New York City Department of Health & Mental Hygiene

Bureau of Communicable Disease

&

New York City Department of Environmental Protection

Bureau of Water Supply

Waterborne Disease Risk Assessment Program

2023 Annual Report

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NYC Filtration Avoidance Determination

NYC Environmental Protection

NYC Health

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LIST OF ACRONYMS

Acronym	Description
ADM	Anti-diarrheal medication
BCD	Bureau of Communicable Disease
CGAP	Cryptosporidium and Giardia Action Plan
CIDT	Culture independent diagnostic test
CUSUM	Cumulative sums
DEP	Department of Environmental Protection
DOHMH	Department of Health and Mental Hygiene
ED	Emergency Department
GI	Gastrointestinal
ICA	Intra-City Agreement
NYC	New York City
NYSDOH	New York State Department of Health
O&P	Ova and parasite test
OTC	Over the counter medication
PCR	Polymerase chain reaction
UHF	United Hospital Fund
WDRAP	Waterborne Disease Risk Assessment Program

ACKNOWLEDGMENTS

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Copies of the questionnaires used for disease surveillance are available from lalleyn@health.nyc.gov.

EXECUTIVE SUMMARY

NYC's Waterborne Disease Risk Assessment Program (WDRAP) helps assure the microbial safety of the municipal water supply, and it is a component of NYC's revised 2017 Filtration Avoidance Determination (FAD). The primary objectives of WDRAP are to: (a) obtain data on the rates of giardiasis and cryptosporidiosis, along with demographic and risk factor information on patients; and (b) provide a system to track gastrointestinal illness (diarrhea or vomiting) to ensure rapid detection of any outbreaks. The program began in 1993 and is jointly administered by two NYC agencies: the Department of Health and Mental Hygiene (DOHMH) and the Department of Environmental Protection (DEP). This report provides an overview of program activities, and highlights of data collected in 2023.

DISEASE SURVEILLANCE

This report presents the number of cases and case rates for giardiasis and cryptosporidiosis in 2023. Citywide 2023 data is provided, along with citywide data from the prior nine years for context. Demographic information for cases of giardiasis and cryptosporidiosis diagnosed in 2023 is also summarized. Telephone interviews of cryptosporidiosis patients were conducted to gather potential risk exposure information, and selected results are presented.

In 2023, there were 1351 reported cases of giardiasis, compared to 963 in 2022. The rate of giardiasis cases reported per 100,000 population increased from 11.7 in 2022 to 16.2 in 2023, which was higher than the range of observed rates over the last decade (rate range 2013–2022: 7.6–14.3; median: 10.5). In 2023, there were 410 reported cases of cryptosporidiosis, compared to 347 in 2022. The rate of cryptosporidiosis per 100,000 population increased from 4.2 in 2022 to 4.9 in 2023. The 2023 rate of reported cryptosporidiosis cases was higher than the range of rates observed over the last decade (rate range 2013–2022: 1.0–4.7; median: 2.1).

While the case counts increased for both cryptosporidiosis and giardiasis in 2023, they closely follow the increasing trend seen in years prior to the CoVID-19 pandemic (from 2015-2019). This pre-pandemic increase is believed to be a result of new diagnostic tests known as syndromic multiplex PCR (SMP) panels, which were introduced in 2015 and have continued to grow in use because they are generally less complicated to administer and less expensive than traditional testing. As reported previously, the drop in cases in 2020 was likely due to changes in healthcare-seeking behaviors during the pandemic, with subsequent case numbers gradually increasing in 2021 and 2022 as the pandemic waned. Further exploration of laboratory data is necessary to determine the cause of the increase in 2023; potential reasons could include: 1) a continued increase in laboratories who use SMP diagnostic testing, 2) an influx of asylum seekers from other countries who were infected prior to arriving in NYC, 3) an increase in disease transmission, or 4) some combination of all three factors.

SYNDROMIC SURVEILLANCE AND OUTBREAK DETECTION

The tracking of sentinel populations (e.g., nursing homes) or surrogate indicators of disease (e.g., anti-diarrheal drug sales) through "syndromic surveillance" can be useful in assessing gastrointestinal (GI) disease trends in the general population. Such tracking programs provide greater assurance that a citywide outbreak would be detected. In addition, such programs can play a role in limiting the extent of an outbreak by providing an early warning so that control measures are rapidly implemented.

DOHMH maintains four distinct and complementary outbreak detection systems: 1) tracks chief complaints from hospital emergency department (ED) databases; 2) monitors the sale of over-the-counter (non-prescription) anti-diarrheal medications; 3) tracks the number of stool specimens submitted to a clinical laboratory for microbiological testing; and 4) involves DOHMH monitoring and assisting in the investigation of GI outbreaks in a number of sentinel nursing homes. A summary of syndromic surveillance findings for 2023 pertaining to GI illness is presented. Citywide trends and signals observed in the ED system were generally consistent with GI viral trends. There was no evidence of a drinking water-related outbreak in NYC in 2023 (consistent with prior years).

INFORMATION SHARING, RESPONSE PLANNING & SPECIAL PROJECTS

Information on *Cryptosporidium* and *Giardia*, WDRAP, and related topics, is available on the websites of NYC's DEP and DOHMH as listed in Section 4 of this report. Included are annual reports on program activities, fact sheets on giardiasis and cryptosporidiosis, and results from the DEP's source water protozoan monitoring program. The annual update of NYC's "Hillview Reservoir *Cryptosporidium* and *Giardia* Action Plan" (CGAP) was issued in December 2023.

1. INTRODUCTION

The Waterborne Disease Risk Assessment Program (WDRAP) is a multi-faceted public health assessment program that provides enhanced assurance of the microbial safety of New York City's (NYC) drinking water supply. This program is a critical element of NYC's Filtration Avoidance Determination (FAD), which was developed in response to US Environmental Protection Agency's Surface Water Treatment Rule regulations. WDRAP is a joint-agency program involving the NYC Department of Health & Mental Hygiene (DOHMH) and NYC Department of Environmental Protection (DEP). This partnership was originally established in 1993 and has continued under a series of joint-agency (DEP-DOHMH) agreements (i.e., Memorandum of Understandings or "MOUs" and Intra-City Agreements or "ICAs"). In 2022, DEP and DOHMH renewed their collaboration by finalizing a new ICA which took effect July 1, 2022, and will continue through June 30, 2027.

The primary objectives of WDRAP are to:

- Obtain data on the rates of giardiasis and cryptosporidiosis, along with demographic and risk factor information on patients; and
- Provide a system to track gastrointestinal illness (diarrhea and vomiting) to ensure rapid detection of any waterborne disease outbreaks.

This report provides a summary of WDRAP highlights and data for the year 2023, information on calculation of rates, case definitions, and water exposure data collection can be found in Appendix A. Water treatment practices are currently in place such that the entire NYC Water Supply System (i.e., Catskill, Delaware, & Croton Systems) meets the inactivation requirements for both *Giardia* and *Cryptosporidium*, based on the NYS Sanitary Code. Previous WDRAP Annual Reports can be accessed for additional information: See Section 4 for weblink.

2. DISEASE SURVEILLANCE

2.1 Trends in Syndromic Multiplex Panel Testing

Syndromic multiplex panels have historically been highly sensitive and specific in the detection of a large variety of enteric pathogens, including *Giardia* and *Cryptosporidium* (Navidad et al. 2013; Madison-Antenucci et al. 2016). These panels are also a quick and less expensive method to screen for a large number (>20) of enteric pathogens, and their use has increased in recent years. In a manuscript published by the DOHMH-based team in 2020, we noted that the reported incidence of cryptosporidiosis increased significantly after the introduction of syndromic multiplex panels in 2015 (Alleyne et al. 2020). The median age-adjusted annual incidence increased from 1.46/100,000 in 2000–2014 to 2.11/100,000 during 2015–2018, following the introduction of syndromic multiplex panels (incidence rate ratio: 1.49, 95% CI: 1.17–1.91). Additionally, a manuscript from Columbia University Medical Center detailed the increased sensitivity of these panels in comparison with the traditional microscopy assay. The authors found that traditional testing identified a pathogen in 4% of samples from 2012–2015 compared to 29% of samples positive for a pathogen using syndromic multiplex panel on samples from 2015–2017 (Axelrad et al. 2019).

In 2015, the proportion of giardiasis and cryptosporidiosis patients diagnosed exclusively by a syndromic multiplex panel at a hospital or commercial laboratory was 5% and 20%, respectively. By 2023, these values reached 52.5% for giardiasis and 85.3 % for cryptosporidiosis. Laboratories in all five boroughs now use syndromic multiplex panels, leading to an increase in reported incidence of cryptosporidiosis across a range of neighborhoods in NYC.

The proportion of giardiasis cases diagnosed in NYC exclusively by syndromic multiplex panels was less than that of cryptosporidiosis, which may potentially be related to the higher sensitivity of traditional diagnostics like an ova and parasite exam for giardiasis compared to cryptosporidiosis. Importantly, DOHMH has also observed substantial increases in reported incidence of a range of additional enteric infections included on syndromic multiplex panels across NYC. These trends have been mirrored across a number of different jurisdictions in the United States (Huang et al. 2016; Marder et al. 2017).

2.2 Giardiasis

Giardiasis is a reportable disease in NYC, per the NYC Health Code, and *Giardia* positive laboratory results are reported to DOHMH via an electronic laboratory reporting system. Case investigations for giardiasis are conducted only for patients who are known or suspected to be in a secondary transmission risk category (e.g., food handler, health care worker, child attending childcare, or childcare worker), or when giardiasis clusters or outbreaks are suspected.

2.2.1 Basic Trends and Demographics

During 2023, a total of 1351 cases of giardiasis were reported to DOHMH resulting in an annual case rate of 16.2 per 100,000 (Table 2.1). For some historical context, the table includes annual case counts and rates for the prior ten years, along with the current reporting year. There is a slight summer seasonality to giardiasis in NYC, as shown in Figure 2.1 with cases most often diagnosed in August and September. The annual giardiasis case count increased 40.3% from 2022 to 2023. While this is a significant increase, when 2023 is compared to the year prior to CoVID-19 (2019), it is only a 12.1% increase. This is more in line with the year-to-year increases observed prior to CoVID-19 (2018 = 8.4%; 2017 = 14.1%) suggesting a continuation of the SMP trend in 2023 after a three-year interruption by the pandemic. Giardiasis case counts and rates have continued to increase since the pandemic. Further exploration of the data will help to better understand the trends.

Table 2.1: Giardiasis, number of cases and case rates, New York City, 2013–2023.

Year	Number of Cases	Case Rate per 100,000
2013	767	9.2
2014	864	10.4
2015	869	10.2
2016	899	10.5
2017	975	11.4
2018	1,112	12.9
2019	1,205	14.3
2020	636	7.6
2021	811	9.8
2022	963	11.7
2023	1,351	16.2

Note: Minor variations in the data may be related to reporting delays, corrections, the removal of duplicate reports, and other data processing refinements. Yearly case numbers and rates in this table may therefore differ from case numbers and rates that appeared in prior WDRAP reports.

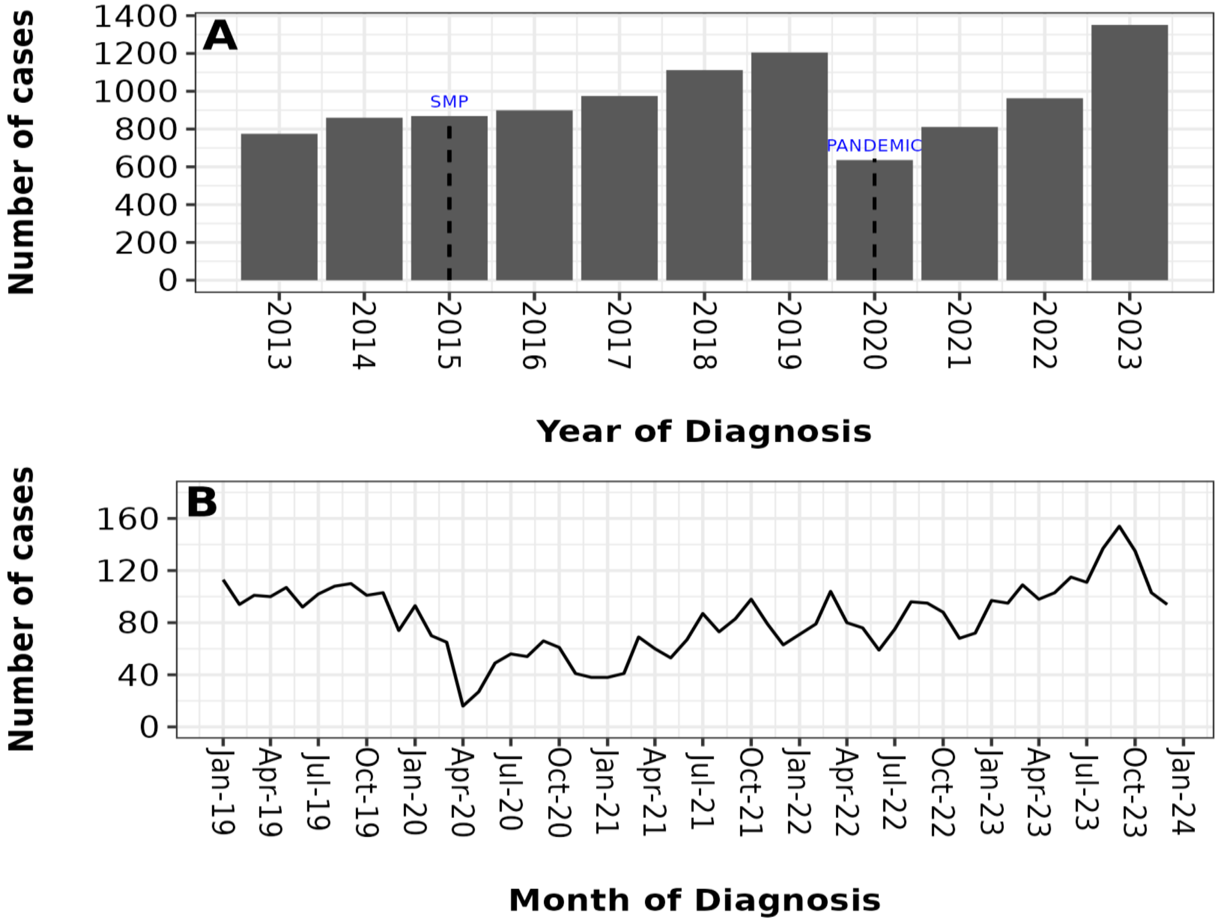

Figure 2.1: (A) Annual giardiasis counts, NYC, 2013 - 2023; and (B) Monthly giardiasis counts for the last five years. The first vertical dotted line shows the date when the first NYC laboratory reported results from syndromic multiplex panels for enteric diseases (2015), and the second marks the start of the pandemic (2020).

Giardiasis was most common in the borough of Manhattan (31 cases per 100,000), and in the United Hospital Fund (UHF) neighborhood of Chelsea-Clinton within Manhattan (84.9 cases per 100,000) (Figure 2.2).

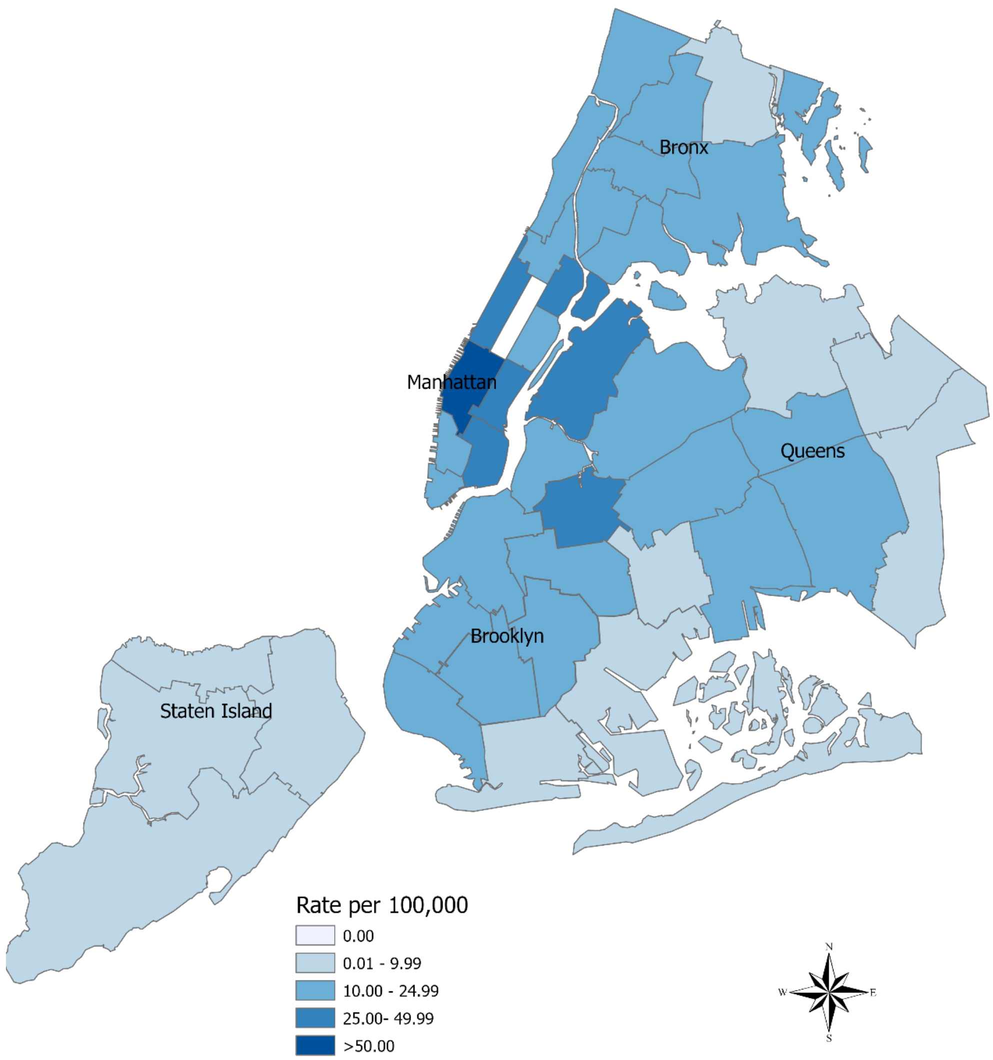

Figure 2.2: Map of Giardiasis annual case rate per 100,000 population by UHF neighborhood, NYC, 2023

Giardiasis was most common in males (24.5 per 100,000), and specifically males in Manhattan (52.6 cases per 100,000) (Figure 2.3**).** The highest age group-specific case rate for giardiasis was among children 5-9 years old (25.7 cases per 100,000) and children <5 years old (24.1 cases per 100,000). The highest age group and sex-specific case rate was among males aged 20–44 years

(34.3 cases per 100,000) and males 5-9 years old (30.8 cases per 100,000) (Figure 2.4). By borough and age, giardiasis was most frequent in children aged 5-9 years in Manhattan (73.6 cases per 100,000), followed by children <5 years old in Manhattan (52.5 cases per 100,000) (Figure 2.5). Information regarding race and ethnicity was available for 713 of 1351 (53%) of cases.

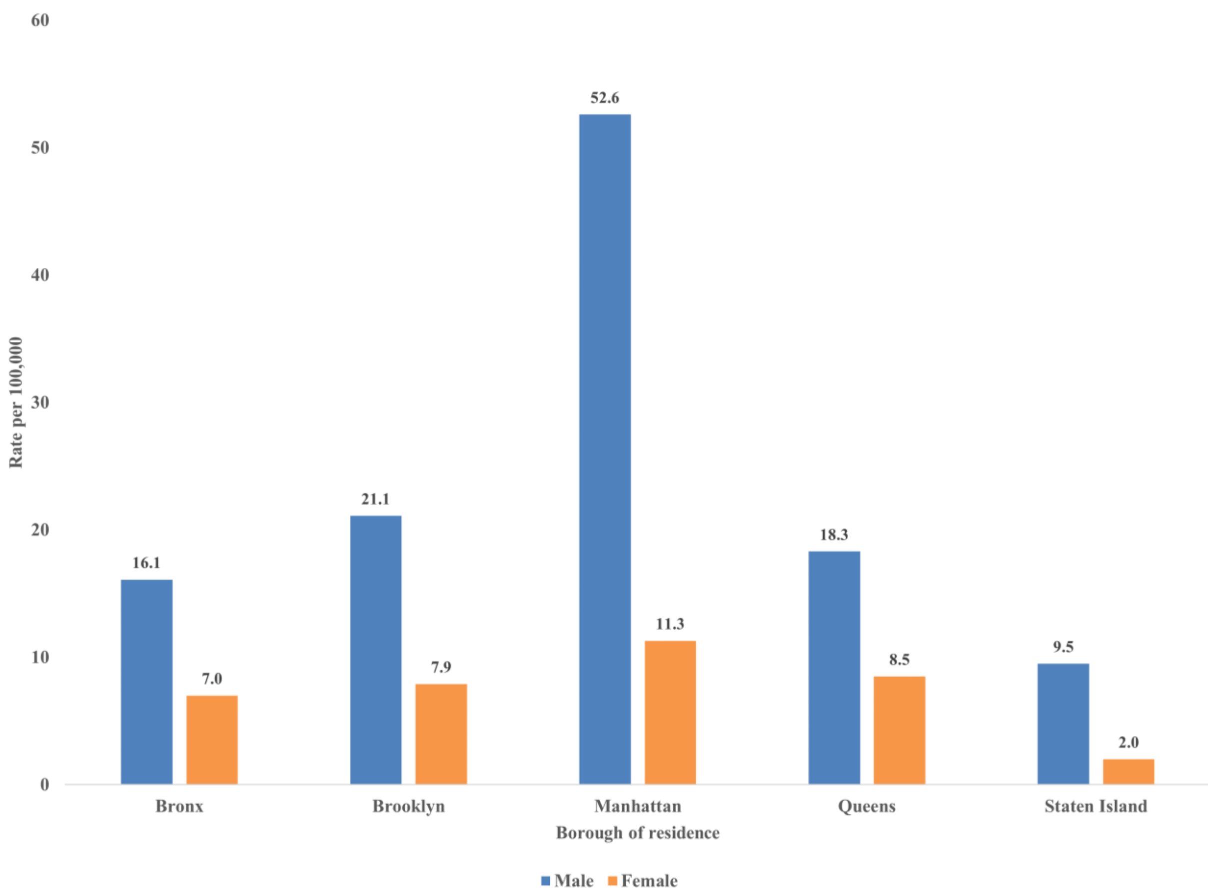

Figure 2.3: Giardiasis, annual case rate per 100,000 population by sex and borough of residence, New York City, 2023

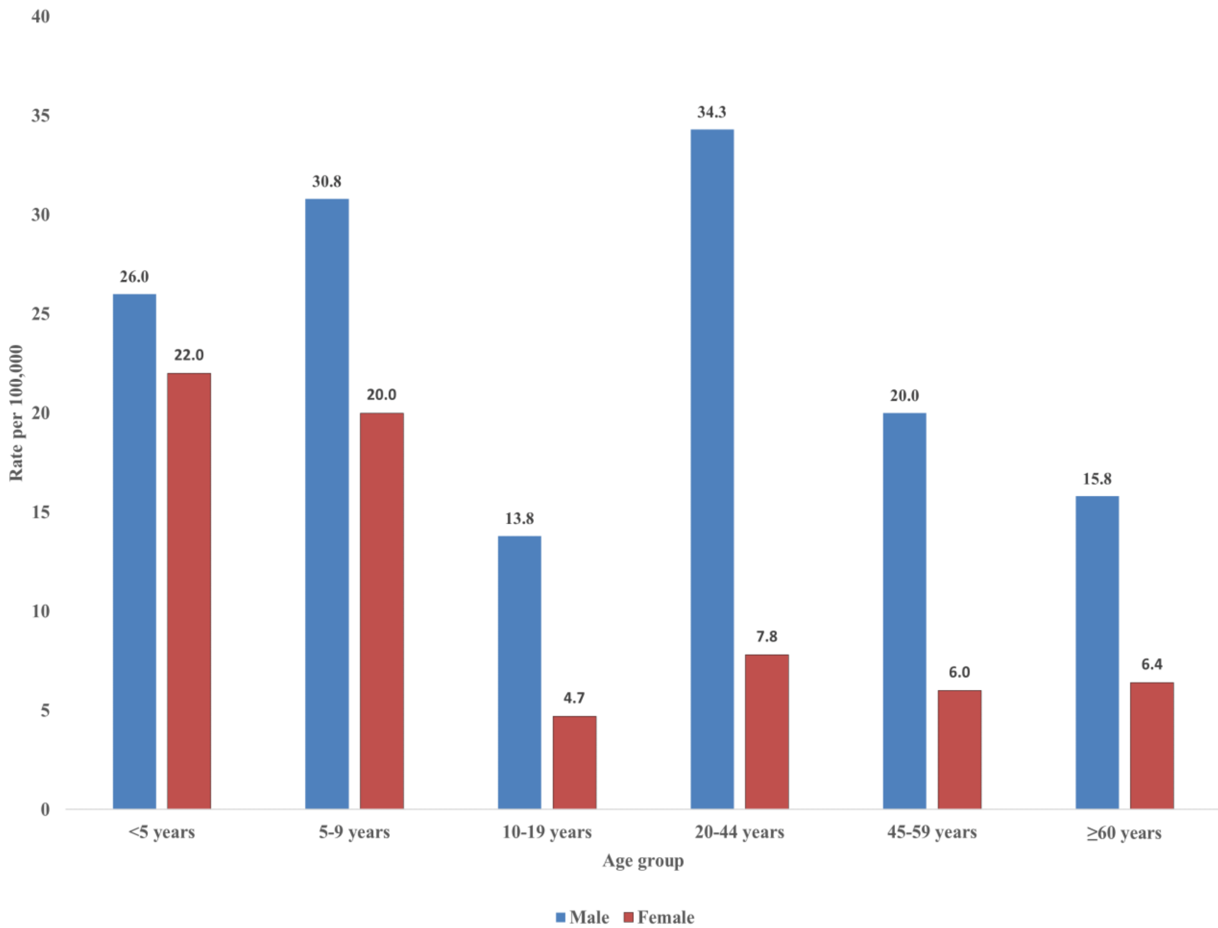

Figure 2.4: Giardiasis, annual case rate per 100,000 population by sex and borough of residence, New York City, 2023.

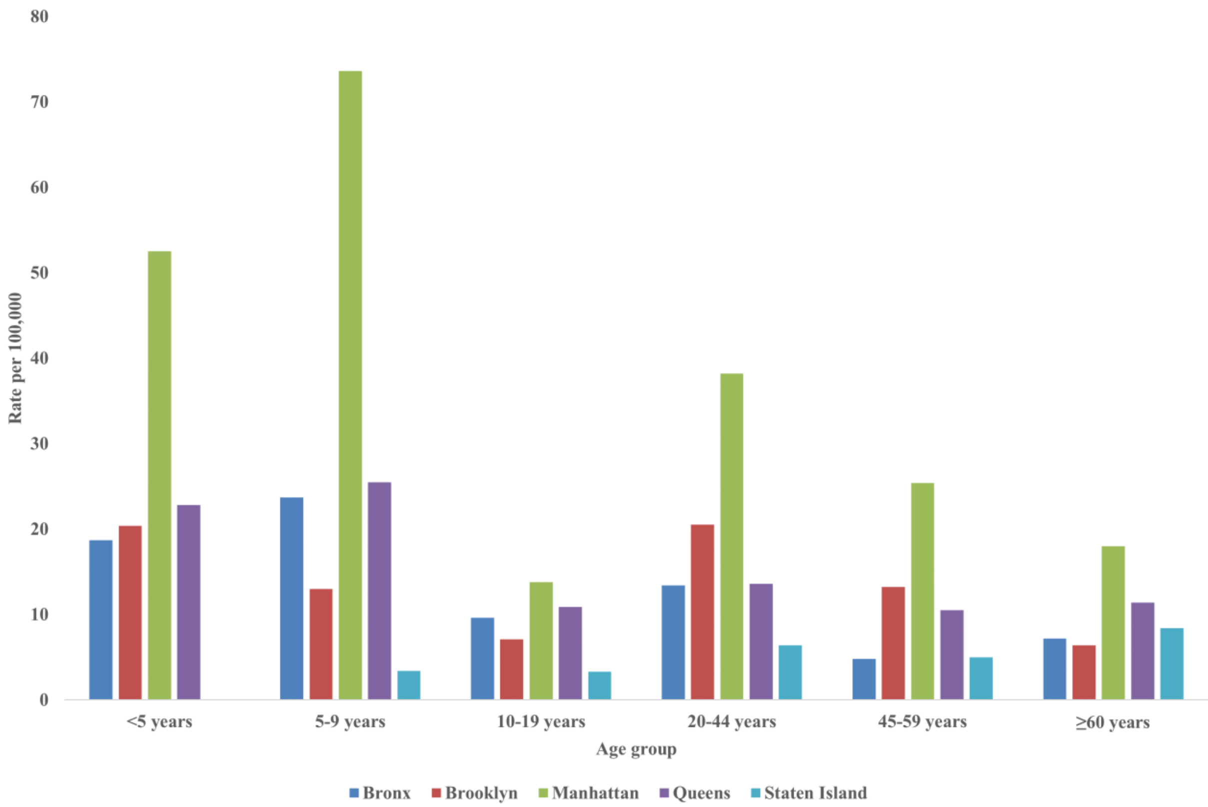

Figure 2.5: Giardiasis, annual case rate per 100,000 population by age group and borough of residence, New York City, 2023.

2.2.2 Risk Factors

In 2023, 12 patients diagnosed with giardiasis were excluded from work or school to reduce the risk of secondary transmission. The exclusions were children aged <5 years in childcare or preschool (n=10), a food handler (n=1) and a healthcare worker (n=1). No cases were associated with outbreaks. As in previous years, the age/sex demographic group with the largest number of diagnosed giardiasis cases in 2023 was adult men aged 20–44 years (47%, 635/1351) followed by adult men aged 45–59 years (14.7%, 198/1351) and adult men aged >=60 years (14.6%, 197/1351). Giardiasis rates have historically and consistently been elevated in Chelsea-Clinton, a neighborhood in Manhattan with a higher prevalence of men who have sex with men compared to the rest of NYC (Bureau of Epidemiology Services New York City Department of Health and Mental Hygiene 2017). It is hypothesized that giardiasis is a sexually transmissible enteric infection among men who have sex with men in NYC and accounts for a considerable burden of reported disease.

Giardiasis is known to be a sexually transmissible enteric infection among men who have sex with men (Mitchell and Hughes 2018). Studies from several decades in NYC demonstrated that giardiasis and amebiasis were commonly detected in this population (Phillips et al. 1981; Kean, William, and Luminais 1979). The authors of one study hypothesized that enteric parasitic infections are hyperendemic in men who have sex with men because of three factors: a high prevalence in the population, the prevalence of sexual behavior that facilitates transmission, and the frequency of exposure to infected persons (Phillips et al. 1981). However, information on exposures such as sexual behavior is not routinely collected for giardiasis patients in NYC, so it is not possible to determine how prevalent sexual behavior with increased risk of fecal/oral contact is among reported giardiasis patients.

2.3 Cryptosporidiosis

Cryptosporidiosis is also a reportable disease in NYC, per the NYC Health Code, and cryptosporidiosis positive laboratory results are reported to DOHMH via an electronic laboratory reporting system. Patient interviews for demographic and risk factor data are attempted for all confirmed cases.

2.3.1 Basic Trends and Demographics

During 2023, a total of 410 cases of cryptosporidiosis were reported to DOHMH, resulting in an annual case rate of 4.9 per 100,000 (Table 2.2). For historical context, Table 2.2 includes annual cryptosporidiosis case counts and rates for the prior ten years, along with the current reporting year. Cryptosporidiosis is highly seasonal in NYC, as shown in Figure 2.6 with cases most often diagnosed in August and September.

Table 2.2 Cryptosporidiosis, number of cases and case rates, New York City, 2013-2023

Year	Number of Cases	Case Rate per 100,000
2013	80	1.0
2014	102	1.2
2015	133	1.6
2016	192	2.2
2017	163	1.9
2018	250	2.9
2019	395	4.7
2020	135	1.6
2021	278	3.4
2022	347	4.2
2023	410	4.9

Note: Minor variations in the data may be related to reporting delays, corrections, the removal of duplicate reports, and other data processing refinements. Yearly case numbers and rates in this table may therefore differ from case numbers and rates that have appeared in prior WDRAP reports.

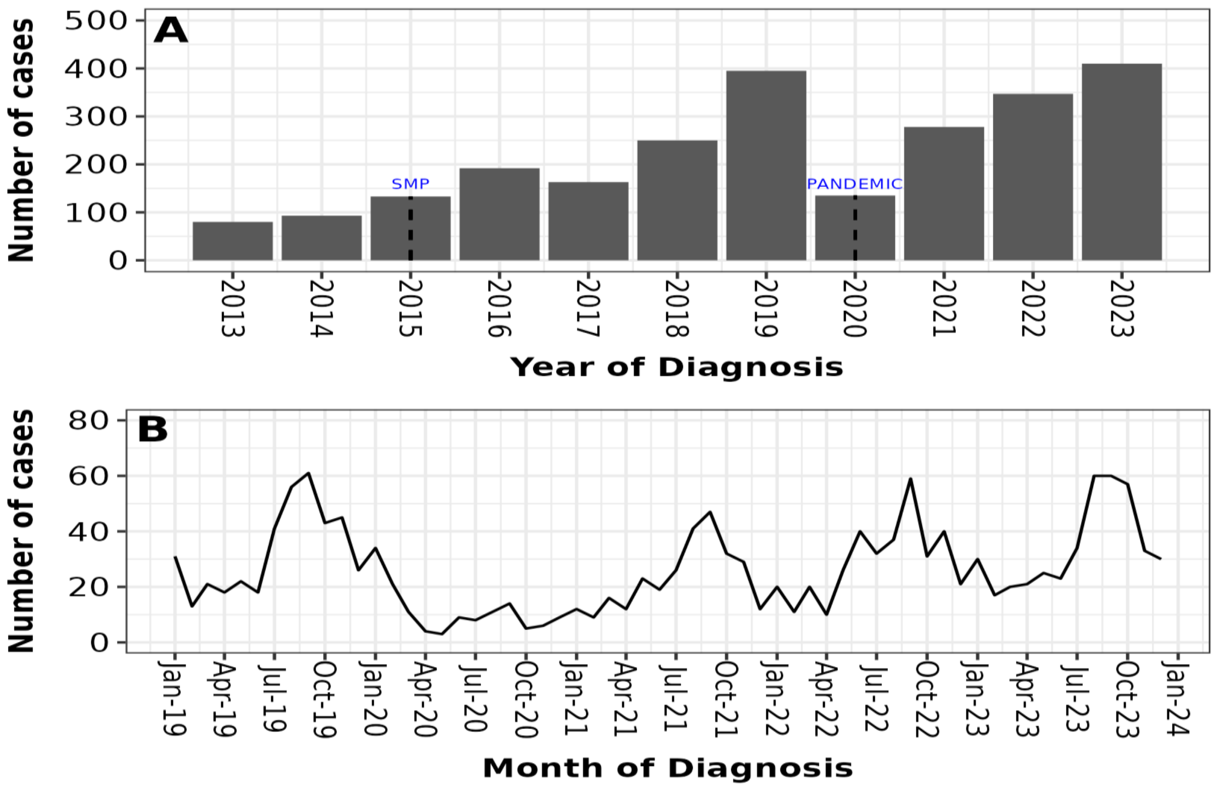

Figure 2.6: (A) Annual cryptosporidiosis counts, NYC, 2013-2023; and (B) monthly cryptosporidiosis counts for the last five years (B). The first vertical dotted line in Part A shows when the first NYC laboratory reported results from syndromic multiplex panels for enteric diseases (2015), and the second marks the start of the pandemic (2020).

The annual cryptosporidiosis case count increased 18.1% from 2022 to 2023. As was noted with giardiasis, cryptosporidiosis case counts and rates in NYC have also continued to increase since the pandemic. However, this pattern is consistent with returning to the pre-pandemic level of increased cases due to SMP testing; moreover, the number of cases observed in 2023 (410) is an insignificant increase when compared to 2019 (395 cases). Further exploration of the data will help to better understand the trends. Manhattan had the highest borough-specific annual case rate (8.2 cases per 100,000), and the Greenpoint UHF neighborhood in Brooklyn had the highest rate overall (20.7 cases per 100,000) (Figure 2.7).

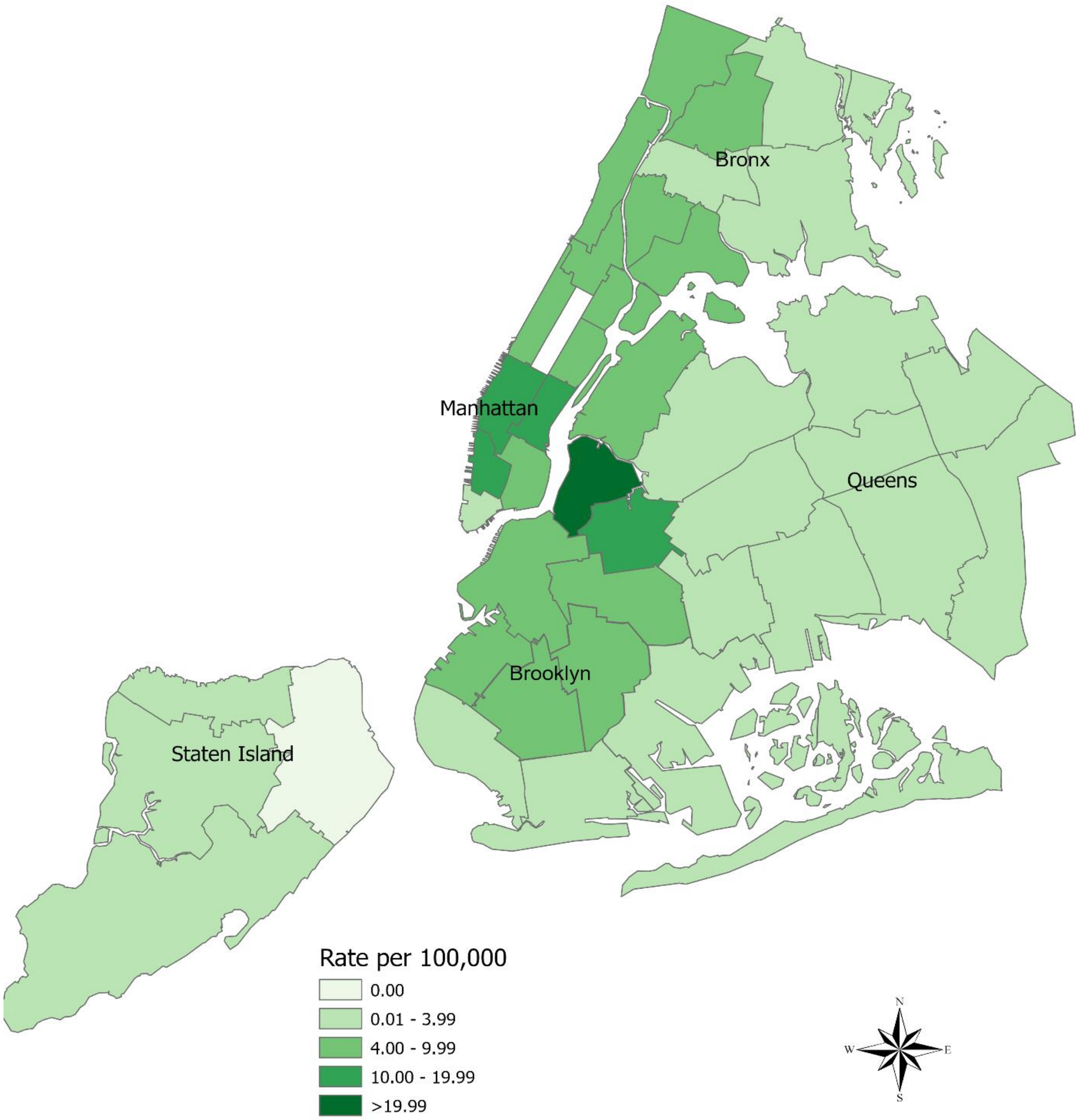

Figure 2.7: Map of Cryptosporidiosis annual case rate per 100,000 population by UHF neighborhood, NYC, 2023

Cryptosporidiosis was most common in males (6.3 cases per 100,000), and specifically males in Manhattan (11.3 cases per 100,000) (Figure 2.8). By age, the rate of cryptosporidiosis was greatest among children <5 years (11.4 cases per 100,000). The rate was highest for males <5 years (12.8 cases per 100,000) (Figure 2.9). The highest age group and borough-specific case rates occurred in children <5 years old in Brooklyn (18.0 cases per 100,000), followed by children <5 years in the Bronx (15.4 cases per 100,000) (Figure 2.10).

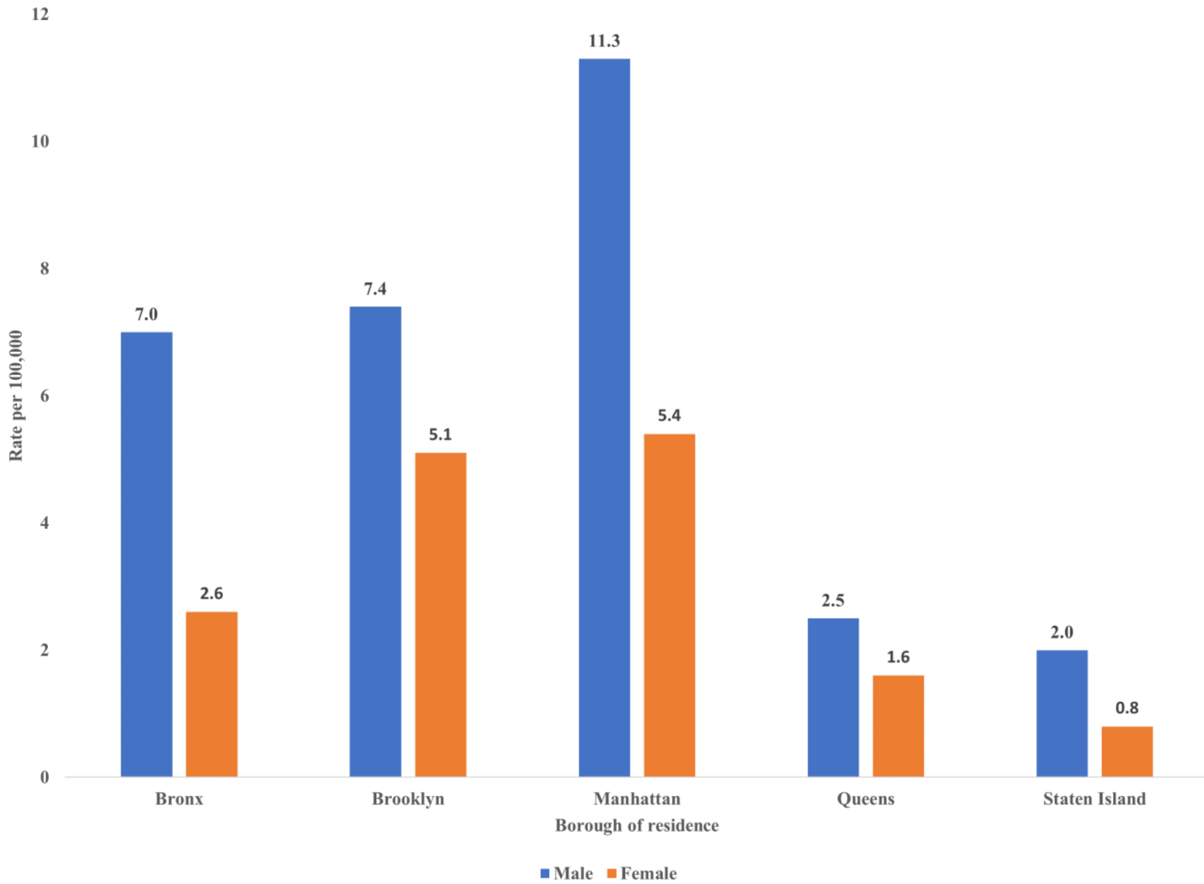

Figure 2.8: Cryptosporidiosis, annual case rate per 100,000 population by sex and borough of residence, New York City, 2023.

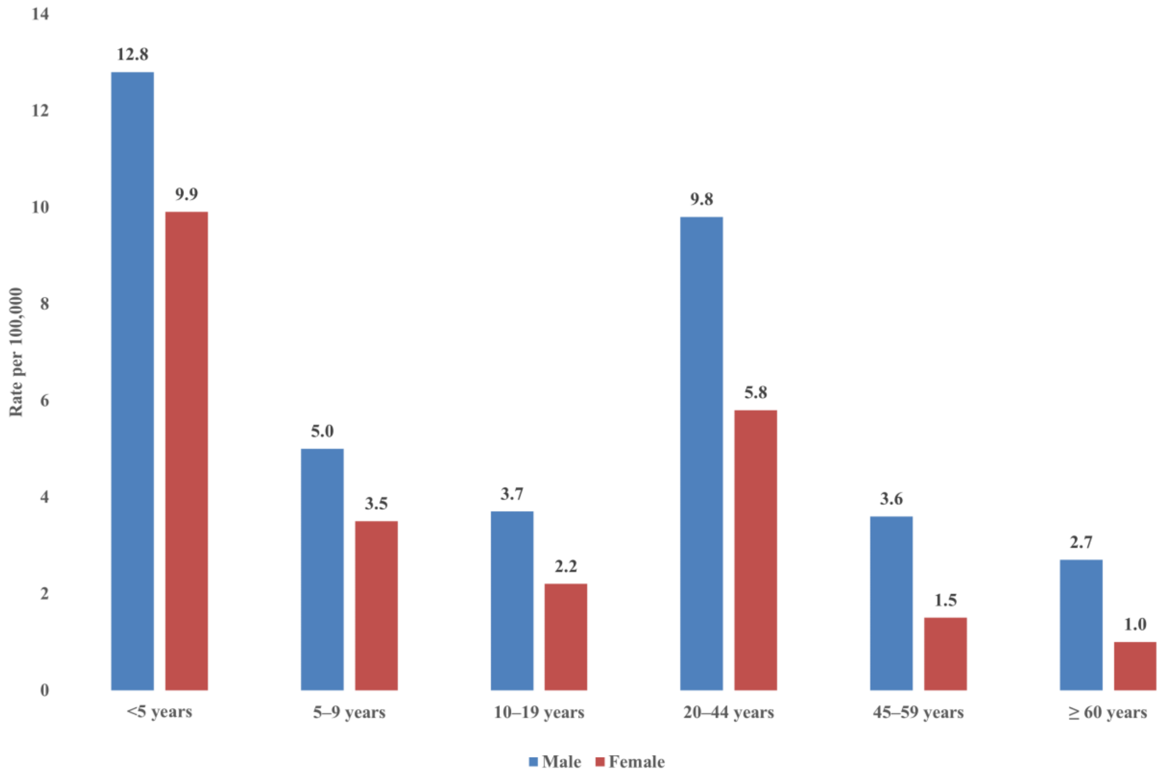

Figure 2.9: Cryptosporidiosis, annual case rate per 100,000 population by age group and sex, New York City, 2023.

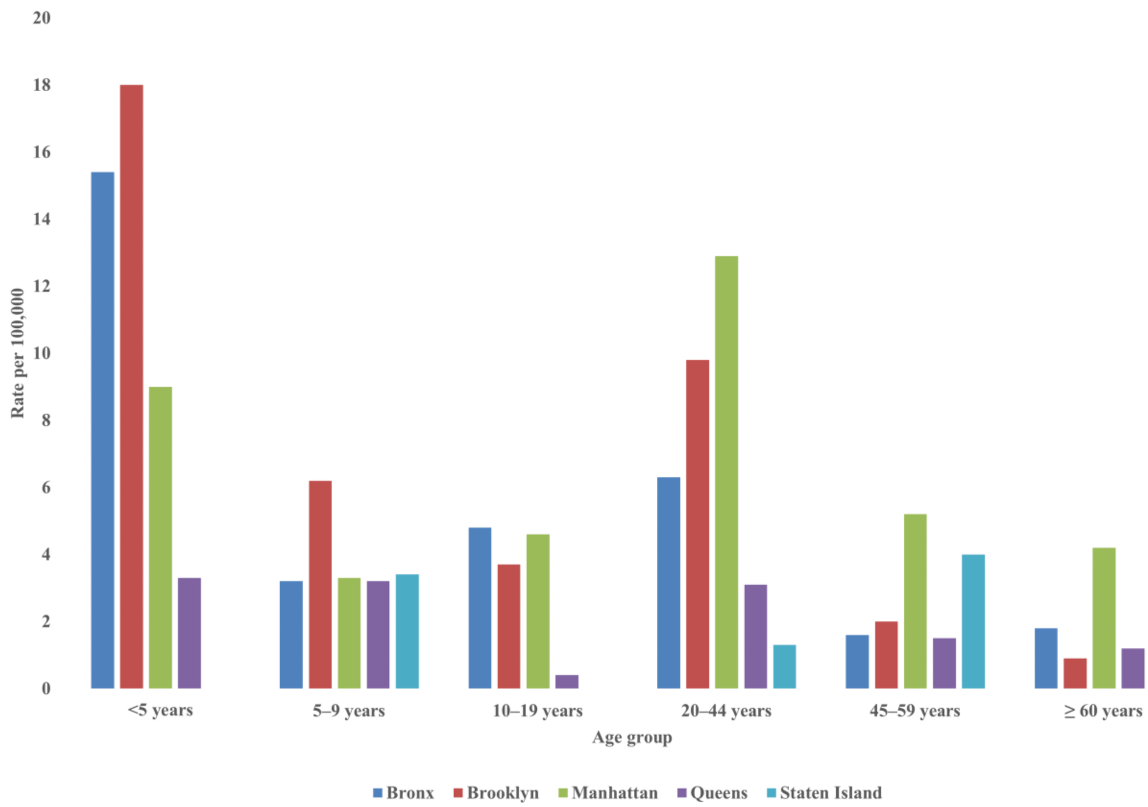

Figure 2.10: Cryptosporidiosis, annual case rate per 100,000 population by age group and borough, New York City, 2023.

Race/ethnicity data was available for the majority of cryptosporidiosis patients (85.4%). Among the major racial/ethnic groups, White, non-Hispanic followed by Hispanic persons had the highest cryptosporidiosis rate (6.7 and 4.3 per 100,000, respectively) (Table 2.3). Cryptosporidiosis rates were highest among White, non-Hispanic persons in Brooklyn (10.1 per 100,000), and next highest among White, non-Hispanic persons in Manhattan (8.7 per 100,000). By age group, rates were highest among White non-Hispanic children <5 years old (17.3 cases per 100,000) (Table 2.4). This paragraph does not describe some race/ethnic groups due to the relatively small number of people in those groups, as findings would be more impacted by random events due to small numbers.

Table 2.3: Cryptosporidiosis, number of cases and annual case rate per 100,000 population (in parentheses) by race/ethnicity and borough of residence, New York City, 2023

	Borough of residence					
Race/Ethnicity	**Manhattan** N (Rate)	**Bronx** N (Rate)	**Brooklyn** N (Rate)	**Queens** N (Rate)	**Staten Island** N (Rate)	**Total** N (Rate)
Hispanic	25 (6.0)	34 (4.4)	18 (3.7)	24 (3.7)	2 (2.2)	103 (4.3)
White	63 (8.7)	3 (2.5)	97 (10.2)	10 (1.8)	2 (0.7)	175 (6.7)
Black/African American	14 (6.8)	24 (5.9)	16 (2.1)	3 (0.7)	0	57 (3.1)
Asian	6 (2.9)	0	5 (1.5)	4 (0.6)	1 (1.5)	16 (1.2)
Pacific Islander, Native Hawaiian, American Indian	0	0	0	0	0	0
Two or more races	1 (2.8)	0	0	0	0	1 (0.6)
Unknown	22	4	24	6	2	58
Total	131 (8.2)	65 (4.7)	160 (6.2)	47 (2.1)	7 (1.4)	410 (4.9)

Table 2.4: Cryptosporidiosis, number of cases and annual case rate per 100,000 population (in parentheses) by race/ethnicity and age group, New York City, 2023

	Age group						
Race/Ethnicity	**<5 years** N (Rate)	**5–9 years** N (Rate)	**10–19 years** N (Rate)	**20–44 years** N (Rate)	**45–59 years** N (Rate)	**≥ 60 years** N (Rate)	**Total** N (Rate)
Hispanic	18 (11.6)	7 (4.4)	11 (3.4)	43 (4.8)	13 (2.9)	9 (2.0)	103 (4.3)
White	24 (17.3)	8 (6.4)	10 (4.2)	106 (11.0)	14 (3.1)	13 (1.9)	175 (6.7)
Black/African American	6 (6.3)	1 (1.1)	3 (1.5)	37 (5.8)	5 (1.7)	5 (1.2)	57 (3.1)
Asian	0	1 (1.4)	1 (0.8)	8 (1.6)	3 (1.1)	3 (1.0)	16 (1.2)
Pacific Islander, Native Hawaiian, American Indian	0	0	0	0	0	0	0
Two or more races, other	0	0	0	1 (1.7)	0	0	1 (0.6)
Unknown	6	3	2	42	2	3	58
Total	54 (11.4)	20 (4.3)	27 (3.0)	237 (7.8)	39 (2.5)	33 (1.7)	410 (4.9)

The number of cryptosporidiosis cases among persons living with HIV/AIDS has continued to decline over time, with only 57 cases reported in 2023 (representing 13.9% of all cases) (Figure 2.11). The count of cryptosporidiosis cases among immunocompetent patients has increased since 2015, rising from 78 to 313 in 2019 (a 300% increase). In 2020, the recorded count of cryptosporidiosis cases among immunocompetent patients fell to 90, coinciding with the overall reduction related to the pandemic, but increased from 196 cases in 2021 to 319 cases in 2023. This trend of increasing cases reported starting in 2015 is coincident with the introduction of syndromic multiplex panels, and likely reflects a broader population being tested for the pathogen more frequently. As cryptosporidiosis infection can be particularly severe among people living with HIV/AIDS (Blanshard et al. 1992; Rashmi and Kumar 2013; Poznansky et al. 1995), physicians were historically more likely to consider cryptosporidiosis in their differential diagnosis of diarrheal disease among persons living with HIV/AIDS than in a person without HIV/AIDS. However, now that syndromic multiplex panels can be ordered for diagnosis of any diarrheal infection in hospitals and clinics that have adopted these assays, cryptosporidiosis is more frequently identified in immunocompetent patients who likely would not have been tested for cryptosporidiosis before 2015.

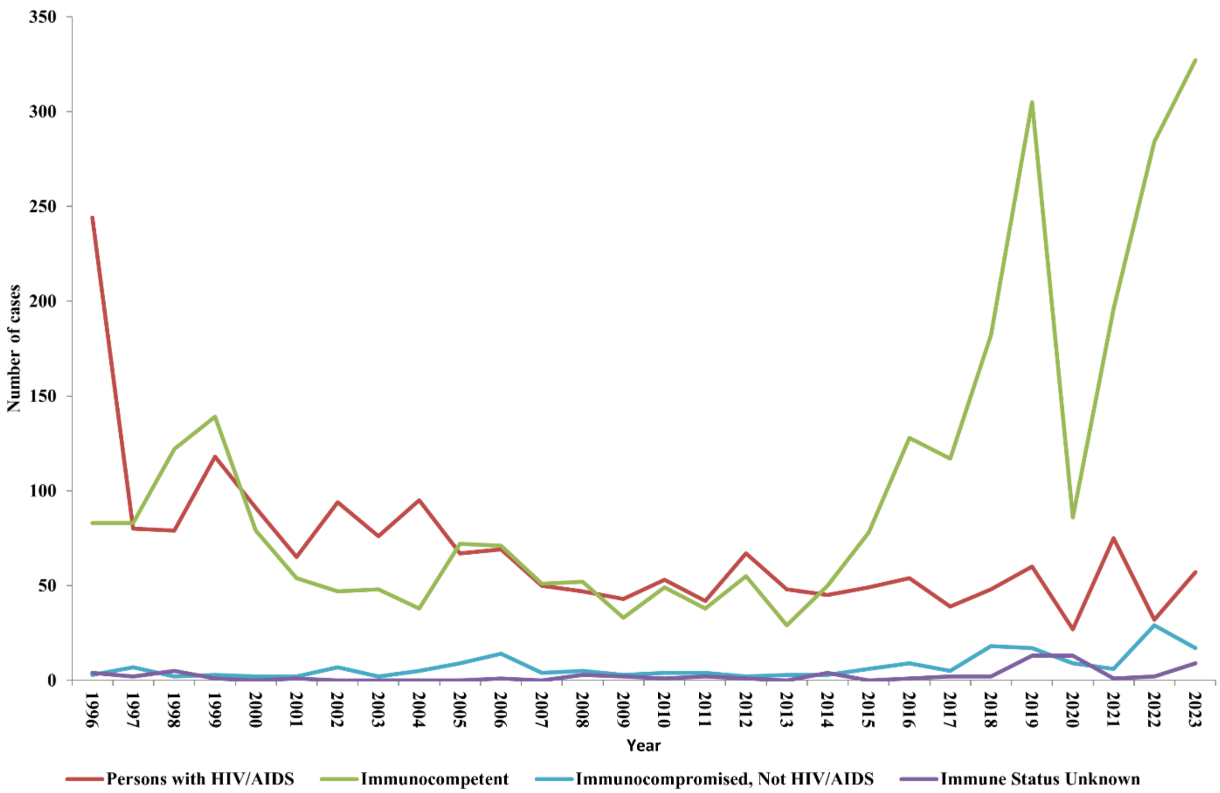

Figure 2.11: Cryptosporidiosis, number of cases by year of diagnosis and immune status, New York City, 1995-2023.

2.3.2 Risk Factors

In 2023, 12 patients diagnosed with cryptosporidiosis were excluded from work or school to reduce the risk of secondary transmission. The exclusions were children aged <5 years in childcare or preschool (n=6), food handlers (n=5), and a daycare employee (n=1).

Of the 410 cryptosporidiosis cases diagnosed among NYC residents in 2023, questionnaires concerning potential exposures were completed for 263 (64%) patients. For patients with missing interview data, investigators were either unable to locate the patient (93 cases, 23%) the patient refused interview (52 cases, 13%), the patient could not be interviewed because of an incapacitating illness (1 case, 0.2%), or the patient died (1 case, 0.2%). The interview data is compiled and reviewed by DOHMH.

As in previous years, and similar to giardiasis, the age/sex demographic group with the largest number of diagnosed cryptosporidiosis cases in 2023 was adult men aged 20–44 years (36% 147/410). Adult men aged 45–59 years accounted for an additional 7% of all people diagnosed with cryptosporidiosis in 2023. This demographic group has been consistently over-represented in surveillance data since the WDRAP began, again similar to the profile of giardiasis. Furthermore, cryptosporidiosis rates have historically and consistently been elevated in Chelsea-Clinton, a neighborhood in Manhattan with a higher prevalence of men who have sex with men compared to the rest of NYC (Bureau of Epidemiology Services New York City Department of Health and Mental Hygiene 2017). Therefore, it is hypothesized that cryptosporidiosis is often an infection among men who have sex with men in NYC.

Men who have sex with men are historically at greater risk for cryptosporidiosis, not only because of a higher prevalence of AIDS in this population (Centers for Disease Control and Prevention 2006), but also because of higher risk sexual practices related to oral/anal contact that entail a low risk for HIV transmission, but increase the risk for fecal contact (Hellard et al. 2003). To help link this risk factor to disease prevalence our survey questions solicit information on sexual behavior. In 2023, there were a total of 88 adult men aged 20–59 years who answered questions related to their sexual behavior during their cryptosporidiosis incubation period. In addition, there were 62 other adults (men aged 18, 19 and >59 years as well as all women ≥18 years) who also answered the sexual behavior questions when interviewed. Among men diagnosed with cryptosporidiosis aged 20–59 years, 47% (41/88) reported high-risk sexual practices, compared to 3% (2/62) of all other adult cryptosporidiosis patients ($p<0.001$, Fishers exact test). There are considerable limitations with large amounts of missing data in the sexual behavior questions. However, the data suggest that adult men diagnosed with cryptosporidiosis are likely to report engaging in sexual behaviors that increase the risk of fecal/oral contact.

3. SYNDROMIC SURVEILLANCE AND OUTBREAK DETECTION

The tracking of sentinel populations or surrogate indicators of disease ("syndromic surveillance") can be useful in assessing gastrointestinal (GI) disease trends in the general population. Such tracking programs provide greater assurance against the possibility that a citywide outbreak would remain undetected. In addition, such programs can play a role in limiting the extent of an outbreak by providing an early indication of a problem so that control measures can be rapidly implemented. There are four systems in place tracking the following data:

1. Hospital Emergency Department (ED) System: Chief complaint logs are monitored for outbreaks.
2. Anti-Diarrheal (ADM) and Over-the-Counter (OTC) System: Sales of anti-diarrheal and over-the-counter medications are monitored for changes.

3. Clinical Laboratory System: The number of stool specimens submitted to a participating clinical laboratory for microbiological testing is monitored.
4. Nursing Home Sentinel Surveillance: GI outbreaks in sentinel nursing homes are monitored and DOHMH staff assist in the investigation of any identified outbreaks.

A description of each system can be found in Appendix B.

Throughout 2023, DOHMH received electronic data from all of NYC's 53 EDs, which reported approximately 9,800 visits per day. Additionally, data were received daily from approximately 400 pharmacies as part of the ADM/OTC system, the large clinical laboratory participating in the Clinical Laboratory system transmitted data by fax 3-4 times per week, and the eight nursing homes participating in the Nursing Home Sentinel Surveillance system were contacted by WDRAP team members throughout 2023.

3.1 Findings: Summary of Syndromic Surveillance Signals

In this section, GI disease signals from NYC's four syndromic surveillance systems are summarized. Figure 3.1 shows the ratio of daily ED visits for the diarrhea syndrome to all other daily ED visits for syndromes not tracked by ED syndromic surveillance ("other visits") from January 1 to December 31, 2023. The graph also indicates the occurrence of citywide signals, spatial residential zip code signals, and hospital signals. There were sustained (i.e.,>1 day) diarrheal hospital ED signals in December 2023. There were no citywide diarrheal ED signals in 2023.

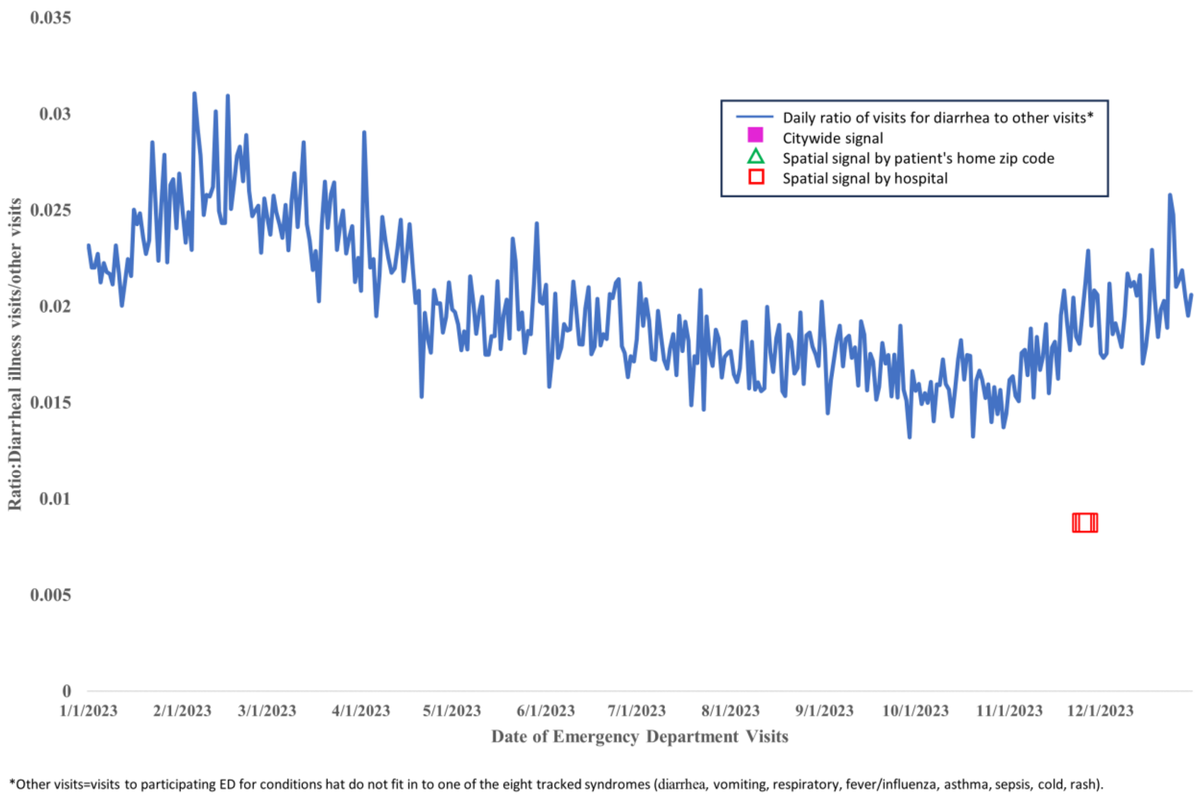

Figure 3.1: Emergency Department Syndromic Surveillance, Trends in visits for the diarrhea syndrome, New York City, January 1, 2023 - December 31, 2023

Figure 3.2 shows the ratio of daily ED visits for the vomiting syndrome compared to all other daily ED visits for syndromes not tracked by ED syndromic surveillance for 2023. There were sustained spatial hospital signals in August and September and 2023. There were no citywide vomiting ED signals in 2023.

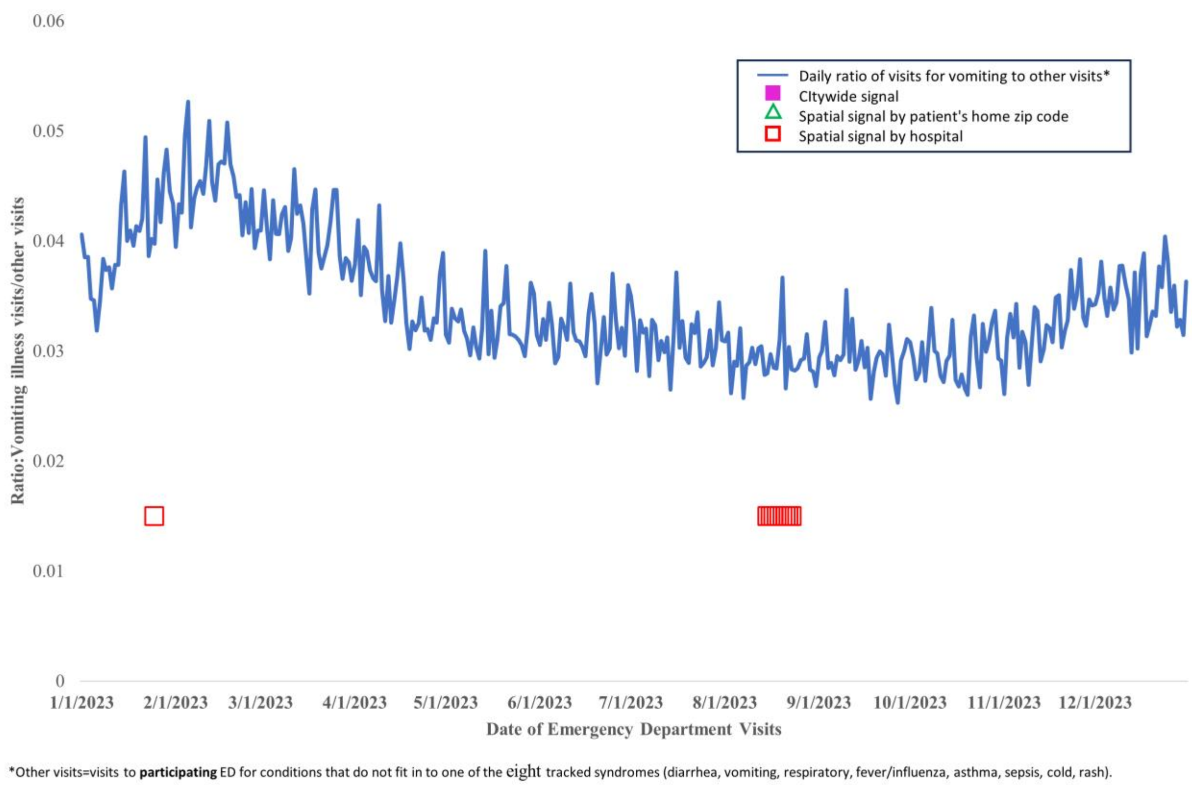

Figure 3.2: Emergency Department Syndromic Surveillance, Trends in visits for the vomiting syndrome, New York City, January 1, 2023 - December 31, 2023

Figure 3.3 shows the timing of signals from all four surveillance systems in 2023. There were no citywide signals in either diarrhea or vomiting from the ED systems. There was one GI outbreak in sentinel nursing homes in February that was caused by Norovirus Genotype II. In the OTC/ADM system, there were sustained signals throughout the year, concentrating specifically in March, July, October, November, and December. Most of the OTC/ADM signals were found to be related to promotional sales at the pharmacy chains, specifically for Pepto Bismol®/Bismuth sales. There was no evidence to suggest that the OTC/ADM signals were related to a waterborne disease outbreak. Additionally, there were three signals in the Clinical Laboratory surveillance system throughout the year. The three signals were only one day in length, which is not suggestive of any sustained signal and supports the conclusion of a lack of a waterborne disease outbreak.

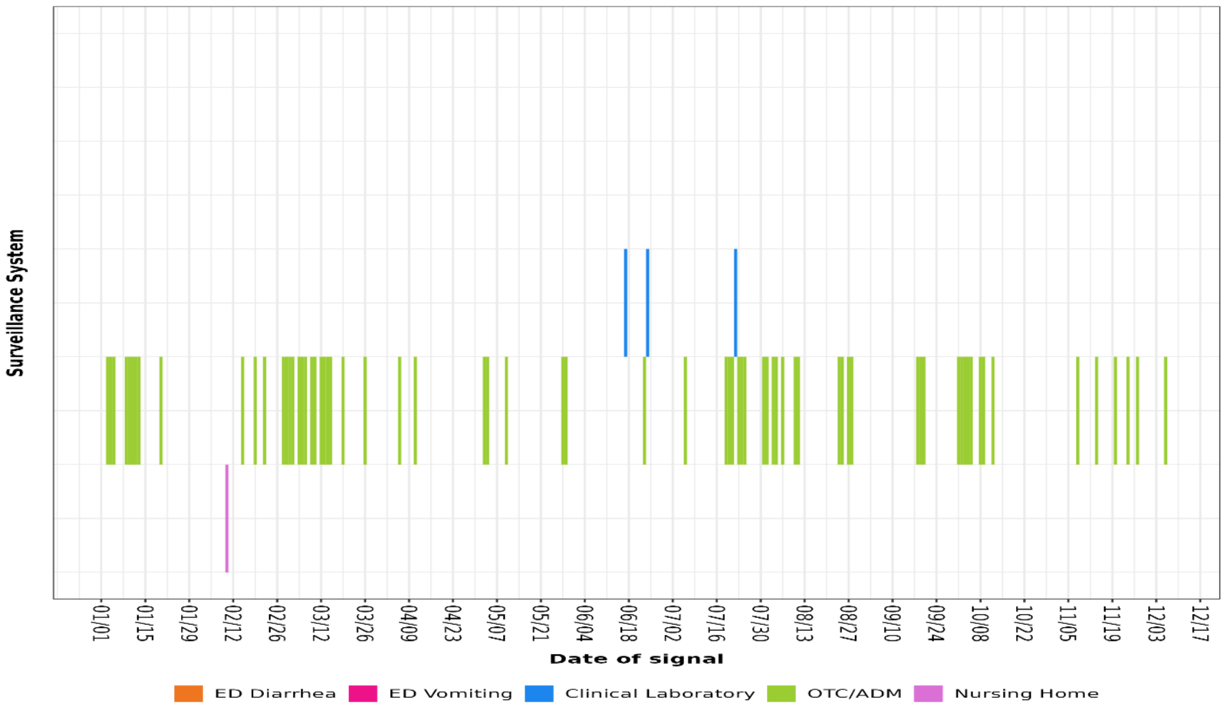

Figure 3.3: Timeline for signals for Gastrointestinal Illness, Syndromic Surveillance Systems, New York City, 2023

Syndromic surveillance signals alone cannot be used to determine etiologic diagnoses. Also, experience has shown that most signals, especially localized spatial signals in the emergency department system or signals in the laboratory or ADM monitoring systems, may be statistical aberrations and not related to public health events. The systems are therefore used in concert. Given the signals observed during this reporting period were localized, were short duration, and lacked corresponding signals in the other monitoring systems, these were not determined to be related to a waterborne disease outbreak.

In conclusion, during 2023, there were no signals consistent with a waterborne disease outbreak from the four syndromic surveillance systems set up to detect an outbreak related to the water supply. This finding is consistent with all prior years of WDRAP surveillance.

4. INFORMATION SHARING, RESPONSE, PLANNING, & SPECIAL PROJECTS

Information pertaining to NYC's Waterborne Disease Risk Assessment Program and related issues are available on both the DEP and DOHMH websites, including results from the NYC source water protozoan monitoring program. Documents on the websites include:

DOHMH Web pages:

- *Giardiasis* fact sheet: https://www1.nyc.gov/site/doh/health/health-topics/giardiasis.page
- *Cryptosporidiosis* fact sheet: http://www1.nyc.gov/site/doh/health/health-topics/cryptosporidiosis.page
- Communicable Disease Surveillance Data: https://a816-health.nyc.gov/hdi/epiquery/visualizations?PageType=ts&PopulationSource=CDSD&Topic=1&Subtopic=43
- Diarrheal Infections in Gay Men and Other Men Who Have Sex with Men: https://www1.nyc.gov/site/doh/health/health-topics/diarrheal-infections.page
- DOHMH and DEP Waterborne Disease Risk Assessment Program Annual Report Data: https://opendata.cityofnewyork.us

DEP Web pages:

- *Waterborne Disease Risk Assessment Program's Annual Reports (1997 – current):* https://www1.nyc.gov/site/dep/water/waterborne-disease-risk-assessment.page *New York City Drinking Water Supply and Quality Statement (for latest posted report):* https://www1.nyc.gov/site/dep/about/drinking-water-supply-quality-report.page
- *DEP Water Supply Testing Results for Giardia and Cryptosporidium:* https://data.cityofnewyork.us/Environment/DEP-Cryptosporidium-And-Giardia-Data-Set/x2s6-6d2j
- Additional Information: https://www1.nyc.gov/site/dep/about/document-portal.page

With regard to response planning, NYC has an action plan for responding to elevations in levels of *Giardia* cysts and *Cryptosporidium* oocysts. The initial response plan was developed in 2001 and is currently called NYC's "Hillview Reservoir *Cryptosporidium* and *Giardia* Action Plan" (CGAP). The plan is reviewed and updated on an annual basis including most recently in December 2023.

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APPENDIX A: INFORMATION ON CALCULATION OF RATES, CASE DEFINITIONS, AND WATER EXPOSURE DATA COLLECTION

This appendix contains additional details relevant to topics or data addressed in the report. Newly added is a section on drinking water questions from the cryptosporidiosis interview form.

<u>POPULATION DENOMINATORS</u>

[This paragraph explains procedures for population denominators, relevant to historic and current WDRAP data]

The population denominators used to calculate rates were intercensal population estimates for all years except 2000 and 2010 to 2012. For the years 1994 through 1999, intercensal population estimates per year were used based upon linear interpolation between 1990 and 2000 NYC Census. For the years 2001 through 2009 and 2013 through 2021, intercensal population estimates for each year were used from data produced by DOHMH based on the US Census Bureau Population Estimate Program and housing unit data obtained from the NYC Department of City Planning. For 2010 to 2012, the year 2010 NYC Census data were used (New York City Department of City Planning 2010). Because rates for the years 2001 through 2009 and the rates for the years 2014 through 2022 were calculated for this report using intercensal population estimates, they may differ from previously reported rates based on year 2000 and 2010 NY Census data. For 2023, the intercensal population estimate for 2022 was used since data for 2023 have yet to be released. Other variations in data between this report and previous reports may be because of factors such as disease reporting delays, correction of errors, and refinements in data processing (for example, the removal of duplicate disease reports). All rates in this report are annual rates. Caution must be exercised when interpreting rates based on very small case numbers.

<u>UHF ZONES</u>

For mapping purposes, the United Hospital Fund (UHF) neighborhood of patient residence was used. New York City is divided on the basis of zip code into 42 UHF neighborhoods. Maps illustrating annual case rates by UHF neighborhood are included in this report.

<u>RACE-ETHNICITY CATEGORIES</u>

In this report, race/ethnicity-specific case rates for 2021 are based upon intercensal population estimates and include the race/ethnicity categories used by the US Census Bureau Population Estimate Program. Prior to 2011, there was one race/ethnicity category entitled “Asian, Pacific Islander, American Indian, Alaskan Native, non-Hispanic”. Since 2011, separate categories have been used for non-Hispanic Asians, non-Hispanic Pacific Islanders and Native Hawaiians, non-Hispanic American Indian and non-Hispanic of two or more races.

CONFIRMED AND PROBABLE CASES

As was first described in the 2012 Annual Report, confirmed and probable cryptosporidiosis cases are now included in the WDRAP reports. Confirmed cases are those in which the laboratory method used has a high positive predictive value (such as light microscopy of stained slide, enzyme immunoassay, polymerase chain reaction, and direct fluorescent antibody test). Probable cases are those in which the laboratory method used has a low positive predictive value (such as the immunochromatographic card/rapid test) or in which the method used for diagnostic testing was not known. The probable case classification for cryptosporidiosis also includes those cases in which laboratory confirmation was not obtained, but the case was epidemiologically linked to a confirmed case and clinical illness was consistent with cryptosporidiosis. DOHMH BCD reports both confirmed and probable cryptosporidiosis cases to the Centers for Disease Control and Prevention through the National Electronic Telecommunications System for Surveillance. BCD interviews all cases. However, if cases are not confirmed at NYS DOH Wadsworth Center then these patients are not considered to be a case and are not included in the final annual count.

CRYPTOSPORIDIOSIS CASE INTERVIEWS – DRINKING WATER CONSUMPTION QUESTIONS

During patient follow up, to determine water drinking habits during their incubation period the following questions are asked:

- Did you (your child) drink any NYC tap water? This includes any NYC municipal water that you may have drank directly from the faucet or which you may have boiled or filtered before drinking, including water used to make tea or coffee that came directly from the tap.
- How many cups of NYC tap water did you (your child) drink on average per day, including directly from the tap, or boiled, or filtered water?
- How many cups of NYC tap water were directly from the tap without being boiled or filtered?
- How many cups of NYC tap water were boiled?
  - How many minutes did you boil NYC tap water?
- How many cups of NYC tap water were filtered? Make of filter and model name and number asked.
- Did you (your child) use unboiled/unfiltered NYC tap water to brush his/her teeth?
- Did you (your child) use unboiled/unfiltered NYC tap water to wash vegetables or fruit?
- Did you (your child) use unboiled/unfiltered NYC tap water to make ice?
- Did you (your child) use unboiled/unfiltered NYC tap water to make juice from concentrate?
- Did you (your child) drink water from a private well? Location asked.

- Did you (your child) drink tap water, or a drink made with tap water when traveling outside of the US?
- Did you (your child) drink municipal water outside NYC, but within the US?
- Did you (your child) drink water from a spring? Location, date and knowledge of other sick person(s) asked.
- Did you (your child) drink water from a pond/lake/river or stream? Location, date and knowledge of other sick person(s) asked.
- Did you (your child) drink commercially bottled water? Brand, amount and location obtained asked.

Note: Some results from patient interviews are available on the NYC DOHMH (Open data) website and are updated yearly.

APPENDIX B: SYNDROMIC SURVEILLANCE SYSTEM DESCRIPTIONS

HOSPITAL EMERGENCY DEPARTMENT (ED) SYSTEM

NYC initiated monitoring of hospital ED visits as a public health surveillance system in 2001, and this system has been in operation since that time. Hospitals transmit electronic files hourly containing chief complaint and demographic information for patient visits. Patients are classified into syndrome categories, and daily analyses are conducted to detect any unusual patterns or signals. The two syndromes used to track GI illness are the vomiting syndrome and the diarrhea syndrome. Temporal citywide analyses assess whether the frequency of ED visits for the syndrome has increased in the last seven days compared to the previous 28 days. Clustering is examined by both hospital location and residential zip code. Statistical significance is based on Monte Carlo probability estimates that adjust for the multiple comparisons inherent in examining many candidate clusters each day. The threshold of significance for citywide and spatial signals is set at a recurrence interval of 365 days, indicating a false signal rate of once every 365 days. The most current description of the system is in Lall, et al 2017.

ANTI-DIARRHEAL MEDICATION (ADM) AND OVER-THE-COUNTER (OTC) SYSTEM

NYC began tracking anti-diarrheal drug sales as an indicator of GI illness trends in 1995 via a system operated by DEP. Major modifications and enhancements to NYC's anti-diarrheal medication surveillance program have been made over the years, including: utilization of different data sources, initiation and expansion of DEP's ADM program, initiation of DOHMH's OTC program in 2002, and in 2012, the merger of the ADM and the OTC systems. The ADM and OTC systems were merged to simplify the processing and analysis of pharmacy data and combine the strengths of the two systems. The combined OTC/ADM system is operated by DOHMH, and the first full year of operation of the merged system was 2013. DOHMH conducted an evaluation of the impact of the merger of the two systems (final report completed in 2014). In 2015, one ADM pharmacy chain data source dropped out of the program, but two additional pharmacy chains were added. Surveillance with both additional pharmacy chains began in 2016.

In summary, the current system involves tracking of sales of over-the-counter, non-bismuth-containing anti-diarrheal medications and of bismuth subsalicylate medications, searching for citywide as well as local signals. DOHMH Bureau of Communicable Disease (BCD) staff review signals on a daily basis to evaluate whether there are any new or sustained signals at citywide and zip-code levels. If there are sustained signals, BCD staff will perform reviews of reportable GI illness, including norovirus and rotavirus, to attempt to rule out a potential waterborne outbreak. Also, information on product promotions (e.g., price discounts) are considered, as these are known to impact on sales volume).

CLINICAL LABORATORY SYSTEM

The number of stool specimens submitted to clinical laboratories for bacterial and parasitic testing also can be a source of information on GI illness trends in the population. The clinical laboratory monitoring system currently collects data from one large laboratory, designated as Laboratory A in this report. The number of participating laboratories has changed over time, as reported in prior WDRAP reports. Laboratory A transmits data by fax to DOHMH BCD 3–4 times per week, indicating the number of stool specimens examined per day for: (a) bacterial culture and sensitivity, (b) ova and parasites, and (c) *Cryptosporidium*.

The Clinical Laboratory Monitoring results are reviewed upon their receipt. Beginning in 2004, DOHMH implemented a model to establish statistical cut-offs for significant increases in clinical laboratory submissions. The model uses the entire historical dataset from November 1995 for Laboratory A. Sundays and holidays are removed because the laboratories do not test specimens on those days. Linear regression is used to adjust for average day-of-week and day-after-holiday effects as certain days routinely have higher volumes than other days. The cumulative sums (CUSUM) method is applied to a two-week baseline to identify statistically significant aberrations (or signals) in submissions for ova and parasites and for bacterial culture and sensitivity. CUSUM is a quality control method that has been adapted for aberration-detection in public health surveillance. CUSUM is described further in Hutwagner, et al. (Hutwagner et al. 1997).

NURSING HOME SENTINEL SURVEILLANCE

The nursing home surveillance system began in 1997. Under the current protocol, when a participating nursing home documents an outbreak of GI illness that is legally reportable to NYSDOH, the nursing home also notifies the WDRAP team at DOHMH. Such an outbreak is defined as onset of diarrhea and/or vomiting involving three or more patients on a single ward/unit within a seven-day period, or more than expected (baseline) number of cases within a single facility. All participating nursing homes have been provided with stool collection kits in advance. When such an outbreak is noted, specimens are to be collected for testing for bacterial culture and sensitivity, ova and parasites, *Cryptosporidium* spp., viruses, and *Clostridium difficile* toxin. Though *C. difficile* is not a waterborne pathogen, *C. difficile* toxin testing was added in 2010 to address a need expressed by infection control practitioners in the nursing homes and was intended to help ensure compliance with the sentinel nursing home protocol.

DOHMH BCD staff facilitates transportation of the specimens to the DOHMH Public Health Laboratory, where culture and sensitivity testing is performed. Specimens designated for ova and parasite tests, *Cryptosporidium* as well as for virus and *C. difficile* toxin testing are sent to NYSDOH Wadsworth Center Laboratory. There are currently eight nursing homes participating in the program. Three are in Manhattan, two are in the Bronx, two are in Queens, and one is in Brooklyn. As feedback for their role in outbreak detection, participating nursing homes are provided with copies of the WDRAP annual report.

All participating nursing homes are visited on an annual basis to help ensure compliance with the program protocol. During the site visits, DOHMH staff members reviewed the rationale for the program and program protocol with nursing administration or infection control staff. In addition, the DOHMH staff members verified that the nursing homes had adequate stool collection supplies on hand.