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
2020 Annual Report

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2017 NYC Filtration Avoidance Determination

Environmental Protection

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
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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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 Filtration Avoidance Program. The primary objectives of WDRAP at this time 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 data collected in 2020.

DISEASE SURVEILLANCE

Active disease surveillance for giardiasis and cryptosporidiosis began in July 1993 and November 1994, respectively, and continued through 2010 when it was replaced by an electronic reporting system. This report presents the number of cases and case rates for giardiasis and cryptosporidiosis in 2020, and it includes data from past years for context. Demographic information for cases of giardiasis and cryptosporidiosis diagnosed in 2020 is also summarized in this report. Telephone interviews of cryptosporidiosis patients were conducted to gather potential risk exposure information, and selected results are presented.

Giardiasis and cryptosporidiosis rates declined over the first twenty years of this surveillance program. However, reported detections of these parasitic diseases, particularly cryptosporidiosis, began to increase in 2015, coinciding with the introduction of new and more sensitive, more convenient, and less expensive diagnostic assays. In 2020, the count and rate of reported cases of giardiasis and cryptosporidiosis were lower than in recent years. There were 636 reported cases of giardiasis in 2020, compared to 1,205 in 2019. The rate of giardiasis cases reported per 100,000 population decreased from 14.3 in 2019 to 7.6 in 2020, which was below the range of observed rates over the last decade (rate range 2010–2019: 9.2–14.3, median: 11.0). In 2020, there were 135 reported cases of cryptosporidiosis, compared to 395 in 2019. The rate of cryptosporidiosis per 100,000 population decreased from 4.7 in 2019 to 1.6 in 2020. The 2020 rate of reported cryptosporidiosis cases was within the range of rates observed over the last decade (rate range 2010 – 2019: 1.0–4.7 median: 1.55), though it is below the range observed over the most recent few years (2016–2019).

The COVID-19 pandemic had an impact on both cryptosporidiosis and giardiasis incidence in NYC in 2020. As with all other reportable diseases, the counts of new cases detected and reported decreased sharply starting in March 2020 when stay at home orders were instituted by New York State (New York State 2020). All persons with mild and moderate illness were instructed to stay at home to avoid COVID-19 exposure, preserve personal protective equipment at healthcare facilities, and to preserve medical care for the most severely ill (New York City Department of Health and Mental Hygiene 2020a). Given these recommendations, healthcare seeking behavior declined sharply beginning in March 2020. The drop in reported parasitic disease likely reflects both a lack of detection given the altered healthcare seeking behavior of the population, as well as an actual reduction in disease through interruption of exposure and person to person transmission. International travel is one of the main hypothesized routes of transmission of cryptosporidiosis and international travel largely stopped starting in March 2020 through the end of the year. However, DOHMH continued to be able to receive and follow up on reports of giardiasis and cryptosporidiosis. In addition, syndromic surveillance was ongoing throughout 2020.

As discussed in prior WDRAP reports, in 2015, the introduction of a new type of diagnostic test coincided with an increasing trend in observed cases of giardiasis and cryptosporidiosis. These assays, known as syndromic multiplex polymerase chain reaction (PCR) panels, can test for the presence of a wide range of enteric organisms including *Cryptosporidium* and *Giardia*. The poor sensitivity of traditional diagnostics in addition to specific testing requirements likely contributed to under-reporting of cryptosporidiosis. However, since 2015, physicians at an increasing number of hospitals and laboratories across NYC can order a single test for a patient with diarrheal disease and evaluate the presence of approximately 20 different pathogens. The increased number of cases of parasitic disease observed between 2015 and 2019 are hypothesized to reflect an increase in the detection of cases and not a true increase in disease for both cryptosporidiosis and giardiasis. This trend has been observed across the United States. DOHMH expected the increase to continue in 2020; however the COVID-19 pandemic resulted in a dramatic reduction in cases of parasitic disease.

SYNDROMIC SURVEILLANCE AND OUTBREAK DETECTION

The tracking of sentinel populations (e.g., nursing homes) or surrogate indicators of disease (e.g., drug sales) through "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 an outbreak so that control measures are rapidly implemented.

DOHMH maintains four distinct and complementary outbreak detection systems: one system involves the tracking of chief complaints from hospital emergency department (ED) databases; a second system monitors the sale of over-the-counter (non-prescription) anti-diarrheal medications; a third system tracks the number of stool specimens submitted to a clinical laboratory for microbiological testing; the fourth system involves DOHMH monitoring and assisting in the investigation of GI outbreaks in eight sentinel nursing homes. A summary of syndromic surveillance findings for 2020 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 2020 (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 protozoa monitoring program. An updated version of NYC's *"Hillview*

Reservoir Cryptosporidium and Giardia Action Plan" (CGAP) was issued in 2020, per annual requirement. During 2020, DEP re-initiated work on a project surveying select U.S. cities about their public health surveillance practices relevant to detection of potentially-waterborne diseases, and related activities. Also, in 2020, WDRAP staff contributed to NYC's FAD Summary and Assessment report, and to review of a NASEM Expert Panel report on NYC's FAD programs.

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 Program, 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, under a joint-agency (DEP-DOHMH) Memorandum of Understanding. The intra-agency agreement between DEP and DOHMH for continuation of WDRAP was updated and signed in 2017, laying out the organizational & funding foundation for WDRAP until 2022.

The primary objectives of WDRAP at this time 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 2020.

2. DISEASE SURVEILLANCE

2.1 The COVID-19 pandemic

The COVID-19 pandemic was unquestionably devastating for NYC in 2020. As one of the first epicenters in the United States (Thompson et al. 2020), NYC had very little warning to prepare for this unprecedented emergency. Though the first COVID-19 patient in NYC was diagnosed on February 29, 2020 the virus is known to have been circulating prior to this (Gonzalez-Reiche et al. 2020), but went undetected in part because of initially limited laboratory testing capacity requiring prioritization based on severity (hospitalized cases) and/or recent travel history to countries with known COVID-19 outbreaks. By the end of 2020, there were over 450,000 confirmed and probable COVID-19 cases and over 25,000 confirmed and probable deaths in NYC alone (New York City Department of Health and Mental Hygiene 2021).

During the first few weeks of the pandemic, the healthcare systems of NYC were quickly overwhelmed. Therefore, DOHMH made urgent recommendations for NYC residents to stay at home and not seek care unless severely ill (New York City Department of Health and Mental Hygiene 2020a). The goals were to ensure healthcare capacity for those who were most severely ill, sufficient personal protective equipment for hospital staff, and to limit unnecessary exposure.

New York State issued stay at home orders starting March 22, 2020 (New York State 2020), which extended through mid-May, 2020. The United States government issued a series of travel limitations starting early in 2020 (Centers for Disease Control and Prevention 2020), severely curtailing international travel both to and from the United States. Recommendations for social distancing, remote work, mask wearing, and other measures, remained in effect through 2020 (and are still in place at the time of this writing).

The COVID-19 pandemic had a dramatic impact on all reportable diseases, including cryptosporidiosis and giardiasis. The sharp decrease of parasitic disease was likely a combination of both a decline in detection given dramatic changes in healthcare seeking behavior, as well as an actual decrease in disease given the sudden change of human behavior. As international travel is a known risk factor for both cryptosporidiosis and giardiasis (Reses et al. 2018; Roy et al. 2004) the travel restrictions for most of 2020 would have led to a reduction in incidence. Additionally, New Yorkers were told to stay at home and avoid meeting in groups or with people outside of their household to prevent COVID-19 transmission. Therefore, person-to-person transmission also likely declined given the reduction in opportunities for spread at, for example, day cares, restaurants, or through sexual activity.

Despite the various impacts of the COVID-19 pandemic on NYC, WDRAP continued, and DOHMH maintained its ability to receive and follow up on reports of giardiasis and cryptosporidiosis throughout 2020 as well as maintain its syndromic surveillance system.

2.2 Giardiasis

Giardiasis is a notifiable disease in NYC, per the NYC Health Code. From 1993 through 2010 active laboratory surveillance – involving visits or calls to labs by DOHMH or DEP staff – was conducted under WDRAP to ensure complete reporting of laboratory diagnosed cases of giardiasis. Since 2011, *Giardia* positive laboratory results have been reported to DOHMH via an electronic laboratory reporting system.

During 2020, a total of 636 cases of giardiasis were reported to DOHMH resulting in an annual case rate of 7.6 per 100,000 (Table 1). The annual case count decreased 47% from 2019 to 2020. After a steep decline in giardiasis rates from 1994–2004 (rate range: 13.4–32.4 per 100,000, median 22.9 per 100,000, decline 59%) giardiasis rates remained relatively constant during 2005–2016 (rate range: 9.2–11.4 per 100,000, median: 10.5 per 100,000), as shown in Figure 1A. In 2019, the giardiasis rate was 14.3 per 100,000 and, fell to 7.6 per 100,000 in 2020 (Figure 1B). The introduction of new syndromic multiplex panels in clinical practice in 2015 impacted the incidence of giardiasis (see further discussion later in this report) and the COVID-19 pandemic resulted in the dramatic drop in cases in 2020.

Table 1: Giardiasis, the number of cases and case rates, New York City, 1994–2020.

Year	Number of Cases	Case Rate per 100,000
1994	2,457	32.3
1995	2,484	32.4
1996	2,288	29.6
1997	1,787	22.9
1998	1,959	24.9
1999	1,896	23.9
2000	1,771	22.1
2001	1,530	19
2002	1,423	17.6
2003	1,214	15
2004	1,088	13.4
2005	875	10.7
2006	938	11.4
2007	852	10.3
2008	840	10
2009	844	10.1
2010	923	11.3
2011	918	11.2
2012	872	10.7
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

Note: Active disease surveillance for giardiasis began in July 1993. Starting January 2011, active laboratory surveillance was replaced by an electronic reporting system. Case numbers in this table conform to the case numbers as they appear in the NYC Department of Health and Mental Hygiene Bureau of Communicable Disease surveillance database for the years 1994–2020, and rates have been accordingly adjusted. 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.

Since 1995, case investigations for giardiasis have been 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 child care worker), or when giardiasis clusters or outbreaks are suspected. In 2020, five patients diagnosed with giardiasis were excluded from work or school to reduce the risk of secondary transmission: two cases were children attending child care, two worked as healthcare professionals and one patient worked as a food handler. No cases were associated with outbreaks.

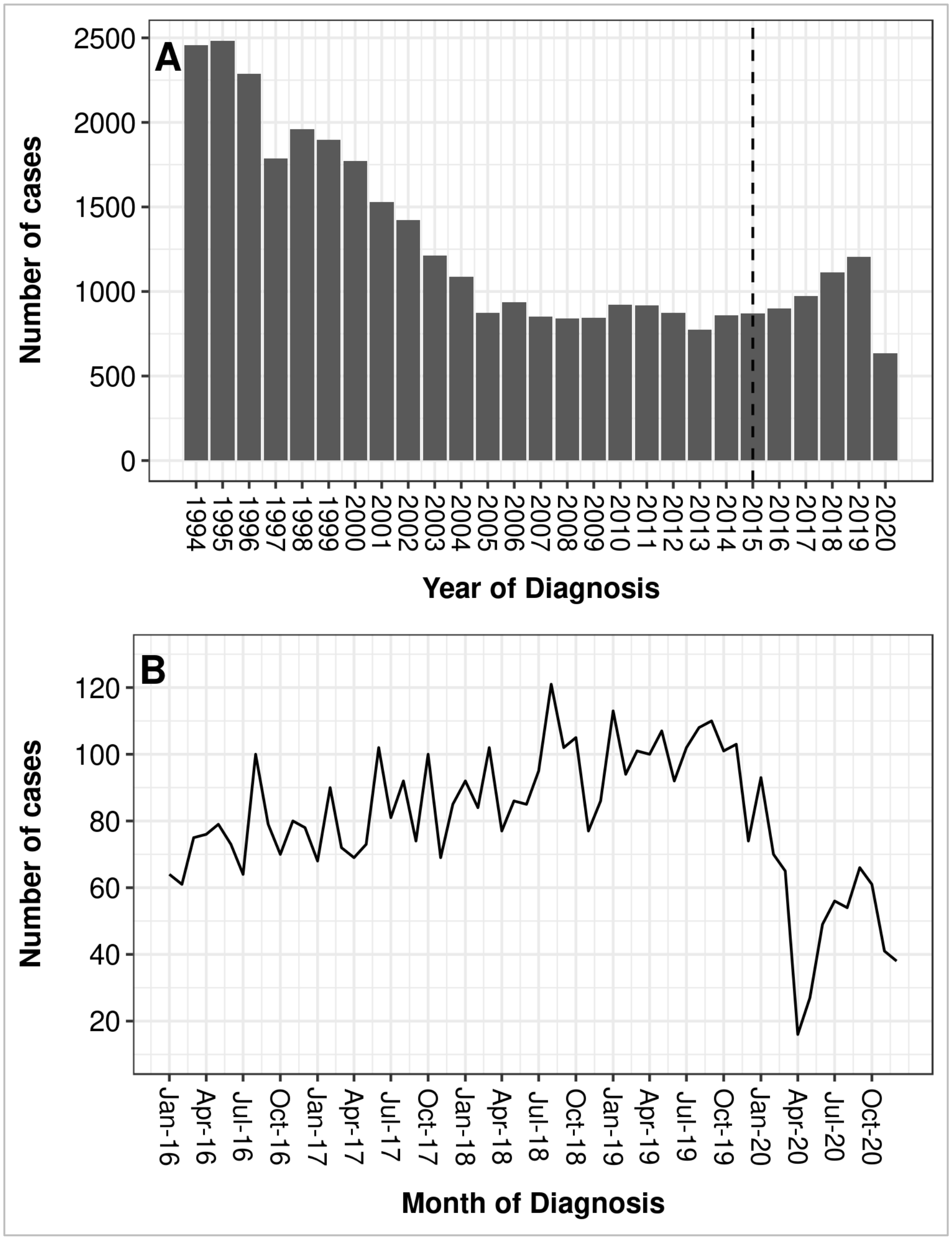

Figure 1: Annual **giardiasis** counts for all years in (A) and monthly counts for the last five years (B). The vertical dotted line shows the date when the first NYC laboratory reported results from syndromic multiplex panels for enteric diseases.

The following provides highlights from the surveillance data for giardiasis among NYC residents diagnosed from January 1 through December 31, 2020. Data are presented in Figures 1 and 2, and Tables 1, 3–7.

2.2.1 Borough of Patient Residence

Borough of patient residence was known for all 636 cases of giardiasis patients who resided in NYC. Manhattan had the highest borough-specific annual case rate (12.8 cases per 100,000) (Table 3). The highest United Hospital Fund (UHF) neighborhood-specific case rate was found in the Chelsea-Clinton neighborhood in Manhattan (27.5 cases per 100,000) (Figure 2 and Table 4).

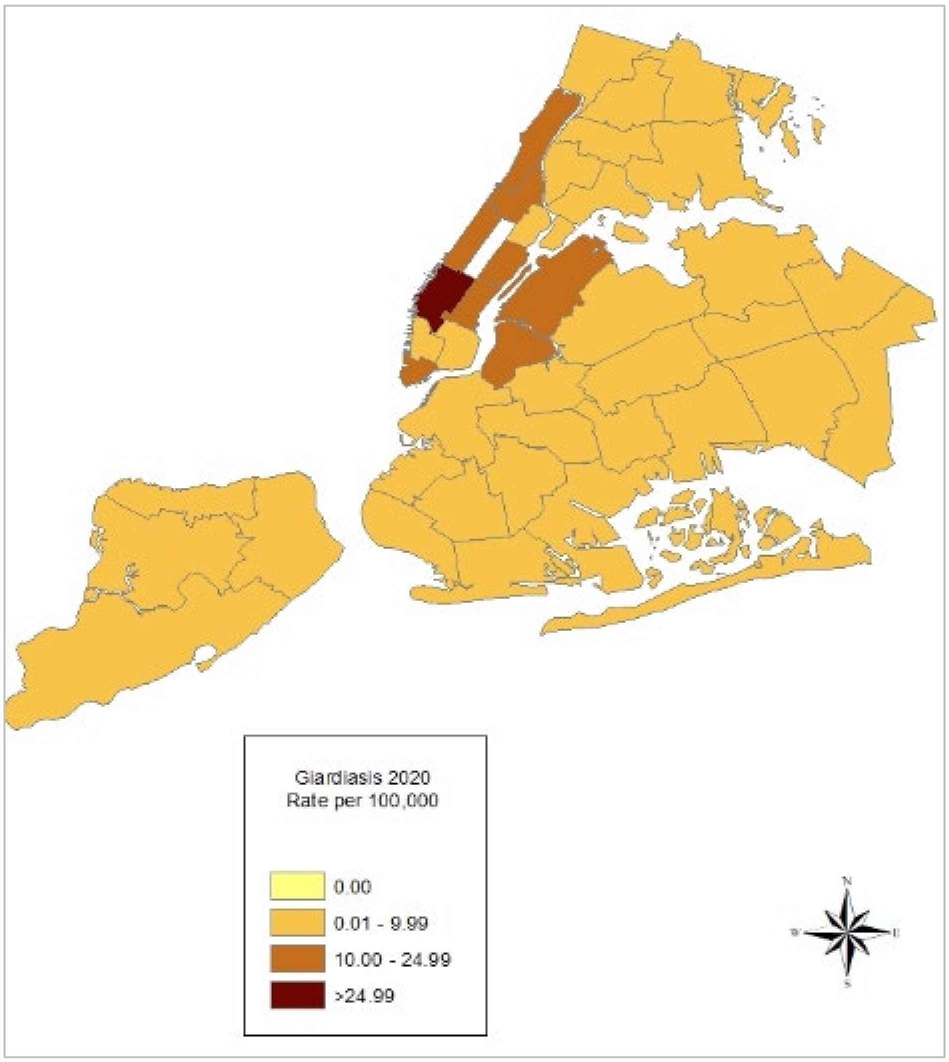

Figure 2: Map of **giardiasis** annual case rate per 100,000 population by United Hospital Fund Neighborhood, NYC, 2020.

2.2.2 Sex

Information regarding patient sex was available for all cases. The count and rate of giardiasis cases were higher in males than females, with 467 males (11.7 per 100,000) and 169 females (3.9 cases per 100,000) reported (Table 3). The highest sex- and borough-specific case rate was observed among males residing in Manhattan (21.4 cases per 100,000) and males residing in Brooklyn (11.3 cases per 100,000) (Table 3).

2.2.3 Age

Information regarding patient age was available for all cases. The highest age group-specific case rate was among persons aged 20–44 years (11.1 cases per 100,000). The highest age group and sex-specific case rate was among males aged 20–44 years (18.3 cases per 100,000) (Table 5). The two highest age-group and borough-specific case rates were in persons aged 20-44 years in Manhattan (17.0 cases per 100,000), followed by persons aged 45–59 years in Manhattan (16.2 cases per 100,000) (Table 6).

2.2.4 Race/Ethnicity

Information regarding patient race/ethnicity was available for only 80 of 636 (12.6%) cases. Ascertainment of race/ethnicity status for patients with giardiasis was poor. As mentioned, giardiasis patients are not routinely interviewed unless they are in occupations or settings that put them at increased risk for secondary transmission or if they are part of a suspected cluster or outbreak. Race/ethnicity information among giardiasis patients should be interpreted with caution as it may be based on the impressions of health care providers and may not reflect the patient's self-reported identity. For this reason, and because race/ethnicity information was missing for the majority of giardiasis disease reports, race/ethnicity findings pertaining to giardiasis patients diagnosed in 2020 are not presented in this report.

2.2.5 Census Tract Poverty Level

Age-adjusted case rates for giardiasis among four levels of census tract poverty, with levels encompassing low poverty to very high poverty, ranged from 9.7 to 10.9 cases per 100,000 population, with the lowest rate occurring in census tracts with very high poverty levels, and the highest rates occurring in census tracts with high poverty levels (Table 7). Based on data from earlier WDRAP reports and from previous analyses (Greene et al. 2015), giardiasis is not typically associated with a high neighborhood poverty level in NYC. However, because giardiasis patients are not routinely interviewed, specific risk factors for giardiasis (e.g. international travel) in areas of low poverty versus high poverty are not known (see APPENDIX A for poverty definition).

2.2.6 Laboratory Diagnosis Trends

Syndromic multiplex panels are highly sensitive and specific in the detection of a large variety of enteric pathogens, including *Giardia* (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 2015, the proportion of giardiasis patients diagnosed exclusively by a syndromic multiplex panel at a hospital or commercial laboratory was 5%. The proportion of all cases of giardiasis that were exclusively diagnosed by a syndromic multiplex panel at a commercial or hospital laboratory proportion grew to 12% in 2016 to close to half (n=551, 46%) in 2019 and remained stable in 2020 (41%). A variety of laboratories were using syndromic multiplex panels to test for giardiasis in 2020. There are now 29 known laboratories reporting to DOHMH using syndromic multiplex panels for enteric diagnoses, including the NYC Public Health Laboratory, 12 large hospitals, 8 high volume commercial laboratories, 3 small volume commercial laboratories and 5 small clinics. There were approximately 27 known laboratories reporting to DOHMH before 2020. Laboratories with syndromic multiplex panels are now used in all five boroughs. The proportion of giardiasis cases diagnosed in NYC exclusively by syndromic multiplex panels was less than that of cryptosporidiosis, as discussed below. This may potentially be related to the higher sensitivity of traditional diagnostics like an ova and parasite exam for giardiasis compared to cryptosporidiosis. It may be that reported giardiasis incidence prior to 2015 was closer to the true burden of disease than was the reported incidence of cryptosporidiosis, given the relatively robust sensitivity of traditional diagnostic assays for giardiasis, and the fact that that the use of syndromic multiplex panels is having a smaller impact on reported giardiasis incidence in NYC.

2.2.7 Giardiasis as a Sexually Transmissible Enteric Infection

As in previous years, the age/sex demographic group with the largest number of diagnosed giardiasis cases in 2020 was adult men aged 20–44 years (44%, 281/636) followed by adult men aged 45–59 years (13%, 81/636). Adult men have been consistently over-represented in surveillance data since the WDRAP began. 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 was added to the list of reportable diseases in the NYC Health Code in January 1994. Active disease surveillance for cryptosporidiosis involving lab visits and calls began in November 1994 and continued through 2010. Starting in 2011, active surveillance was replaced by electronic laboratory reporting. Patient interviews for demographic and risk factor data were initiated in 1995 and are ongoing.

During 2020, a total of 135 cases of cryptosporidiosis were reported to DOHMH, all of which met the case definition for confirmed cryptosporidiosis (see APPENDIX A for case definition description). The 2020 annual case rate was 1.6 per 100,000 (Table 2). The annual case count decreased 66% from 2019 to 2020. After a sharp decline in cryptosporidiosis rates from 1995–2006 (rate range: 1.5–6.1 per 100,000, median 2.1 per 100,000, decline 75%), cryptosporidiosis rates remained relatively constant during 2007–2014 (rate range: 1.0–1.5 per 100,000, median: 1.3 per 100,000) as shown in Figure 3A. Cryptosporidiosis rates started to increase in 2015, rising from 1.6 per 100,000 to 4.7 per 100,000 in 2019. Again, because of the COVID-19 pandemic, rates were much lower in 2020.

In 2020, three 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 child care or preschool (n=2), followed by a food handler (n=1).

Cryptosporidiosis is highly seasonal in NYC, as shown in Figure 3B, with cases most often diagnosed in August and September. However, given the dramatic impact of COVID-19, January had the most cases (41%, n=7) in 2020 as it was the only month without the influence of the pandemic.

The following provides highlights from the surveillance data for cryptosporidiosis among NYC residents from January 1 through December 31, 2020. Data are presented in Figures 3─5 and Tables 8─18.

Table 2: Cryptosporidiosis, number of cases and case rates, New York City, 1994─2020

	Number of Cases	Case Rate per 100,000
1994	288	3.8
1995	471	6.1
1996	334	4.3
1997	172	2.2
1998	207	2.6
1999	261	3.3
2000	172	2.1
2001	122	1.5
2002	148	1.8
2003	126	1.6
2004	138	1.7
2005	148	1.8
2006	155	1.9
2007	105	1.3
2008	107	1.3
2009	81	1
2010	107	1.3
2011	86	1.1
2012	125	1.5
2013	80	1
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

Note: Case numbers in this table conform to the case numbers as they appear in the NYC Department of Health and Mental Hygiene Bureau of Communicable Disease surveillance database for the years 1994–2020, and rates have been accordingly adjusted. 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.

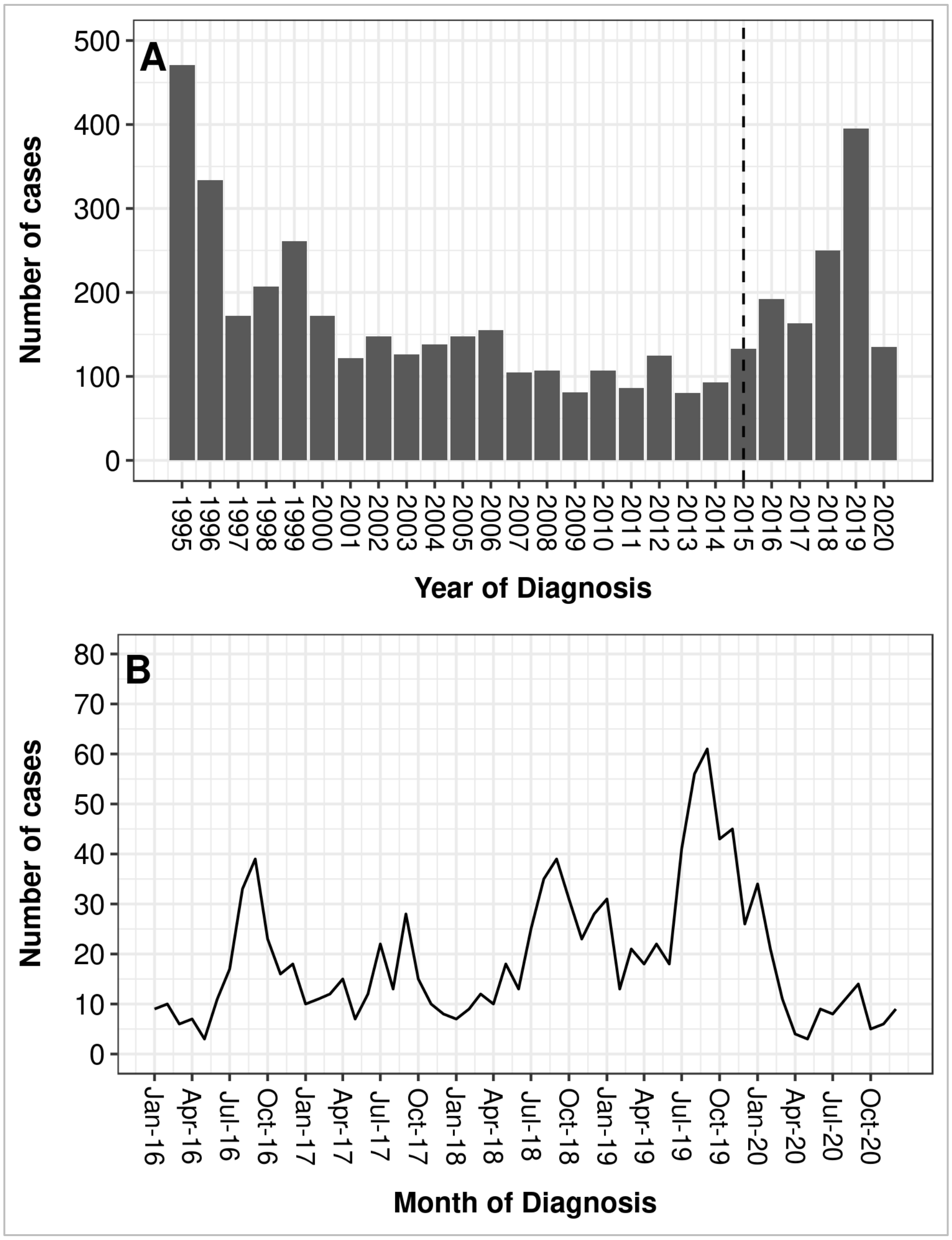

Figure 3: Annual **cryptosporidiosis** counts for all years in (A) and monthly counts for the last five years (B). The vertical dotted line shows the date when the first NYC laboratory reported results from syndromic multiplex panels for enteric diseases.

2.3.1 Borough of patient residence

Information on borough of residence was available for all 135 cases of cryptosporidiosis. Manhattan had the highest borough-specific annual case rate (3.3 cases per 100,000) (Table 8). The highest UHF neighborhood-specific case rate was in the Chelsea-Clinton neighborhood in

Manhattan 10.6 cases per 100,000), followed by Greenwich village-Soho in Manhattan (6.1 cases per 100,000) (Figure 4 and Table 9).

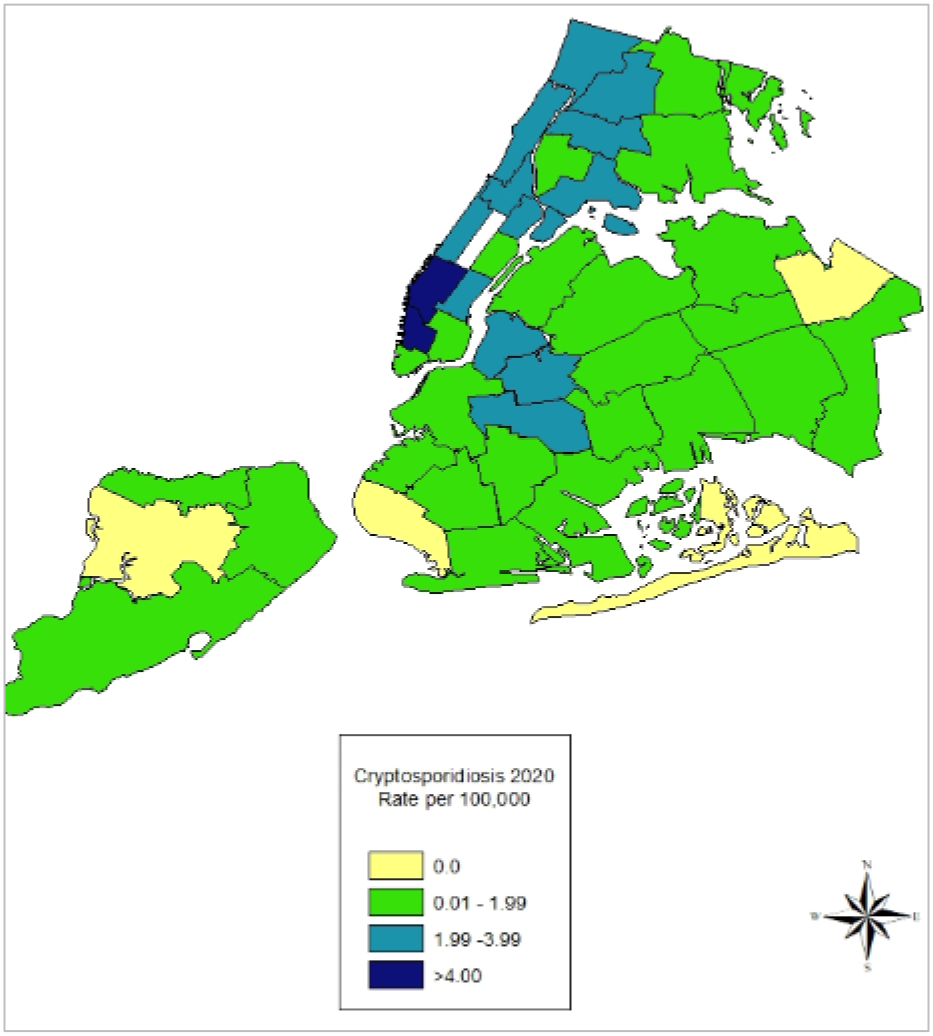

Figure 4: Map of **cryptosporidiosis** annual case rate per 100,000 population by United Hospital Fund neighborhood, NYC, 2020.

2.3.2 Sex

Information regarding patient sex was available for all cases. The count and rate of cryptosporidiosis cases was higher in males than females, with 90 males (2.3 cases per 100,000), and 45 females (1.0 cases per 100,000) (Table 8). The borough- and sex-specific case rate was highest for males in Manhattan (4.7 cases per 100,000) (Table 8).

2.3.3 Age

Information regarding patient age was available for all cases. The highest age group-specific case rates were in persons aged 20-44 years (2.5 cases per 100,000). The highest age group- and sex-specific case rates were in males aged 20-44 years (3.7 cases per 100,000) (Table 10). The highest age group and borough-specific case rates occurred in persons aged 45-59 years in Manhattan (5.5 cases per 100,000), followed by persons aged 20–44 years in Manhattan (4.4 cases per 100,000) (Table 11).

2.3.4 Race/Ethnicity

Patient race/ethnicity information was available for 122 of 135 cases (90.4%). Among the major racial/ethnic groups, White, non-Hispanic persons had the highest cryptosporidiosis rate (2.0 per 100,000) followed by Hispanic persons (1.7 per 100,000) (Table 12). Cryptosporidiosis rates were highest among White, non-Hispanic persons in Manhattan (4.0 per 100,000), and next highest among White, non-Hispanic persons in the Bronx (3.1 per 100,000) (Table 12). By age group, rates were highest among Hispanic children aged 0-4years (3.4 cases per 100,000) Hispanic persons aged 20-44 years (3.2 cases per 100,000). Among non-Hispanic persons, rates were highest among White non-Hispanic persons aged 20-44 years (3.2 cases per 100,000). Among Black/African American persons, rates were highest among persons aged 20-44 years (2.5 per 100,000) (Table 13). This paragraph does not describe some race/ethnic groups due to relatively small number of people in those groups.

2.3.5 Census Tract Poverty Level

Age-adjusted case rates for cryptosporidiosis among four levels of census tract poverty ranged from 1.5 to 2.5 cases per 100,000 population, with no clear pattern between age-adjusted rate and increasing or decreasing census tract poverty level in 2020 (Table 14).

2.3.6 Laboratory Diagnosis Trend

Similar to the trends in giardiasis testing, a number of large healthcare facilities in NYC began to report cryptosporidiosis diagnosed by syndromic multiplex panels to DOHMH during 2015─2020. Notably, Columbia University Medical Center began using a syndromic multiplex panel in 2015; and in 2019, they published a manuscript detailing the increased sensitivity they found with 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 NYC cryptosporidiosis patients diagnosed exclusively by a syndromic multiplex panel at a hospital or commercial laboratory was 20%. This proportion grew to 34% in 2016, 48% in 2017 and by 2019 was 74%. This trend continued into 2020, with 80% of cryptosporidiosis patients diagnosed exclusively by a syndromic multiplex panel. This trend has been mirrored across a number of different jurisdictions in the United States (Huang et al. 2016; Marder et al. 2017). The sensitivity and specificity of these panels for the detection of cryptosporidiosis over traditional microscopic diagnostic techniques is described by others as well (Buss et al. 2015; Navidad et al. 2013). And, importantly, the panels are considerably less expensive. Of note, as indicated in Section 2.1.6, the number of laboratories reporting to DOHMH using syndromic multiplex panels for enteric diseases was higher in 2020 than in prior years.

In the manuscript published by the DOHMH-based team in 2020, which details the descriptive epidemiology of cryptosporidiosis in NYC between 1995–2018, we noted that the reported incidence of cryptosporidiosis increased significantly after the introduction of syndromic multiplex panels in 2015, and that the demographic profile of patients changed (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). After these new tests were adopted, cryptosporidiosis patients were more likely to be aged 10-19 years of age, HIV negative, and non-Hispanic White, compared with the period prior to syndromic multiplex availability. Given the dramatic consequences of cryptosporidiosis amongst people living with HIV/AIDS, clinicians treating this population would have likely been more aware of the need to specifically request testing for this parasite in the pre-syndromic multiplex panel era. The relative increase in HIV-negative patients in recent years (Figure 5) likely reflects increased case finding among the general population. A change in the racial profiles of patients might reflect both the populations residing in the specific catchment areas of the laboratories using syndromic multiplex panels, as well as disparities in health care access by race/ethnicity.

The increased range of hospitals and laboratories using the syndromic multiplex panels is leading to an increase in reported incidence of cryptosporidiosis across a range of neighborhoods in NYC. Importantly, DOHMH has also observed substantial increases in reported incidence of a range of additional enteric infections included on syndromic multiplex panels across NYC. Some infections with increasing incidence because of the use of syndromic multiplex panels, such as norovirus, are transmitted predominately by person-to-person contact or fecal-oral contact and are not normally related to waterborne transmission.

2.3.7 Cryptosporidiosis and Immune Status

Trends observed over the years in reported numbers of cryptosporidiosis cases have differed between persons living with HIV/AIDS and those who are immunocompetent. Reported cryptosporidiosis cases among persons living with HIV/AIDS declined dramatically during 1995–1997, corresponding with the introduction of highly active antiretroviral therapy for HIV/AIDS. The count of cryptosporidiosis cases among persons living with HIV/AIDS has continued to decline since then, with only 27 cases reported in 2020 (representing 20% of all cases). The count of cryptosporidiosis cases among immunocompetent patients has increased since 2015, however, rising from 78 to 313 in 2019 (a 300% increase), but then falling to 90 in 2020 because of the overall reduction related to COVID-19 (Figure 5). The trend of increasing cases reported starting in 2015 is also coincident with the introduction of syndromic multiplex panels in 2015 as mentioned in section 2.2.6. 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. The decline observed in 2020 was especially notable in the count of the number of immunocompetent persons diagnosed with cryptosporidiosis, but also was apparent in the HIV/AIDS population.

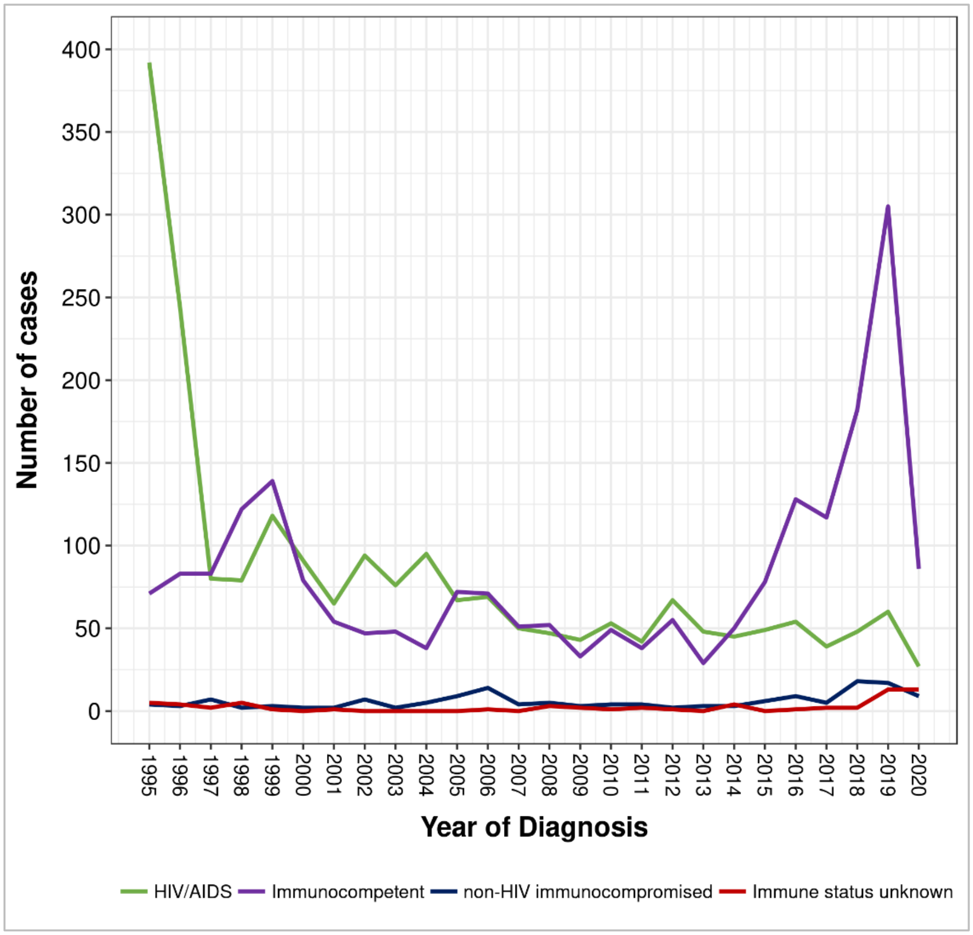

Figure 5: Cryptosporidiosis, number of cases by year of diagnosis and immune status, New York City, 1995–2020.

2.3.8 Cryptosporidiosis and Potential Risk Exposures

Of the 135 cryptosporidiosis cases diagnosed among NYC residents in 2020, questionnaires concerning potential exposures were completed for 94 (69.6%) patients. For patients with missing interview data, investigators were either unable to locate the patient (33 cases, 24.4%) or the patient refused interview (8 cases, 6%). Of the immunocompetent patients, interviews were completed for 71 patients (78.9%). Among persons with HIV/AIDS, interviews were completed for 15 patients (55.5%), and interviews were completed for 8 patients (88.9%) who were immunocompromised for reasons other than HIV/AIDS. Summary data for 1995 through 2020 on commonly reported potential risk exposures, obtained from patient interviews of persons with HIV/AIDS and from interviews of persons who are immunocompetent, are presented in Table 15 and Table 16, respectively. Information has also been collected regarding type of tap water consumption, and is presented in Table 17 and Table 18.

Tables 15─18 indicate the percentage of patients who reported engaging in each of the listed potential risk exposures for cryptosporidiosis before disease onset. However, it must be noted that the determination of an association between exposure to possible risk factors for cryptosporidiosis and acquisition of cryptosporidiosis cannot be made without reference to a suitable control population (i.e., non-*Cryptosporidium*-infected controls). As exposure data for a control population are not available, such determinations of association cannot be made.

Though no conclusions about association can be reached, in an attempt to assess if there are any patterns of interest, data have been compared between patients who are immunocompromised because of HIV/AIDS and patients who are immunocompetent. In 2020, interviewed patients who were immunocompetent were moderately more likely to report international travel (35.2% compared to patients with HIV/AIDS (13.3%) (p=0.0562, Fishers exact test); however again it is important to remember that international travel was only possible, with the comparable ease of prior years, in the first three months of 2020. Interviewed immunocompetent patients were slightly more likely to report exposure to recreational water (31%) compared to patients with HIV/AIDS (13.3%) (p=0.1390, Fishers exact test); but again, these activities would have been largely restricted to the less-than-three-month period in the winter prior to lockdown in 2020. There were no significant differences in reported contact with an animal between the two groups (45% and 33%, respectively, p=0.2783, chi-square test). Finally, interviewed patients with HIV/AIDS were no more likely to report high-risk sexual activity (20%) compared to immunocompetent patients (19%) in 2020 (p=1.0, chi-square test). It should be noted that high-risk sex in this context refers to having a penis, finger or tongue in a partner's anus. Information about sexual practices is gathered via phone interview and may not be reliable. Overall, these data indicate that, for most years, immunocompetent patients were more likely to travel internationally and have greater recreational water exposure than immunocompromised patients. International travel and exposure to recreational water may be more likely risk factors for the acquisition of cryptosporidiosis in the immunocompetent group. However, as noted above, the extent to which these risk factors may have been associated with cryptosporidiosis cannot be determined without comparison to a control population. In the context of 2020, these data likely reflect the exceptional changes to the day-to-day activities of New Yorkers.

2.3.9 Cryptosporidiosis as a Sexually Transmissible Enteric Infection

As in previous years, and similar to giardiasis, the age/sex demographic group with the largest number of diagnosed cryptosporidiosis cases in 2020 was adult men aged 20─44 years (41%, 56/135). Adult men aged 45─59 years accounted for an additional 12% of all people diagnosed with cryptosporidiosis in 2020. 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). In 2020, there were a total of 36 adult men aged 20─59 years who answered questions related to sexual behavior in their cryptosporidiosis incubation period. There were a total of 27 other adults (men aged 18 and 19 years and men aged >59 years as well as all women ≥18 years) who answered the sexual behavior questions during interview. Among men diagnosed with cryptosporidiosis aged 20─59 years, 44% (16/36) reported high-risk sexual practices, compared to 4% (1/27) 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. Beginning in the 1990s, NYC established and has maintained a number of distinct and complementary outbreak detection systems. One system utilizes hospital emergency department (ED) chief complaint logs to monitor for outbreaks. The ED system is relied upon most heavily for monitoring the burden of diarrheal illness in NYC. A second system monitors sales of anti-diarrheal medications: the Anti-Diarrheal Monitoring System (ADM)/over-the-counter medication (OTC) system. A third system monitors the number of stool specimens submitted to a participating clinical laboratory for microbiological testing. Finally, the fourth system monitors for GI outbreaks in sentinel nursing homes and DOHMH staff assist in the investigation of any identified outbreaks. A full description of each system can be found in APPENDIX B.

Other than the ED system, which is mandated under the NYC Health Code, all systems rely upon the voluntary participation of the organizations providing the syndromic data. A summary of syndromic surveillance findings pertaining to GI illness for 2020 is provided in Section 3.1 and in Figure 6, Figure 7, and Figure 8.

Throughout 2020, DOHMH received electronic data from all of NYC's 53 EDs, which reported approximately 11,500 visits per day. Additionally, data were received daily from approximately 515 pharmacies in 2020 as part of the ADM/OTC system. These data systems were not interrupted during the COVID-19 pandemic. Due to the COVID-19 pandemic, in 2020 WDRAP team members did not make site visits to any of the eight nursing homes participating in the Nursing Home Sentinel Surveillance system.

3.1 Findings: Summary of Syndromic Surveillance Signals

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. A signal in one system is compared to other systems to evaluate the presence of concurrent signals. In this report, Figures 6─8 summarize GI disease signals from NYC's syndromic surveillance systems. Figure 6 and Figure 7 summarize signals from the Emergency Department system only. Figure 8 summarizes signal results from all syndromic surveillance systems operated by DOHMH during 2020.

Of note, DOHMH saw a significant increase in rotavirus reports through routine surveillance activities during mid-February and mid-March 2020. There were 51 reports of rotavirus per week the week of March 1, 2020. For context, the maximum weekly report case count in 2019 was 34. These increases were likely related to the introduction of syndromic multiplex panels and potentially a genuine increase in disease activity. There was not a corresponding increase in norovirus activity in early 2020. For the most up-to-date data on all communicable diseases from DOHMH, please see the Epiquery webpage (New York City Department of Health and Mental Hygiene 2020b).

Figure 6 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, 2020. The impact of COVID-19 on healthcare seeking behavior is evident in the dramatic drop off in the ratio of visits for diarrhea to total visits starting in mid-March 2020, when the number of visits for COVID-19 like illness (CLI) began to increase dramatically as the pandemic spread rapidly through NYC (New York City Department of Health and Mental Hygiene 2021). The graph also indicates the occurrence of citywide signals and of the spatial residential zip code and hospital signals. The diarrheal hospital ED signals in January and February 2020 were likely related to seasonal gastroenteritis (especially rotavirus). There were also diarrheal signals in March, April and May 2020. There were no citywide diarrheal ED signals in 2020.

Figure 7 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 2020. Again, the pronounced impact of the pandemic is noted starting in March 2020. There were several spatial-hospital signals in March, April, May, August and October 2020. There were no citywide ED signals for vomiting in 2020.

COVID-19 is known to lead to symptoms of gastroenteritis such as diarrhea and vomiting (Sultan et al. 2020), especially in children (Wang et al. 2020). DOHMH hypothesizes that some of the observed gastroenteritis signals may be related to the pandemic. WDRAP staff reviewed the signals and found that there was no unusual spatial distribution of cases. WDRAP staff also reviewed the DEP water contamination dashboard and did not identify any water testing parameters that exceeded normal limits. None of the ED signals in 2020 were determined to be related to a waterborne disease outbreak. Given the signals 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.

Figure 8 shows the timing of signals from all four surveillance systems in 2020. There were no citywide signals in either diarrhea or vomiting from the ED systems and there were no nursing home signals in 2020. However, there were a number OTC/ADM signals throughout the year, concentrating specifically in April, May, June, September, and December. The majority 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 nine signals in the Clinical Laboratory surveillance system throughout the year. All of these 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. In summary, there were no citywide ED signals for GI illness in 2020. In conclusion, during 2020, 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

In 2020, DOHMH published a manuscript in collaboration with DEP detailing the epidemiology of cryptosporidiosis in NYC from 1995–2018 (Alleyne et al. 2020). The paper appeared in the March 2020 edition of the Emerging Infectious Diseases journal and is expected to reach a large audience of public health practitioners and infectious disease clinicians, both in NYC and elsewhere.

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 City's source water protozoa monitoring program. Documents on the websites include:

DOHMH Webpages:

- *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

DEP Webpages:

- ***Waterborne Disease Risk Assessment Program's Annual Reports***
  - For the latest WDRAP annual report posted:
    https://www1.nyc.gov/site/dep/water/waterborne-disease-risk-assessment.page
  - For WDRAP Annual reports going back to 1997:
    https://www1.nyc.gov/site/dep/about/document-portal.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***
  (Data are collected and entered on the website each week; historical data are also included).
  https://data.cityofnewyork.us/Environment/DEP-Cryptosporidium-And-Giardia-Data-Set/x2s6-6d2j

With regard to response planning, NYC has developed an action plan for responding to elevations in levels of either *Giardia* cysts or *Cryptosporidium* oocysts at a key water supply monitoring location. The initial response plan was developed in 2001. The plan in its current form is known as, NYC's *"Hillview Reservoir Cryptosporidium and Giardia Action Plan"* (CGAP), and the plan is reviewed & updated on an annual basis; it was updated in 2020.

During 2020, DEP re-initiated work on a project surveying select U.S. cities about their public health surveillance practices relevant to the detection of potentially-waterborne diseases, and related activities. This project may provide information and contacts useful towards NYC's WDRAP program moving forward. This survey project is still underway. Also, in 2020, WDRAP staff contributed towards NYC's FAD Summary and Assessment report, and participated in review and consideration of recommendations of an Expert Panel convened by the National Academies of Science, Engineering & Medicine, which reviewed NYC's Watershed Protection program (& other FAD) programs (National Academies of Sciences Engineering and Medicine 2020).

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6. ADDITIONAL TABLES AND FIGURES

Table 3: Giardiasis, number of cases and annual case rate per 100,000 population (in parentheses) by sex and borough of residence, New York City, 2020.

		Borough of residence				
Sex	Citywide	Manhattan	Bronx	Brooklyn	Queens	Staten Island
Male	467 (11.7)	165 (21.4)	58 (8.7)	137 (11.3)	99 (9.1)	8 (3.5)
Female	169 (3.9)	44 (5.1)	29 (3.9)	46 (3.4)	41 (3.5)	9 (3.7)
Total	636 (7.6)	209 (12.8)	87 (6.1)	183 (7.1)	140 (6.2)	17 (3.6)

Table 4: Giardiasis, number of cases and annual case rate per 100,000 by United Hospital Fund neighborhood of residence, New York City, 2020.

United Hospital Fund Neighborhood	Borough	Number of Cases	Population	Case Rate
Chelsea-Clinton	Manhattan	44	159914	27.5
Upper West Side	Manhattan	36	218099	16.5
Greenpoint	Brooklyn	22	137790	16.0
Upper East Side	Manhattan	28	214420	13.1
C Harlem-Morningside Hgts	Manhattan	22	179303	12.3
Gramercy Park-Murray Hill	Manhattan	16	130775	12.2
Lower Manhattan	Manhattan	7	59885	11.7
Washington Heights-Inwood	Manhattan	28	266801	10.5
Long Island City-Astoria	Queens	21	206636	10.2
High Bridge-Morrisania	Bronx	21	215772	9.7
Williamsburg-Bushwick	Brooklyn	20	216151	9.3
Kingsbridge-Riverdale	Bronx	8	91225	8.8
Bedford Stuyvesant-Crown Hgts	Brooklyn	27	321266	8.4
West Queens	Queens	37	448307	8.3
Downtown Heights-Slope	Brooklyn	21	255498	8.2
Fresh Meadows	Queens	8	98699	8.1
Union Sq-Lower East Side	Manhattan	15	186452	8.0
Borough Park	Brooklyn	25	330055	7.6
East Flatbush-Flatbush	Brooklyn	22	293870	7.5
East Harlem	Manhattan	8	113465	7.1
Southwest Queens	Queens	19	278637	6.8
Ridgewood-Forest Hills	Queens	17	252912	6.7
Sunset Park	Brooklyn	8	121676	6.6
Fordham-Bronx Park	Bronx	16	262610	6.1
Greenwich Village-Soho	Manhattan	5	82307	6.1
Pelham-Throgs Neck	Bronx	18	298911	6.0
Bayside-Littleneck	Queens	5	86896	5.8
Coney Island-Sheepshead Bay	Brooklyn	16	289492	5.5
Bensonhurst-Bay ridge	Brooklyn	11	205312	5.4
Hunts Point-Mott Haven	Bronx	7	139572	5.0
Southeast Queens	Queens	10	210409	4.8
Port Richmond	Staten Island	3	68439	4.4
Crotona-Tremont	Bronx	9	211274	4.3
South Beach-Tottenville	Staten Island	8	191532	4.2
Rockaway	Queens	5	124730	4.0
Northeast Bronx	Bronx	8	201656	4.0
Flushing-Clearview	Queens	9	249370	3.6
Willowbrook	Staten Island	3	92524	3.2
Canarsie-Flatlands	Brooklyn	6	204196	2.9
Jamaica	Queens	9	311734	2.9
East New York	Brooklyn	5	184597	2.7
Stapleton-St. George	Staten Island	3	123648	2.4

Note: this table does not include three cases of giardiasis in which UHF neighborhood could not be determined.

Table 5: Giardiasis, number of cases and annual case rate per 100,000 population (in parentheses) by age group and sex, New York City, 2020.

	Sex		
Age Group	Total	Male	Female
<5 years	28 (5.3)	18 (6.7)	10 (3.9)
5–9 years	32 (6.6)	19 (7.7)	13 (5.5)
10–19 years	33 (3.7)	22 (4.9)	11 (2.5)
20–44 years	349(11.1)	281(18.3)	68 (4.2)
45–59 years	111 (7.2)	81 (11.0)	30 (3.7)
≥ 60 years	83 (4.7)	46 (6.1)	37 (3.7)
Total	636 (7.6)	467 (11.7)	169 (3.9)

Table 6: Giardiasis, number of cases and annual case rate per 100,000 population (in parentheses) by age group and borough of residence, New York City, 2020.

		Borough of residence				
Age Group	Citywide	Manhattan	Bronx	Brooklyn	Queens	Staten Island
<5 years	28 (5.3)	2 (2.6)	7 (7.0)	8 (4.4)	11 (8.0)	0
5–9 years	32 (6.6)	6 (9.3)	10 (10.0)	9 (5.5)	6 (4.7)	1 (3.5)
10–19 years	33 (3.7)	3 (2.4)	8 (4.3)	11 (3.9)	10 (4.3)	1 (1.7)
20–44 years	349 (11.1)	120 (17.0)	32 (6.3)	119 (12.0)	72 (9.1)	6 (3.9)
45–59 years	111 (7.2)	47 (16.2)	16 (6.1)	27 (6.1)	16 (3.5)	5 (5.1)
≥ 60 years	83 (4.7)	31 (8.5)	14 (5.3)	9 (1.8)	25 (4.9)	4 (3.6)
Total	636 (7.6)	209 (12.8)	87 (6.1)	183 (7.1)	140 (6.2)	17 (3.6)

Table 7: Giardiasis, number of cases and case rates by census tract poverty level, New York City, 2020.

Census Tract Poverty Level	Number of cases	Case Rate per 100,000	Age adjusted rate
Low [a]	198	8.0	10.8
Medium [b]	201	7.8	10.4
High [c]	122	7.3	10.9
Very high [d]	112	7.0	9.7

Poverty levels are defined by the American Community Survey, 2014–2018 and are defined as the proportion of residents that have household incomes below 100% of the federal poverty level: [a] Low poverty: <10%; [b] Medium poverty: 10–19%; [c] High poverty: 20–29%; [d] Very high poverty: ≥30%.

Note: Three cases (0.5%) were excluded from this table because geolocating information for census tract identification was unavailable.

Table 8: Cryptosporidiosis, number of cases and annual case rate per 100,000 population (in parentheses) by sex and borough of residence, New York City, 2020.

		Borough of residence				
Sex	Citywide	Manhattan	Bronx	Brooklyn	Queens	Staten Island
Male	90 (2.3)	36 (4.7)	7 (0.9)	11 (0.8)	13 (1.2)	0
Female	45 (1.0)	18 (2.1)	20 (3.0)	21 (1.7)	5 (0.4)	4 (1.6)
Total	135 (1.6)	54 (3.3)	27 (1.9)	32 (1.3)	18 (0.8)	4 (0.8)

Table 9: Cryptosporidiosis, number of cases and annual case rate per 100,000 population by United Hospital Fund neighborhood of residence, New York City, 2020.

United Hospital Fund Neighborhood	Borough	Number Of Cases	Population	Case Rate
Chelsea-Clinton	Manhattan	17	159914	10.6
Greenwich Village-Soho	Manhattan	5	82307	6.1
Upper West Side	Manhattan	8	218099	3.7
East Harlem	Manhattan	4	113465	3.5
Crotona-Tremont	Bronx	6	211274	2.8
CHarlem-Morningside Hgts	Manhattan	5	179303	2.8
Fordham-Bronx Park	Bronx	7	262610	2.7
Washington Heights-Inwood	Manhattan	7	266801	2.6
Bedford Stuyvesant-CrownHgts	Brooklyn	8	321266	2.5
Williamsburg-Bushwick	Brooklyn	5	216151	2.3
Gramercy Park-Murray Hill	Manhattan	3	130775	2.3
Kingsbridge-Riverdale	Bronx	2	91225	2.2
Greenpoint	Brooklyn	3	137790	2.2
Hunts Point-Mott Haven	Bronx	3	139572	2.1
Lower Manhattan	Manhattan	1	59885	1.7
Downtown Heights-Slope	Brooklyn	4	255498	1.6
West Queens	Queens	7	448307	1.6
Northeast Bronx	Bronx	3	201656	1.5
Port Richmond	Staten Island	1	68439	1.5
East Flatbush-Flatbush	Brooklyn	4	293870	1.4
Pelham-Throgs Neck	Bronx	4	298911	1.3
Southwest Queens	Queens	3	278637	1.1
Union Sq-Lower East Side	Manhattan	2	186452	1.1
South Beach-Tottenville	Staten Island	2	191532	1.0
Fresh Meadows	Queens	1	98699	1.0
Canarsie-Flatlands	Brooklyn	2	204196	1.0
Jamaica	Queens	3	311734	1.0
Upper East Side	Manhattan	2	214420	0.9
High Bridge-Morrisania	Bronx	2	215772	0.9
Borough Park	Brooklyn	3	330055	0.9
Sunset Park	Brooklyn	1	121676	0.8
Stapleton-St.George	Staten Island	1	123648	0.8
East New York	Brooklyn	1	184597	0.5
Long Island City-Astoria	Queens	1	206636	0.5
Southeast Queens	Queens	1	210409	0.5
Flushing-Clearview	Queens	1	249370	0.4
Ridgewood-Forest Hills	Queens	1	252912	0.4
Coney Island-Sheepshead Bay	Brooklyn	1	289492	0.3

Table 10: Cryptosporidiosis, number of cases and annual case rate per 100,000 population (in parentheses) by age group and sex, New York City, 2020.

		Sex	
Age Group	Total	Male	Female
<5 years	7 (1.3)	5 (1.9)	2 (0.8)
5–9 years	6 (1.2)	1 (0.4)	5 (2.1)
10–19 years	7 (0.8)	2 (0.4)	5 (1.1)
20–44 years	77 (2.5)	56 (3.7)	21 (1.3)
45–59 years	26 (1.7)	16 (2.2)	10 (1.2)
≥ 60 years	12 (0.7)	10 (1.3)	2 (0.2)
Total	135 (1.6)	90 (2.3)	45 (1.0)

Table 11: Cryptosporidiosis, number of cases and annual case rate per 100,000 population (in parentheses) by age group and borough, New York City, 2020.

		Borough of residence				
Age Group	Citywide	Manhattan	Bronx	Brooklyn	Queens	Staten Island
<5 years	7 (1.3)	0	3 (3.0)	2 (1.1)	2 (1.5)	0
5–9 years	6 (1.2)	2 (3.1)	0	3 (1.8)	1 (0.8)	0
10–19 years	7 (0.8)	2 (1.6)	4 (2.1)	0	0	1 (1.7)
20–44 years	77 (2.5)	31 (4.4)	16 (3.2)	20 (2.0)	8 (1.0)	2 (1.3)
45–59 years	26 (1.7)	16 (5.5)	3 (1.1)	3 (0.7)	4 (0.8)	0
≥ 60 years	12 (0.7)	3 (0.8)	1 (0.4)	4 (0.8)	3 (0.6)	1 (0.9)
Total	135 (1.6)	54 (3.3)	27 (1.9)	32 (1.3)	18 (0.8)	4 (0.8)

Table 12: Cryptosporidiosis, number of cases and annual case rate per 100,000 population (in parentheses) by race/ethnicity and borough of residence, New York City, 2020.

		Borough of residence				
Race/Ethnicity	Citywide	Manhattan	Bronx	Brooklyn	Queens	Staten Island
Hispanic	40	11	15	5	8	1
	(1.7)	(2.6)	(1.9)	(1.0)	(1.3)	(1.1)
White, non-Hispanic	54	31	4	12	5	2
	(2.0)	(4.0)	(3.1)	(1.3)	(0.9)	(0.7)
Black/African American, non-Hispanic	23	3	6	9	5	0
	(1.3)	(1,5)	(1.4)	(1.2)	(1.2)	
Asian, non-Hispanic	3	0	0	2	0	1
	(0.2)			(0.6)		(2.0)
Pacific Islander, Native Hawaiian, American Indian, non-Hispanic	0	0	0	0	0	0
Two or more races, other, non-Hispanic	2	1	0	1	0	0
	(1.3)	(2.9)		(2.0)		
Unknown	13	8	2	3	0	0
Total	135	54	27	32	18	4
	(1.6)	(3.3)	(1.9)	(1.3)	(0.8)	(0.8)

Table 13: Cryptosporidiosis, number of cases and annual case rate per 100,000 population (in parentheses) by race/ethnicity and age group, New York City, 2020.

	Age group						
Race/Ethnicity	Total	<5 years	5–9 years	10–19 years	20–44 years	45–59 years	≥ 60 years
Hispanic	40	6	2	2	18	8	4
	(1.7)	(3.4)	(1.1)	(0.6)	(2.0)	(1.8)	(1.0)
White, non-Hispanic	54	1	3	3	33	10	4
	(2.0)	(0.7)	(2.4)	(1.3)	(3.2)	(2.2)	(0.6)
Black/African American, non-Hispanic	23	0	0	0	16	6	1
	(1.3)				(2.5)	(1.6)	(0.3)
Asian, non-Hispanic	3	0	0	1	1	0	1
	(0.2)			(0.9)	(0.2)		(0.4)
Pacific Islander, Native Hawaiian, American Indian, non-Hispanic	0	0	0	0	0	0	0
Two or more races, other, non-Hispanic	2	0	0	0	1	0	1
	(1.3)				(1.8)		(5.9)
Unknown	13	0	1	1	8	2	1
Total	135	7	6	7	77	26	12
	(1.6)	(1.3)	(1.2)	(0.8)	(2.5)	(1.7)	(0.7)

Table 14: Cryptosporidiosis, number of cases and case rates by census tract poverty level, New York City, 2020.

Census Tract Poverty Level	Number of cases	Case Rate per 100,000	Age adjusted rate
Low [a]	41	1.6	2.2
Medium [b]	44	1.7	2.4
High [c]	20	1.2	1.5
Very high [d]	29	1.8	2.5

Poverty levels are defined by the American Community Survey, 2014–2018 and are defined as the proportion of residents that have household incomes below 100% of the federal poverty level: [a] Low poverty: <10%; [b] Medium poverty: 10–19%; [c] High poverty: 20–29%; [d] Very high poverty: ≥30%.

Note: One case (0.7%) was excluded from this table because geolocating information for census tract identification was unavailable

Table 15: Percentage of interviewed **cryptosporidiosis** patients reporting selected potential risk exposures before disease onset, persons with HIV/AIDS, New York City 1995–2020, median (range).

Exposure Type[a]	Persons with HIV/AIDS					
	1995–1999	2000–2004	2005–2009	2010–2014	2015–2019	2020
Contact with an animal[b]	25% (33-36%)	40% (24%-43%)	38% (31%-44%)	34% (20%-43%)	32% (25%-45%)	33%
High-risk sexual activity[c] (aged ≥ 18 years)	20% (9%-22%)	24% (16-34%)	31% (21%-39%)	17% (7%-25%)	33% (21%-42%)	20%
International travel[d]	9% (9%-18%)	13% (10%-15%)	8% (6%-17%)	6% (4%-13%)	11% (7%-13%)	13%
Recreational water contact[e]	16% (8%-16%)	13% (8%-21%)	14% (5%-18%)	10% (4%-14%)	8% (5%-13%)	13%

Note:

Determination of an association between exposure to possible risk factors for cryptosporidiosis and acquisition of cryptosporidiosis cannot be made without reference to a suitable control population (i.e., non-*Cryptosporidium*-infected controls).

The format of the patient interview form changed in 1997, 2001, 2002 and 2010:

a: From January 1, 1995 to April 25, 2010, patients were asked about potential risk exposures during the month before disease onset. Beginning April 26, 2010, patients were asked about potential risk exposures during the 14 days before onset.

b: Contact with an animal: includes having a pet, or visiting a farm or petting zoo (1995–1996); expanded to include: visiting a pet store, or veterinarian office (1997–2012); or other animal exposure (2020).

c: High-risk sexual activity: includes having a penis, finger or tongue in a sexual partner's anus (1995–2020)

d: International travel: travel outside of the United States (1995–2020)

e: Recreational water contact: includes swimming in a pool, or swimming in or drinking from a stream, lake, river or spring (1995–1996); expanded to include: swimming in the ocean or visiting a recreational water park (1997–2012); swimming in a hot tub or swimming or drinking water from a pond or body of water (2020).

Table 16: Percentage of interviewed **cryptosporidiosis** patients reporting selected potential risk exposures before disease onset, immunocompetent persons, New York City, 1995–2020, median (range).

Exposure Type[a]	Immunocompetent persons					
	1995–1999	2000–2004	2005–2009	2010–2014	2015–2019	2020
Contact with an animal[b]	35% (7%-41%)	34% (23%-37%)	36% (28%-40%)	34% (18%-41%)	33% (30%-41%)	45%
High-risk sexual activity[c] (aged ≥18 years)	12% (10%-25%)	23% (13%-31%)	17% (7%-19%)	8% (4%-11%)	14% (8%-29%)	19%
International travel[d]	28% (26%-30%)	45% (33%-47%)	45% (37%-52%)	44% (35%-62%)	42% (39%-45%)	35%
Recreational water contact[e]	24% (21%-40%)	34% (32%-35%)	40% (28%-52%)	35% (32%-48%)	32% (26%-39%)	31%

Note:

Determination of an association between exposure to possible risk factors for cryptosporidiosis and acquisition of cryptosporidiosis cannot be made without reference to a suitable control population (i.e., non-*Cryptosporidium*-infected controls).

The format of the patient interview form changed in 1997, 2001, 2002 and 2010:

a: From January 1, 1995 to April 25, 2010, patients were asked about potential risk exposures during the month before disease onset. Beginning April 26, 2010, patients were asked about potential risk exposures during the 14 days before onset.

b: Contact with an animal: includes having a pet, or visiting a farm or petting zoo (1995–1996); expanded to include: visiting a pet store, or veterinarian office (1997–2012); or other animal exposure (2020).

c: High-risk sexual activity: includes having a penis, finger or tongue in a sexual partner's anus (1995–2020)

d: International travel: travel outside of the United States (1995–2020)

e: Recreational water contact: includes swimming in a pool, or swimming in or drinking from a stream, lake, river or spring (1995–1996); expanded to include: swimming in the ocean or visiting a recreational water park (1997–2012); swimming in a hot tub or swimming or drinking water from a pond or body of water (2020).

Table 17: Percentage of interviewed **cryptosporidiosis** patients by type of tap water exposure before disease onset, persons with HIV/AIDS, New York City, 1995–2020, median (range).

Exposure Type[a]	Persons with HIV/AIDS					
	1995–1999	2000–2004	2005–2009	2010–2014	2015–2019	2020
Plain tap[b]	69% (64%-71%)	55% (49%-77%)	67% (58%-76%)	63% (50%-71%)	50% (46%-63%)	40%
Filtered tap[c]	12% (9%-20%)	20% (13%-22%)	14% (7%-18%)	11% (8%-25%)	15% (8%-24%)	7%
Boiled tap[d]	5% (3%-7%)	6% (0%-6%)	7% (0%-11%)	4% (2%-11%)	3% (0%-8%)	7%
Incidental plain tap only[e]	15% (8%-16%)	15% (4%-19%)	10% (4%-17%)	18% (8%-20%)	24% (13%-33%)	40%
No tap[f]	2% (0%-5%)	4% (2%-6%)	2% (0%-6%)	4% (0%-4%)	3% (0%-13%)	0%

Note:

Determination of an association between exposure to possible risk factors for cryptosporidiosis and acquisition of cryptosporidiosis cannot be made without reference to a suitable control population (i.e., non-*Cryptosporidium*-infected controls).

The format of the patient interview form changed in 1997, 2001, 2002 and 2010:

a: From January 1, 1995 to April 25, 2010, patients were asked about tap water exposure during the month before disease onset. Beginning April 26, 2010, patients were asked about tap water exposure during the 14 days before onset.

b: Plain tap: drank unboiled/unfiltered NYC tap water (1995–5/10/2001) or drank greater than 0 cups of unboiled/unfiltered NYC tap water (5/11/2001–12/31/2013).

c: Filtered tap: drank filtered NYC tap water (1995–5/10/2001) or drank greater than 0 cups of filtered NYC tap water, and 0 or more cups of boiled NYC tap water, and no unboiled/unfiltered NYC tap water (5/11/2001–12/13/2020).

d: Boiled tap: drank boiled NYC tap water (1995–5/10/2001) or drank greater than 0 cups of boiled NYC tap water, and no unboiled/unfiltered NYC tap water, and no filtered NYC tap water (5/11/2001–12/31/2020).

e: Incidental plain tap only: did not drink any NYC tap water but did use unboiled/unfiltered NYC tap water to brush teeth, or to wash vegetables/fruits, or to make ice (1995–1996), expanded to include make juice from concentrate (1997–2020).

f: No tap: did not drink any NYC tap water and did not use unboiled/unfiltered NYC tap water to brush teeth, or to wash vegetables/fruits, or to make ice (1995–1996); expanded to include make juice from concentrate (1997–2020).

Table 18: Percentage of interviewed **cryptosporidiosis** patients by type of tap water exposure before disease onset, immunocompetent persons, New York City, 1995–2020, median (range).

Exposure Type[a]	Immunocompetent persons					
	1995–1999	2000–2004	2005–2009	2010–2014	2015–2019	2020
Plain tap[b]	58% (56%-67%)	36% (27%-56%)	30% (27%-47%)	33% (28%-49%)	39% (31%-47%)	24%
Filtered tap[c]	21% (17%-25%)	31% (17%-44%)	23% (20%-30%)	24% (17%-27%)	26% (11%-30%)	23%
Boiled tap[d]	8% (3%-11%)	2% (0%-7%)	5% (0%-14%)	2% (0%-7%)	4% (2%-6%)	3%
Incidental plain tap only[e]	9% (7%-12%)	16% (8%-21%)	25% ((14%-28%)	15% (11%-22%)	23% (14%-29%)	24%
No tap[f]	4% (2%-7%)	9% (2%-21%)	14% (3%-27%)	21% (11%-29%)	12% (11%-14%)	13%

Note:

Determination of an association between exposure to possible risk factors for cryptosporidiosis and acquisition of cryptosporidiosis cannot be made without reference to a suitable control population (i.e., non-*Cryptosporidium*-infected controls).

The format of the patient interview form changed in 1997, 2001, 2002 and 2010:

a: From January 1, 1995 to April 25, 2010, patients were asked about tap water exposure during the month before disease onset. Beginning April 26, 2010, patients were asked about tap water exposure during the 14 days before onset.

b: Plain tap: drank unboiled/unfiltered NYC tap water (1995–5/10/2001) or drank greater than 0 cups of unboiled/unfiltered NYC tap water (5/11/2001–12/31/2013).

c: Filtered tap: drank filtered NYC tap water (1995–5/10/2001) or drank greater than 0 cups of filtered NYC tap water, and 0 or more cups of boiled NYC tap water, and no unboiled/unfiltered NYC tap water (5/11/2001–12/13/2020).

d: Boiled tap: drank boiled NYC tap water (1995–5/10/2001) or drank greater than 0 cups of boiled NYC tap water, and no unboiled/unfiltered NYC tap water, and no filtered NYC tap water (5/11/2001–12/31/2020).

e: Incidental plain tap only: did not drink any NYC tap water but did use unboiled/unfiltered NYC tap water to brush teeth, or to wash vegetables/fruits, or to make ice (1995–1996), expanded to include make juice from concentrate (1997–2020).

f: No tap: did not drink any NYC tap water and did not use unboiled/unfiltered NYC tap water to brush teeth, or to wash vegetables/fruits, or to make ice (1995–1996); expanded to include make juice from concentrate (1997–2020).

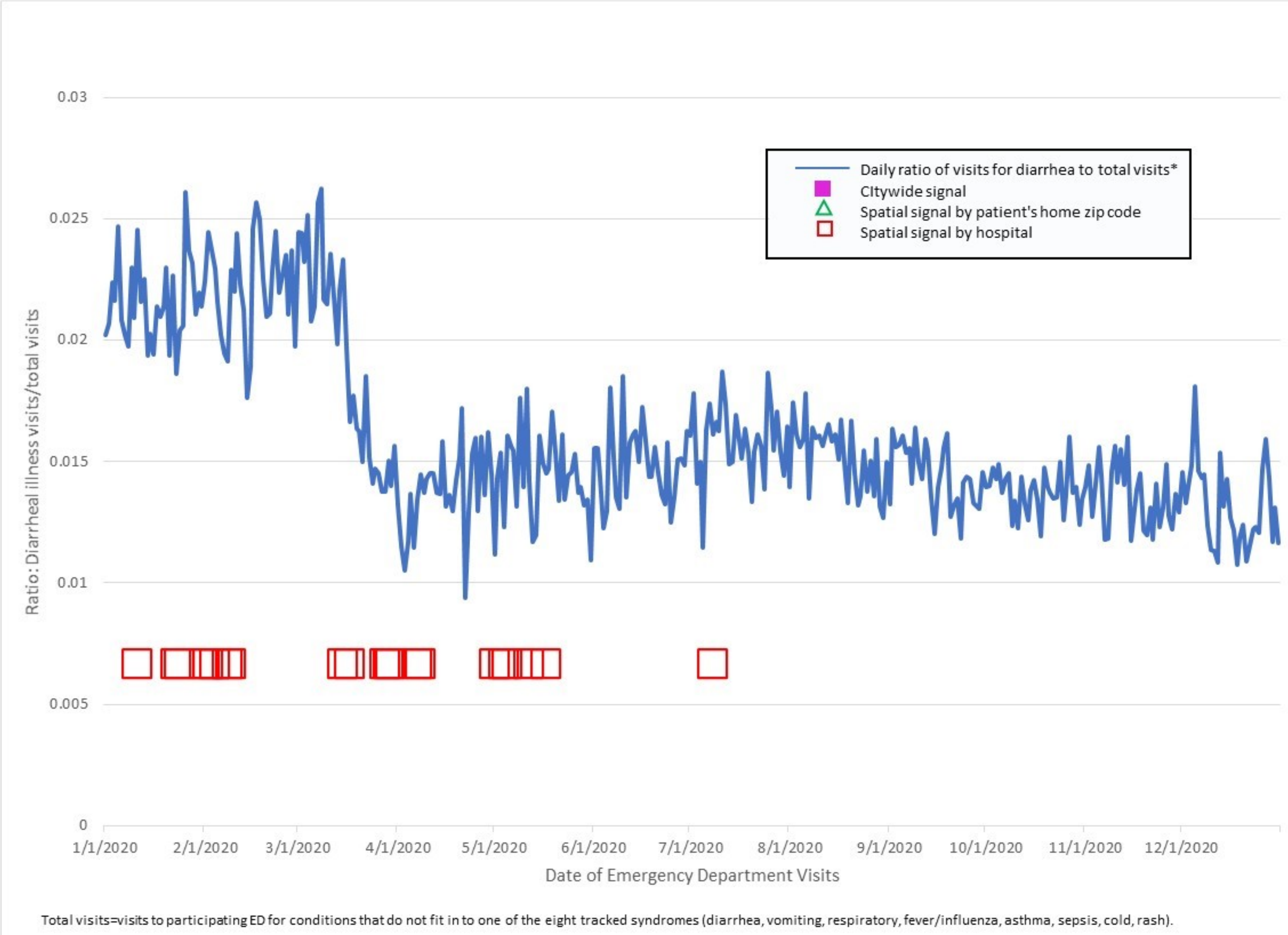

Figure 6: Emergency Department Syndromic Surveillance, Trends in visits for the diarrhea syndrome, New York City, January 1, 2020–December 31, 2020.

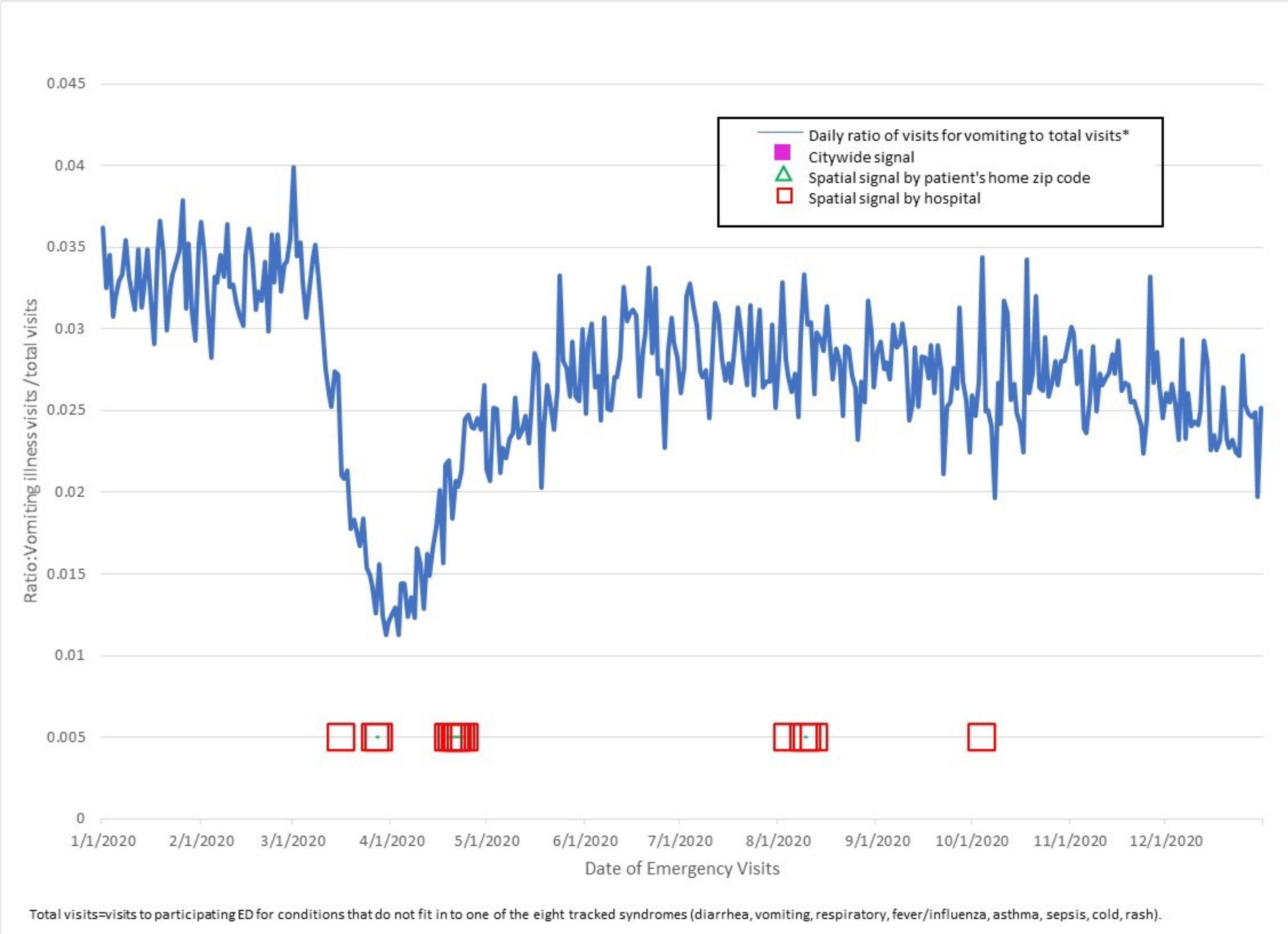

Figure 7: Emergency Department Syndromic Surveillance, Trends in visits for the vomiting syndrome, New York City, January 1, 2020–December 31, 2020.

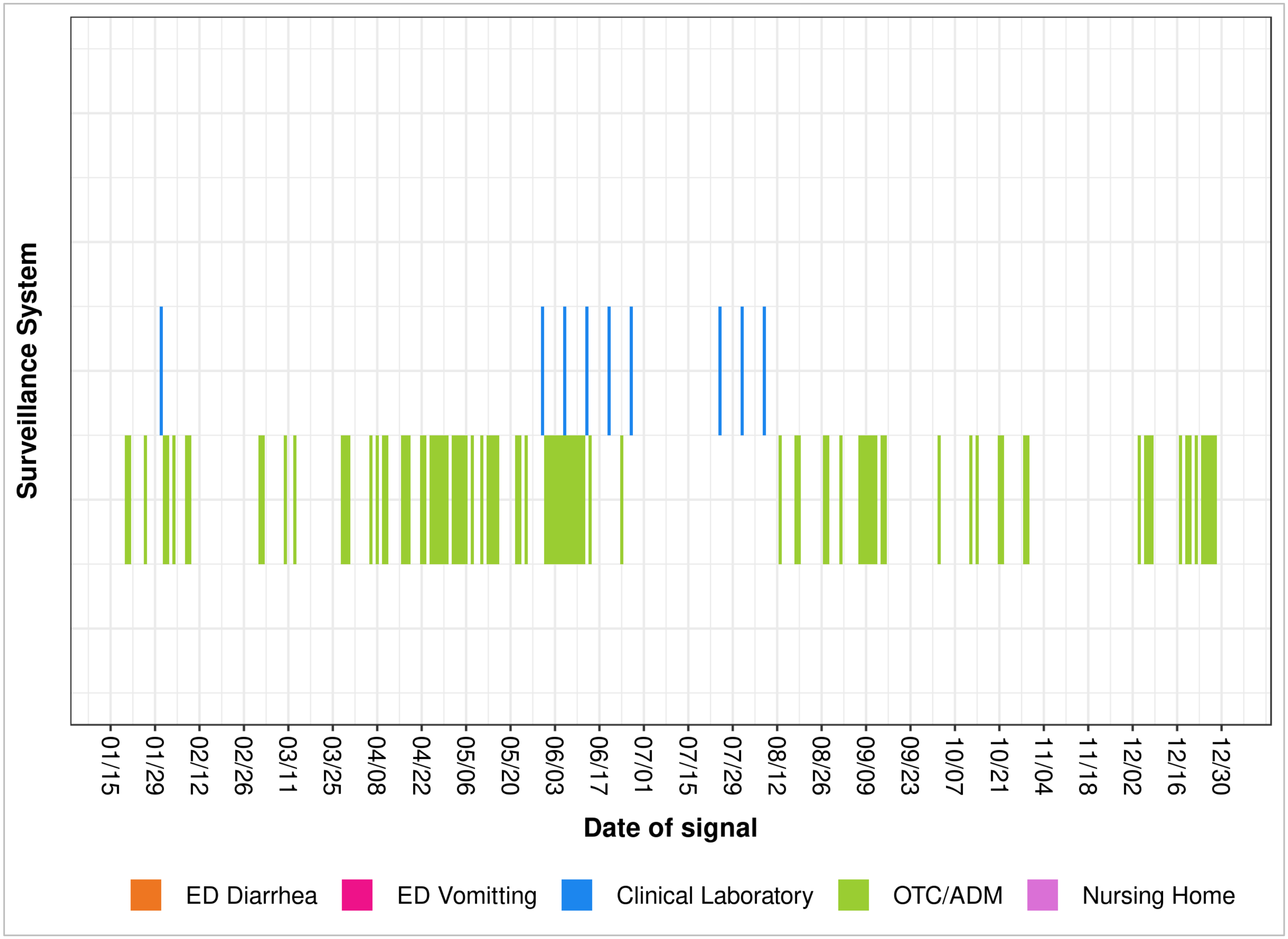

Figure 8: Signals for Gastrointestinal Illness, Syndromic Surveillance Systems, New York City, 2020.

7. APPENDIX A: Information on calculation of rates, case definitions and risk factor collection

Population denominators

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 2020, 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 2020 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. 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.

UHF Zones

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.

Race-Ethnicity Categories

In this report, race/ethnicity-specific case rates for 2020 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.

Socioeconomic Status

Beginning with the 2011 WDRAP Annual Report, socioeconomic status (SES) is now included as a measure as part of the demographic description of cases of giardiasis and cryptosporidiosis in NYC. Differences in SES among cases of a disease may indicate economically-related disparities in health. Neighborhood poverty can be used as a proxy for individual SES. The poverty level of the neighborhood of patient resident is measured as the percentage of individuals in the neighborhood who live below the federal poverty level, as reported in census data. Four categories of poverty level were used for the WDRAP analysis (see Tables 7 & 14). Further explanation of how SES designations were made can be found in the 2011–2014 WDRAP Annual reports.

Age-adjusted case rates

Age-adjusted case rates were calculated for each of the four neighborhood poverty levels using direct standardization and weighing by the US 2000 Standard Population. Cases were grouped into three age group categories (aged <24 years, 25–44 years, and ≥45 years) (Klein and Schoenborn 2001).

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 and Potential Risk Factors

Tables 15, 16, 17, and 18–a change to table format was introduced, starting with the 2015 annual report. This change involves grouping and summarizing data in 5-year sets (e.g., 1995– 1999, 2000–2004, etc.). This change was made to continue providing historical data for comparison, and to allow for easier comprehension of trends. Potential risk exposure data for individual years, rather than grouped years, can be viewed in the earlier WDRAP Annual Reports. Only the new data (i.e., the year of the report) is listed independently as a single year.

8. APPENDIX B: Syndromic Surveillance System Descriptions

Hospital Emergency Department (ED) Monitoring

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 each morning containing chief complaint and demographic information for patient visits during the previous 24 hours. 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 one, two, or three days compared to the previous 14 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 was originally set at $p<0.01$, indicating that less than 1 out of every 100 analyses would generate a cluster due to chance alone. Beginning in 2005, the threshold of significance for spatial signals was changed to $p<0.005$, while the threshold of significance for citywide signals remained at $p<0.01$. The system is described further in Heffernan *et al.* (Heffernan et al. 2004).

Anti-Diarrheal Medication Monitoring

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 Monitoring 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.