls in order to assess the risk factors for sporadic giardiasis. The objective of the study is to identify specific risk factors associated with sporadic *Giardia* infection in the United States to inform prevention efforts.

Methods

Surveillance

The Foodborne Diseases Active Surveillance Network (FoodNet) surveillance system sites in Colorado and Minnesota and the CDC conducted a matched case-control study to assess risk factors for sporadic giardiasis among persons in the United States. Persons with laboratory-confirmed *Giardia* infection were identified by the Colorado and Minnesota FoodNet sites in 2003 and 2004. The laboratories in these catchment areas were contacted regularly by FoodNet investigators who collected information on all laboratory-confirmed cases of *Giardia*.

Under a protocol approved by the CDC and FoodNet states' Institutional Review Boards, public health departments identified case-patients over a 12-month period by monitoring reports of laboratory-confirmed *Giardia* infections not associated with known outbreaks under investigation by the state health department. Colorado monitored the Colorado Electronic Disease Reporting System for laboratory-confirmed cases in their catchment area, consisting of 7 counties within the Denver metro area. Minnesota received reports from the entire state through a passive reporting system. Due to the higher incidence of giardiasis and larger catchment area in Minnesota, every second laboratory-confirmed case was eligible for the study.

Cases were defined as individuals with symptomatic, laboratory-confirmed, non-outbreak associated giardiasis and an onset of illness within 6 weeks of their interview date. Cases enrolled after 42 days of symptom onset were included in a separate study evaluating extraintestinal symptoms, severity of gastrointestinal illness, and predictors of delayed *Giardia* diagnosis (9). For each case-patient, up to two controls were identified.

Controls were matched to case-patients on site (Colorado and Minnesota) and age group (≤11 months, 1-4 years, 5-11 years, 12-17 years, 18-44 years, 45-64 years, and ≥65 years). Controls were recruited using progressive digit dialing anchored on the case-patient's phone number, with only one control recruited per household.

Investigators contacted case-patients and controls by telephone and enrolled them in the study. Investigators obtained informed consent from participants, and the study was conducted in accordance with guidelines for human experimentation as specified by the US Department of Health and Human Services. Interview consent was obtained directly from participants or from parents or guardians of participants <18 years of age. A structured telephone questionnaire was administered by trained staff to participants ≥12 years of age or to the parent or guardian of participants <12 years of age. Participants were asked about demographic information, health care utilization, chronic medical conditions, illness signs and symptoms, treatment, and possible exposures occurring in the 14 days prior to the estimated onset of gastrointestinal symptoms in the matched case-patient. Risk factor questions addressed health status and medications, drinking water consumption, recreational water exposure, travel and outdoor activity, food and drink consumption, contact with young children and persons with diarrhea, contact with animals, and sexual practices (only among persons ≥18 years of age). Questions about childcare were restricted to persons ≥18 years of age.

Case-patients and controls were excluded if they lived outside of the FoodNet catchment area, were not reached after 15 telephone attempts, had unavailable telephone numbers, were physically or emotionally unable to answer questions, were non-English speakers, or were recent immigrants, adoptees, or refugees. Additional exclusion criteria

that applied only to case-patients included asymptomatic infection, unknown illness onset date, *Giardia* infection within the previous 3 months, and not having the earliest symptom onset date within a family cluster of laboratory-confirmed giardiasis. Additional exclusion criteria that applied only to controls included diarrhea during the 4 weeks before the illness onset date of the matched case-patient, or diarrhea in a household contact during the 4 weeks before the illness onset date of the matched case-patient.

Statistical Analysis

Over 500 exposure questions were asked in the questionnaire. In order to prioritize risk factors for model building, we created a logical framework for exposures that are known risk factors for giardiasis or are biologically plausibly associated with infection (Figure 1). The framework was built around host factors and the main transmission pathways for *Giardia* infection. These pathways included direct fecal contact and indirect fecal contact, and host factors included illnesses and medications that we hypothesized would impact susceptibility to infection.

The direct fecal contact node included risk factors for animal-to-person transmission and person-to-person transmission. Animal-to-person transmission risk factors included contact with farm mammals, contact with domestic pets, visiting a farm or petting zoo, or contact with animal manure. Person-to-person risk factors included contact with children wearing diapers, contact with children in daycare, contact with persons with diarrhea, and high-risk sexual contact. The high-risk sexual contact variable was derived from questions asked regarding having sex with a partner of the same sex,

engaging in rimming or contact with a sex partner's anus, and having sex with a partner who had diarrhea.

Indirect fecal contact involved drinking water consumption, recreational water exposures, food consumption, travel, and outdoor activity. Drinking water consumption was comprised of drinking water from a well, drinking water from a river, lake, stream, or spring, and using ineffective or no water treatment. Recreational water exposure was comprised of boating and swimming. Swimming consisted of swimming in a natural body of water (i.e., ocean, lake, river, or hot spring), and swimming in a manmade venue (i.e., hot tub, spa, water park, or pool). We also included specific pool types and exposures related to water being splashed in the face and swallowed. Potentially unsafe food consumption included eating raw vegetables and fruit, eating lettuce, eating food from a salad bar, and eating organic produce. Travel and outdoor activity were categorized as 'other' or a combination of exposures involving contaminated water or food. This category contained traveling internationally, traveling in the United States, camping, and picnicking outdoors.

Host factors consisted of medications and illnesses that may influence susceptibility to giardiasis infection. Medications included pain medications, stomach acid decreasing medications, immunosuppressing medications, antibiotics, and psychoactive drugs. Illnesses that may affect the risk of *Giardia* infection included chronic lower gastrointestinal conditions, chronic upper gastrointestinal conditions, previous giardiasis infection, acute infection, and any immunodeficiency.

The exposures of interest within transmission pathways were derived by combining multiple items from the questionnaire and recoding free text responses. After

creating variables to represent all exposures in our framework, some were further combined to create a final parsimonious set of exposures to be used in bivariate and multivariable regression models (Table 1). We selected analysis exposures from the framework based on those biologically plausibly associated with giardiasis, previously reported associations, and those that summarized transmission pathway risk factors and contained at least 25 exposed individuals.

Data were analyzed using SAS software, version 9.3 (SAS Institute, Cary, NC). We first performed a descriptive analysis of demographic characteristics. To estimate odds ratios (OR) and 95% confidence intervals (CI) for the association between *Giardia* infection and individual risk factors of interest, unconditional logistic regression models were used, controlling for the matching variables age and site. Unadjusted ORs were also computed for each risk factor and were essentially equivalent to those adjusted for age and site, so results from the unadjusted bivariate models were considered in further analyses. We used unconditional logistic regression rather than conditional logistic regression because we determined that the matched analysis did not result in an increase in efficiency. Age and site were not associated with *Giardia* infection in the analysis, and matching on non-confounding variables leads to increases in variance (78).

To estimate adjusted odds ratios (aOR) and 95% CIs, we performed multivariable logistic regression with exposures that showed an association with disease status with $P<0.2$ in a bivariate model or those that have been previously reported to be associated with giardiasis. An additional, reduced multivariable model included only those exposures that were associated with *Giardia* with $P<0.2$ in the full multivariable model. Both multivariable models controlled for sex, age, and site. Population attributable

fractions (PAF), the estimates of the fraction of the total disease in the population that would not have occurred if the effect associated with the risk factor of interest were absent, were calculated for the factors positively associated with *Giardia* infection in the multivariable models (79).

To isolate the effect of risk factors for domestically-acquired giardiasis, we performed additional bivariate and multivariable analyses that excluded individuals with a history of international travel during the two week exposure period. This multivariable model, referred to as the domestic-only model, also controlled for sex, age, and site.

Statistical Analysis: High-Risk Sexual Contact Risk Factors

To better estimate the association of sexual risk factors with giardiasis among men, particularly MSM, interaction between gender and the high-risk sexual contact variable was assessed in a separate multivariable model. The distributions of the specific sexual behaviors by gender were described.

Statistical Analysis: Semi-Bayes Shrinkage Methods

Given the large number of potential risk factors assessed in the questionnaire, a separate analysis applied semi-Bayes shrinkage methods to the distribution of ORs for exposures that have not previously been shown to have an association with giardiasis. We also used this method to assess specific behaviors that had too few cases and controls exposed to be included in conventional multivariable regression models. Exposures with a well-established association with giardiasis were excluded from this analysis and were assessed only using traditional regression methods, as described above. After excluding

all associations that we expected *a priori*, we applied semi-Bayes shrinkage methods to the distribution of the remaining ORs (80, 81). Semi-Bayes shrinkage narrows the distribution of observed ORs and improves their precision by applying a regression-derived shrinkage estimator (82). When this method is applied, imprecisely measured associations that are well above or below the null are drawn towards the center of the distribution (82). This reduces the potential to overestimate the true associations and allows us to identify new associations with improved validity (82). To implement this method, it was assumed that 95% of the true ORs would fall between 0.25 and 4. Each OR was adjusted for age, site, sex, international travel, and drinking water from a river, lake, stream, or spring. We adjusted for international travel and drinking water from a river, lake, stream, or spring because these exposures are previously reported strong risk factors.

Results

Study Population

During the 12-month study period, 653 cases of laboratory-confirmed *Giardia* infection were identified in the Colorado and Minnesota FoodNet sites (Figure 2). Among those identified, 213 were enrolled in the study. The 440 cases not enrolled were most commonly excluded from enrollment because they had onset of gastrointestinal symptoms greater than 6 weeks (43.6%), refused to participate (12.7%), were recent immigrants, adoptees, or refugees (12.3%), or asymptomatic (9.3%). Other reasons for non-enrollment included inability to be reached (7.3%), non-English speaking (6.6%),

failure to have the earliest illness onset within a family cluster of laboratory-confirmed giardiasis (2.3%), incomplete interview (0.5%), and other miscellaneous reasons (5.5%). A total of 213 case-patients were enrolled, of which 199 were matched with 381 controls; fourteen case-patients were excluded because matched controls were not found.

Demographic Characteristics

Case-patients were mostly white (97.0%) and non-Hispanic (92.9%) (Table 2). The median age of enrolled case-patients and controls was 37 years. One third (33.3%) of case-patients had a household income of ≥$75,000 and 14.6% reported an income of <$25,000. Approximately half of all case-patients lived in Colorado (50.3%) and half lived in Minnesota (49.8%). Case-patients and controls were generally similar with regard to the distribution of race, ethnicity, income, site, and age, but more case-patients were male compared with controls (56.3% of cases versus 39.1% of controls; OR=2.0; 95% CI=1.4, 2.8).

Risk Factor Analysis

In the primary bivariate and the multivariable analyses, international travel, high-risk sexual contact, drinking water from a river, lake, stream, or spring, swimming in a natural body of water, taking antibiotics, and having a chronic gastrointestinal condition were statistically significant risk factors for *Giardia* infection, and eating raw vegetables or fruit was associated with a decreased odds of giardiasis (Table 3). Contact with children wearing diapers showed a marginally significant association with *Giardia* infection in the multivariable analysis. Factors that were statistically significantly

associated with giardiasis in the bivariate analysis but not in the multivariable model included camping, animal contact, swimming in a manmade venue, and taking psychoactive medication.

The reduced multivariable model produced OR estimates similar to those from the full multivariable model. In the reduced model, international travel, high-risk sexual contact, drinking water from a river, lake, stream, or spring, swimming in a natural body of water, taking antibiotics, having a chronic gastrointestinal condition, and eating raw vegetables or fruit remained associated with *Giardia* infection.

The results from the secondary analysis excluding individuals with history of international travel were generally similar to those from the models including all case-patients and controls (Table 4). Unlike the model including all participants, the domestic-only model showed a significant association between giardiasis and contact with children wearing diapers. In addition, traveling in the United States was associated with giardiasis in the bivariate analysis among individuals who did not have international travel history.

Sexual Behavior Risk Factors

Of the 25 case-patients with high-risk sexual contact, 20 (80%) were men (Table 5). Among these 20 male cases with high-risk sexual contact, 17 (85%) had sex with a partner of the same sex, 10 (50%) engaged in rimming or anal contact during sex, and 6 (30%) had sex with a partner who had diarrhea. Sex with a partner of the same sex was more common among male cases (N=17) than among female cases (N=1). Rimming or anal contact was reported among male cases (N=10) but not among female cases (N=0). Having sex with a partner who had diarrhea was distributed similarly across male cases

(N=6) and female cases (N=5). Of the 17 male cases who reported having sex with a man, 10 also reported rimming or anal contact, and 2 reported both rimming or anal contact and having a sex partner with diarrhea.

Interaction between high-risk sexual contact and gender was assessed in the multivariable model including all case-patients and controls. While the interaction term was not statistically significant (p=0.098), the magnitude of the OR for high-risk sexual contact was higher among men (aOR= 9.4; 95% CI=3.2, 27.5) than among women (aOR= 2.4; 95% CI=0.7, 8.2).

PAFs

Among all case-patients, the proportion whose illness could be attributed to foreign travel was 11.2% in both the full and reduced models (Table 3). In the full multivariable analysis, the largest PAF of 13.4% resulted from contact with children wearing diapers. Having a chronic gastrointestinal condition or taking medication for such a condition represented a PAF of 13.3%. Other large PAFs were associated with swimming in a natural body of water (10.4%), high-risk sexual contact (10.2%), and drinking water from a lake, river, stream, or spring (9.3%). The PAFs from the reduced multivariable model were similar to those from the full model. In the domestic-only analysis, 17.9% of case-patients' illness could be attributed to contact with children wearing diapers.

Semi-Bayes Shrinkage Methods

Table 6 shows the conventional and semi-Bayes-adjusted ORs and 95% CIs for an expanded list of 68 exposures, including many lower-prevalence components of risk factors considered in Tables 3 and 4. Prior to semi-Bayes adjustment, the conventional ORs ranged from 0.1 (95% CI=0.008, 0.5) for swimming or entering a recreational water park to 16.3 (95% CI=1.8, 140.8) for swimming in or entering a hot spring. After semi-Bayes adjustment, the aORs ranged from 0.5 (95% CI=0.2, 1.1) for taking pain medication to 3.9 (95% CI=1.2, 12.3) for having sex with a partner of the same sex. The mean conventional OR was 2.0, and the mean OR after semi-Bayes adjustment was 1.3. As expected, all of the semi-Bayes aORs shifted towards the null after semi-Bayes adjustment.

Of the 68 exposures considered, ten were associated with an increased odds of giardiasis, and four were associated with a decreased odds of giardiasis prior to semi-Bayes adjustment. After semi-Bayes adjustment, the only exposure that remained significantly associated with giardiasis was having sex with a partner of the same sex.

Discussion

This case-control study represents the largest and most extensive assessment of a wide range of risk factors for sporadic *Giardia* infection in the United States. The results from this study support the importance of previously reported risk factors and identify additional risk factors and host-level factors that deserve attention. We provide evidence for previously reported protective factors (i.e., eating raw vegetables and fruit) and risk factors including international travel, drinking water from a river, lake, stream, or spring,

swimming in a natural body of water, and contact with children wearing diapers. This is the first epidemiologic study to report statistically significant associations between giardiasis and high-risk sexual contact, having a chronic gastrointestinal condition, taking antibiotics, and taking psychoactive medication.

Direct person-to-person transmission through contact with children in diapers was an important risk factor for giardiasis in the analysis of individuals without history of international travel. A relationship between giardiasis and diaper handling has been reported previously (32, 35, 83). Similar to our results, a study in the United Kingdom found an association between diaper changing and giardiasis only among individuals without a history of international travel (32). In our study, the association between giardiasis and diaper contact was not particularly strong, but it represented the largest PAFs among all risk factors, with PAFs of 17.9% in the domestic-only model and 13.4% in the model including international travelers. These elevated PAFs suggest that if diaper contact is, in fact, associated with *Giardia*, it could represent an important risk factor as it is a relatively common exposure. Our results indicate that much *Giardia* infection could be reduced if prevention efforts targeted diaper-handling hygiene practices in home and daycare settings.

In addition to direct transmission associated with contact with children in diapers, we found that a different form of person-to-person transmission–high-risk sexual contact–was also an important risk factor in our study, representing a PAF of 10.2%. To our knowledge, this analysis is the first epidemiologic study to investigate and report a statistically significant association between giardiasis and high-risk sexual contact. Since the late 1970's, high *Giardia* prevalence has frequently been reported among MSM,

suggesting transmission through homosexual contact (21, 25, 27). The increased risk for MSM might be attributable to oral-anal sexual contact, but specific sexual behaviors have not been previously assessed in case-control studies. We created a high-risk sexual contact variable that combined rimming or contact with a sex partner's anus, sex with a partner of the same sex, and sex with a partner with diarrhea. While these components do not represent the same behaviors, we lacked the statistical power to analyze them individually. We identified a larger effect of high-risk sexual contact among men than among women; this suggests that riskier sexual contact among MSM (e.g., engaging in oral-anal sex more frequently than heterosexual partners and women who have sex with women) or sexual networks among MSM having an increased prevalence of giardiasis might be driving the elevated risk. This hypothesis was further supported by the distribution of gender and behaviors among the 25 case-patients with high-risk sexual contact: 20 were male, 85% of the male cases had sex with a partner of the same sex, and 50% of the male cases engaged in rimming or anal contact during sex. In addition, sex with a partner of the same sex was much more common among male cases (N=17) than among female cases (N=1), and sex with a partner of the same sex remained associated with giardiasis after semi-Bayes adjustment. This method draws imprecisely measured associations towards the null and reduces the potential to overestimate true associations, thereby strengthening our evidence of elevated risk associated with sex with a partner of the same sex among men. While we did not have the statistical power needed to assess the association between giardiasis and specific sexual behaviors using conventional methods, our results suggest that male-male sex and sex involving anal contact were largely responsible for the observed association between giardiasis and high-risk sexual

contact. Given these findings, transmission of giardiasis through sexual contact could be reduced by using barriers between the mouth and a partner's genitals or rectal area, and washing hands after handling a condom or barrier used during anal sex and after touching the anus or rectal area (68).

Among all transmission pathways, person-to-person transmission, via contact with children in diapers and high-risk sexual contact, was responsible for the largest percentage of illness among case-patients. While these risk factors represented the largest PAFs, it is likely that person-to-person transmission was underestimated in our study, as case-patients were excluded from the study if they did not have the earliest symptom onset date within a household cluster. Accordingly, while we did not detect an association between giardiasis and contact with children in daycare, transmission to close contacts of persons attending or working in daycare has been frequently reported (23, 48), and it is likely that our study underestimated the risk associated with child-care centers. The relatively high PAFs associated with person-to-person transmission (≈30%), in spite of the exclusion of ill household members, suggest that person-to-person transmission represents an important transmission pathway for sporadic giardiasis in the United States, and prevention efforts should target behaviors associated with direct fecal contact.

Indirect transmission, through consumption of contaminated water and food, was also evidenced in our study. The low infectious dose of *Giardia*, large number of cysts excreted by infectious persons, and the cysts' environmental hardiness and moderate chlorine tolerance make *Giardia* ideally suited for waterborne transmission (68). Further, as infected persons shed up to one billion cysts in their stool per day, waste in water from

one infected individual can lead to many others becoming infected by ingesting contaminated water (51). Drinking water from a river, lake, stream, or spring was identified as a strong risk factor for giardiasis in our study. Waterborne outbreaks and sporadic cases have been previously associated with consuming non-potable water from natural bodies of water including rivers and streams (23, 38, 51, 57, 84). Studies in Colorado (57), Minnesota (77), and New Hampshire (23) have identified consumption of untreated water to be an important cause of sporadic giardiasis in the United States.

In addition to direct consumption of untreated water, recreational water activities in lakes, rivers, and swimming pools have been implicated in numerous outbreak investigations and studies of sporadic giardiasis in the United States (35, 37, 46, 51, 85). In our study, swimming in a natural body of water (i.e., ocean, lake, pond, river, stream, or hot spring) was associated with *Giardia* infection, whereas swimming in a manmade venue (i.e., swimming pool, water park, hot tub, spa, whirlpool, or jacuzzi) was not associated. Untreated (i.e., natural) recreational waters lack filtration and chemical remediation options, leaving swimmers susceptible to infection from pathogens in the water due to direct microbial input from bathers and re-suspension of sediment (86). Swimming in a manmade venue was a risk factor in the bivariate analysis, underscoring the importance of health promotion efforts focused on swimming behaviors (e.g., staying out of the water if one has diarrhea) to improve swimmer hygiene and prevent water contamination in both treated and untreated settings.

As with water, food can become contaminated by *Giardia* cysts, and links between giardiasis and various types of produce have been reported (36, 37). In our study, we found that eating raw vegetables or fruit was inversely associated with

giardiasis. A similar protective effect was recently reported in a sporadic giardiasis case-control study in the United Kingdom (32), but eating raw produce, lettuce, and salads has also been found to be a risk factor for sporadic giardiasis (37, 60). A negative association with infection was also reported for cryptosporidiosis (87, 88), and it has been suggested that repeated exposure via contaminated raw produce could provide protective immunity (87). Food handling hygiene may also play a large role in *Giardia* transmission (52). Fruit and vegetables can become contaminated during irrigation and fertilization activities, by water used during processing or packing, or by unwashed hands during harvesting, use, or any point in the production chain (52). Cysts have been detected on spinach, lettuce, various herbs, strawberries, sprouted seeds, potatoes, carrots, and fresh coriander (89-92). Since fruits and vegetables are often eaten raw, prevention of produce contamination is particularly important (93).

Giardia infection was strongly associated with international travel, supporting the results of previous case-control studies in the United States (48) and other developed countries including the United Kingdom (32, 47), Canada (83), and New Zealand (35). Despite this strong association, only 11.2% of the illness in case-patients was attributed to international travel, underscoring the importance of domestic risk factors for giardiasis. The actual transmission pathway that results in infection associated with international travel cannot be definitively determined, but transmission is likely driven by activities and behaviors associated with travel including drinking local water, eating undercooked food, and direct fecal contact due to lower-hygiene conditions. Therefore, individuals should practice extra caution when traveling and avoid eating undercooked food and drinking and using inadequately treated water and ice.

Though only detected in the bivariate analysis, traveling in the United States (among individuals without international travel history) and camping were found to be associated with giardiasis. Camping has been frequently reported as a risk factor for giardiasis (32, 47, 48, 57), and one study in New Zealand reported domestic travel as a risk factor (36). Like international travel, camping and domestic travel may confer an elevated risk due to activities and behaviors such as eating undercooked food, practicing poor hygiene, drinking untreated surface water, and drinking water from new sources for which individuals lack immunity. Camping and traveling in the United States might not have remained associated with giardiasis after multivariable adjustment because the models controlled for the direct high-risk behaviors (e.g., drinking water from a river, lake, stream, or spring).

Also only detected in the bivariate analysis, contact with animals had a negative association with *Giardia* infection, suggesting that animal contact might confer a protective effect. Although animal contact was reported as a risk factor previously (32, 51, 94), repeated low dose exposure to *Giardia* via direct contact with animals could lead to immunity, but more data are needed to support this hypothesis. Molecular characterization of *Giardia* samples would have improved our understanding of this mode of transmission. Based on our current understanding, animals are usually infected with species-specific *Giardia* assemblages that are not pathogenic to humans (15).

Few epidemiologic studies have investigated the role of host factors (e.g., illnesses and medications that may influence host susceptibility) in *Giardia* transmission. We identified a previously unreported risk for giardiasis associated with taking antibiotics during the two weeks prior to symptom onset. Disruption of the microbiota

with antibiotics often precedes the emergence of several enteric pathogens including *Salmonella* spp. and *Clostridium difficile* (62, 63, 95, 96). Antimicrobial use may lead to prolonged alterations in the microbiota and decreased colonization resistance, lowering the dose of pathogens needed for colonization and infection, and therefore increasing the risk of illness (63). It is plausible that such disruption enhances the ability of *Giardia* to capitalize upon the increased enteric vulnerability due to disturbance of the resident microbiota (62). While antibiotics are beneficial when clearly indicated, our result underscores the importance of avoiding unnecessary use.

In addition to antibiotics, we found a previously unreported host-level risk for giardiasis associated with taking psychoactive medication in the bivariate analysis. Psychoactive medications, including medications for anxiety, depression, and psychosis, may be a marker for psychological stress, which has been shown to negatively impact the composition of the gut microbiota (64). Additionally, some psychoactive medications might influence gut motility and sensation, and have antimicrobial activity, which could also change the composition of gut microbiota (97, 98). As with antibiotics, any disruption of the microbiota can lead to decreased colonization resistance and increased infection vulnerability. Alternatively, associations between medications and infection could reflect increased health-seeking behavior among cases, as those who are more likely to see a health care provider and obtain a prescription might also be more likely to be seek care for their gastrointestinal illness and receive a *Giardia* diagnosis.

We identified an additional novel host-level association between giardiasis and having a chronic gastrointestinal condition or taking a medication for a chronic gastrointestinal condition. This was an important risk factor, with 13.3% of the case-

patients' illness attributable to having a chronic gastrointestinal condition or taking an associated medication. Conditions and medications in this category included chronic diarrhea, Crohn's disease, irritable bowel syndrome, stomach ulcer disease, stomach acid-reducing medications, laxatives, enemas, and anti-diarrheal medication. Elevated giardiasis prevalence has been reported in patients with Crohn's disease (99), irritable bowel syndrome (32), celiac disease (100), and other gastrointestinal diseases (99). It has been suggested that any anatomic lesion of the intestinal mucosa can be an underlying predisposition for giardiasis (100, 101). Gastrointestinal conditions and medications may influence *Giardia* infection susceptibility by disturbing the protective function of the mucosa in inflammatory states (99). Acid reducing medications have not previously been reported as a risk factor for *Giardia* infection, but are known to increase risk for other enteric infections (102). Alternatively, the clinical presentation of giardiasis closely resembles many gastrointestinal conditions (103), so it is possible that the association between gastrointestinal conditions and giardiasis could be spurious; patients with chronic gastrointestinal conditions often have symptoms resembling those of giardiasis, and therefore they may be more likely to receive testing for *Giardia (32).* It is also not clear whether these individuals are more susceptible to infection or whether they are more likely to develop symptomatic disease. In this case-control study design, we cannot completely disentangle underlying susceptibility to giardiasis due to underlying conditions, risk conferred by medications for these conditions, or that giardiasis is diagnosed during a workup for another suspected condition. However, the finding of this association warrants further investigation in studies with more extensive clinical data.

Our study has several limitations. The study design was a retrospective case-control in which exposure information was ascertained via subject interview after disease status was known. Therefore, differential exposure misclassification may impact our results, as cases could be more likely to recall their exposures, introducing recall bias into our study. In addition, ill persons may have been misclassified as controls since asymptomatic infections can occur, and stool samples from laboratories were not available to confirm absence of infection in the controls and molecularly characterize *Giardia*. Our study's sample size was also somewhat limited, and this may have affected our ability to detect additional risk factors for giardiasis and conduct sex-specific and age-specific modeling. Further, our data were collected within two states during a 12-month period, thereby limiting generalizability. Additionally, questions about sexual behavior may not have been answered truthfully, and it is likely that oral-anal sex and sex with a partner of the same sex were underreported due to social desirability bias (104). Sexual behavior questions were also only asked to participants of ages 18 years and older. This likely exacerbated the underreporting of sexual behaviors, as it is probable that some of the participants younger than 18 years old did engage in sex and risky sexual behaviors. Other stigmatized behaviors (e.g., taking psychoactive medication) might also have been underreported. We speculate that underreporting of stigmatized behavior may be more common among case-patients in retrospective studies in which patients know they have the disease at the time of their interview (104). This would result in the observed risk being biased towards the null, thus underestimating the true risk associated with sexual behaviors.

In addition, certain exposures are not well-suited to investigation in this study. A case-control study is not the ideal design for identifying risk associated with public water systems, in which contamination would likely be a short-term occurrence in a specific water system or portion of the water system. Person-to-person transmission in the household is similarly not well-suited to investigation in this study, as case-patients who were most likely to have contracted giardiasis from a household contact were excluded by design. This exclusion likely led to an underestimation of the risk associated with contact with children in diapers, high-risk sexual contact, and contact with children in daycare. Despite this exclusion, person-to-person transmission was attributed with the largest PAFs among all transmission pathways, highlighting the importance of person-to-person contact in the transmission of sporadic giardiasis in the United States.

Although the data for this study were collected in 2003 and 2004, we are not aware of any major changes that have occurred in the United States that could impact *Giardia* transmission pathways. Rates have declined since data collection; a total of 20,084 and 20,962 cases were reported in 2003 and 2004 (105), and a total of 16,868 and 15,223 cases were reported in 2011 and 2012 (68). Changes in disease transmission could explain this decrease, but reported rates may have also declined due to a decreased emphasis on giardiasis surveillance in public health agencies or the 2011 change in case definition clarifying that clinical symptoms are necessary for categorizing giardiasis cases as confirmed (68). Some changes in public water systems may have occurred since the data were collected; the 2002 Long Term 1 Enhanced Surface Water Treatment Rule and the 2006 Long Term 2 Enhanced Surface Water Treatment Rule have likely helped to reduce *Giardia* in public drinking water systems with surface water sources (106, 107).

However, public water consumption did not confer an elevated risk for giardiasis in our study (data not shown), so improved water regulation would not be expected to lead to different results. To our knowledge, there have also been no major regulations or changes in behavior that would affect the person-to-person or animal-to-person transmission pathways. Among the host-level factors, antibiotic consumption in the Unites States decreased from 2000-2010 (108), whereas an increase in psychoactive drug use from 2005 to 2008 has been reported (109). Therefore, these medications may now be attributed with different proportions of illness compared with when our data were collected. Despite these small changes, our results represent an important contribution to the understanding of sporadic giardiasis epidemiology in the United States.

In summary, this study provides additional evidence of the importance of previously reported protective factors (i.e., eating raw produce) and risk factors (i.e., international travel, contact with children in diapers, drinking water from a river, lake, stream, or spring, and swimming in a natural body of water). Further, this is the first epidemiologic study to identify high-risk sexual contact and host-level factors including taking antibiotics, taking psychoactive medication, and having a chronic gastrointestinal condition as risk factors for sporadic giardiasis. This analysis suggests that addressing the main risk factors for *Giardia* infection could prevent a great deal of transmission in the United States. Educational efforts to decrease exposure to unsafe drinking and recreational water, improve personal hygiene, and prevent person-to-person transmission have the potential to reduce sporadic giardiasis transmission. Efforts to decrease person-to-person transmission may be particularly important, as our results indicate that risk factors associated with this pathway may be responsible for much of the illness in the

United States. In addition, our finding that international travel was responsible for less than 12% of the illness among case-patients emphasizes the importance of domestic giardiasis transmission. This result also highlights the need for improved awareness of non-travel associated infection in primary care and diagnostic microbiology laboratories to allow for correct treatment to be administered and disease incidence to be measured more accurately. In conclusion, our analysis provides valuable information about *Giardia* transmission through multiple pathways, and targeting the risk factors identified can be used to prevent disease in the future.

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Tables and Figures

Figure 1. All risk factors and transmission pathways considered for analysis in the Foodborne Diseases Active Surveillance Network giardiasis case-control study, Colorado and Minnesota.

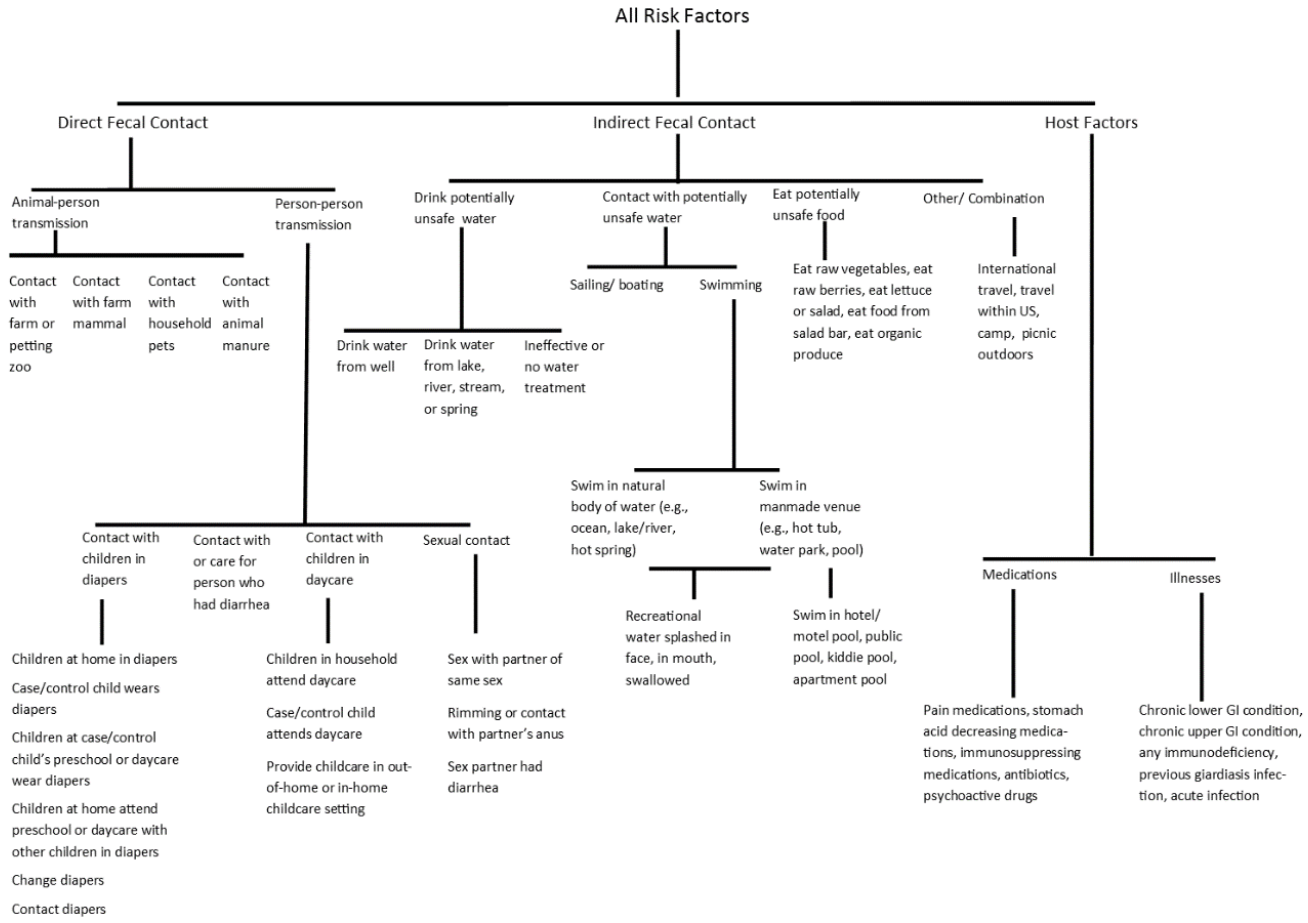

Figure 2. Recruitment of reported laboratory-confirmed *Giardia* cases and matched controls in the Foodborne Diseases Active Surveillance Network giardiasis case-control study, Colorado and Minnesota.

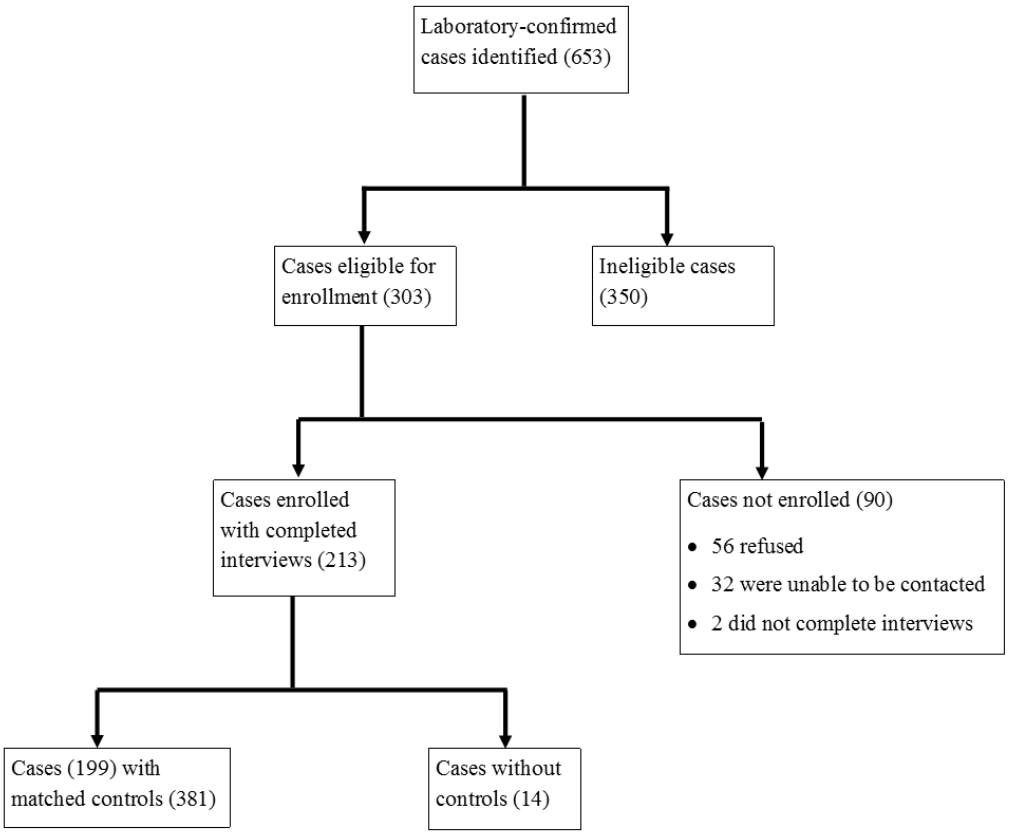

Table 1. Composition of derived risk factors for *Giardia* infection in the Foodborne Diseases Active Surveillance Network giardiasis case-control study, Colorado and Minnesota.

Transmission Pathway and Risk Factor	Description of Risk Factor Components	Question Asked in Questionnaire[1]	Cases (N=199) n/N (%)	Controls (N=381) n/N (%)
Direct fecal contact				
Person-to-person transmission				
Contact with children wearing diapers				
	Children at home in diapers	Were any children at home in diapers?	29/160 (18.1)	33/318 (10.4)
	Case/control child wears diapers [only child in household]	Was your case/control child in diapers? [if child was not the only child in household]	4/38 (21.1)	2/62 (4.4)
	Case/control child wears diapers [not the only child in household]	Was your case/control child in diapers? [if child was only child in household]	3/38 (7.9)	0/62 (0.0)
	Children at case child's preschool or daycare in diapers	Were any children at your (case) child's preschool or at the location at which your child received childcare in diapers?	9/38 (23.7)	–
	Children at control child's preschool or daycare in diapers	Were any children at your (control) child's preschool or at the location at which your child received childcare in diapers?	–	6/61 (9.8)
	Children at home attend preschool or daycare with other kids in diapers	Were any children at your child's preschoold or at the location at which your child received childcare in diapers? [not the only child in household]	23/198 (11.6)	32/378 (8.5)
	Case/control child attends preschool or daycare with other kids in diapers	Were any children at your case/control child's preschoold or at the location at which your child received childcare in diapers? [only child in household]	2/38 (5.3)	3/62 (4.8)
	Change diapers	Did you change any diapers?	38/196 (19.4)	59/377 (15.6)
	Contact with children in diapers	Did you have contact with any children in diapers?	24/188 (12.8)	31/361 (8.6)
Contact with person with diarrhea				
	Come in contact with person with diarrhea	Did you come in contact with anyone who had diarrhea?	24/188 (12.8)	31/361 (8.6)
	Provide direct care to person with diarrhea	Did you provide direct care to a person with diarrhea?	8/187 (4.3)	9/359 (2.5)
Contact with children in daycare				
	Children in household in out-of-home preschool or daycare	Were any children in your household in out-of-home childcare?	25/199 (12.6)	44/381 (11.5)
	Case child attends preschool or daycare	Was your (case) child in out-of-home childcare? [not the only child in household]	10/38 (26.3)	–
	Control child attends preschool or daycare	Was your (control) child in out-of-home childcare? [not the only child in household]	–	6/61 (9.8)
	Case/control child attends preschool or daycare	Was your case/control child in out-of-home childcare? [only child in household]	3/38 (7.9)	3/62 (4.8)
	Provide childcare in out-of-home childcare center	Did you provide childcare in an out-of-home childcare center?	3/198 (1.5)	5/378 (1.3)
	Provide childcare in in-home childcare center	Did you provide childcare in an in-home childcare center?	2/198 (1.0)	3/378 (0.8)
High-risk sexual contact				
	Sex partner had diarrhea during two weeks before having sex	Did any of your sex partners have diarrhea during the 2 weeks before you had sex with them?	3/147 (2.0)	1/279 (0.4)
	Sex partner had diarrhea during two weeks after having sex	Did any of your sex partners have diarrhea during the 2 weeks after you had sex with them?	10/146 (6.9)	6/281 (2.1)
	Practice rimming or have contact with a partner's anus	Did you practice "rimming" or have contact with a partner's anus?	10/150 (6.7)	5/284 (1.8)
	Have sex with a partner of the same sex	Did you have sex with anyone of the same sex?	18/152 (11.8)	6/283 (2.1)
Animal-to-person transmission				
Animal contact				
	Contact with domestic animal (i.e., cat, kitten, dog, or puppy)	Contact with domestic animal (i.e., cat, kitten, dog, or puppy) [2]	127/199 (63.8)	273/381 (71.7)
	Animal present? (lived on farm)	1. If you lived on a farm, was the animal present?		
	Enter the living area of the animal? (lived on farm)	2. If you lived on a farm, did you enter the living area of the animal?		
	Care for sick/birthing animals? (lived on farm)	3. If you lived on a farm, did you care for sick/birthing animal?		
	Animal present? (worked on farm)	4. If you worked on a farm other than your own farm, was the animal present?		
	Enter the living area of the animal? (worked on farm)	5. If you worked on a farm other than your own farm, did you enter the living area of the animal?		
	Care for sick/birthing animals? (worked on farm)	6. If you worked on a farm other than your own farm, did you care for sick/birthing animal?		
	Animal present? (visited farm or petting zoo)	7. If you visited a farm or petting zoo, was animal present?		
	Enter the living area of the animal? (visited farm or petting zoo)	8. If you visited a farm or petting zoo, did you enter the living area of the animal?		
	Care for sick/birthing animals? (visited farm or petting zoo)	9. If you visited a farm or petting zoo, did you care for sick/birthing animal?		
	Contact with animal? (household pet)	10. Contact with household pet animal		
	Contact with animal feces (household pet)	11. Contact with household pet feces (cleaning cage, scooping poop, etc.)?		
	Contact with farm mammal (i.e., calf, cow, goat, sheep, lamb, horse, or pig)	Contact with farm mammal (i.e., calf, cow, goat, sheep, lamb, horse, or pig) [3]	19/199 (9.6)	32/381 (8.4)
	Animal present? (lived on farm)	1. If you lived on a farm, was the animal present?		
	Enter the living area of the animal? (lived on farm)	2. If you lived on a farm, did you enter the living area of the animal?		
	Care for sick/birthing animals? (lived on farm)	3. If you lived on a farm, did you care for sick/birthing animal?		
	Animal present? (worked on farm)	4. If you worked on a farm other than your own farm, was the animal present?		
	Enter the living area of the animal? (worked on farm)	5. If you worked on a farm other than your own farm, did you enter the living area of the animal?		
	Care for sick/birthing animals? (worked on farm)	6. If you worked on a farm other than your own farm, did you care for sick/birthing animal?		
	Animal present? (visited farm or petting zoo)	7. If you visited a farm or petting zoo, was animal present?		
	Enter the living area of the animal? (visited farm or petting zoo)	8. If you visited a farm or petting zoo, did you enter the living area of the animal?		
	Care for sick/birthing animals? (visited farm or petting zoo)	9. If you visited a farm or petting zoo, did you care for sick/birthing animal?		

[1] All questions refer to the specific two week exposure period corresponding to the two weeks prior to matched cases developing symptoms

[2] These 11 questions were asked separately for each type of domestic animal (i.e., cats, kittens, dogs, and puppies). Individual values for each question are therefore not shown.

[3] These 9 questions were asked separately for each type of farm mammal (i.e., calf, cow, goat, sheep, lamb, horse, or pig). Individual values for each question are therefore not shown.

Transmission Pathway and Risk Factor	Description of Risk Factor Components	Question Asked in Questionnaire[1]	Cases (N=199) n/N (%)	Controls (N=381) n/N (%)
Indirect fecal contact				
Drink Potentially Unsafe Water				
Drink water from lake, river, stream, or spring				
	Drink water from lake, river, or stream	Did you drink any water from a lake, river, or stream?	22/195 (11.3)	5/380 (1.3)
	Drink water from a spring; recoded from free-text responses	Did you have any other sources of drinking water outside the home? Specify.	0/199 (0.0)	1/381 (0.3)
Drink water from well				
	Well water is source of water at home	What were your sources of drinking water at home?	31/195 (15.9)	62/380 (16.3)
	Well water is source of water outside the home	What were your sources of drinking water outside the home, for example, at school or work?	27/190 (14.2)	41/379 (10.8)
Contact with Potentially Unsafe Water				
Swim in natural body of water				
	Enter or swim in ocean	Did you swim in, wade in, or enter an ocean or beach?	12/194 (6.2)	4/380 (1.1)
	Enter or swim in lake, pond, river, or stream	Did you swim in, wade in, or enter a lake, pond, river, or stream?	27/194 (13.9)	15/380 (4.0)
	Enter or swim in hot spring	Did you swim in, wade in, or enter a hot spring?	4/195 (2.1)	1/380 (0.3)
Swim in manmade venue				
	Enter or swim in hot tub, spa, whirpool, jacuzzi	Did you swim in, wade in, or enter a hot tub, spa, whirlpool, or jacuzzi?	20/194 (10.3)	17/380 (4.5)
	Enter or swim in recreational water park	Did you swim in, wade in, or enter a recreational water park?	1/192 (0.5)	10/380 (2.6)
	Enter or swim in swimming pool	Did you swim in, wade in, or enter a swimming pool?	37/195 (19.0)	56/380 (14.7)
Eat Potentially Unsafe Food				
Eat raw vegetables or fruit				
	Ate lettuce or garden salad	How many times did you eat lettuce or garden salad regardless of whether it was prepared in or out of your home? [Categorized responses as any vs. none]	154/198 (77.8)	324/379 (85.5)
	Ate raw vegetables	How many times did you eat raw vegetables such as carrots, tomatoes, cucumbers, or green onions regardless of whether it was prepared in or out of your home? [Categorized responses as any vs. none]	165/198 (83.3)	339/378 (89.7)
	Ate raw berries	How many times did you eat raw berries (e.g., strawberries and raspberries) regardless of whether it was prepared in or out of your home? [Categorized responses as any vs. none]	88/197 (44.7)	202/380 (53.2)
	Ate raw fruits with skin/peel	How many times did you eat raw fruits with skin/peel (e.g., melons, apples) regardless of whether it was prepared in or out of your home? [Categorized responses as any vs. none]	156/198 (78.8)	309/381 (81.1)
	Ate any organically-grown produce	Did you eat any "organically grown" produce?	40/178 (22.5)	121/360 (33.6)
Other/ Combination of Water, Food				
International Travel	Travel outside of the United States	Did you travel or take a cruise to another country?	24/199 (12.1)	5/381 (1.3)
Travel in United States				
	Travel within your state but more than 100 miles from home	Did you travel within your state but more than 100 miles from your home?	55/197 (27.9)	83/380 (21.8)
	Travel out of your state but stay within the United States	Did you travel out of your state but stay within the United States?	39/199 (19.6)	71/380 (18.7)
Camp	Go camping	Did you go camping or backpacking?	29/199 (14.6)	26/381 (6.8)

[1]All questions refer to the specific two week exposure period corresponding to the two weeks prior to matched cases developing symptoms

Transmission Pathway and Risk Factor	Description of Risk Factor Components	Question Asked in Questionnaire[1]	Cases (N=199) n/N (%)	Controls (N=381) n/N (%)
Host Factors				
Medications and Illnesses				
Take antibiotics	Take antibiotics	Did you take antibiotics for reasons other than your giardiasis?	21/199 (10.6)	22/381 (5.8)
Take psychoactive medication	Recoded free-text responses including medications for anxiety, depression, and psychosis	Did you take any other medications? Specify.	21/199 (10.6)	15/381 (3.9)
Chronic gastrointestinal condition or medication				
	Chronic lower gastrointestinal condition; recoded free-text responses	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Other, specify.	6/199 (3.0)	1/381 (0.3)
	Chronic diarrhea	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Chronic diarrhea.	6/199 (3.0)	2/381 (0.5)
	Crohn's disease	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Crohn's disease.	0/199 (0.0)	0/381 (0.0)
	Irritable bowel disease	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Irritable bowel disease.	4/199 (2.0)	10/381 (2.6)
	Chronic upper gastrointestinal condition; recoded free-text responses	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Other, specify.	6/199 (3.0)	1/381 (0.3)
	Stomach ulcer disease	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Stomach ulcer disease.	7/199 (3.5)	9/381 (2.4)
	Take medication that decreases stomach acid	Did you take any of the following medications or receive any of the following medical treatments? Pills that decrease stomach acid (e.g., Pepcid, Zantac).	35/199 (17.6)	55/381 (14.4)
	Take laxatives	Did you take any of the following medications or receive any of the following medical treatments? Laxatives.	4/199 (2.0)	7/381 (1.8)
	Take enemas	Did you take any of the following medications or receive any of the following medical treatments? Enemas.	0/199 (0.0)	2/381 (0.5)
	Take antidiarrheal medication: recoded free-text responses	Did you take any of the following medications or receive any of the following medical treatments? Other, specify.	2/199 (1.0)	0/381 (0.0)
Immunsuppressing condition, medication, or treatment				
	Diabetes	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Diabetes.	7/199 (3.5)	18/381 (4.7)
	Cancer	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Cancer (other than skin cancer).	4/199 (2.0)	10/381 (2.6)
	HIV/AIDS	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? HIV/AIDS.	7/199 (3.5)	0/381 (0.0)
	Organ transplant	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Organ transplant.	0/199 (0.0)	2/381 (0.5)
	Other immunodeficiency	Have you ever had any of the following procedures or were told by a physician that you have any of the following illnesses? Other immunodeficiency. Specify.	2/199 (1.0)	9/381 (2.4)
	Take oral steroids	Did you take any of the following medications or receive any of the following treatments? Oral steroids (e.g., Prednisone, Dexamethazone, Medrol).	4/199 (2.0)	10/381 (2.6)
	Take cyclosporine	Did you take any of the following medications or receive any of the following treatments? Cyclosporine.	0/199 (0.0)	1/381 (0.3)
	Chemotherapy treatment	Did you take any of the following medications or receive any of the following treatments? Chemotherapy.	1/199 (0.5)	1/381 (0.3)
	Radiation treatment	Did you take any of the following medications or receive any of the following treatments? Radiation.	0/199 (0.0)	1/381 (0.3)

[1]All questions refer to the specific two week exposure period corresponding to the two weeks prior to matched cases developing symptoms

Table 2. Distribution of demographic characteristics for giardiasis cases and controls in the Foodborne Diseases Active Surveillance Network giardiasis case-control study, Colorado and Minnesota.

Characteristic	Cases (N=199) n/N (%)	Controls (N=381) n/N (%)
Gender		
Female	87/199 (43.7)	232/381 (60.9)
Male	112/199 (56.3)	149/381 (39.1)
Race		
White	191/197 (97.0)	336/364 (92.3)
Black	1/197 (0.5)	10/364 (2.8)
Other*	5/197 (2.5)	18/364 (5.0)
Ethnicity		
Hispanic	14/198 (7.1)	23/378 (6.1)
Non-Hispanic	184/198 (92.9)	355/378 (93.9)
Age		
0 – < 12 months	1/199 (0.5)	1/375 (0.3)
1 – < 5 years	16/199 (8.0)	29/375 (7.7)
5 – < 12 years	17/100 (8.5)	30/375 (8.0)
12 – < 18 years	4/199 (2.0)	8/375 (2.1)
18 – < 45 years	92/199 (46.2)	172/375 (45.9)
45 – < 65 years	58/199 (29.2)	116/375 (30.9)
65+ years	11/199 (5.5)	19/375 (5.1)
Household income		
<$25,000	25/171 (14.6)	50/318 (15.7)
$25,000 – <$55,000	53/171 (31.0)	107/318 (33.7)
$55,000 – <$75,000	36/171 (21.1)	59/318 (18.6)
≥$75,000	57/171 (33.3)	102/318 (32.1)
State of residence		
Colorado	100/199 (50.3)	200/381 (52.5)
Minnesota	99/199 (49.8)	181/381 (47.5)

* Other race includes American Indian/Alaskan Native, Asian/Pacific Islander, mixed, other

Table 3. Bivariate and multivariable analysis of exposures in the two weeks before illness onset caused by *Giardia* infection in the Foodborne Diseases Active Surveillance Network giardiasis case-control study, Colorado and Minnesota.

Exposure	Cases (N=199) n(%)	Controls (N=381) n(%)	Odds Ratio[1] (95% CI)	Odds Ratio[2] (95% CI)	Population-Attributable Fraction[3] (%)	Odds Ratio[4] (95% CI)	Population-Attributable Fraction[5] (%)
International travel	24 (12.1)	5 (1.3)	10.3 (3.9, 27.5)	13.7 (4.7, 39.6)	11.2	14.7 (5.1, 42.2)	11.2
Travel in United States	78 (39.2)	123 (32.3)	1.4 (0.9, 1.9)	1.0 (0.7, 1.6)	0.0		
Camp	29 (14.6)	26 (6.8)	2.3 (1.3, 4.1)	1.3 (0.6, 2.7)	3.4		
Animal contact	129 (64.8)	278 (73.0)	0.7 (0.5, 1.0)	0.7 (0.5, 1.1)	—	0.7 (0.5, 1.1)	—
Contact with children wearing diapers	80 (40.2)	138 (36.2)	1.2 (0.8, 1.7)	1.5 (1.0, 2.5)	13.4	1.6 (1.0, 2.5)	15.1
Contact with person with diarrhea	24 (12.1)	31 (8.1)	1.5 (0.9, 2.7)	1.3 (0.7, 2.6)	2.8		
Contact with children in daycare	32 (16.1)	54 (14.12)	1.2 (0.7, 1.9)	1.5 (0.8, 2.8)	5.4	1.5 (0.8, 2.7)	5.4
High-risk sexual contact	25 (12.6)	13 (3.4)	4.1 (2.0, 8.1)	5.4 (2.5, 11.5)	10.2	5.3 (2.5, 11.3)	10.2
Drink water from well	48 (24.1)	87 (22.8)	1.1 (0.7, 1.6)	1.1 (0.7, 1.9)	2.2		
Drink water from lake, river, stream, or spring	22 (11.1)	5 (1.3)	9.3 (3.5, 25.1)	6.3 (2.0, 19.9)	9.3	7.3 (2.5, 21.2)	9.5
Swim in natural body of water	30 (15.1)	16 (4.2)	4.1 (2.1, 7.6)	3.2 (1.5, 6.8)	10.4	3.6 (1.7, 7.6)	10.9
Swim in manmade venue	48 (24.1)	61 (16.0)	1.7 (1.1, 2.6)	1.3 (0.8, 2.3)	5.6		
Eat raw vegetables or fruit	187 (94.0)	374 (98.2)	0.3 (0.1, 0.8)	0.3 (0.1, 0.8)	—	0.3 (0.1, 0.8)	—
Take antibiotics	21 (10.6)	22 (5.8)	1.9 (1.0, 3.6)	2.6 (1.3, 5.2)	6.5	2.6 (1.3, 5.2)	6.5
Take psychoactive medication	21 (10.6)	15 (3.9)	2.9 (1.4, 5.7)	1.9 (0.8, 4.3)	5.0	1.8 (0.8, 4.1)	4.7
Chronic gastrointestinal condition or medication	56 (28.1)	68 (17.9)	1.8 (1.2, 2.7)	1.9 (1.2, 3.1)	13.3	2.0 (1.2, 3.3)	14.1
Immunosuppressing condition, medication, or treatment	21 (10.6)	41 (10.8)	1.0 (0.6, 1.7)				

[1] Unadjusted odds ratios

[2] Odds ratios from full multivariable model adjusting for age, site, sex, and all exposures that have been previously reported to be associated with giardiasis and showed an association with disease status with P<0.2 in the bivariate models. Given these criteria, immunosuppressing condition, medication, or treatment was excluded from the multivariable analysis

[3] Population-attributable Fractions (PAF) for full multivariable model

[4] Odds ratios from reduced multivariable model adjusting for age, site, sex, and all exposures that showed an association with disease status with P<0.2 in the full multivariable model

[5] PAFs for reduced multivariable model

Table 4. Bivariate and multivariable analysis of exposures in the two weeks before illness onset restricted to domestically-acquired *Giardia* infection in the Foodborne Diseases Active Surveillance Network giardiasis case-control study, Colorado and Minnesota.

Exposure	Cases (N=175) n(%)	Controls (N=376) n(%)	Odds Ratio[1] (95% CI)	Odds Ratio[2] (95% CI)	Population-Attributable Fraction (%)
Travel in United States	74 (42.3)	119 (31.6)	1.6 (1.1, 2.3)	1.1 (0.7, 1.8)	3.8
Camp	27 (15.4)	24 (6.4)	2.7 (1.5, 4.8)	1.6 (0.8, 3.4)	5.8
Animal contact	116 (66.3)	275 (73.1)	0.7 (0.5, 1.1)	0.7 (0.4, 1.1)	—
Contact with children wearing diapers	76 (43.4)	136 (36.2)	1.4 (0.9, 2.0)	1.7 (1.0, 2.7)	17.9
Contact with person with diarrhea	20 (11.4)	30 (8.0)	1.5 (0.8, 2.7)	1.4 (0.7, 2.7)	3.3
Contact with children in daycare	30 (17.1)	54 (14.4)	1.2 (0.8, 2.0)	1.5 (0.8, 2.8)	5.7
High-risk sexual contact	24 (13.7)	13 (3.5)	4.4 (2.2, 8.9)	5.5 (2.6, 11.9)	11.2
Drink water from well	44 (25.1)	85 (22.6)	1.2 (0.8, 1.7)	1.2 (0.7, 2.0)	4.2
Drink water from lake, river, stream, or spring	21 (12.0)	5 (1.3)	10.1 (3.7, 27.3)	5.3 (1.7, 16.8)	9.7
Swim in natural body of water	26 (14.9)	15 (4.0)	4.2 (2.2, 8.2)	3.3 (1.5, 7.3)	10.4
Swim in manmade venue	39 (22.3)	59 (15.7)	1.5 (1.0, 2.4)	1.3 (0.8, 2.2)	5.1
Eat raw vegetables or fruit	164 (93.7)	369 (98.1)	0.3 (0.1, 0.7)	0.3 (0.1, 0.8)	—
Take antibiotics	18 (10.3)	21 (5.6)	1.9 (1.0, 3.7)	2.8 (1.4, 5.9)	6.6
Take psychoactive medication	18 (10.3)	15 (4.0)	2.8 (1.4, 5.6)	1.8 (0.8, 4.2)	4.6
Chronic gastrointestinal condition or medication	49 (28.0)	67 (17.8)	1.8 (1.2, 2.7)	2.0 (1.2, 3.3)	14.0
Immunosuppressing condition, medication, or treatment	21 (12.0)	41 (10.9)	1.1 (0.6, 2.0)		

[1] Unadjusted odds ratios

[2] Odds ratios from full multivariable model adjusting for age, site, sex, and all exposures that have been previously reported to be associated with giardiasis and showed an association with disease status with P<0.2 in the bivariate models. Given these criteria, immunosuppressing condition, medication, or treatment was excluded from the multivariable analysis

Table 5. Distribution of sexual activity risk factors by gender for giardiasis cases and controls in the Foodborne Diseases Active Surveillance Network giardiasis case-control study, Colorado and Minnesota.

Characteristic	Cases (N=199) n/N (%)	Controls (N=381) n/N (%)
Any high-risk sexual contact	25/199 (12.6)	13/381 (3.4)
Males	20/25 (80.0)	5/13 (38.5)
Females	5/25 (20.0)	8/13 (61.5)
Rimming or anal contact	10/199 (5.0)	5/381 (1.3)
Males	10/10 (100.0)	2/5 (40.0)
Females	0/10 (0.0)	3/5 (60.0)
Sex partner had diarrhea	11/199 (5.5)	6/381 (1.6)
Males	6/11 (54.5)	3/6 (50.0)
Females	5/11 (45.5)	3/6 (50.0)
Sex with partner of same sex	18/199 (9.1)	6/381 (1.6)
Males	17/18 (94.4)	1/6 (16.7)
Females	1/18 (5.6)	5/6 (83.3)
Sex with partner of same sex and rimming or anal contact	10/199 (5.0)	2/381 (0.5)
Males	10/10 (100.0)	0/2 (0.0)
Females	0/10 (0.0)	2/2 (100.0)
Sex with partner of same sex and sex partner had diarrhea	4/199 (2.0)	1/381 (0.3)
Males	3/4 (75.0)	0/1 (0.0)
Females	1/4 (25.0)	1/1 (100.0)
Rimming or anal contact and sex partner had diarrhea	2/199 (1.0)	2/381 (0.5)
Males	2/2 (100.0)	1/2 (50.0)
Females	0/2 (0.0)	1/2 (50.0)
Sex with partner of same sex, sex partner had diarrhea, and rimming or anal contact	2/199 (1.0)	1/381 (0.3)
Males	2/2 (100.0)	0/2 (0.0)
Females	0/2 (0.0)	1/2 (50.0)

Table 6. Conventional and semi-Bayes adjusted odds ratios for exposures in the two weeks before illness onset caused by *Giardia* infection in the Foodborne Diseases Active Surveillance Network giardiasis case-control study, Colorado and Minnesota.

Exposure	Cases (N=199)	Controls (N=381)	Conventional Odds Ratio and 95% CI			Semi-Bayes Odds Ratio and 95% CI		
	n(%)	n(%)	OR[1]	LCL[2]	UCL[3]	OR	LCL	UCL
Visit, live, or work on farm or petting zoo	33 (16.58)	55 (14.44)	1.13	0.67	1.91	1.14	0.43	2.99
Touch, shovel, or walk through animal manure	68 (34.17)	116 (30.45)	1.12	0.75	1.67	1.12	0.45	2.81
Contact with live chicken or turkey	4 (2.01)	12 (3.15)	0.47	0.13	1.71	0.72	0.20	2.52
Contact with live rabbit	1 (0.5)	14 (3.67)	0.07	0.01	0.76	0.57	0.13	2.44
Contact with live amphibian	2 (1.01)	11 (2.89)	0.27	0.05	1.48	0.65	0.17	2.53
Contact with live fish	4 (2.01)	1 (0.26)	10.69	1.16	98.30	2.17	0.51	9.18
Sex partner had diarrhea	11 (5.53)	6 (1.57)	4.44	1.55	12.71	2.73	0.84	8.89
Rimming or contact with sex partner's anus	10 (5.03)	5 (1.31)	3.76	1.23	11.51	2.37	0.71	7.91
Sex with a partner of the same sex	18 (9.05)	6 (1.57)	6.96	2.65	18.32	3.88	1.23	12.25
Work in garden	40 (20.1)	92 (24.15)	0.82	0.52	1.29	0.85	0.33	2.16
Garden or handle soil without globves	36 (18.09)	78 (20.47)	0.85	0.53	1.36	0.88	0.34	2.26
Handle soil from the ground	35 (17.59)	68 (17.85)	0.97	0.60	1.57	0.99	0.38	2.56
Handle soil from compost	5 (2.51)	20 (5.25)	0.40	0.14	1.16	0.60	0.18	1.94
Handle soil bought packaged	7 (3.52)	29 (7.61)	0.47	0.19	1.14	0.61	0.20	1.88
Eat raw fruits or vegetables from garden	29 (14.57)	60 (15.75)	0.73	0.43	1.25	0.78	0.29	2.05
Sail, boat, raft, kayak, canoe, or tube in water	31 (15.58)	36 (9.45)	1.08	0.58	2.01	1.09	0.40	2.99
Swim or enter ocean	12 (6.03)	4 (1.05)	2.65	0.69	10.19	1.78	0.50	6.37
Swim or enter lake	27 (13.57)	15 (3.94)	2.51	1.19	5.33	2.11	0.73	6.11
Swim or enter hot spring	4 (2.01)	1 (0.26)	16.25	1.76	149.79	2.44	0.58	10.31
Swim or enter hot tub	20 (10.05)	17 (4.46)	2.68	1.32	5.42	2.26	0.80	6.41
Swim or enter recreational water park	192 (96.48)	380 (99.74)	0.06	0.01	0.54	0.48	0.12	2.02
Swim or enter swimming pool	37 (18.97)	56 (14.74)	0.83	0.49	1.39	0.86	0.33	2.26
Swim or enter municipal pool	7 (3.52)	19 (4.99)	0.64	0.24	1.68	0.78	0.25	2.45
Swim or enter neighborhood, condo, or apartment pool	6 (3.02)	12 (3.15)	0.95	0.32	2.81	1.03	0.31	3.39
Swim or enter private home pool	5 (2.51)	8 (2.1)	1.16	0.34	3.96	1.16	0.34	4.02
Swim or enter private club or membership pool	5 (2.51)	14 (3.67)	0.61	0.20	1.87	0.79	0.24	2.63
Swim or enter hotel or motel pool	17 (8.54)	11 (2.89)	2.16	0.89	5.25	1.80	0.59	5.53
Swim or enter kiddie/wading pool	3 (1.51)	3 (0.79)	2.77	0.52	14.60	1.66	0.43	6.42
Swim or enter school/college pool	1 (0.5)	1 (0.26)	1.84	0.11	30.20	1.28	0.29	5.69
Dive into water	19 (9.55)	31 (8.14)	0.83	0.42	1.65	0.89	0.31	2.50
Use slide to enter water	5 (2.51)	13 (3.41)	0.57	0.18	1.82	0.76	0.23	2.58
Recreational water splashed in face	60 (30.15)	61 (16.01)	1.86	1.16	2.96	1.77	0.69	4.54
Recreational water in mouth	43 (21.61)	50 (13.12)	1.58	0.94	2.65	1.52	0.58	3.99
Recreational water in mouth and swallowed	27 (13.57)	32 (8.4)	1.29	0.69	2.44	1.27	0.46	3.50
Eat raw fruits with skin/peel	156 (78.79)	309 (81.1)	0.88	0.55	1.41	0.91	0.35	2.33
Eat organic produce	40 (20.1)	121 (31.76)	0.53	0.34	0.83	0.57	0.22	1.46
Contact with raw meat	108 (54.27)	242 (63.52)	0.75	0.50	1.12	0.77	0.31	1.94
Eat any meals from restaurant	150 (75.38)	279 (73.23)	0.93	0.61	1.43	0.95	0.38	2.41
Eat any fast food meals	145 (72.86)	276 (72.44)	1.07	0.69	1.64	1.07	0.42	2.72
Eat take-out meals	86 (43.22)	188 (49.34)	0.80	0.56	1.17	0.82	0.33	2.04
Eat meals from cafeteria	32 (16.08)	59 (15.49)	1.12	0.68	1.86	1.13	0.43	2.94
Eat meals prepared in friend or relative's home	94 (47.24)	188 (49.34)	0.86	0.59	1.25	0.88	0.35	2.17
Consume unpasteurized milk	3 (1.51)	6 (1.57)	0.59	0.12	2.97	0.87	0.23	3.34
Consume unpasteurized apple juice or cider	3 (1.51)	10 (2.62)	0.59	0.15	2.41	0.84	0.23	3.04
Consume other unpasteurized juices	8 (4.02)	4 (1.05)	2.77	0.76	10.13	1.85	0.52	6.53
Consume unpasteurized cheese	20 (10.05)	31 (8.14)	1.20	0.62	2.30	1.19	0.43	3.31
Eat cold cuts, chicken salad, egg salad, or tuna salasd	124 (62.31)	234 (61.42)	1.04	0.71	1.52	1.05	0.42	2.60
Eat other cold salads (e.g., coleslaw, potato salad, or pasta salad)	91 (45.73)	183 (48.03)	0.92	0.63	1.35	0.94	0.38	2.32
Drink cider or juice	120 (60.3)	232 (60.89)	0.94	0.64	1.37	0.95	0.38	2.36
Eat raw shellfish	9 (4.52)	21 (5.51)	0.81	0.34	1.95	0.90	0.29	2.74
Eat cooked shellfish	49 (24.62)	98 (25.72)	0.94	0.61	1.45	0.95	0.38	2.42
Eat raw oysters	4 (2.01)	2 (0.52)	3.67	0.65	20.84	1.82	0.47	7.15
Picnic outdoors	54 (27.14)	77 (20.21)	0.97	0.61	1.57	0.99	0.39	2.56
Take pain medication	101 (50.75)	273 (71.65)	0.42	0.28	0.63	0.46	0.18	1.14
Take stomach acid-reducing medication	35 (17.59)	55 (14.44)	1.33	0.80	2.23	1.31	0.50	3.43
Previous giardiasis diagnosis	14 (7.04)	3 (0.79)	8.30	2.23	30.86	3.28	0.92	11.63
Acute infection	9 (4.52)	3 (0.79)	5.85	1.50	22.79	2.66	0.74	9.54
Take cardiovascular medication	11 (5.53)	16 (4.2)	1.10	0.46	2.66	1.12	0.37	3.42
Take allergy, degongestant, or asthmas medication	13 (6.53)	17 (4.46)	1.65	0.74	3.65	1.51	0.51	4.46
Take diabetes medication	3 (1.51)	2 (0.52)	3.36	0.54	20.95	1.71	0.43	6.84
Take thyroid medication	8 (4.02)	9 (2.36)	1.54	0.51	4.62	1.38	0.42	4.58
Heart disease	7 (3.52)	7 (1.84)	2.02	0.68	6.04	1.64	0.49	5.42
High blood pressure	14 (7.04)	39 (10.24)	0.65	0.32	1.32	0.73	0.26	2.09
Liver disease	6 (3.02)	3 (0.79)	3.91	0.94	16.28	2.10	0.57	7.67
Respiratory condition	7 (3.52)	11 (2.89)	1.60	0.60	4.29	1.44	0.45	4.58
Thyroid condition	3 (1.51)	3 (0.79)	0.84	0.12	6.12	1.05	0.26	4.29
Central nervous system disorder	6 (3.02)	2 (0.52)	4.43	0.82	23.83	2.00	0.52	7.77
Blood disorder	2 (1.01)	2 (0.52)	1.45	0.16	12.84	1.24	0.30	5.22

[1] Odds ratio adjusted for age, site, sex, international travel, and drinking water from a lake, river, stream, or spring

[2] LCL: Lower confidence limit

[3] UCL: Upper confidence limit

Appendix: Case Questionnaire

RED = variable name

PURPLE = asked only for pediatric questionnaire, not adult

BLUE = asked only for adult questionnaire, not pediatric

Identifier Variables

UniqueID = unique identification number
Cases start with 1000+
Controls start with 1+

adped = adult or pediatric questionnaire
0 = adult
1 = pediatric

caco = case or control
0 = control
1 = case

inclusion = inclusion of case/control in study
001 = included in the study
002 = excluded in the study

version = version of questionnaire used
1 = 9/05/2003 version
2 = 7/26/2004 version

*Minnesota variables
dualinf = dual infection?
specdual = specify dual infection

*Colorado variables – (in Animal Contact Section)
dogpark, dogparks, listpark1, listpark2, listpark3

GIARDIA C-C STUDY
CASE QUESTIONNAIRE

Case: Last name _____ First name _____

Date of Birth: |___|___|-|___|___|-|___|___| Home telephone |__|__|__|-|__|__|__|-|__|__|__|__|

MM DD YY Work telephone |__|__|__|-|__|__|__|-|__|__|__|__|

Address:

_____

City: _____

Zip code: |__|__|__|__|__|

Date of Interview: |__|__|-|__|__|-|__|__| Interviewer: _____

MM DD YY

Telephone Contact History

Date (mm/dd)	time (am/pm)	Outcome Code
1._____	_____	_____
2._____	_____	_____
3._____	_____	_____
4._____	_____	_____
5._____	_____	_____
6._____	_____	_____
7._____	_____	_____
8._____	_____	_____
9._____	_____	_____
10._____	_____	_____
11._____	_____	_____
12._____	_____	_____
13._____	_____	_____
14._____	_____	_____
15._____	_____	_____

OUTCOME CODES

01 = completed interview
02 = refused interview
07 = no eligible respondent
08 = language barrier

03 = no answer
04 = busy tone
05 = non-working number
06 = fax machine
05 = business phone
09 = interview terminated within questionnaire
11 = physical/mental impairment
12 = answering machine
13 = setting up a better time
99 = unknown

GIARDIA CASE-CONTROL STUDY
CASE QUESTIONNAIRE

- **TEXT IN REGULAR TYPE IS TO BE READ TO THE RESPONDENT.**
- **TEXT IN *ITALICS* IS AN INSTRUCTION FOR THE INTERVIEWER TO EMPHASIZE THAT/THOSE SPECIFIC WORD(S) WHEN READING TO THE RESPONDENT.**
- **TEXT IN BOLD CAPS IS AN INSTRUCTION FOR THE INTERVIEWER AND SHOULD NOT BE READ TO THE RESPONDENT.**

Study ID number |__|__|--**GIARDIA-CC-2002** **(PUT CO OR MN IN FIRST 2 BOXES)**
studyidnum
Case report number |__|__|--|__|__|__| **(PUT CO OR MN IN FIRST 2 BOXES AND THEN UNIQUE NUMBER)**
casereport caserepor1
Matched CONTROL report number |__|__|--|__|__|__| **(PUT CO OR MN IN FIRST 2 BOXES AND THEN UNIQUE NUMBER)**
matchedcon matchedcol1

Interview outcome code |__|__| **(SEE PREVIOUS PAGE)**
interviewo
Date of interview |__|__|-|__|__|-|__|__| **dateinterv**
MM DD YY
2 week exposure period |__|__|-|__|__|-|__|__| to |__|__|-|__|__|-|__|__|
MM DD YY MM DD YY
date1 **date2**

YOU SHOULD HAVE COMPLETED THE CASE INTRODUCTION INTERVIEW AND BE SPEAKING WITH AN ADULT CASE. THERE IS A SEPARATE FORM FOR PEDIATRIC CASES.

BEFORE YOU INTERVIEW CASE: HAVE A CALENDAR IN FRONT OF YOU.

Before we begin, I need to make sure you live in one of the counties under our jurisdiction. What county do you currently live in? (County) ___**countydoyo**____

- **IF NOT IN CATCHMENT AREA, READ:**

Your county is not under our jurisdiction. Therefore, I am unable to continue with the survey. I would like to thank you very much for your time and cooperation.

- **IF THIS CITY OR TOWN IS IN THE CATCHMENT AREA, CONTINUE WITH QUESTIONNAIRE (GO TO "CONTINUE" ON THE FOLLOWING PAGE).**

- **IF RESPONDENT ANSWERS "DON'T KNOW," ASK:**

What city or town do you currently live in?
(CITY)_____**cityortown**_____

- **IF NOT IN CATCHMENT AREA, READ:**

Your city or town is not under our jurisdiction. Therefore, I am unable to continue with the survey. I would like to thank you very much for your time and cooperation.

- **IF THIS CITY OR TOWN IS IN THE CATCHMENT AREA, CONTINUE WITH QUESTIONNAIRE.**

Now we can start to discuss your recent activities. It would be helpful if you had a calendar in front of you, as we will be discussing specific dates.

REMINDER OF EXCLUSION CRITERIA (QUESTIONS A1-A3): SEE METHODS FOR OTHER EXCLUSION CRITERIA

1) **INTERVIEWEE HAD LAB-CONFIRMED GIARDIASIS DISTINCT FROM THIS LAB REPORT IN THE PAST 90 DAYS [STUDYCOORDINATOR SHOULD EXLUDE THESE CASES BEFORE THE INTERVIEW]**
2) **HOUSEHOLD MEMBER HAD LAB-CONFIRMED GIARDIASIS IN THE PAST 60 DAYS WITH ONSET BEFORE THIS CASE'S ONSET DATE**
3) **NO GASTROENTERITIS REPORTED IN PAST 60 DAYS**
4) **IF ONSET DATE $\geq$ 6 WEEKS (42 DAYS) BEFORE INTERVIEW DATE, SWITCH TO "GIARDIASIS IMPACT" SURVEY**
5) **NO ONSET DATE FOR GASTROENTERITIS**

FOR EXCLUSIONS 2, 3, AND 5 ONLY COLLECT DEMOGRAPHIC DATA, SECTION K

AFTER GETTING THE DATE OF ONSET FOR ILLNESS (A3), MARK THE 2 WEEKS PRECEECDING THAT ONSET DATE ON THE CALENDAR FOR USE IN ASKING THE EXPOSURE QUESTION IN SECTIONS.

SECTION A: GASTROENTERITIS SYMPTOMS

READ: I would like to start by asking you some questions about your recent illness.

A1. Have any other household member become ill with laboratory test confirmed giardiasis in the last 6 weeks? **household**

YES.....	001	**(GO TO A1a.)**
NO.....	002	**(GO TO A2)**
REFUSED.....	888	**(COMPLETE DEMOGRAPHICS, SECTION K)**
UNKNOWN.....	999	**(COMPLETE DEMOGRAPHICS, SECTION K)**

A1a. Did any of these family members become ill before you became ill with giardiasis? **familyill**

YES 001

A1b; Which family members became ill with laboratory-confirmed giardiasis before you became ill?

First name Last name
1.___**fam1**_____
2.___**fam2**_____
3.____**fam3**_____
Terminate interview with this case and check records to confirm which individual(s) as/have laboratory confirmed giardiasis and select the individual with the earliest illness onset date for interview

NO	002	
REFUSED.	888	**(COMPLETE DEMOGRAPHICS, SECTION K)**
UNKNOWN	999	**(COMPLETE DEMOGRAPHICS, SECTION K)**

A2. Have you had any gastrointestinal symptoms, defined as diarrhea, vomiting, or other symptoms such as severe or unusual cramping, belching, bloating, or gas production in the last 60 days? **gastsx**

YES.....	001	
NO.....	002	**(COMPLETE DEMOGRAPHICS, SECTION K)**
REFUSED.....	888	**(COMPLETE DEMOGRAPHICS, SECTION K)**
UNKNOWN.....	999	**(COMPLETE DEMOGRAPHICS, SECTION K)**

A3. What was the date of the *first* day that you became ill?

ILLNESS ONSET DATE |__|__|-|__|__|-|__|__| **(IF INTERVIEWEE CAN ESTIMATE WITHIN 1 WEEK,**
illnessons MM DD YY **USE MIDDLE POINT)**

IF ONSET DATE ≥ 6 WEEKS BEFORE TODAYS INTERVIEW DATE…SWITCH TO "GIARDIASIS IMPACT" SURVEY
Because so much time has passed since you became ill, we will use a a shorter survey which addresses different aspects of your illness and the impact its had on your life.

REFUSED..... 888 **(COMPLETE DEMOGRAPHICS, SECTION K)**
UNKNOWN..... 999 **(COMPLETE DEMOGRAPHICS, SECTION K)**

A4. Do you currently have any gastrointestinal symptoms?
currentsx
YES..... 001 **(GO TO A6,)**
NO..... 002
REFUSED..... 888 **(GO TO A6,)**
UNKNOWN..... 999 **(GO TO A6,)**

A5. IF NO, when did these symptoms end?

ILLNESS END DATE: |__|__|-|__|__|-|__|__| **(IF INTERVIEWEE CAN ESTIMATE WITHIN 1 WEEK,**
illnessend MM DD YY **USE MIDDLE POINT)**

refunk REFUSED..... 888
UNKNOWN..... 999

A6. Which of the following symptoms did you have, and how long did you experience each from beginning to end, regardless if you felt better on some days in between?
[READ THE LIST OF SYMPTOMS. IF YES, CIRCLE THE CORRESPONDING DURATION FOR EACH.]

SYMPTOM	0 days	1 day	2-5 days	6-14 days	>14 days	REF	UNK
a. Nausea **anausea**	000	001	002	006	014	888	999
b. Vomiting **bvomiting**	000	001	002	006	014	888	999
c. Fever **cfever** **IF YES, ASK A7 AS WELL**	000	001	002	006	014	888	999
d. Loss of appetite **dlossappet**	000	001	002	006	014	888	999
e. Abdominal cramps **eabdominal**	000	001	002	006	014	888	999
f. Bloating/Gas **fbloatingg**	000	001	002	006	014	888	999

g. Headache **gheadache**	000	001	002	006	014	888	999

A7. IF YES TO FEVER, what was the highest temperature measured?

fevfahren **fevcels**

a. **NUMBER** |__|__|__| **.** |__| **degrees F** **OR** **b. NUMBER** |__|__|__| **.** |__| **degrees C**

feltwarnfev Felt warm/feverish, but temperature not measured … 222
REFUSED..... 888
UNKNOWN..... 999

A8. Did you lose any weight?

loseweight

YES..... 001
NO..... 002 **(GO TO A10)**
REFUSED..... 888 **(GO TO A10)**
UNKNOWN..... 999 **(GO TO A10)**

A9. IF YES, how much weight did you lose?

losslbs **losskg**

a. NUMBER |__|__|__| **pounds** **OR** **b. NUMBER** |__|__|__| **kilograms**
REFUSED..... 888
UNKNOWN..... 999

What is your normal weight?

wgtlbs **wgtkg**

c. NUMBER |__|__|__| **pounds** **OR** **d. NUMBER** |__|__|__| **kilograms**
REFUSED..... 888
UNKNOWN..... 999

A10. Did you have blood in your stool during your gastrointestinal illness?

bloodstool

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

A11. Did you have diarrhea? By diarrhea, I mean *3 or more loose or watery stools in 24 hours.*

diarrhea

YES..... 001
NO..... 002 **(GO TO SECTION B,)**
REFUSED…..... 888 **(GO TO SECTION B,)**

UNKNOWN…..... 999 **(GO TO SECTION B,)**

A12. IF YES, what was the date on which your diarrhea started?

diarrheaoon

DIARRHEA ONSET DATE: |__|__|-|__|__|-|__|__| **(IF INTERVIEWEE CAN ESTIMATE WITHIN 1 WEEK,**

MM DD YY **USE MIDDLE POINT)**

refused888 REFUSED..... 888
UNKNOWN.....…..... 999

A13. What was the *maximum* number of loose stools you had in a 24-hour period during this illness?

maxstool

NUMBER |__|__|__| maximum number of loose stools in 24-hour period

REFUSED……..... 888
UNKNOWN...……..... 999

A14. Was there a period when your diarrhea went away for more than a day and then came back?

wentaway

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

A15. Do you currently have diarrhea?

currentdi

YES..... 001 **(GO TO SECTION B,)**
NO.....…..... 002
REFUSED.....……. 888 **(GO TO SECTION B,)**
UNKNOWN..... 999 **(GO TO SECTION B,)**

A16. IF NO, How many days did your diarrhea (loose or watery stools) last, by this I mean from the first day of diarrhea to the last day of diarrhea even if the diarrhea stopped and started in between?

diend

NUMBER |__|__|__| **days before diarrhea *completely* ended [DO NOT SUBTRACT DAYS IN BETWEEN WITHOUT DIARRHEA]**

OR

IF THE NUMBER OF DAYS IS UNKNOWN, ASK:

On what date did the diarrhea *completely* end?

enddate

|__|__|-|__|__|-|__|__| **(IF INTERVIEWEE CAN ESTIMATE WITHIN 1 WEEK, USE MIDDLE POINT)**

MM DD YY

REFUSED..... 888
UNKNOWN..... 999

SECTION B: CLINICAL TREATMENT

READ: Next, I am going to ask you some questions about the treatment and diagnosis of your *gastrointestinal or diarrheal* illness.

		Yes	No	Refused	Unknown
B1.	a. Did you consult a healthcare provider over the *phone*?…… **phonecon** ……..	001	002	888	999
	b. Did you *visit* a health care provider?…**visitdr**.....	001	002	888	999
	c. **totnum** **IF YES,** total number of times you visited? |__|__|__|			888	999
	d. Did you *visit* an Emergency Room?… **visiter** ….	001	002	888	999
	e. **totnumer** **IF YES,** total number of ER visits? |__|__|__|			888	999
	f. Were you *admitted* to the hospital?… **admhosp**…	001	002	888	999
	g. **numdays** **IF, YES** total number of days hospitalized? |__|__|__| **(000 = < 1 day)**			888	999
	h. Were you given intravenous fluids?… **giveiv**…......	001	002	888	999

READ: We would now like to ask you about the sequence of events during your visits to a health care provider . We will refer to each visit you made, *regardless if it was the same healthcare provider or hospital.*

B2. Once your illness began, how long were you ill before you made your first healthcare visit?

longill

NUMBER |__|__|__| days / weeks /months [CIRCLE APPROPRIATE PERIOD OF TIME]

REFUSED..... 888
UNKNOWN..... 999

B3. IF >1 VISIT TO HEALTHCARE PROVIDER, ER, OR HOSPITAL., Did you change healthcare providers while being treated for this illness?

chngprov

YES..... 001
NO..... 002 **(GO TO B5)**
REFUSED..... 888 **(GO TO B5)**
UNKNOWN..... 999 **(GO TO B5)**

B4. IF YES, what was the reason for changing healthcare providers? **[READ CHOICES ONLY IF NECESSARY]**

b4reasonfo

Symptoms did not improve with treatment…..…… 011
Received referral to another physician/specialist..……. 022
Healthcare provider unavailable…..……..……. 033

Change in insurance coverage and provider not in-network 044
Provider relocated……. 055
Patient relocated…..……... 066
Too far to travel to healthcare provider……. 077
Cost/lack of insurance…….. 088
Other……..…… 099
a. Specify_____ **aspecify**_____
REFUSED…… 888
UNKNOWN…… 999

B5. Now, I am going to ask about anti-diarrheal medications. Did you take any of the following anti-diarrheal medications for this illness? **[READ THE LIST. CIRCLE ALL THAT APPLY]**

MEDICATION	**YES**	**NO**	**REFUSED**	**UNKNOWN**
a. Pepto-Bismol **apeptobism**	001	002	888	999
b. Kaopectate **bkaopectat**	001	002	888	999
c. Immodium **cimmodium**	001	002	888	999
d. Lomotil **dlotomil**	001	002	888	999
e. Other anti-diarrheals **eotheranti** f. Specify: **fspecify**	001	002	888	999

B6. Did you receive a prescription for an antibiotic or antiparasitic during this gastrointestinal illness?

b6prescrip

YES..... 001
NO..... 002 **(GO TO B9,)**

REFUSED..... 888 **(GO TO B9,)**
UNKNOWN..... 999 **(GO TO B9,)**

B7. IF YES, On which number healthcare visit was an antibiotic or antiparasitic *first* prescribed?

	numpres
HEALTHCARE VISIT NUMBER	**|__|__|__|**
REFUSED.....	888
UNKNOWN.....	999

B8. Please list all antibiotic or antiparasitic medications you received in the order you received them. **[DO NOT READ THE LIST. IF THE RESPONDENT IS NOT SURE, ENCOURAGE THEM TO GET THE PILL BOTTLES OR RECEIPTS. CIRCLE THE NUMBERS FOR ALL OF THE MEDICATIONS INDICATED BY THE RESPONDENT AND SEQUENCE THEM IN THE ORDER THAT THEY WERE PRESCRIBED. IF MULTIPLE ANTIBIOTICS OR ANTIPARASITICS ARE PRESCRIBED IN A SINGLE VISIT, GIVE THEM THE SAME SEQUENCE NUMBER.]**

MEDICATION	NO.	SEQUENCE
Albendazole…albendazol	1	|__|__|__|
Albenza…albenza1	1	|__|__|__|
Alinia…alinia50	50	|__|__|__|
Amoxicillin…amoxicilli	2	|__|__|__|
Amoxicillin/Clavulanate…amoxicill1	3	|__|__|__|
Ampicillin…ampicillin	4	|__|__|__|
Augmentin…augmentin	3	|__|__|__|
Avelox…avelox38	38	|__|__|__|
Azithromycin…azithromyc	5	|__|__|__|
Bactrim…bactrim6	6	|__|__|__|
Biaxin…biaxin7	7	|__|__|__|
Ceclor…ceclor8	8	|__|__|__|
Cefaclor…cefaclor8	8	|__|__|__|
Ceftin…ceftin9	9	|__|__|__|
Cefixime…cefixime10	10	|__|__|__|
Cefuroxime…cefuroxime	11	|__|__|__|
Cefzil…cefzil12	12	|__|__|__|
Cefprozil…cefprozil1	12	|__|__|__|
Cephalexin…cephalexin	13	|__|__|__|
Cephradine…cephradine	14	|__|__|__|
Cipro…cipro15	15	|__|__|__|
Ciprofloxacin…ciproflox	15	|__|__|__|
Clarithromycin…clarithrom	7	|__|__|__|
Clavulanate/Amoxicillin…clavulant	3	|__|__|__|
Dapsone…dapsone16	16	|__|__|__|
Doxycycline…doxycyclin	17	|__|__|__|
Duricef…duricef18	18	|__|__|__|
Erythromycin…erythromyc	19	|__|__|__|
Erythromycin/Sulfisoxazole…erythromyl	20	|__|__|__|
Flagyl…flagyl21	21	|__|__|__|

MEDICATION	NO.	SEQUENCE
Floxin…floxin22	22	|__|__|__|
Furazolidone…furazolido	23	|__|__|__|
Furoxone…furoxine23	23	|__|__|__|
Humatin…humatin24	24	|__|__|__|
Keflex…keflex25	25	|__|__|__|
Keftab…keftab25	25	|__|__|__|
Levofloxacin…levofloxac	26	|__|__|__|
Levoquin…levoquin26	26	|__|__|__|
Metronidazole…metronidaz	21	|__|__|__|
Moxafloxacin…moxafloxac	38	|__|__|__|
Nitazoxanide…nitazoxani	50	|__|__|__|
Noroxin…noroxin27	27	|__|__|__|
Norfloxacin…norfloxaci	27	|__|__|__|
Ofloxacin…ofloxacin2	22	|__|__|__|
Paromomycin…paromomyci	24	|__|__|__|
Pediazol…pediazol20	20	|__|__|__|
Quinicrine…quinicrine	28	|__|__|__|
Septra…septra6	6	|__|__|__|
Sulfa/Trimethoprim…sulfatrime	6	|__|__|__|
Sulfisoxazole/Erythromycin…sulfisoxaz	20	|__|__|__|
Suprax…suprax10	10	|__|__|__|
Tetracycline…tetracycli	29	|__|__|__|
Tinidazole…tinidazole	30	|__|__|__|
Trimox…trimox2	2	|__|__|__|
Trimethoprim/sulfa…trimethopr	6	|__|__|__|
Trovafloxin…trovafloxi	31	|__|__|__|
Trovan…trovan31	31	|__|__|__|
Velosef…velosef14	14	|__|__|__|
Zithromax…zithromax5	5	|__|__|__|

I received an antibiotic/antiparasitic but don't remember the name — 036 ireceiveda / ireceiveda1
Antibiotic received is not on this list — 037 antibiotic

Specify____ specantib_____

REFUSED — 888
UNKNOWN — 999

B9. In the *2 weeks* before your illness, did you take any of the following medications or receive any of the following medical treatments? **[READ THE LIST. CIRCLE ALL THAT APPLY]**

MEDICATION	**YES**	**NO**	**REF**	**UNK**
a. Oral steroids (e.g. Prednisone, Dexamethazone, Medrol) **steroid**	001	002	888	999
b. Cyclosporine **cyclospor**	001	002	888	999
c. Chemotherapy **chemo**(specify: **specchemo**	001	002	888	999
d. Radiation therapy **radiation**	001	002	888	999
e. Antibiotics for reasons other than your giardiasis **antiother** f. Specify:_____ **antispec1**_____ g. Specify:____ **antispec2**_____ h. Specify: ____ **antispec3**_____	001	002	888	999
i. Pills that decrease stomach acid (e.g. Pepcid, Zantac) **stomacid**	001	002	888	999
j. Laxatives **laxative**	001	002	888	999
k. Enemas **enemas**	001	002	888	999
l. Aspirin **aspirin**	001	002	888	999
m. Tylenol (or other form of acetaminophen)	001	002	888	999
n. Pain medicine such as Ibuprofen, Advil, Naprosyn **tylenol**	001	002	888	999
o. Other **othermed** p. Specify: **specmed, specmed1, specmed2, specmed3, specmed4, specmed5, specmed6, specmed7, specmed8**	001	002	888	999

SECTION C: IMPACT ON DAILY ACTIVITIES

READ: We would now like to discuss how this illness impacted your daily activities.

C1. When your illness began, were you employed, meaning you had a paid job performed either outside or inside your home?

job

YES..... 001

NO..... 002 **(GO TO C5)**
REFUSED..... 888 **(GO TO C5)**
UNKNOWN..... 999 **(GO TO C5)**

C2. IF YES, As part of your job duties, did you: **[READ EACH QUESTION. CIRCLE ALL THAT APPLY]**
[ADULT CASE ONLY]

QUESTION	YES	NO	REF	UNK
a. Handle or prepare food? **handfood**	001	002	888	999
b. Provide healthcare? **provhealth**	001	002	888	999
c. Provide childcare? **provchild**	001	002	888	999

C3. IF YES TO EMPLOYED, During your illness, did you miss any time from work, for example because you called in sick or took time off to see a doctor?

sicktime
YES..... 001
NO..... 002 **(GO TO C5)**
REFUSED..... 888 **(GO TO C5)**
UNKNOWN..... 999 **(GO TO C5)**

dayssick
C4. IF YES, how many days? |___|___| **days** **(IF IN HOURS, i.e. <1 DAY, THEN CODE AS ZERO)**

REFUSED…….. 888
UNKNOWN…….. 999

C5. Did this illness prevent you from performing daily activities such as school, recreation, or vacation activities, or working within the home?

prevadl
YES..... 001
NO..... 002 **(GO TO C7,)**
REFUSED..... 888 **(GO TO C7,)**
UNKNOWN..... 999 **(GO TO C7,)**

daysadl
C6. IF YES, how many days? |___|___|___| **days** **(IF IN HOURS, i.e. <1 DAY, THEN CODE AS ZERO)**

REFUSED…….. 888
UNKNOWN…….. 999

C7. Did *your* gastrointestinal or diarrheal illness cause *other* household members to lose time at work?

famwork

YES..... 001
NO..... 002 **(GO TO C9)**
REFUSED..... 888 **(GO TO C9)**
UNKNOWN..... 999 **(GO TO C9)**

famdays

C8. IF YES, how many days? |___|___|___| **days** **(IF IN HOURS, i.e. <1 DAY, THEN CODE AS ZERO)**

REFUSED..... 888
UNKNOWN..... 999

C9. *Not* including the prescriptions from your healthcare provider, did you or another family member buy any over-the-counter medications, special drinks, or other things that you needed *only* because of this illness?

otcmeds

YES..... 001
NO..... 002 **(GO TO C11)**
REFUSED..... 888 **(GO TO C11)**
UNKNOWN..... 999 **(GO TO C11)**

C10. IF YES, About how much of your own or your household's money did you spend altogether for these over-the-counter medicines, special drinks, and other things that you bought *only* because you were ill? **[IF UNKNOWN, PLEASE ASK FOR BEST ESTIMATE]**

otccost

$0-25..... 001
$26-50..... 002
$51-75..... 003
$76-100..... 004
$101-150..... 005
$151-200..... 006
MORE THAN $200..... 007
REFUSED 888
UNKNOWN..... 999

C11. In the 30-day period *after* your illness began, did anyone else in your household begin to have gastrointestinal or diarrheal illness?

famdiarr

YES..... 001
NO..... 002 **(GO TO SECTION D,)**
REFUSED..... 888 **(GO TO SECTION D,)**
UNKNOWN..... 999 **(GO TO SECTION D,)**

C12. IF YES, How many people in your household become ill?

numfamdi

NUMBER |___|___| **household members who became ill**

REFUSED..... 888
UNKNOWN..... 999

C13. IF YES, Were any of the ill household members diagnosed with *Giardia*?

famgiard

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

C14. Did gastrointestinal or diarrheal illness in these household members cause *you or other* household members to lose time at work or prevent you or other household members from performing daily activities such as school, recreation, or vacation activities, or working in the home?

famactiv

YES..... 001
NO..... 002 **(GO TO SECTION D,)**
REFUSED..... 888 **(GO TO SECTION D,)**
UNKNOWN..... 999 **(GO TO SECTION D,)**

daysactiv

C15. IF YES, how many days? |___|___|___| **days** **(IF IN HOURS, i.e. <1 DAY, THEN CODE AS ZERO)**

REFUSED..... 888
UNKNOWN..... 999

SECTION D: GENERAL HEALTH AND POTENTIAL NON-GI SEQUELAE OF GIARDIASIS

READ: Now I would like to ask you a few questions about your general health

[FOR MALE RESPONDENTS GO TO D4,]

D1. Were you pregnant at any time during your illness? **[ADULT CASE ONLY]**

werepreg

YES..... 001
NO..... 002 **(GO TO D4)**

REFUSED..... 888 **(GO TO D4)**
UNKNOWN..... 999 **(GO TO D4)**

D2. Are you currently pregnant? **[ADULT CASE ONLY]**

currpreg

YES..... 001
NO..... 002 **(GO TO D4)**
REFUSED..... 888 **(GO TO D4)**
UNKNOWN..... 999 **(GO TO D4)**

D3. IF YES, how many months/weeks pregnant are you now? **[ADULT CASE ONLY]**

monthspreg

1-3 months (or 1-12 weeks)…….. 001
4-6 months (or 13-24 weeks)…..…….. 004
7-9 months (or 25-36+ weeks)…….. 007
REFUSED.....……..... 888
UNKNOWN.....……. 999

D4. We would like to know about your medical history prior to your illness, in order to determine if some conditions make it easier to get giardiasis or if giardiasis causes symptoms other than diarrheal illness. Some of these questions are of a sensitive nature. You can refuse to answer any question at any time.
I will now read a list of health problems and ask if you ever had any of the following procedures or were told by a physician that you have any of the following illnesses. If yes, I will ask whether your diagnosis was made before, during, or after your illness with giardiasis. **[READ THE LIST. CIRCLE ALL THAT APPLY]**

ILLNESS/PROCEDURE	**1) Illness/Procedure**				**[IF YES THAN ASK] 2) Time in relation to illness**				
	YES 001	NO 002	REFUSED 888	UNKNOWN 999	BEFORE 003	DURING 004	AFTER 005	REFUSED 888	UNKNOWN 999
a. Diabetes	**adiabetes**				**adiabetes1**				
b. Heart Disease	**bheartdise**				**bheartdis1**				
c. High Blood Pressure/ Hypertension	**chighblood**				**chighbloo1**				
d. Kidney Disease	**dkidneydis**				**dkidneydi1**				
e. End-Stage Kidney Disease	**eendstagek**				**eendstage1**				
f. Organ Transplant	**forgantran**				**forgantra1**				
g. Stomach Ulcer Disease	**gstomachul**				**gstomachu1**				
h. Stomach Surgery	**hstomachsu**				**hstomachs1**				
i. Liver Disease	**iliverdise**				**iliverdis1**				
j. Chronic Diarrhea	**jchronicdi**				**jchronicd1**				
k. Crohn's Disease	**kcrohnsdis**				**kcrohnsdi1**				
l. Irritable Bowel Disease	**lirritable**				**lirritabl1**				
m. Cancer (other than skin cancer)	**mcancernon**				**mcancerno1**				
n. Lupus/Systemic lupus erythematosus	**nlupussyst**				**nlupussys1**				
o. Arthritis	**oarthritis**				**oarthriti1**				
p. HIV/AIDS	**phivaids**				**phivaids1**				
q. Other immunodeficiency r. Specify:	**qotherimmuno** **rspecify**				**qotherimmun1**				
s. Reiter's syndrome	**sreiterssy**				**sreiterss1**				
t. Previous Giardiasis Diagnosis	**tpreviousg**				**tprevious1**				
u. Other v. Specify:_____ w. Specify: x. Specify: y. Specify:	**uother** **vspecify** **wspecify** **xspecify** **yspecify**				**uother1**				

READ: Now, I would also like to ask you about a few symptoms in detail.

D5. Did you start having *arthritis or joint problems after* the onset of gastrointestinal or diarrheal illness?

arthritis

YES..... 001
NO..... 002 **(GO TO D11)**
REFUSED..... 888 **(GO TO D11)**

UNKNOWN..... 999 **(GO TO D11)**

D6. IF YES,
How many days *after* your gastrointestinal or diarrheal illness did the arthritis or joint problems start?
arthdays

0-3 days.....	003
Over 3 days but within 1 week.....	007
Over a week but within 1 month.....	030
Over a month but within 2 months.....	060
REFUSED.....	888
UNKNOWN.....	999

D7. Do you *still* have the arthritis or joint problems?
arthstill

YES.....	001	**(GO TO D9)**
NO.....	002	
REFUSED.....	888	**(GO TO D9)**
UNKNOWN.....	999	**(GO TO D9)**

D8. IF NO, how long did the arthritis or joint problems last?
arthlast

0-3 days.....	003
Over 3 days but within 1 week.....	007
Over a week but within 1 month.....	030
Over a month but within 2 months.....	060
REFUSED.....	888
UNKNOWN.....	999

D9. The following questions are about treatment and diagnosis of *your arthritis or joint problems*.

QUESTION	**YES**	**NO**	**REF**	**UNK**
a. Did you *call* a healthcare provider? **arthcall**	001	002	888	999
b. Did you *visit* a healthcare provider? **arthvisdr**	001	002	888	999
c. Did you *visit* an Emergency Room? **arther**	001	002	888	999
d. Were you *admitted* to the hospital? **arthadm**	001	002	888	999
e. Did a provider give you a specific diagnosis? **arthdx**	001	002	888	999
f. Specify: **arthspec**				

D10. Which joints were affected by arthritis or joint problems *after* your gastrointestinal or diarrheal illness began? **[DO NOT READ THE LIST OF BODY PARTS. CIRCLE ALL THE JOINT(S) INDICATED AND THEN ASK THE QUESTIONS ONLY FOR THE JOINTS INDICATED]**

⇩ **ASK QUESTIONS ONLY FOR BODY PARTS MENTIONED**

AREA	Is this joint involved? **Y N** 001 002	Is it stiff? **Y N R UK** 001 002 888 999	Is it swollen? **Y N R UK** 001 002 888 999	Is it red or inflamed? **Y N R UK** 001 002 888 999	Is it painful? **Y N R UK** 001 002 888 999	What side is involved? **L R BOTH** 003 004 005
a. All Joints	**aalljoints**	**aalljoint1**	**aalljoint2**	**aalljoint3**	**aalljoint4**	**aalljoint5**
b. Ankle	**bankle**	**bankle1**	**bankle2**	**bankle3**	**bankle4**	**bankle5**
c. Back/ Spine	**cbackspine**	**cbackspin1**	**cbackspin2**	**cbackspin3**	**cbackspin4**	**cbackspin5**
d. Elbow	**delbow**	**delbow1**	**delbow2**	**delbow3**	**delbow4**	**delbow5**
e. Fingers	**efingers**	**efingers1**	**efingers2**	**efingers3**	**efingers4**	**efingers5**
f. Foot	**ffoot**	**ffoot1**	**ffoot2**	**ffoot3**	**ffoot4**	**ffoot5**
g. Hand	**ghand**	**ghand1**	**ghand2**	**ghand3**	**ghand4**	**ghand5**
h. Heel	**hheel**	**hheel1**	**hheel2**	**hheel3**	**hheel4**	**hheel5**
i. Hip	**ihip**	**ihip1**	**ihip2**	**ihip3**	**ihip4**	**ihip5**
j. Jaw	**jjaw**	**jjaw1**	**jjaw2**	**jjaw3**	**jjaw4**	**jjaw5**
k. Knee	**kknee**	**kknee1**	**kknee2**	**kknee3**	**kknee44**	**kknee5**
l. Neck	**lneck**	**lneck1**	**lneck2**	**lneck3**	**lneck4**	**lneck5**
m. Shoulder	**mshoulder**	**mshoulder1**	**mshoulder2**	**mshoulder3**	**mshoulder4**	**mshoulder5**
n. Toes	**ntoes**	**ntoes1**	**ntoes2**	**ntoes3**	**ntoes4**	**ntoes5**
o. Wrist	**owrist**	**owrist1**	**owrist2**	**owrist3**	**owrist4**	**owrist5**

D11. Did you get *a rash, itchiness or other skin problems after* the onset of gastrointestinal or diarrheal illness?

rashafter

YES..... 001
NO..... 002 **(GO TO D18)**
REFUSED..... 888 **(GO TO D18)**

UNKNOWN..... 999 **(GO TO D18)**

D12. IF YES,

How many days *after* your gastrointestinal or diarrheal illness did the skin problems start?

rashdays

0-3 days..... 003
Over 3 days but within 1 week..... 007
Over a week but within 1 month..... 030
Over a month but within 2 months..... 060
REFUSED..... 888
UNKNOWN..... 999

D13. Do you still have the skin problems?

stillskin

YES..... 001 **(GO TO D15)**
NO..... 002
REFUSED..... 888 **(GO TO D15)**
UNKNOWN..... 999 **(GO TO D15)**

D14. IF NO, how long did the skin problems last?

longskin

0-3 days..... 003
Over 3 days but within 1 week..... 007
Over a week but within 1 month..... 030
Over a month but within 2 months..... 060
REFUSED..... 888
UNKNOWN..... 999

D15. The following questions are about treatment and diagnosis of *your skin problems*.

QUESTION	YES	NO	REF	UNK
a. Did you *call* a healthcare provider? **skincall**	001	002	888	999
b. Did you *visit* a healthcare provider? **skinvisdr**	001	002	888	999
c. Did you *visit* an Emergency Room? **skiner**	001	002	888	999
d. Were you *admitted* to the hospital? **skinadm**	001	002	888	999
e. Did a provider give you a specific diagnosis? **skindx**	001	002	888	999
f. Specify: **skinspec**				

D16. What kind of skin problems did you have *after* your gastrointestinal or diarrheal illness began? **[ASK THE QUESTIONS ACROSS THE TOP ROW FOR POSSIBLE SKIN PROBLEMS. CIRCLE EACH RESPONSE AND THEN ASK WHERE THE SKIN PROBLEM OCCURRED. CIRCLE THE APPROPRIATE BODY AREA. DO NOT READ THE LIST OF BODY AREAS.**

⇨ ASK QUESTIONS ACROSS TOP ROW, CIRCLE ONLY BODY AREAS MENTIONED

AREA OF SKIN	Did you have a rash? **rash** **IF YES,** where? **Y N R UK** 001 002 888 999	Did you have any ulcers/open lesions? **ulceropen** **IF YES,** where? **Y N R UK** 001 002 888 999	Did you have any blisters with clear fluid? **withclearf** **IF YES,** where? **Y N R UK** 001 002 888 999	Did you have any blisters with pus? **withpus** **IF YES,** where? **Y N R UK** 001 002 888 999	Did you have any hard lumps under the skin (nodules)? **underskin** **IF YES,** where? **Y N R UK** 001 002 888 999
a. Ankle	**aankle**	**aankle1**	**aankle2**	**aankle3**	**aankle4**
b. Arms	**barms**	**barms1**	**barms2**	**barms3**	**barms4**
c. Armpits	**carmpits**	**carmpits1**	**carmpits2**	**carmpits3**	**carmpits4**
d. Back **IF YES, ASK E-F**	**dback**	**dback1**	**dback2**	**dback3**	**dback4**
e. lower back	**elowerback**	**elowerbac1**	**elowerbac2**	**elowerbac3**	**elowerbac4**
f. upper back	**fupperback**	**fupperbac1**	**fupperbac2**	**fupperbac3**	**fupperbac4**
g. Breast	**gbreast**	**gbreast1**	**gbreast2**	**gbreast3**	**gbreast4**
h. Buttocks	**hbuttocks**	**hbuttocks1**	**hbuttocks2**	**hbuttocks3**	**hbuttocks4**
i. Chest	**ichest**	**ichest1**	**ichest2**	**ichest3**	**ichest4**
j. Ears	**jears**	**jears1**	**jears2**	**jears3**	**jears4**
k. Face	**kface**	**kface1**	**kface2**	**kface3**	**kface4**
l. Feet **IF YES, ASK M-N**	**lfeet**	**lfeet1**	**lfeet2**	**lfeet3**	**lfeet4**
m. soles	**msoles**	**msoles1**	**msoles2**	**msoles3**	**msoles4**
n. top of foot	**ntopfoot**	**ntopfoot1**	**ntopfoot2**	**ntopfoot3**	**ntopfoot4**
o. Genitalia	**ogenitalia**	**ogenitali1**	**ogenitali2**	**ogenitali3**	**ogenitali4**
p. Groin	**pgroin**	**pgroin1**	**pgroin2**	**pgroin3**	**pgroin4**
q. Hands **IF YES, ASK R-T**	**qhands**	**qhands1**	**qhands2**	**qhands3**	**qhands4**
r. Back of hand	**rbackhands**	**rbackhand1**	**rbackhand2**	**rbackhand3**	**rbackhand4**
s. Fingers	**sfingers**	**sfingers1**	**sfingers2**	**sfingers3**	**sfingers4**
t. Palms of hand	**tpalms**	**tpalms1**	**tpalms2**	**tpalms3**	**tpalms4**
u. Legs	**ulegs**	**ulegs1**	**ulegs2**	**ulegs3**	**ulegs4**
v. Mouth	**vmouth**	**vmouth1**	**vmouth2**	**vmouth3**	**vmouth4**
w. Neck	**wneck**	**wneck1**	**wneck2**	**wneck3**	**wneck4**
x. Scalp	**xscalp**	**xscalp1**	**xscalp2**	**xscalp3**	**xscalp4**
y. Stomach	**ystomach**	**ystomach1**	**ystomach2**	**ystomach3**	**ystomach4**
z. Throat	**zthroat**	**zthroat1**	**zthroat2**	**zthroat3**	**zthroat4**

IF YES TO RASH: GO TO D17a.

IF NO TO RASH BUT YES TO OTHER SKIN PROBLEMS: GO TO D17k.

D17. Please answer the following questions regarding the skin problems you experienced *after* your gastrointestinal or diarrheal illness began. **[READ THE LIST. CIRCLE ALL THAT APPLY]**

SYMPTOM	**YES**	**NO**	**REF**	**UNK**
IF YES TO RASH, was it: a. flat? **rashflat**	001	002	888	999
b. raised ? **rashraised**	001	002	888	999
c. red? **rashred**	001	002	888	999
d. brown or other color? **rashbrown**	001	002	888	999
e. itchy? **rashitch**	001	002	888	999

f. swollen? **rashswell**	001	002	888	999
g. painful? **Rashpain**	001	002	888	999
What was the appearance or arrangement of the rash?				
h. patches/spots? **rashpatch**	001	002	888	999
i. circles? **rashcirc**	001	002	888	999
j. lines? **rashlines**	001	002	888	999
IF YES TO OTHER SKIN PROBLEMS: k. Did you experience any pain with these other skin problems? **skinpain**	001	002	888	999

D18. Did you start having any problems with your eyes, such as pain or redness, *after* the onset of your gastrointestinal or diarrheal illness?

eyes

YES..... 001
NO..... 002 **(GO TO D25)**
REFUSED..... 888 **(GO TO D25)**
UNKNOWN..... 999 **(GO TO D25)**

D19. IF YES

How many days *after* your gastrointestinal or diarrheal illness did the eye problems start?

eyesdays

0-3 days..... 003
Over 3 days but within 1 week..... 007
Over a week but within 1 month..... 030
Over a month but within 2 months..... 060
REFUSED..... 888
UNKNOWN..... 999

D20. Do you still have the eye problems?

eyestill

YES..... 001 **(GO TO D22)**
NO..... 002
REFUSED..... 888 **(GO TO D22)**
UNKNOWN..... 999 **(GO TO D22)**

D21. IF NO, how long did the eye problems last?

eyeslong

0-3 days..... 003
Over 3 days but within 1 week..... 007
Over a week but within 1 month..... 030
Over a month but within 2 months..... 060
REFUSED..... 888
UNKNOWN..... 999

D22. The following questions are about treatment and diagnosis of *your eye problems*.

QUESTION	YES	NO	REF	UNK
a. Did you *call* a healthcare provider? **eyescall**	001	002	888	999
b. Did you *visit* a healthcare provider? **eyesvisdr**	001	002	888	999
c. Did you *visit* an Emergency Room? **eyeser**	001	002	888	999
d. Were you *admitted* to the hospital? **eyesadm**	001	002	888	999
e. Did a provider give you a specific diagnosis? **eyesdx** f. Specify: **eyesspec**	001	002	888	999

D23. Please answer the following questions regarding the eye problems you experienced *after* your gastrointestinal or diarrheal illness began. **[READ THE LIST. CIRCLE ALL THAT APPLY]**

SYMPTOM	YES	NO	REF	UNK
a. Redness **eyered**	001	002	888	999
b. Itchiness **eyeitch**	001	002	888	999
c. Inflamed under eyelid(s) **eyeinflam**	001	002	888	999
d. Weeping **eyeweep**	001	002	888	999
e. Crusty **eyecrusty**	001	002	888	999
f. Painful/burning **eyepainful**	001	002	888	999
g. Light sensitive **eyesens**	001	002	888	999
h. Decreased vision **eyedecvis**	001	002	888	999
i. Blurred vision **eyeblur**	001	002	888	999
j. Scaly skin on the eyelid or around the eye **eyescal**	001	002	888	999
k. Other **eyeother** l. Specify: **eyespec**	001	002	888	999

D24. Which eye is/was causing you a problem?

whicheye

Left eye..... 001
Right eye..... 002
Both eyes..... 003
REFUSED..... 888
UNKNOWN..... 999

D25. Did you start having a urinary tract problem, such as pain or burning during urination or a discharge, *after* the onset of your gastrointestinal or diarrheal illness?

uriprob

YES..... 001
NO..... 002 **(GO TO SECTION E)**
REFUSED..... 888 **(GO TO SECTION E)**
UNKNOWN..... 999 **(GO TO SECTION E)**

D26. IF YES,

How many days *after* your gastrointestinal or diarrheal illness did the urinary tract problem start?

uridays

0-3 days..... 003
Over 3 days but within 1 week..... 007
Over a week but within 1 month..... 030
Over a month but within 2 months..... 060
REFUSED..... 888
UNKNOWN..... 999

D27. Do you *still* have the urinary tract problem?
uristill
YES..... 001 **(GO TO D29)**
NO..... 002
REFUSED..... 888 **(GO TO D29)**
UNKNOWN..... 999 **(GO TO D29)**

D28. IF NO, how long did the urinary tract problem last?
urilong
0-3 days..... 003
Over 3 days but within 1 week..... 007
Over a week but within 1 month..... 030
Over a month but within 2 months..... 060
REFUSED..... 888
UNKNOWN..... 999

D29. The following questions are about treatment and diagnosis of *your urinary tract problem.*

QUESTION	YES	NO	REF	UNK
a. Did you *call* a healthcare provider? **uricall**	001	002	888	999
b. Did you *visit* a healthcare provider? **urivisdr**	001	002	888	999
c. Did you *visit* an Emergency Room? **urier**	001	002	888	999
d. Were you *admitted* to the hospital? **uriadm**	001	002	888	999
e. Did a provider give you a specific diagnosis? **uridx**	001	002	888	999
f. Specify: **urispec**				

SECTION E: DRINKING WATER

READ: I would now like to talk about how you might have acquired your illness. These questions are about water and food, your travel history, and contact with children and animals. First, I would like to talk about your exposure to water during the two weeks before you became ill **(QUESTION A3),** that would be the period from /___/___/___/ to /___/___/___/.

date3 **date4**

E1. During the 2 weeks before your illness, what were your sources of drinking water *at home*?
[READ THE LIST. CIRCLE ALL THAT APPLY]

QUESTION	YES	NO	REF	UNK
a. Municipal or city water direct from tap **watmuntap**	001	002	888	999
b. Municipal or city water with additional filtration or treatment **watmunfilt**	001	002	888	999
c. Refrigerator dispenser **watrefr**	001	002	888	999
d. Private well water **watwell**	001	002	888	999
e. Commercially bottled water **watbot**	001	002	888	999
f. Other **watoth** g. Specify: **watspec**	001	002	888	999
h. Does not drink water at home **watno**	001	002	888	999
i.. Unknown **watunk**	001	002	888	999

E2. Do you treat or process your water at home using any of the following methods?
[READ THE LIST. CIRCLE ALL THAT APPLY.]

QUESTION	YES	NO	REF	UNK
a. Filtered **homfilt** **IF YES, ASK E3 AS WELL**	001	002	888	999
b. Refrigerator dispenser with filter **homrefr** **IF YES, ASK E3 AS WELL**	001	002	888	999
c. A device that uses ultraviolet light **homuv**	001	002	888	999
d. Boiled **homboil**	001	002	888	999
e. Softened **homesoft**	001	002	888	999
f. Other **homoth** g. Specify: **homspec**	001	002	888	999
h. Unknown **homunk**	001	002	888	999

E3. If yes to E2a or E2b, which type of filter(s) do you use?
[READ THE LIST. CIRCLE ALL THAT APPLY.]

IF YES to a filter type, please estimate to the number of days from today's interview the filter element was last changed?

QUESTION	Y 001	N 002	R 888	UK 999	<30 days 001	1 to 3 months 002	>3 to 6 months 003	>6 months 004	When indicator light says to 005	R 888	UK 999
a. A unit that uses reverse osmosis	**filtosm**				**osmchange**						
b. A filter that is mounted on the faucet	**filtfauc**				**cauchange**						
c. A carafe or jug filter, metimes called "a pour through" filter (e.g. a carbon filter)	**filtcaraf**				**carchange**						
d. A counter top filter	**filtcount**				**couchange**						
e. A filter mounted under the sink	**filtsink**				**sinchange**						
f. Refrigerator dispenser	**filtrefr**				**refchange**						
g. Other h. Specify:	**filtoth** **filtspec**				**othchange**						

E5. During the 2 weeks before your illness, what were your sources of drinking water *outside the home*, for example, at school or work? **[READ THE LIST. CIRCLE ALL THAT APPLY.]**

QUESTION	YES	NO	REF	UNK
a. Municipal or city water direct from tap **owatmuntap**	001	002	888	999
b. Municipal or city water with additional filtration or treatment **owatmunfilt**	001	002	888	999
c. Refrigerator dispenser **owatrefr**	001	002	888	999
d. Private well water **owatwell**	001	002	888	999
e. Commercially bottled water **owatbot**	001	002	888	999
f. Does not drink water outside the home **owatno**	001	002	888	999
g. Unknown **owatunk**	001	002	888	999
h. Other **owatoth** i. Specify: **owatspec**	001	002	888	999

E6. What percentage of the water that you drink in a day at home and outside the home is additionally filtered at the tap?

percenfilt

PERCENT |__|__|__|
REFUSED …… 888

UNKNOWN …… 999

E7. What was your usual source of *ice* during the 2 weeks before you became ill? **[READ THE LIST. CIRCLE ALL THAT APPLY]**

SOURCE	YES	NO	REF	UNK
a. From your home **icehome**	001	002	888	999
b. From outside your home **iceout**	001	002	888	999
c. Do not use ice **iceno**	001	002	888	999

E8. *Before* you became ill, please estimate the number of 12 ounce glasses of water you drank in a day both inside and outside your home? Please include drinks you made yourself such as Kool-Aid, frozen orange juice, etc. This does not include boiled drinks like tea or coffee. As a comparison, a soft drink can has 12 ounces.

SOURCE	NONE	1-2	3-5	>5	REFUSED	UNKNOWN
a. Home **numhom**	001	002	003	004	888	999
b. Out of home **numout**	001	002	003	004	888	999

SECTION F: SWIMMING

READ: Now I would like to ask you about your *swimming* activities during the two weeks *before* you became ill **(QUESTION A3)**, that would be the period from /___/___/___/ to /___/___/___/.

date5 **date6**

F1. During the 2 weeks before you became ill, did you swim or enter water (other than in a bathtub or shower)?

swim

YES.....	001	
NO.....	002	**(GO TO SECTION G)**
REFUSED.....	888	**(GO TO SECTION G)**
UNKNOWN.....	999	**(GO TO SECTION G)**

F2. During the two weeks before you became ill, which recreational water settings did you swim in, wade in, or enter? **[READ THE LIST. CIRCLE ALL THAT APPLY]**

		IF YES, on how many days did you swim or enter the water in the two weeks before you became ill?	**IF YES,** what parts of the week did you swim or enter the water?	**IF YES,** did you put your face under the water?
Setting	**Y N R UK** 001 002 888 999	**Number of days?** 1-5 6-10 11-15	**What part of the week?** weekday weekend both	**Y N R UK** 001 002 888 999
a. Ocean, Beach	**aoceanbeac**	**aoceanbea1**	**aoceanbea2**	**aoceanbea3**
b. Lake, Pond, River or Stream	**blakepondr**	**blakepond1**	**blakepond2**	**blakepond3**
c. drainage ditch, irrigation canal	**cdrainaged**	**cdrainage1**	**cdrainage2**	**cdrainage3**
d. Hot spring	**dhotspring**	**dhotsprin1**	**dhotsprin2**	**dhotsprin3**
e. Hot Tub, Spa, Whirlpool, Jacuzzi	**ehottubspa**	**ehottubsp1**	**ehottubsp2**	**ehottubsp3**
f. Recreational Water Park	**frecreatio**	**frecreati1**	**frecreati2**	**frecreati3**

F3. During the two weeks before you became ill, did you swim, wade or enter in a swimming pool?

swimpool

YES.....	001	
NO.....	002	**(GO TO F5)**
REFUSED.....	888	**(GO TO F5)**
UNKNOWN.....	999	**(GO TO F5)**

F4. IF YES, During the two weeks before you became ill, please list the types of swimming pools that you swam in or entered? **[DO NOT READ THE LIST. CIRCLE ALL THAT APPLY]**

		IF YES, on how many days did you swim or enter the water in the 2 weeks before you became ill?	**IF YES,** which parts of the week did you swim or enter the water?	**IF YES,** did you put your face under the water?
Venue	**Y N** 001 002	**How many days?** 1-5 6-10 11-15	**What part of the week?** weekday weekend both	**Y N R UK** 001 002 888 999
a. Municipal	**amunicipa2**	**amunicipa3**	**amunicipa4**	**amunicipa5**
b. Neighborhood, subdivision, condo, apartment	**bneighborh**	**bneighbor1**	**bneighbor2**	**bneighbor3**
c. private home	**cprivateho**	**cprivateh1**	**cprivateh2**	**cprivateh3**
d. private club/ membership	**dprivatecl**	**dprivatec1**	**dprivatec2**	**dprivatec3**
e. hotel/motel/ resort vacation	**ehotelmote**	**ehotelmot1**	**ehotelmot2**	**ehotelmot3**
f. school/ college/ university	**fschoolcol**	**fschoolco1**	**fschoolco2**	**fschoolco3**
g. hospital therapy	**ghospitalt**	**ghospital1**	**ghospital2**	**ghospital3**
h. camp	**hcamp**	**hcamp1**	**hcamp2**	**hcamp3**
i. kiddie/wading (e.g., inflatable)	**ikiddiewad**	**ikiddiewa1**	**ikiddiewa2**	**ikiddiewa3**
j. Pool using hot spring water	**jpoolusing**	**jpoolusin1**	**jpoolusin2**	**jpoolusin3**
k. Other (specify) __ **swimspec** __	**kother1**	**kother2**	**kother3**	**kother4**

READ: The following questions ask about typical swimming activities during visits to *any* types of recreational water, not just pools, that you may have visited in the 2 weeks before you became ill.

F5. During the 2 weeks before your illness, did you get water *splashed in your face*?
watsplash

Yes…… 001
No……..……. 002
REFUSED…..888
UNKNOWN…..... 999

F6. During the 2 weeks before your illness, did you get *any* water in your mouth?

watmouth

Yes……	001	
No……..…….	002	(GO TO F9)
REFUSED….....	888	(GO TO F9)
UNKNOWN….....	999	(GO TO F9)

F7. IF EXPOSED, During the 2 weeks before your illness, did you *swallow* any of this water?

watswallow

Yes……	001	
No……..…….	002	(GO TO F9)
REFUSED….....	888	(GO TO F9)
UNKNOWN…......	999	(GO TO F9)

F8. During the 2 weeks before your illness, did you *dive* into the water?

watdive

Yes……	001
No……..…….	002
REFUSED….....	888
UNKNOWN….....	999

F9. During the 2 weeks before your illness, did you *use a slide* to enter the water at a recreational area?

watslide

Yes……	001
No……..…….	002
REFUSED….....	888
UNKNOWN….....	999

SECTION G: FOOD/DRINKS

READ: Now I would like to concentrate on your diet during the two weeks *before* you became ill **(QUESTION A3)**, that would be the period from /___/___/___/ to /___/___/___/.

date7 **date8**

G1. In the 2 weeks before you became ill, how many fast-food meals did you eat from a *typical fast-food restaurant*?

numbermeal

	NUMBER OF MEALS	**|__|__|__|**
	REFUSED.....	888
	UNKNOWN.....	999

G2. In the 2 weeks before you became ill, how many times did you eat at or take out food from a *deli counter, grocery store or other take-out* establishment?

orothertak

	NUMBER OF MEALS	**|__|__|__|**
	REFUSED.....	888
	UNKNOWN.....	999

G3. In the 2 weeks before you became ill, how many meals did you eat from a *cafeteria*, either at work or school?

mealcaf

	NUMBER OF MEALS	|__|__|__|
	REFUSED.....	888
	UNKNOWN.....	999

G4. In the 2 weeks before you became ill, how many meals did you eat from a *restaurant(s)* other than a fast-food restaurant?

mealrest

	NUMBER OF MEALS	|__|__|__|
	REFUSED.....	888
	UNKNOWN.....	999

G5. In the 2 weeks before you became ill, how many meals did you eat that were prepared in a *friend's or relative's* home?

mealfriend

	NUMBER OF MEALS	|__|__|__|
	REFUSED.....	888
	UNKNOWN.....	999

G6. In the 2 weeks before you became ill, which of the following raw or uncooked foods did you *handle or had contact with*, in or outside of your home? **[READ THE LIST. CIRCLE ALL THAT APPLY]**

FOOD	YES	NO	REFUSED	UNKNOWN
a. Raw meat **rawmeat**	001	002	888	999
b. Raw fruits **rawfruit**	001	002	888	999
c. Raw vegetables **rawveg**	001	002	888	999

G7. In the 2 weeks before you became ill, how many times did you eat any food from a *salad bar*?

NUMBER OF MEALS |__|__|__|
mealsalad REFUSED..... 888
UNKNOWN..... 999

G8. In the 2 weeks before you became ill, did you eat any "organically grown" produce?
organic

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

G9. During the 2 weeks before you became ill, how many times did you eat any of the following food items regardless of whether it was prepared in or out of your home? **(READ THE LIST. CIRCLE ALL THAT APPLY]**

FOOD	0	1-5	6-10	11-15	>15	REF	UNK
a. Lettuce or garden salad **alettuceor**	000	001	006	011	015	888	999
b. Cold cuts, chicken salad, egg **bcoldcutsc** salad, or tuna salad	000	001	006	011	015	888	999
c. Other cold salads such as **cothercold** coleslaw, potato salad, or pasta salad	000	001	006	011	015	888	999
d. Raw vegetables such as **drawvegeta** carrots, tomatoes, cucumbers, green onions	000	001	006	011	015	888	999
e. Raw berries (e.g. strawberries **erawberrie** and raspberries)	000	001	006	011	015	888	999
f. Raw fruits *with* skin/peel (e.g., **frawfruits** melons, apples)	000	001	006	011	015	888	999
g. Cider or juice **gciderorju**	000	001	006	011	015	888	999

h. Raw shellfish **hrawshellf**	000	001	006	011	015	888	999
i. Cooked shellfish **icookedshe**	000	001	006	011	015	888	999
j. Raw oysters **jrawoyster**	000	001	006	011	015	888	999
k. Cooked oysters **kcookedoys**	000	001	006	011	015	888	999

G10. If you consume unpeeled fresh fruit, lettuce or vegetables at home, do you wash them before you eat them? [READ CHOICES: ALWAYS, USUALLY, SOMETIMES, NEVER]

washfood

Always…… 001
Usually……..…… 002
Sometimes……...003
Never……004
Not applicable……..005
REFUSED…..888
UNKNOWN…..... 999

G11. If you consume raw berries at home, do you wash them before you eat them? [READ CHOICES: ALWAYS, USUALLY, SOMETIMES, NEVER]

washberry

Always…… 001
Usually……..…… 002
Sometimes……...003
Never……004
Not applicable……..005
REFUSED…..888
UNKNOWN…..... 999

G12. During the two weeks before you became ill, did you consume any of the following *unpasteurized* foods or drinks? This may include products supplied from health food stores or imported from other countries. **[READ THE LIST. CIRCLE ALL THAT APPLY]**

FOOD	YES	NO	REF	UNK
a. Milk **amilk**	001	002	888	999
b. Apple juice/cider **bapplecjuic**	001	002	888	999
c. Other juices **cotherjuic**	001	002	888	999
d. Unpasteurized cheese **dunpasteur** (e.g. brie, goat cheese, white cheese, queso fresco)	001	002	888	999
e. Other **eother** f. Specify: **specunpast**	001	002	888	999

G13. How likely are you to wash your hands *before* preparing food? [READ CHOICES: ALWAYS, USUALLY, SOMETIMES, NEVER]

washbefore

Always…… 001
Usually……..…… 002

Sometimes……...003
Never……004
Not applicable……..005
REFUSED…..888
UNKNOWN…..... 999

G14. How likely are you to wash your hands *after* preparing food? [READ CHOICES: ALWAYS, USUALLY, SOMETIMES, NEVER]

washafter

Always…… 001
Usually……..……. 002
Sometimes……...003
Never……004
Not applicable……..005
REFUSED…..888
UNKNOWN…..... 999

G15. How likely are you to wash your hands *before* eating? [**READ CHOICES: ALWAYS, USUALLY, SOMETIMES, NEVER]**

washeat

Always…… 001
Usually……..……. 002
Sometimes……...003
Never……004
Not applicable……..005
REFUSED…..888
UNKNOWN…..... 999

SECTION H: TRAVEL AND OUTDOOR ACTIVITIES

READ: Now I would now like to ask you a few questions about your travel history and outdoor activities during the 2 weeks before you became ill **(QUESTION A3)** /___/___/___/ to /___/___/___/.

date9 **date10**

H1. During the 2 weeks before you became ill, did you travel within your state but more than 100 miles from your home?

trav100

YES..... 001
NO..... 002
REFUSED..... 888

UNKNOWN..... 999

H2. During the 2 weeks before you became ill, did you travel out of your state but stay within the United States? **travstate**

YES	001
NO	002
REFUSED	888
UNKNOWN	999

H3. During the two weeks before you became ill, did you travel or take a cruise to another country?

travcountr

YES	001	
NO	002	**(GO TO H5)**
REFUSED	888	**(GO TO H5)**
UNKNOWN	999	**(GO TO H5)**

H4. IF YES TO TRAVEL OUTSIDE U.S/CRUISE, Please tell me which country/countries you visited and the number of days you spent in each country.

	COUNTRY CODE (see code list)	DAYS	REFUSED (888)	UNKNOWN (999)
a.	**country1**	**countday1**	|__|__|__|	|__|__|__|
b.	**country2**	**countday2**	|__|__|__|	|__|__|__|
c.	**country3**	**countday3**	|__|__|__|	|__|__|__|
d.	**country4**	**countday4**	|__|__|__|	|__|__|__|
e.	**country5**	**countday5**	|__|__|__|	|__|__|__|

H5. During the 2 weeks before you became ill, did you work in a garden?

garden

YES	001	
NO	002	**(GO TO H8)**
REFUSED	888	**(GO TO H8)**
UNKOWN	999	**(GO TO H8)**

H6. IF YES TO GARDEN, In the 2 weeks before your illness, did you do any gardening without gloves or handle soil without gloves?

gloves

YES.....	001	
NO.....	002	**(GO TO H8)**
REFUSED.....	888	**(GO TO H8)**
UNKNOWN.....	999	**(GO TO H8)**

H7. IF YES, What type of soil was it? **[READ LIST. CIRCLE ALL THAT APPLY]**

SOIL	YES	NO	REF	UNK
a. Soil from the ground **soilground**	001	002	888	999
b. Soil bought packaged **soilpack**	001	002	888	999
c. Manure from your home/farm/ loose (without packaging) **manure**	001	002	888	999
d. Manure bought packaged **manupack**	001	002	888	999
e. Compost **compost**	001	002	888	999
e. Other **othersoil** (specify soil source) **specsoil**	001	002	888	999

H8. During the 2 weeks before your illness, did you eat any raw fruits or vegetables from a garden?

rawguard

YES.....	001
NO.....	002
REFUSED.....	888
UNKNOWN.....	999

H9. During the 2 weeks before your illness, did you go camping or backpacking?

camp

YES.....	001
NO.....	002
REFUSED.....	888
UNKNOWN.....	999

H10. During the 2 weeks before your illness, did you go sailing, boating, rafting, kayaking, canoeing, tubing or other similar freshwater/marine activity?

sail

YES.....	001
NO.....	002
REFUSED.....	888
UNKNOWN.....	999

H11. During the 2 weeks before your illness, did you picnic out doors?

picnic

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

H12. During the 2 weeks before your illness, did you drink any water from a lake, river or stream?

watlake

YES..... 001

a. Did you treat the water? YES 001

watreat NO 002

NO..... 002 **(GO TO SECTION I)**
REFUSED..... 888 **(GO TO SECTION I)**
UNKNOWN..... 999 **(GO TO SECTION I)**

H13. IF YES, how did you treat this water? **[READ THE LIST. CIRCLE ALL THAT APPLY]**

WATER TREATMENT	YES	NO	REF	UNK
a. Commercial water filter **commfilt**	001	002	888	999
b. Boiling **boil**	001	002	888	999
c. Halogen tablets/ drops (iodine/ chlorine/ bromine) **halogen**	001	002	888	999
d. Other **othertreat** e. Specify: **treatspec**	001	002	888	999

SECTION I: YOUNG CHILDREN AND PERSONS WITH DIARRHEA

READ: Now I would now like to ask you a few questions about your contact with young children and persons with diarrhea during the 2 weeks before you became ill **(QUESTION A3)** /__/__/__/ to /__/__/__/.

date11 **date12**

I1. Do you have children (<18 years old) living in your home?
Do you have other children (<18 years old) living in your home, not including your ill child?

children

Yes..... 001
{adult/ped}

No..... 002 **(GO TO I8)**
{adult/ped}

REFUSED..... 888 **(GO TO I8)**
{adult/ped}

UNKNOWN..... 999 **(GO TO I8)**
{adult/ped}

I2. IF YES, How many children live in your house?
IF YES, How many other children live in your house, not including your ill child?

numchild

NUMBER OF CHILDREN |__|__|
REFUSED..... 888
UNKNOWN..... 999

I3. Was your ill child in diapers at the time of his/her illness?
wasdiap

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

I3. What are the children's age(s) in years, their sex and did they have diarrhea in the 2 weeks before your symptoms of diarrhea began? (not including the child of interest)

CHILD	AGE? **(INDICATE YRS OR MTHS)**	What sex? **(001=MALE, 002=FEMALE)**	Had diarrhea? **YES** 001	**NO** 002	**REF** 888	**UNK** 999
CHILD 1	**childage1**	**childsex1**	**childdi1**			
CHILD 2	**childage2**	**childsex2**	**childdi2**			
CHILD 3	**childage3**	**childsex3**	**childdi3**			
CHILD 4	**childage4**	**childsex4**	**childdi4**			
CHILD 5	**childage5**	**childsex5**	**childdi5**			
CHILD 6	**childage6**	**childsex6**	**childdi6**			
CHILD 7	**childage7**	**childsex7**	**childdi7**			
CHILD 8	**childage8**	**childsex8**	**childdi8**			
CHILD 9	**childage9**	**childsex9**	**childdi9**			
CHILD 10	**childage10**	**childsex10**	**childdi10**			

I4. Were any children at home in diapers?
diaper

YES..... 001

a. IF YES, **numdiap**

Number of children in diapers? |___|___|___|
(ENTER 888 IF REFUSED, 999 IF UNKNOWN)

NO..... 002

REFUSED..... 888
UNKNOWN..... 999

I5. Were any children in your household in *out-of-home* t any time during the 2 weeks before you became ill?

childcare

YES..... 001

a. Was your ill child **[CASE PATIENT]** one of them? 001 002 888 999 **illchild**

NO..... 002 **(GO TO I8)**
REFUSED..... 888 **(GO TO I8)**
UNKNOWN..... 999 **(GO TO I8)**

I6. IF YES, Were any children at your child's preschool or at the location at which your child received childcare *in diapers*?

childdiap

YES..... 001

a. Was this your ill child' daycare? 001 002 888 999

illdiap

NO..... 002

REFUSED..... 888
UNKNOWN..... 999

I7. IF YES TO CHILDCARE, Were any children in your household in a *day camp* during the 2 weeks before you became ill? By a day camp I mean a center with activities where children spend all or part of the day, often during the summer months when school is out. By comparison, a day care center is often for toddlers.

daycamp

YES..... 001

a. Was your ill child one of them? 001 002 888 999 **(GO TO I12) illcamp**

NO..... 002
REFUSED..... 888
UNKNOWN..... 999

If your ill child is the *only* child in your household, answer the following questions about your ill child.

I8. Was your ill child in diapers?

wasdiap2

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

I9. Was your ill child in *out-of-home* childcare at any time during the 2 weeks before he/she became ill?

childcare2

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

I10. IF YES, Were any children at your child's preschool or at the location at which your child received childcare *in diapers*?

childdiap2

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

I11. IF YES TO CHILDCARE, Was your child in a *day camp* during the 2 weeks before he/she became ill? By a day camp I mean a center with activities where children spend all or part of the day, often during the summer months when school is out. By comparison, a day care center is often for toddlers.

daycamp2

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

I8/I12. During the 2 weeks before illness, did you *provide* childcare in any of the following childcare settings? **[READ THE LIST. CIRCLE ALL THAT APPLY]**

SETTING	YES	NO	REFUSED	UNKNOWN
a. Out-of-home childcare center **outchild**	001	002	888	999
b. In-home childcare center **inchild**	001	002	888	999
c. Out-of-home babysitter **outbaby**	001	002	888	999
d. In-home babysitter **inbaby**	001	002	888	999
e. Other **otherbaby** f. Specify: **specbaby**	001	002	888	999

I9/I13. During the 2 weeks before illness, did you have contact with any children in diapers?

contactdi

YES..... 001
NO..... 002 **(GO TO I11)**
REFUSED..... 888 **(GO TO I11)**
UNKNOWN..... 999 **(GO TO I11)**

I10/I14. IF YES, during the 2 weeks before illness, did you change any diapers?

changedi

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

I11/I15. During the 2 weeks before you became ill, did you come in contact with anyone who had diarrhea?

contactdia

Yes..... 001
No..... 002 **(GO TO SECTION J)**
REFUSED.....888 **(GO TO SECTION J)**
UNKNOWN..... 999 **(GO TO SECTION J)**

I12/I16. IF YES, did they include: **[READ THE LIST. CIRCLE ALL THAT APPLY]**

	YES	**NO**	**REF**	**UNK**
a. Children ≤ 3 years of age **diarrhea3**	001	002	888	999
b. Children >3 to <12 years of age **diarrhea12**	001	002	888	999
c. Teenagers 12 to <18 years **diarrhea18**	001	002	888	999
d. Adults **diarrheadu**	001	002	888	999

I13/I17. Did you provide direct care to a person with diarrhea?

carediar

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

SECTION J: ANIMAL CONTACT

READ: The next few questions are about your contact with animals during the 2 weeks before you became ill **(QUESTION A3)** /___/___/___/ to /___/___/___/.
date13 **date14**

J1. During the 2 weeks before your illness, did you *live* on a farm?
livefarom

YES..... 001
NO..... 002 **(GO TO J3)**
REFUSED..... 888 **(GO TO J3)**
UNKNOWN..... 999 **(GO TO J3)**

J2. IF YES, Were any of the following animals *present on your* farm?
[READ THE LIST OFANIMALS. CIRCLE AND ASK THE CORRESPONDING QUESTIONS.]

Animal	Animal present? **Y N R UK** 001 002 888 999	Contact with animal (feeding, petting, playing, slaughtering)? **Y N R UK** 001 002 888 999	Animal have diarrhea? **Y N R UK** 001 002 888 999	Enter the living area of the animal (barn, stall, pen, kennel)? **Y N R UK** 001 002 888 999	Care for sick/birthing animals? **Y N R UK** 001 002 888 999
a. Calf	**acalf**	**acalf1**	**acalf2**	**acalf3**	**acalf4**
b. Cow	**bcow**	**bcow1**	**bcow2**	**bcow3**	**bcow4**
c. Goat/Sheep/Lamb	**cgoatsheep**	**cgoatshee1**	**cgoatshee2**	**cgoatshee3**	**cgoatshee4**
d. Horse	**dhorse**	**dhorse1**	**dhorse2**	**dhorse3**	**dhorse4**
e. Pigs	**epigs**	**epigs1**	**epigs2**	**epigs3**	**epigs4**
f. Poultry (chicken, turkey, etc.)	**fpoultry**	**fpoultry1**	**fpoultry2**	**fpoultry3**	**fpoultry4**
g. Kitten (<6 months)	**gkitten6mo**	**gkitten6m1**	**gkitten6m2**	**gkitten6m3**	**gkitten6m4**
h. Cat	**hcat**	**hcat1**	**hcat2**	**hcat3**	**hcat4**
i. Puppy (<6 months)	**ipuppy**	**ipuppy1**	**ipuppy2**	**ipuppy3**	**ipuppy4**
j. Dog	**jdog**	**jdog1**	**jdog2**	**jdog3**	**jdog4**
k. Rabbit	**krabbit**	**krabbit1**	**krabbit2**	**krabbit3**	**krabbit4**
l. Amphibian/reptile (frog, turtle, lizard,, etc)	**lamphibian**	**lamphibia1**	**lamphibia2**	**lamphibia3**	**lamphibia4**
m. Other (Specify)	**mother**	**mother1**	**mother2**	**mother3**	**mother4**

J3. During the 2 weeks before your illness, did you *work* on a farm, *other than your own farm*?

workfarm

YES.....	001	
NO.....	002	**(GO TO J5)**
REFUSED.....	888	**(GO TO J5)**
UNKNOWN.....	999	**(GO TO J5)**

J4. IF YES, Were any of the following animals on the farm you *worked* on?
[READ THE LIST OFANIMALS. CIRCLE AND ASK THE CORRESPONDING QUESTIONS.]

Animal	Animal present? **Y N R UK** 001 002 888 999	Contact with animal (feeding, petting, playing, slaughtering)? **Y N R UK** 001 002 888 999	Animal have diarrhea? **Y N R UK** 001 002 888 999	Enter the living area of the animal (barn, stall, pen, kennel)? **Y N R UK** 001 002 888 999	Care for sick/birthing animals? **Y N R UK** 001 002 888 999
a. Calf	**acalf5**	**acalf6**	**acalf7**	**acalf8**	**acalf9**
b. Cow	**bcow5**	**bcow6**	**bcow7**	**bcow8**	**bcow9**
c. Goat/Sheep/Lamb	**cgoatshee5**	**cgoatshee6**	**cgoatshee7**	**cgoatshee8**	**cgoatshee9**
d. Horse	**dhorse5**	**dhorse6**	**dhorse7**	**dhorse8**	**dhorse9**
e. Pigs	**epigs5**	**epigs6**	**epigs7**	**epigs8**	**epigs9**
f. Poultry (chicken, turkey, etc.)	**fpoultry5**	**fpoultry6**	**fpoultry7**	**fpoultry8**	**fpoultry9**
g. Kitten (<6 months)	**gkitten6m5**	**gkitten6m6**	**gkitten6m7**	**gkitten6m8**	**gkitten6m9**
h. Cat	**hcat5**	**hcat6**	**hcat7**	**hcat8**	**hcat9**
i. Puppy (<6 months)	**ipuppy5**	**ipuppy6**	**ipuppy7**	**ipuppy8**	**ipuppy9**
j. Dog	**jdog5**	**jdog6**	**jdog7**	**jdog8**	**jdog9**
k. Rabbit	**krabbit5**	**krabbit6**	**krabbit7**	**krabbit8**	**krabbit9**
l. Amphibian/reptile (frog, turtle, lizard,, etc)	**lamphibia5**	**lamphibia6**	**lamphibia7**	**lamphibia8**	**lamphibia9**
m. Other (Specify)	**mother5**	**mother6**	**mother7**	**mother8**	**mother9**

J5. During the 2 weeks before illness, did you *visit* a farm or petting zoo?
visitfarm

YES..... 001

IF YES, Which did you visit? (circle one) farm petting zoo both **whichvisit**

NO..... 002 **(GO TO J7)**
REFUSED..... 888 **(GO TO J7)**
UNKNOWN..... 999 **(GO TO J7)**

J6. IF YES, Were any of the following animals present on the farm/petting zoo you *visited*?

[READ THE LIST OFANIMALS. CIRCLE AND ASK THE CORRESPONDING QUESTIONS.]

Animal	Animal present? **Y N R UK** 001 002 888 999	Contact with animal (feeding, petting, playing, slaughtering)? **Y N R UK** 001 002 888 999	Animal have diarrhea? **Y N R UK** 001 002 888 999	Enter the living area of the animal (barn, stall, pen, kennel)? **Y N R UK** 001 002 888 999	Care for sick/birthing animals? **Y N R UK** 001 002 888 999
a. Calf	**acalf10**	**acalf11**	**acalf12**	**acalf13**	**acalf14**
b. Cow	**bcow10**	**bcow11**	**bcow12**	**bcow13**	**bcow14**
c. Goat/Sheep/Lamb	**cgoatshe10**	**cgoatshe11**	**cgoatshe12**	**cgoatshe13**	**cgoatshe14**
d. Horse	**dhorse10**	**dhorse11**	**dhorse12**	**dhorse13**	**dhorse14**
e. Pigs	**epigs10**	**epigs11**	**epigs12**	**epigs13**	**epigs14**
f. Poultry (chicken, turkey, etc.)	**fpoultry10**	**fpoultry11**	**fpoultry12**	**fpoultry13**	**fpoultry14**
g. Kitten (<6 months)	**gkitten610**	**gkitten611**	**gkitten612**	**gkitten613**	**gkitten614**
h. Cat	**hcat10**	**hcat11**	**hcat12**	**hcat13**	**hcat14**
i. Puppy (<6 months)	**ipuppy10**	**ipuppy11**	**ipuppy12**	**ipuppy13**	**ipuppy14**
j. Dog	**jdog10**	**jdog11**	**jdog12**	**jdog13**	**jdog14**
k. Rabbit	**krabbit10**	**krabbit11**	**krabbit12**	**krabbit13**	**krabbit14**
l. Amphibian/reptile (frog, turtle, lizard,, etc)	**lamphibi10**	**lamphibi11**	**lamphibi12**	**lamphibi13**	**lamphibi14**
m. Other (Specify)	**mother10**	**mother11**	**mother12**	**mother13**	**mother14**

J7. IF NO TO ANIMAL CONTACT AT A FARM OR PETTING ZOO (NO TO J1, J3, AND J5),
IF YES, GO TO J9

During the 2 weeks before your illness, did you have contact with any household pets?
contacpets

YES..... 001 (GO TO J8)
NO..... 002 **(GO TO J9)**
REFUSED..... 888 **(GO TO J9)**

UNKNOWN..... 999 **(GO TO J9)**

IF YES TO ANIMAL CONTACT AT FARM OR PETTING ZOO (YES TO J1, J3, OR J5)

During the 2 weekes before your illness, did you have andy/additional contact with household pets other than at the farm or petting zoo?

otherpets

YES..... 001 (GO TO J8)
NO..... 002 **(GO TO J9)**
REFUSED..... 888 **(GO TO J9)**
UNKNOWN..... 999 **(GO TO J9)**

J8. IF YES, What household pets did you have contact with? [ASK ALL 3 QUESTIONS]

Animal	Contact with animal? **Y N R UK** 001 002 888 999	Animal have diarrhea? **Y N R UK** 001 002 888 999	Contact with animal feces (cleaning cage, scooping poop, etc)? **Y N R UK** 001 002 888 999
a. Kitten (<6 months)	**akittento6**	**akittento7**	**akittento8**
b. Cat	**bcat**	**bcat1**	**bcat2**
c. Puppy (<6 months)	**cpuppyto6m**	**cpuppyto61**	**cpuppyto62**
d. Dog	**ddog**	**ddog1**	**ddog2**
e. Rabbit	**erabbit**	**erabbit1**	**erabbit2**
f. Amphibian/reptile (frog, turtle, lizard,, etc)	**famphibian**	**famphibian1**	**famphibian2**
g. Other (specify) **specify4**	**gother1**	**gother2**	**gother3**

J9. During the 2 weeks before your illness, did you touch or shovel animal manure or walk through any area where animal manure was on the ground?

animalmanu

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

SECTION K: DEMOGRAPHICS

READ: I would now like to ask you some basic questions about yourself and your household.

K1. CIRCLE CODE FOR SUBJECT'S SEX **gender**

MALE	001
FEMALE	002
REFUSED	888
UNKNOWN	999

K2. Which racial group do you consider yourself part of? **whichrace**
[READ ONLY IF NECESSARY. CIRCLE ALL THAT APPLY]

WHITE	001
BLACK	002
AMERICAN INDIAN/ALASKAN NATIVE	003
ASIAN/PACIFIC ISLANDER	004
MIXED	005
OTHER	006
a. SPECIFY ___**specrace**_____	
REFUSED	888
UNKNOWN	999

K3. Do you consider yourself to be Hispanic or Latino? **hispanic**

YES	001
NO	002
REFUSED	888
UNKNOWN	999

K4. What is the highest level of formal school *you* completed or the highest degree *you* have received? **[READ ONLY IF NECESSARY]** **education**

Less than 1st grade	001
1st through 8th grade	002
9th through 12th grade (No Diploma)	003
High school graduate: high school diploma or equivalent (GED)	004
Some college but no degree	005
Associate degree in college (AA, AS)	006
Bachelor's degree (for example: BA, AB, BS)	007
Master's degree (for example: MA, MS, MEng, MSW, MBA)	008
Doctorate degree (for example: MD, DVM, PhD, JD)	009
Technical degree	010
Other	011
a. (Specify other ___**specedu**_____)	

REFUSED…….…… 888
UNKNOWN…… 999

K5. Which of the following places best describes where you live? **[READ THE LIST]**
wherelive

City or urban area..... 001
Suburban area..... 002
Town or village..... 003
Rural area but not a farm..... 004
Farm..... 005
REFUSED.....888
UNKNOWN..... 999

K6. What is your zip code?

zipcode

ZIP CODE |___|___|___|___|___|
REFUSED.....888
UNKNOWN..... 999

K7. Now I am going to read you a list of income categories. Please stop me when a category best describes *your total household income before* taxes.
income

Less than $15,000…… 001
$15,000 to < $25,000…… 002
$25,000 to < $40,000…… 003
$40,000 to < $55,000…… 004
$55,000 to < $75,000…… 005
$75,000 to < $100,000…… 006
More than $100,000…… 007
REFUSED..... 888
UNKNOWN..... 999

1) IF THIS PERSON IS A MINOR AGE 12-17 YEARS OF AGE, GO TO END OF QUESTIONNAIRE AND TERMINATE, . DO NOT ASK SEXUAL ACTIVITY QUESTIONS

2) IF THIS PERSON IS AN ADULT GO TO SECTION L

3) IF THIS PERSON IS NOT A CASE. I.E., A1 RESPONSE = GIARDIASIS IN FAMILY IN PAST 60 DAYS, REFUSED, UNKNOWN OR, A2 RESPONSE = NOT ILL, REFUSED, OR UNKNOWN OR,

A3 RESPONSE = COULD NOT REMEMBER THE DATE OF ONSET, DATE OF ONSET ≥ 6 WEEKS BEFORE INTERVIEW DATE, REFUSED, OR UNKNOWN
GO TO END OF QUESTIONNAIRE AND TERMINATE.

SECTION L: SEXUAL PRACTICES

SEXUAL BEHAVIOR QUESTIONS TO BE ASKED ONLY OF ADULTS (≥18 YEARS)

READ: Finally, I would like to ask you a few questions about possible sexual exposures. Some of these questions may be very personal so you can refuse to answer any question at any time. For questions that refer to the 2 weeks before your illness, that means the time period from (**QUESTION A3**) /___/___/___/ to /___/___/___/.
date15 **date16**

L1. Did you have sex in the 2 weeks before your illness?
sex2week

YES.....	001
NO.....	002 **(GO TO END OF QUESTIONNAIRE)**
REFUSED.....	888 **(GO TO END OF QUESTIONNAIRE)**
UNKNOWN.....	999 **(GO TO END OF QUESTIONNAIRE)**

L2. **IF YES TO HAD SEX,** Did any of your sex partners have diarrhea during the 2 weeks *before* you had sex with them?
partdibef

YES.....	001
NO.....	002
REFUSED.....	888
UNKNOWN.....	999

L3. Did any of your sex partners have diarrhea during the 2 weeks *after* you had sex with them?
partdia

YES.....	001
NO.....	002
REFUSED.....	888
UNKNOWN.....	999

L4. Were any of your sex partners diagnosed with *Giardia* during the 2 weeks before your illness?
partgiard

YES.....	001
NO.....	002
REFUSED.....	888
UNKNOWN.....	999

L5. During the 2 weeks *before* your illness, did you have sex with anyone of the same sex?
samesex

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

L6. During the 2 weeks before your illness, did you practice "rimming" or have contact with a partner's anus?

rimming

YES..... 001
NO..... 002
REFUSED..... 888
UNKNOWN..... 999

END OF QUESTIONNAIRE: This concludes our questionnaire. I would like to thank you very much for your time, patience, and cooperation in answering our questions. We would be happy to answer any questions you may have at this point.

If you have any further questions about this study please remember that you can call:

Colorado/Minnesota Department of Health
Study questions and your rights as a participant: Colorado, Alicia Cronquist, 303-692-2700; Minnesota, Dr Kirk Smith, 612-676-5240

Centers for Disease Control and Prevention
Study questions: Dr. Michael Beach, 770-488-7763.
Your rights as a participant: 1-800-584-8814, leave a message including name, phone number, and protocol #3607 and someone will call you back as soon as possible.

Further information on *Giardia* can be found at the Internet address www.cdc.gov/ncidod/dpd/parasites/giardiasis/factsht_giardia.htm. If you do not have Internet access we can send the fact sheet to you.

Do we need to send the *Giardia* fact sheet (circle) yes no