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Giardiasis Diagnosis and Treatment Practices Among Commercially Insured Persons in the United States

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Abstract

Background—Giardiasis, the most common enteric parasitic infection in the United States, causes an estimated 1.2 million episodes of illness annually. Published clinical recommendations include readily available *Giardia*-specific diagnostic testing and antiparasitic drugs. We investigated sequences of giardiasis diagnostic and treatment events using MarketScan, a large health insurance claims database.

Methods—We created a longitudinal cohort of 2995 persons diagnosed with giardiasis (*International Classification of Diseases, Ninth Revision, Clinical Modification* [*ICD-9-CM*] code 007.1) from 2006 to 2010, and analyzed claims occurring 90 days before to 90 days after initial diagnosis. We evaluated differences in number and sequence of visits, diagnostic tests, and prescriptions by age group (children 1–17 years, adults 18–64 years) using χ^2 tests and data visualization software.

Results—Among 2995 patients (212 433 claims), 18% had a *Giardia*-specific test followed by or concurrent with an effective antiparasitic drug, without ineffective antibiotics. Almost two-thirds of patients had an antiparasitic and 27% had an antibiotic during the study window. Compared with children, adults more often had ≥3 visits before diagnosis (19% vs 15%; $P = .02$). Adults were also less likely to have a *Giardia*-specific diagnostic test (48% vs 58%; $P < .001$) and more likely to have an antibiotic prescription (28% vs 25%; $P = .04$). When *Giardia*-specific tests and antiparasitic and antibiotic prescriptions were examined, pediatric clinical event sequences most frequently began with a *Giardia*-specific test, whereas adult sequences most frequently began with an antiparasitic prescription.

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Conclusions—Giardiasis care infrequently follows all aspects of clinical recommendations. Multiple differences between pediatric and adult care, despite age-agnostic recommendations, suggest opportunities for provider education or tailored guidance.

Keywords

Giardia; MarketScan; administrative claims; data visualization

Giardiasis, the disease caused by the parasite *Giardia intestinalis* (also known as *Giardia duodenalis* or *Giardia lamblia*), is the most frequently reported human intestinal parasitic infection in the United States [1, 2]. With a burden of illness similar to that of nontyphoidal *Salmonella* infections, *Giardia* causes an estimated 1.2 million episodes of illness annually with the highest incidence among children aged 1–9 years [1–3]. *Giardia*-related hospitalizations in the United States cost an estimated $34 million per year [3]. Although giardiasis is frequently reported among travelers returning from endemic areas, only 7%–8% of US giardiasis cases are travel-associated [2, 4, 5].

Giardia parasite transmission occurs through ingestion of fecally contaminated food or water, or through person-to-person contact [6, 7]. Symptoms include prolonged diarrhea, abdominal pain, malabsorption, bloating, dehydration, and weight loss. Parasites are shed intermittently in feces, and intermittently symptomatic or asymptomatic infections occur frequently [8, 9]. Acute giardiasis is disruptive to daily living and can lead to dehydration, with children at greater risk of severe dehydration than adults [10]. Following acute infection, giardiasis might also lead to long-term chronic disease, including irritable bowel syndrome [11, 12].

Current giardiasis diagnostic and treatment recommendations include guidance on diagnostic testing and appropriate medications [13, 14]. Several stool-based assays can identify *Giardia* infection, including the ova and parasites microscopy test, and *Giardia*-specific enzyme immunoassay, indirect fluorescent assay, and direct fluorescent antibody assay. Because *Giardia* parasites are shed in stool only intermittently, collecting 3 stool samples on 3 different days is recommended to maximize diagnostic sensitivity [15]. Increasingly, highly sensitive molecular diagnostics are also used. Multiple antiparasitic drugs are effective against *Giardia*, including metronidazole, tinidazole, and nitazoxanide; metronidazole and tinidazole are the first-line treatments in the United States [14, 16].

Despite being the most common human intestinal parasitic infection in the United States, basic information on giardiasis care and treatment practices is lacking. Some previous studies suggest the occurrence of delayed diagnosis of giardiasis (measured as time from symptom onset to diagnosis) and inefective treatment with antibiotics. In a US study of 290 individuals with confirmed giardiasis from 2 states with active laboratory-based surveillance, 27% were enrolled >6 weeks after their reported symptom onset date [17]. In the same study, 10% of patients reported receiving antibiotics, such as ciprofloxacin, which are ineffective against *Giardia*. These data suggest the possibility that delays in giardiasis diagnosis and ineffective treatment occur widely. One explanation for these findings is low index of suspicion of giardiasis, which causes nonspecific symptoms (eg, diarrhea) common to many enteric diseases. In a survey of 1000 pediatricians, only 10% indicated they would

suspect parasites in a patient with persistent diarrhea lasting more than 1–2 weeks [18]. If *Giardia* is suspected, specific tests must be ordered because routine bacterial stool cultures will not detect the parasite [15]. Therefore, multiple potential areas exist for improvement in the diagnosis and treatment of giardiasis in the United States.

Here, we present an analysis of clinic visits for *Giardia*-related symptoms and diagnoses, diagnostic tests, and drug prescriptions from 2006 to 2010 among a giardiasis patient cohort (N = 2995), created using a large US health insurance claims database.

Methods

Data Source

We used insurance claims contained in the MarketScan Commercial Claims and Encounters database (Truven Health Analytics, Ann Arbor, Michigan), from 2006 to 2010. The database contains insurance billing data for patient visits (doctors' office and emergency department), hospital stays, diagnostic tests and procedures, and prescription medication for >143 million persons in the United States covered by employer-sponsored private health insurance (employees, retirees under age 65, former employees, and spouses/partners and dependents of these individuals) [19]. Because MarketScan contains de-identified, preexisting insurance billing records, and because no interaction or intervention with human subjects occurred and no personally identifiable information was used, collected, or transmitted, this analysis was not considered human subjects research (as defined in the US Code of Federal Regulations, Title 45 Part 46), and therefore was not subject to review by the Centers for Disease Control and Prevention (CDC) institutional review board.

Cohort Construction

We constructed a cohort of persons with at least 1 outpatient visit for giardiasis, defined as *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) code 007.1, with initial giardiasis diagnosis occurring from 1 January 2006 through 31 December 2010. Of 80 million persons enrolled during that time period, 6056 had at least 1 giardiasis diagnosis. Of these, we excluded 3061 for 1 or more of the following reasons that would lead to incomplete data: hospital stay (prescription drugs are not recorded in database during hospital stays; n = 390), gaps in enrollment in a MarketScan insurance plan (n = 374), no evidence of prescription coverage (n = 1270), and enrollments of <90 days before or after initial diagnosis (n = 1948).

The analysis was limited to claims dated from 90 days before to 90 days after each patient's first giardiasis diagnosis (ie, first clinic visit with a giardiasis diagnosis code), creating a 180-day study window for each patient.

Variable Definitions and Analytical Approach

We focused on a set of diagnosis codes, procedures codes, and prescription drugs likely to be associated with an episode of giardiasis (Supplementary Table 1). We included insurance claims for patient visits with a diagnosis code for giardiasis (*ICD-9-CM* code 007.1) or other gastrointestinal (GI) illnesses or problems (*ICD-9-CM* codes 001–009, 520–529, 787, and

792.1). We specifically identified visits with a diagnosis of *Shigella*, *Salmonella*, *Campylobacter*, *Escherichia coli*, *Cryptosporidium*, *Clostridium difficile*, or norovirus infection, to assess alternate infectious diagnoses or coinfections. We also included insurance claims for diagnostic tests used to diagnose giardiasis or other gastrointestinal illnesses or problems [20]. Use of molecular assays (eg, film array– and bead-based assays) was likely uncommon in the study time period. Among prescription drug claims, we included prescriptions for systemic antiparasitic drugs (drugs effective against *Giardia:* albendazole, furazolidone, metronidazole, nita-zoxanide, ornidazole, paromomycin sulfate, quinacrine, secnidazole and tinidazole) and systemic antibiotics (drugs ineffective against *Giardia:* cephalosporins, erythromycin and macrolides, penicillins, quinolones, sulfonamides, and miscellaneous antibiotics). The MarketScan database contains the date a prescription was filled but does not indicate which healthcare encounter was associated with the prescription. Additionally, medications can be prescribed for a variety of indications. For example, metronidazole is often prescribed for giardiasis but is also indicated for treatment of bacterial vaginosis, trichomoniasis, amebiasis, and anaerobic bacterial infections [21]. Thus, we included only prescriptions filled within the 7 days before to 30 days after a visit involving abdominal pain, diarrhea, or giardiasis. These visit-associated prescriptions [22] comprised 96% of total prescriptions during the 180-day study window.

We grouped these diagnosis codes, diagnostic test codes, and prescriptions into the following giardiasis-related “event” types: patient visits with a giardiasis diagnosis, visits for GI symptoms, *Giardia*-specific diagnostic tests, diagnostic tests for other GI-related illnesses or problems, antiparasitic prescriptions, and antibiotic prescriptions. We considered the timing of each event and identified the first and last date of each event type (Supplementary Table 2).

We then assessed the frequency of each event type, and because we hypothesized that giardiasis care experiences might differ for pediatric and adult patients, we stratified analyses by age at first giardiasis diagnosis (0–17 years, 18–64 years). We also evaluated differences in diagnostic testing and prescriptions by sex and US census region of residence (Northeast, South, Midwest, and West). We evaluated statistical differences in proportions using χ^2 test, or Fisher exact test when expected cell counts were <5. Data management and analyses were conducted using SAS software version 9.3 (SAS Institute, Cary, North Carolina) and R version 3.1.3 (R Foundation for Statistical Computing, Vienna, Austria).

We then used the EventFlow data visualization tool (University of Maryland, Human-Computer Interaction Lab; http://hcil.umd.edu/eventfow) to visually inspect the data and identify clinically relevant temporal event sequences [23–25]. EventFlow aggregates longitudinal data by grouping individuals with similar sequences of events and representing these groups with color-coded vertical bars in a single graphic display that summarizes information on event order, time between events, and frequency of particular event sequences (Supplementary Figure 1). Each row in an EventFlow figure represents 1 patient's sequence of events during a period of time. The height of each bar is proportional to the number of records with that sequence, and its horizontal position is determined by the median time between events. Groups of sequences with the same preceding event are sorted by the number of records in each group. The sequence groups are shown from top to bottom

in descending order of number of patients per group. A brief demonstration video illustrates the process (http://go.umd.edu/eventfow-overview). We also used EventFlow to search the patient event sequences for signatures of giardiasis care and treatment recommendations. Specifically, we queried for sequences containing a *Giardia*-specific test, followed by or concurrent with an antiparasitic prescription, and without any antibiotic prescription.

Results

Within the cohort of 2995 giardiasis patients, half were female, and 30% were aged ≤17 years at diagnosis (Table 1).

Half of all patients (50%; n = 1496) had ≥3 clinic visits with codes for GI symptoms or giardiasis, and adults were more likely to have ≥3 visits compared with children (52% vs 46%; Table 2). Preceding their initial visit with a giardiasis diagnosis, 18% of all patients (n = 535) had ≥3 visits for GI symptoms, and adults were more likely than children (19% vs 15%) to have ≥3 GI symptom visits before receiving a diagnosis. Overall, 22% of patients (n = 657) waited >30 days from their first GI symptom visit to their first visit with a giardiasis diagnosis, and 40% (n = 1192) waited >30 days from first to last GI symptom or giardiasis diagnosis visit during the study window. These intervals did not vary by age group.

More than half of patients (62%; n = 1853) had a diagnostic test for gastrointestinal illnesses or problems, including *Giardia* (Table 3). Among these, 82% (n = 1515) had a *Giardia*-specific test. Pediatric patients were significantly more likely than adults to have had at least 1 *Giardia*-specific test (58% vs 48%).

Most patients (72%; n = 2142) had prescriptions for either antiparasitic or antibiotic drugs. About two-thirds (64%; n = 1906) had an antiparasitic drug (Table 4). Adult patients were significantly more likely than pediatric patients to have an antiparasitic prescription of any kind (68% vs 53%). Metronidazole was most common overall, but pediatric patients were significantly more likely to have nitazoxanide compared with adults (23% vs 5%). Twenty-seven percent of all patients (816/2995) had a systemic antibiotic ineffective against *Giardia*.

We quantified comorbid GI diagnoses and *Giardia*-specific tests and drugs, to evaluate the validity of the giardiasis diagnosis used to define the cohort. Comorbid diagnoses of *Shigella*, *Salmonella*, *Campylobacter*, *E. coli*, *Cryptosporidium*, *C. diffcile*, or norovirus infection were uncommon (2.2%), and most patients (83%) had either a *Giardia*-specific diagnostic test or a prescription appropriate for giardiasis.

The proportion of patients receiving a *Giardia*-specific diagnostic test varied from 44% in the South to 60% in the Northeast ($P < .001$), proportions of patients with antiparasitic prescriptions varied from 55% in the Northeast to 68% in the South ($P < .001$), and antibiotic prescriptions varied from 22% in the Northeast to 30% in the South ($P = .004$) (not shown).

Temporal event sequences analyzed in EventFlow revealed that the giardiasis care and treatment event sequence is variable, with 1010 (34%) unique event sequences represented among the entire cohort. In total, patients had a median of 5 events (eg, visits, tests or

prescriptions; range, 1–47) during the 180-day study window. Median elapsed time from first to last event was 23 days (range, 0–196 days) (Supplementary Figure 2). The first event recorded for most patients was a visit for a GI-related symptom (61%); for 22% of patients, the first event was an antiparasitic prescription. For 28% of patients, the first event was either an antiparasitic or antibiotic prescription (SupplementaryTable 2).

Eighteen percent (n = 541) of patient event sequences included a *Giardia*-specific test followed by or concurrent with an antiparasitic prescription, with no antibiotic prescription, and thus were consistent with published recommendations. Event sequences differed between pediatric and adult patients. When *Giardia*-specific tests and antiparasitic and antibiotic prescriptions were examined, event sequences for pediatric patients most frequently began with a *Giardia*-specific test, whereas event sequences for adult patients most frequently began with an antiparasitic prescription (Figure 1).

Discussion

Using a large insurance claims database to characterize giardiasis diagnosis and treatment in the United States, we showed that the entire clinical event sequence takes >3 weeks for most patients, and often requires multiple visits, procedures, and prescriptions. Furthermore, we found that pediatric giardiasis care differs substantially from adult care, even though treatment recommendations do not differ by age group. Our results suggest that giardiasis diagnosis can be time-consuming and potentially costly for patients and clinicians, and that many patients do not have recommended diagnostics or drugs.

Our analysis also revealed that the giardiasis diagnosis and treatment process is highly variable and sometimes at odds with established guidelines. Nearly 40% of patients experienced >30 days between their first and last physician visit for GI symptoms, and 22% experienced ≥30 days before their first visit with a giardiasis diagnosis code. This finding is consistent with a previous study of laboratory-confirmed giardiasis patients in which 27% of laboratory-confirmed cases could not be enrolled until >6 weeks after their reported onset, suggesting a protracted (delayed) diagnostic process [17]. Only 18% of patients had a *Giardia*-specific test followed by an antiparasitic medication effective against giardiasis, without an ineffective antibiotic, a sequence we examined based on consistency with current recommendations. On the other hand, 27% of patients had an antibiotic ineffective against *Giardia* at some point in the study window, which is nearly 3-fold higher than a previous estimate [17]. The low consistency with recommended practice was surprising, in light of the availability of multiple sufffciently sensitive diagnostic testing options, effective antiparasitic drugs, and published guidance that suggests the use of such tests and drugs as best practices [13, 14, 26, 27]. However, the finding that 30% of patients had a visit-associated antiparasitic or antibiotic prescription as their first event suggests that, for some clinicians and patients, the presumed speed and ease of empiric treatment might outweigh the potential discomfort and expense of additional diagnostic visits. Empiric treatment carries the risk of patients taking unnecessary and ineffective medications that might contribute to the development of antibiotic resistance, and empirically treating contacts of laboratory-confirmed cases may increase the number of probable vs confirmed cases notified to CDC and could result in an underestimated national disease burden. Rapid molecular

assays, while unlikely to be used in MarketScan during this study period, could increase the use and sensitivity of gastroenteritis diagnostics, and reduce apparent empirical treatment.

We found that pediatric patients had more *Giardia*-specific tests, but fewer prescriptions, than adults. Moreover, data visualization using EventFlow showed that age-specific event sequences had distinct hallmarks, when the subset of diagnostic tests and prescription events were analyzed: Children often had 1 or more tests preceding prescriptions, while a majority of adults began with antiparasitic or antibiotic prescriptions. Together, these observations suggest that children tend to have a more thorough workup, while adults have more frequent prescriptions without preceding diagnostic tests, suggesting empiric treatment. Although current giardiasis care recommendations are not age-specific, differences between pediatric and adult giardiasis care are not surprising. The incidence of giardiasis (and other gastroenteritis) is not uniform across the age spectrum in the United States. Giardiasis incidence is highest in children [1], and a recent study of laboratory-tested acute gastroenteritis patients showed that likelihood of detecting any GI pathogen in feces decreases significantly with age [29], suggesting that pediatric practitioners might suspect giardiasis (or other pathogenic etiologies) more often, and be more familiar with testing and treatment methods compared with adult practitioners. As expected, the majority of antiparasitic prescriptions for all patients were for metronidazole. Tat pediatric patients had more nitazoxanide prescriptions than adult patients might be explained by nitazoxanide but not metronidazole availability in an oral suspension.

Although administrative data such as insurance claims records can provide large amounts of data at comparatively low cost to investigators, we acknowledge several limitations in these data. First, our cohort represents giardiasis patients who were commercially insured for >6 months and might have different clinical experiences from the uninsured or briefly insured, or persons with Medicaid coverage. In particular, the uninsured might seek to minimize visits and diagnostic testing. Second, the structure of the medical and prescription claims databases did not allow us to precisely assign prescriptions to the disease or symptom for which they were prescribed. To restrict our analyses to prescriptions associated with giardiasis, we only included prescriptions filled from 7 days preceding to 30 days following a visit for giardiasis, abdominal pain, or diarrhea [22]. Finally, giardiasis diagnoses could not be validated with medical records, and while the database contains insurance claims for diagnostic tests, it is unknown whether separate tests involve separately collected specimens or what proportion of tests had confirmed positive results. Administrative data have been validated for irritable bowel syndrome and other diseases [30–33], but have not been used previously for giardiasis. However, an alternate infectious diagnosis was identified in only 2.2% of patients in our cohort, and 83% of patients had a *Giardia*-specific test or antiparasitic prescription, increasing our confidence that most patients in our cohort indeed had giardiasis.

In this comprehensive characterization of the giardiasis clinical care experience within a large cohort of commercially insured patients, we found that receiving all aspects of recommended care—including a diagnostic test, a prescription for antiparasitic medication, and no prescription for ineffective antibiotics—was relatively rare. Valid reasons may exist for these deviations from recommendations in many instances, although lack of awareness

might be a factor. Qualitative studies exploring clinicians' rationale for giardiasis-related clinical decisions would be useful for planning public health messaging and clinician education. We also identified substantial differences in pediatric and adult giardiasis care, with children more often receiving diagnostic testing and adults more often starting care with a prescription. Although current clinical guidance does not differ by age, acknowledging practical reasons for age-group differences might present opportunities for revised public health guidance that better refects the unique scenarios presented by adults and children with gastrointestinal illnesses. Finally, this study contributes a greater understanding of real-world giardiasis care, which could inform future studies of the consequences of missing or ineffective treatment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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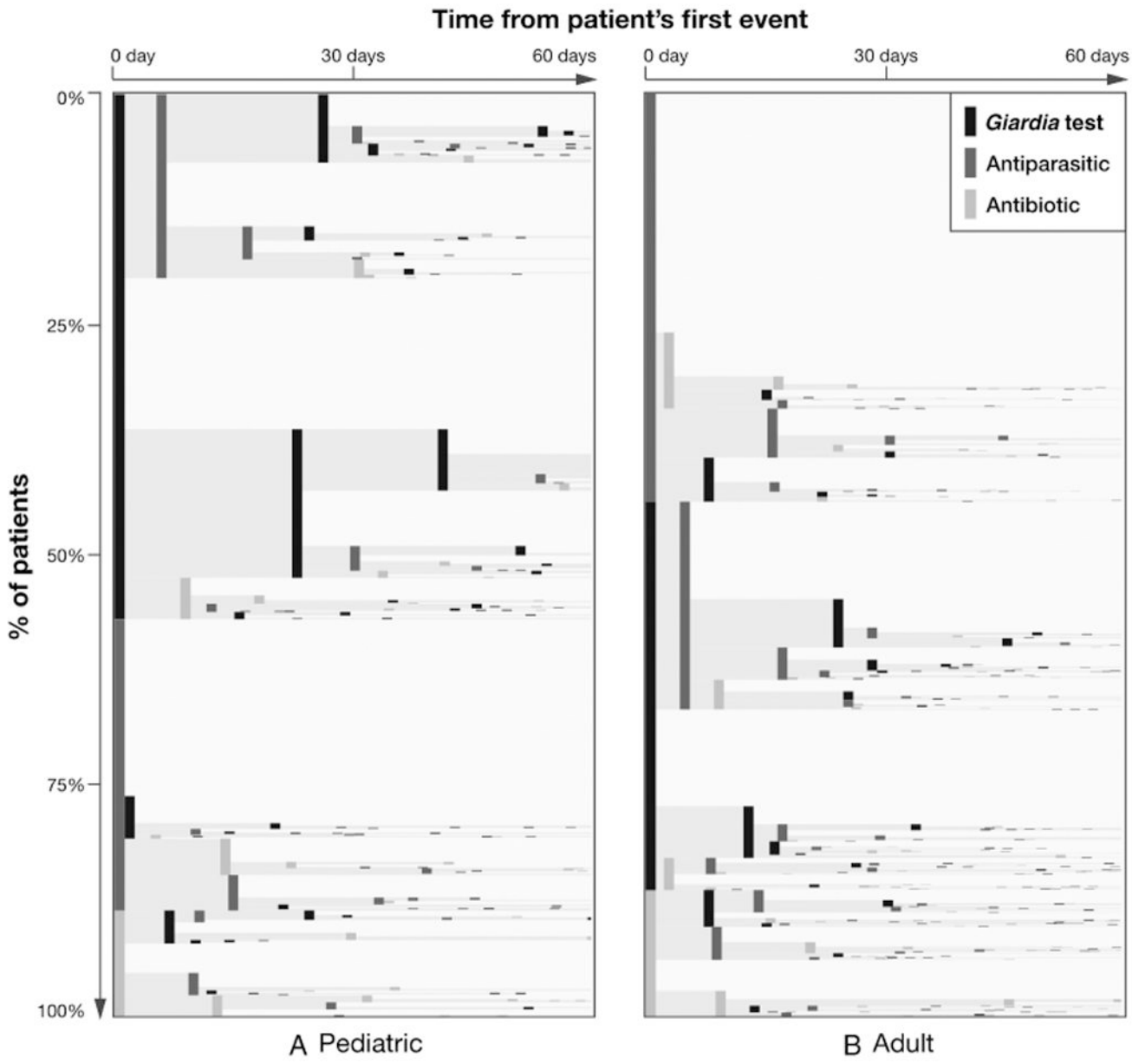

Figure 1.

EventFlow plots of pediatric (*A*) and adult (*B*) giardiasis event sequences. All sequences (rows) are aggregated by event order, with each patient's first event during the study window represented by a vertical bar at the far left. Bar height represents the proportion of patients with a given sequence, and bar shading represents event type. Distance between bars is equivalent to median time in days between any 2 events. Three *Giardia*-specific event types are shown: *Giardia*-specific tests (black), antiparasitic prescriptions (dark gray), and antibiotic prescriptions (light gray). Most but not all cohort patients had at least 1 of these 3 events. Therefore, plots show pediatric (n = 782; 86%) and adult (n = 1808; 87%) sequences containing any of the 3 events. Time from first event (horizontal axis) is truncated to 60 days for clarity; 72% of all sequences had total elapsed time of ≤60 days. Starting from the left of

the panels, we saw that more pediatric vs adult sequences started with a *Giardia*-specific test (black bars) and included multiple consecutive tests, whereas adult sequences were more likely to begin with an antiparasitic drug (dark gray bars).

Table 1

Giardiasis Outpatient Cohort Characteristics (N = 2995) in the MarketScan National Insurance Claims Database, 2006–2010

Characteristic	No.	(%)
Female sex	1499	(50.1)
Age, y		
0–17	910	(30.4)
18–34	612	(20.4)
35–44	537	(17.9)
45–54	515	(17.2)
55–64	421	(14.1)
US Census Region of residence		
South	1297	(43.3)
West	774	(25.8)
Midwest	546	(18.2)
Northeast	361	(12.1)
Unknown	17	(0.6)

Table 2

Giardiasis Outpatient Visits for Gastrointestinal Symptoms During 180-Day Study Window (N = 2995)

Event Type	All Outpatients (N = 2995)		Age <18 y (n = 910)		Age 18–64 y (n = 2085)		*P* Value[a]
Total giardiasis or GI symptom visits[b]							.01
1	932	(31.1)	305	(33.5)	627	(30.1)	
2	567	(18.9)	190	(20.9)	377	(18.1)	
≥3	1496	(50.0)	415	(45.6)	1081	(51.9)	
Median (range)	2	(1–31)	2	(1–19)	3	(1–31)	
GI symptom visits before initial giardiasis diagnosis							.02
0	1428	(47.7)	457	(50.2)	971	(46.6)	
1	591	(19.7)	186	(20.4)	405	(19.4)	
2	441	(14.7)	134	(14.7)	307	(14.7)	
≥3	535	(17.9)	133	(14.6)	402	(19.3)	
Median (range)	1	(0–15)	0	(0–14)	1	(0–15)	
Days from first symptom visit until initial diagnosis[c]							.23
Same day	1428	(47.7)	457	(50.2)	971	(46.6)	
1–7 d	279	(9.3)	79	(8.7)	200	(9.6)	
8–30 d	631	(21.1)	191	(21.0)	440	(21.1)	
31–90 d	657	(21.9)	183	(20.1)	474	(22.7)	
Median (range)	2	(0–90)	0	(0–90)	3	(0–90)	
Total days from first to last giardiasis or GI symptom visit							.45
Same day	932	(31.1)	305	(33.5)	627	(30.1)	
1–7 d	305	(10.2)	88	(9.7)	217	(10.4)	
8–30 d	566	(18.9)	165	(18.1)	401	(19.2)	
31–90 d	902	(30.1)	269	(29.6)	633	(30.4)	
≥91 d	290	(9.7)	83	(9.1)	207	(9.9)	
Median (range)	17	(0–175)	16	(0–159)	17	(0–175)	

Data are presented as No. (%) unless otherwise indicated.

Abbreviation: GI, gastrointestinal.

[a] χ^2 test of age group vs event type.

[b] Includes visits for giardiasis (*International Classification of Diseases, Ninth Revision, Clinical Modification* code 007.1) and any of 83 GI-related conditions or symptoms.

[c] "Same day" denotes outpatients whose first GI-related visit included a giardiasis diagnosis, with or without additional GI symptoms.

Table 3

Gastrointestinal-Related and *Giardia*-Specific Diagnostic Tests During 180-Day Study Window (N = 2995)

Test	All Outpatients (N = 2995)		Age <18 y (n = 910)		Age 18–64 y (n = 2085)		*P* Value
Any GI-related test[a]	1853	(61.9)	578	(63.5)	1275	(61.2)	.22
Any *Giardia*-specific test[b]	1515	(50.6)	523	(57.5)	992	(47.6)	<.001
≥3 *Giardia*-specific tests	744	(24.8)	300	(33.0)	444	(21.3)	<.001
Any O&P microscopy test[c]	1181	(39.4)	404	(44.4)	777	(37.3)	<.001
Any *Giardia* enzyme immunoassay[d]	924	(30.9)	354	(38.9)	570	(27.3)	<.001
Any *Giardia* indirect fluorescent assay	58	(1.9)	12	(1.3)	46	(2.2)	.11
Any *Giardia* direct fluorescent antibody[e]	51	(1.7)	18	(2)	33	(1.6)	.44

Data are presented as No. (%) unless otherwise indicated.

Abbreviations: GI, gastrointestinal; O&P, ova and parasites.

[a] GI-related tests include *Giardia*-specific tests, and are defined in Supplementary Table 1.

[b] *Giardia*-specific tests are defined and listed in Supplementary Table 1.

[c] Includes tests with or without trichrome stain.

[d] This category includes “rapid” diagnostic tests (eg, ImmunoCard STAT).

[e] Gold standard for *Giardia* diagnostic testing.

Table 4

Visit-Associated[a] Antimicrobial Prescriptions During 180-Day Study Window (N = 2995)

Prescription	All Outpatients (N = 2995)		Age <18 y (n = 910)		Age 18–64 y (n = 2085)		*P* Value
Patients receiving ≥1 antiparasitic prescription[b]							
Any visit-associated antiparasitic prescriptions	1906	(63.6)	480	(52.8)	1426	(68.4)	<.001
Metronidazole	1516	(50.6)	281	(30.9)	1235	(59.2)	<.001
Nitazoxanide	320	(10.7)	211	(23.2)	109	(5.2)	<.001
Tinidazole	247	(8.3)	40	(4.4)	207	(9.9)	<.001
Albendazole	32	(1.1)	3	(0.3)	29	(1.4)	.01[c]
Paromomycin	12	(0.4)	1	(0.1)	11	(0.5)	.12[c]
Patients receiving ≥1 antibiotic prescription[d]							
Any visit-associated antibiotic prescriptions	816	(27.3)	225	(24.7)	591	(28.4)	.04
Quinolones	307	(10.3)	6	(0.7)	301	(14.4)	<.001
Penicillin	196	(6.5)	100	(11.0)	96	(4.6)	<.001
Macrolides	187	(6.2)	60	(6.6)	127	(6.1)	.60
Cephalosporins	123	(4.1)	67	(7.4)	56	(2.7)	<.001
Sulfonamides	113	(3.8)	32	(3.5)	81	(3.9)	.63
Tetracyclines	71	(2.4)	9	(1.0)	62	(3.0)	.001
Miscellaneous antibiotics	47	(1.6)	4	(0.4)	43	(2.1)	<.001[c]

Data are presented as No. (%) unless otherwise indicated.

[a] Prescriptions paid from 7 days before to 30 days following a visit for giardiasis or gastrointestinal symptoms.

[b] Antiparasitic prescriptions are medications effective against *Giardia*. No outpatient had prescriptions for quinacrine, ornidazole, secnidazole, or furazolidone.

[c] Fisher exact test *P* value.

[d] Antibiotic prescriptions are systemic antimicrobials not effective against *Giardia*.