New York City Department of Health & Mental Hygiene
Bureau of Communicable Diseases
&
New York City Department of Environmental Protection
Bureau of Water Supply

Waterborne Disease Risk Assessment Program

2016 Annual Report

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This report was prepared by:

Lisa Alleyne, MPA (DOHMH)
Sharon Balter, MD (DOHMH)
Robert Fitzhenry, PhD (DOHMH)
Anne Seeley, MPH (DEP)
With Robert Mathes and other members of the Waterborne Disease Risk Assessment Program Team

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THE WATERBORNE DISEASE RISK ASSESSMENT PROGRAM TEAM

The Waterborne Disease Risk Assessment Program (WDRAP) is an interagency program involving the N.Y.C. Departments of Environmental Protection and Health and Mental Hygiene

- **New York City Department of Health and Mental Hygiene (DOHMH)**
  Bureau of Communicable Disease
  42-09 28th Street, CN-22A, Queens, New York, NY 11101-4132

  Marcelle Layton, M.D., Assistant Commissioner
  Don Weiss, M.D., M.P.H., Medical Director, Surveillance
  Sharon Balter, M.D., Medical Director (*WDRAP Coordinator for DOHMH)*
  Robert Fitzhenry, Ph.D., City Research Scientist (*WDRAP Asst. Coordinator)*
  Lisa Alleyne, M.P.A., Public Health Epidemiologist

  Bureau of Communicable Disease:
  Erlinda Amoroso, Tracey Assanah, Dominique Balan, Judy Chen, Fazlul Chowdhury, Chantal Hall, Fatema Haque, Muhammad Iftekharuddin, Yin Ling Leung, Robert Mathes, Michelle Middleton, Daniel Osuagwu, Jose Poy, Renee Stewart and Rajmohan Sunkara

- **New York City Department of Environmental Protection (DEP)**
  Bureau of Water Supply
  59-17 Junction Blvd., 20th Floor, Flushing, NY 11373-5108.

  Lorraine L. Janus, Ph.D., Chief, Water Quality Science & Research
  Anne Seeley, M.P.H., Section Chief, Health Assessment & Policy Coordination (*WDRAP Coordinator for DEP)*

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Additional copies of WDRAP reports are available from Anne Seeley by mail (at DEP address above), phone (718-595-5346), or E-mail (aseeley@dep.nyc.gov). Also at DEP website (see Part III of report).

Copies of the questionnaires used for disease surveillance are available from Robert Fitzhenry at the DOHMH address listed above, by phone (347-396-2623), or E-mail (rfitzhenry@health.nyc.gov).

The authors wish to acknowledge the dedication of the other members of the Waterborne Disease Risk Assessment Program Team, also to acknowledge Lorraine Janus for report review, and the assistance of Fran Guerriero (DEP) and Giselle Merizalde (DOHMH).

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EXECUTIVE SUMMARY

The primary objectives of New York City's Waterborne Disease Risk Assessment Program are to: (a) obtain data on the rates of giardiasis and cryptosporidiosis, along with demographic and risk factor information on case-patients; and (b) provide a system to track diarrheal illness to ensure rapid detection of any outbreaks. The program, jointly administered by the Department of Health and Mental Hygiene (DOHMH) and the Department of Environmental Protection (DEP), began in 1993. This report provides an overview of program progress, and data collected, during 2016.

DISEASE SURVEILLANCE

Active disease surveillance for giardiasis and cryptosporidiosis began in July 1993 and November 1994, respectively, and continued through 2010. This early surveillance involved laboratory visits or calls by DOHMH staff to insure all positive tests were reported. In January 2011, active laboratory surveillance for giardiasis and cryptosporidiosis was replaced by an electronic reporting system. This report presents the number of cases and case rates for giardiasis and cryptosporidiosis in 2016 (and includes data from past years for comparison). Also, demographic information for cases of giardiasis and cryptosporidiosis in 2016 was gathered and is summarized in this report. Telephone interviews of cryptosporidiosis case-patients to gather potential risk exposure information continued, and selected results are presented. Giardiasis and cryptosporidiosis rates have been on a downward trend over the years of this surveillance program. The giardiasis case rate increased from 10.2 per 100,000 population in 2015 to 10.5 per 100,000 (899 cases) in 2016, but was within the range seen over the past decade (case rates 2005-2015: 9.2-11.3, median 10.4). The cryptosporidiosis case rate increased from 1.6 per 100,000 in 2015 to 2.2 per 100,000 (192 cases) in 2016, which is greater than the range of case rates seen in the last decade (case rates 2005-2015: 1-1.9, median 1.3). The increase observed in the cryptosporidiosis case rate was likely due to the availability of a new rapid PCR test kit that can test for the presence of a wide range of enteric organisms including *Cryptosporidium*. Therefore the increased number of observations are not thought by DOHMH to represent a true increase in disease, but rather an increase in the detection of cases.

A swimming pool (treated water) incident (3 cryptosporidiosis cases) was detected through routine surveillance during October of 2016. This resulted in an environmental investigation of the pool which included enhanced surveillance for cryptosporidiosis among persons who used the pool, and in disinfection of the swimming pool.

SYNDROMIC SURVEILLANCE / 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 potentially play a role in limiting the extent of an outbreak by providing an early indication of a problem so that control measures may be rapidly implemented.

DOHMH maintains four distinct and complementary outbreak detection systems: one system involves the tracking of chief complaints from hospital emergency department (ED) logs; under another system DOHMH monitors and assists in the investigation of GI outbreaks in eight sentinel nursing homes; a third system tracks the number of stool specimens submitted to a clinical laboratory for microbiological testing; and a fourth system involves the monitoring of sales of over-the-counter (non-prescription) anti-diarrheal medications.

A summary of syndromic surveillance findings for 2016 pertaining to GI illness is presented. Citywide signals in the ED system that were sustained (i.e., > 1 day), were observed in January, February, March, June, September, October, November and December, which is consistent with annual gastrointestinal viral trends. There was no evidence of a drinking water-related outbreak in New York City in 2016.

INFORMATION SHARING AND PUBLIC EDUCATION

Information on *Cryptosporidium* and *Giardia* continues to be available on New York City Department of Environmental Protection's and New York City Department of Health and Mental Hygiene's websites (as listed in Part III of this report: "Information Sharing and Public Education"). Included are annual reports on program activities, fact sheets on giardiasis and cryptosporidiosis, and results from the Department of Environmental Protection's source water protozoa monitoring program.

INTRODUCTION

The ongoing primary objectives of New York City's Waterborne Disease Risk Assessment Program (WDRAP) are to:

- obtain data on the rates of giardiasis and cryptosporidiosis, along with demographic and risk factor information on case-patients; and
- provide a system to track diarrheal illness to ensure rapid detection of any outbreaks.

DEP and DOHMH work together on activities related to the WDRAP. The next sections of this report provide a summary of WDRAP highlights and data for the year 2016.

Please note that portions of this report are modified in comparison with prior year's reports, in that certain information (e.g., definitions, explanations) has been pulled from the body of the report and is now included in an Appendix section. This was done for more efficient annual report preparation and review, and for enhanced report readability.

PART I: DISEASE SURVEILLANCE

Giardiasis

Giardiasis, per the DOHMH Health Code, is a notifiable disease and since 2011 *Giardia* positive laboratory reports are reported to DOHMH via an electronic laboratory reporting system. From 1993 to 2011 active laboratory surveillance by DOHMH ensured reporting of laboratory diagnosed cases of giardiasis.

During 2016, a total of 899 cases of giardiasis were reported to DOHMH resulting in annual case rate of 10.5 per 100,000. Annual case numbers increased 3.5% from 2015 to 2016 but there has been a downward trend in giardiasis cases from 1994 to 2016 (range 767-2484, median 938; decline of 63.4%), with the decline prominent in years 1994/1995 – 2005. Since 2005, giardiasis annual case numbers showed less variability with a range of 767 – 938 (median 871). (Table 1).

Since September 1995, case investigations for giardiasis are conducted only for case-patients who are in a secondary transmission risk category (e.g., food handler, health care worker, child attending day care, or day care worker), or when giardiasis clusters or outbreaks are suspected. A total of 11 such cases of giardiasis occurred in 2016, and all were investigated. No cases were associated with outbreaks; 2 cases were healthcare workers, 1 case was a food handler, and 8 cases were investigated but not found to be in a secondary transmission risk category.

The following provides some highlights from the surveillance data for giardiasis among New York City residents diagnosed from January 1 through December 31, 2016. Additional data are presented in the tables, figures and maps that appear on pages 13-19.

Borough of case-patient residence

Borough of case-patient residence was known for all 899 giardiasis case-patients who resided in New York City. Manhattan had the highest borough-specific annual case rate (20.4 cases per 100,000) (Table 2). The highest UHF neighborhood-specific case rate was found in the Chelsea-Clinton neighborhood in Manhattan (53.3 cases per 100,000) (Map 1 and Table 3).

Sex

Information regarding sex was available for all cases. The number and rate of giardiasis cases were higher in males than females, with 665 males (16.3 cases per 100,000) and 234 females (5.2 cases per 100,000) reported. The highest sex- and borough-specific case rate was observed among males residing in Manhattan (36.1 cases per 100,000) (Table 2).

Age

Information regarding age was available for all cases. The highest age group-specific case rates, with all genders combined, were among children 5 to 9 years old (14.8 cases per 100,000) followed by persons 20-44 years old (13.8 cases per 100,000). The highest age group and sex-specific case rate was among males 20-44 years old (23.0 cases per 100,000) (Table 4). The two highest age-group and borough-specific case rates were persons 45-59 years old in Manhattan (28.2 cases per 100,000), followed by persons 20-44 years old in Manhattan (26.3 cases per 100,000) (Table 5).

Race/Ethnicity

Information regarding race/ethnicity was available for 101 of 899 cases (11.2 %). Ascertainment of race/ethnicity status for giardiasis cases was poor. As indicated above, giardiasis case-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. For the majority of giardiasis cases, race/ethnicity information, when provided, is not based upon self-report, but rather upon the impressions of health care providers, which may be inaccurate. For this reason, and because race/ethnicity information was missing from many giardiasis disease reports, race/ethnicity findings pertaining to giardiasis cases diagnosed in 2016 are not presented in this report.

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 12.0 to 16.4 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 low poverty levels (Table 6).

Cryptosporidiosis

Cryptosporidiosis was added to the list of reportable diseases in the New York City Health Code, effective January 1994. Active disease surveillance for cryptosporidiosis began in November 1994 and continued through 2010. Starting in 2011, active surveillance was replaced by electronic laboratory reporting. Case interviews for demographic and risk factor data were initiated in January 1995 and are ongoing.

During 2016, a total of 192 cases of cryptosporidiosis were reported to DOHMH. (Please note that confirmed and probable cases are now included in the WDRAP reports. See Appendix B for further explanation). The annual case rate was 2.2 per 100,000. Annual case numbers increased 44.4% from 2015 to 2016; case rates also increased. Looking at the data from 1994 to 2016, annual case numbers were higher in the years 1994-1999 (range: 2.2 – 6.1 cases per 100,000, median 3.6 cases per 100,000) and lower in the years 2000 – 2015 (range: 1.0 – 2.1 cases per 100,000, median 1.5 cases per 100,000) (Table 7).

An increase in cryptosporidiosis cases was noted in the fall of 2015 and continued in 2016. The increase was observed especially in the area of one of the university hospitals. Further investigation linked many of the early cases to "BioFire," a PCR test for multiple enteric organisms that had been made newly available in the hospital. This test is now being used in additional laboratories in the City. Of all PCR specimens from NYC residents that were sent to the New York State Department of Health Public Health Laboratory for confirmation, in 2015, 84% were confirmed, and in 2016 75.3% were confirmed. Thus the increase in cryptosporidiosis cases observed in 2015 and 2016 is thought by DOHMH to represent an increase in testing -- because of the availability of the PCR tests and the fact that this new test is ordered on people who might not ordinarily get a test for Cryptosporidium -- rather than an increase in cases. (Cryptosporidiosis is believed to be underdiagnosed when PCR is not available as it is not included in a routine ova and parasite test (O&P).

Because diagnosis may occur sometime after onset, information is collected in the interview regarding date of symptom onset. The date of onset can be used more accurately than date of diagnosis to estimate when case-patients were likely exposed to *Cryptosporidium*. The number of cryptosporidiosis cases by month of onset for the period January 1995 to December 2016 is presented in Figure 3.

The following provides some highlights from the surveillance data for cryptosporidiosis among New York City residents from January 1 through December 31, 2016. Additional data are presented in the tables, figures and maps that appear on pages 20-33.

Borough of case-patient residence

Information on borough of residence was available for all cases of cryptosporidiosis. Manhattan had the highest borough-specific annual case rate (5.0 cases per 100,000) (Table 8). The highest UHF neighborhood-specific case rate was in the Chelsea-Clinton neighborhood in Manhattan (9.3 cases per 100,000) (Map 2 and Table 9).

Sex

Information regarding sex was available for all cases. The number and rate of cryptosporidiosis cases were higher in males than females, with 127 males (3.1 cases per 100,000), and 65 females (1.5 cases per 100,000). The borough- and sex-specific case rate was highest for males in Manhattan (7.1 cases per 100,000) (Table 8).

Age

Information regarding age was available for all cases. The highest age group-specific case rates with all genders combined, were among persons 20-44 years old (3.1 cases per 100,000) and children <5 years old (3.0 cases per 100,000). The highest age group- and sex-specific case rates were in males 20-44 years old (4.6 cases per 100,000) (Table 10). The highest age group and borough-specific case rates occurred in children 10 to 19 years old in Manhattan (8.6 cases per 100,000), followed by persons 20-44 year old in Manhattan (6.0 cases per 100,000) (Table 11).

Race/Ethnicity

Race/ethnicity information was available for 180 of 192 cases (93.8%). Citywide, the racial/ethnic group-specific case rate was highest among Hispanics of any race (2.5 cases per 100,000). The highest race/ethnicity and borough-specific case rate occurred among Black non-Hispanics in Manhattan (6.7 cases per 100,000) (Table 12). The highest age group and race/ethnicity-specific case rates occurred among <5 year old Asian non-Hispanics (3 cases, 4.1 cases per 100,000), followed by 10-19 year old Hispanics of any race (13 cases, 3.9 cases per 100,000) (Table 13).

Census Tract Poverty Level

Age-adjusted case rates for cryptosporidiosis among four levels of census tract poverty ranged from 2.2 to 4.0 cases per 100,000 population, with the highest case rate (including age-adjusted case rates) occurring in census tracts with the highest poverty level (Table 14).

Investigation of a Cryptosporidiosis Cluster Related to Swimming Pool Contamination

On 10/06/2016, the DOHMH became aware of two children <1 year of age diagnosed with cryptosporidiosis who attended the same swimming classes in the borough of Brooklyn in NYC. The swim classes were held at a swimming pool in a private apartment condominium. The first case was diagnosed with cryptosporidiosis in 09/2016 and had an onset of 09/18/2016. This case attended daycare and was excluded per NYC Health Code. The second case was identified on review of cryptosporidiosis cases < 6 years old occurring in this time period in Brooklyn. The diagnosis date for the second case was 09/30/2016 and the onset date was 09/18/2016. The child attended the same swim classes as the first case.

DOHMH proceeded with an environmental investigation of the pool which included sampling pool water for the presence of *Cryptosporidium* and enhanced surveillance for possible cryptosporidiosis cases associated with pool users. 181 interviews were conducted and symptomatic pool users were asked to submit stool samples for *Cryptosporidium* testing. One specimen, collected from a symptomatic pool user, was positive for *Cryptosporidium* at the NYC Public Health Laboratory and confirmed by New York State Wadsworth Laboratory. This third case had an onset of 9/27/2016. Pool users were sent a notification letter and *Cryptosporidium* fact sheet. The pool was closed on 10/18/2016, and disinfection was performed on 10/27/2016. The pool was re-opened two week after closure, but children <6 years old were not allowed in the pool until two weeks from disinfection (November 10, 2016). The management company worked with the pool operator and the swimming school to resubmit an updated safety plan.

Cryptosporidiosis and Immune Status

Trends observed over the years in reported number 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 decreased from 392 in 1995 to 54 in 2016, thus causing a decline in the overall number of cryptosporidiosis cases in New York City. During the same time period (1995-2016), the number of cases of cryptosporidiosis among immunocompetent persons has shown less variation, ranging from a high of 139 cases in 1999 and a range of 29 to 128 cases in the years 2001 – 2016 (see Figures 4, 5 and 6). An analysis of trends using Poisson regression to compare the number of cases of cryptosporidiosis among persons with HIV/AIDS to the number of cases among the immunocompetent indicates that the overall decline from 1995 to 2016 was significantly greater in patients who were immunocompromised than in those who were not (P<.01). This decline is generally thought to be due to highly active antiretroviral therapy which was introduced in 1996-1997 for persons living with HIV/AIDS.

Cryptosporidiosis and Potential Risk Exposures

Of the 192 cryptosporidiosis cases diagnosed among NYC residents in 2016, questionnaires concerning potential exposures were completed in 157 cases (81.7%). Reasons for non-completion of questionnaires were: unable to locate case-patient (19 cases, 9.9%), refused (14 cases, 7.3%) and died (2 cases, 1.0%). Of the immunocompetent case-patients, interviews were completed for 118 case-patients (92.1%). Among persons with HIV/AIDS, interviews were completed for 33 case-patients (61%), and interviews were completed for 6 case-patients (66.7%) who were immunocompromised for reason other than HIV/AIDS. Summary data for 1995 through 2016 on commonly reported potential risk exposures, obtained from case-patient interviews of persons with HIV/AIDS and from interviews of persons who are immunocompetent, are presented in Tables 15 and 16, respectively. Information has also been collected regarding type of tap water consumption, and is presented in Tables 17 and 18. Tables 15 to 18 indicate the percentage of case-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 for cryptosporidiosis cannot be made without reference to a suitable control population (i.e., non-*Crytposporidium*-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 due to HIV/AIDS and patients who are immunocompetent. Looking at four potential risk categories (Tables 15 and 16) using the chi-square test for comparison of data since 2001, the following results were observed. Patients who were immunocompetent were significantly more likely to report international travel (P<.01 all years except 2009, P<.05); and to report exposure to recreational water in all years except 2003, 2006, 2007, and 2011 (2001, 2002, P<.01; 2003, P=.17; 2004, P<.05; 2005, P<.01; 2006, P=.24; 2007, P=.06; 2008, P<.05; 2009-2010, P<.01; 2011, P=.06; 2012, 2013,2014, 2015, 2016 P=<.01). There was no statistically significant difference between these two groups in the proportion of cases reporting animal contact from 2001 to 2016, or reporting high-risk sex from 2001 to 2005, 2007, and 2009 to 2016. In 2006 and 2008, the proportion of cases reporting high-risk sex was significantly

higher among persons with HIV/AIDS than among immunocompetent persons ($P<.01$). 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. These data indicate that, for most years, immunocompetent case-patients were more likely to travel internationally and have greater recreational water exposure than immunocompromised case-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.

PART II: SYNDROMIC SURVEILLANCE / OUTBREAK DETECTION

Introduction

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 potentially play a role in limiting the extent of an outbreak by providing an early indication of a problem so that control measures may be rapidly implemented. Over the years, beginning in the 1990s, the City has established and maintained a number of distinct and complementary outbreak detection systems. One system monitors and assists in the investigation of GI outbreaks in sentinel nursing homes. Another system monitors the number of stool specimens submitted to a participating clinical laboratory for microbiological testing, and a third system utilizes hospital emergency department (ED) chief complaint logs to monitor for outbreaks. The ED system is relied upon most for monitoring the burden of diarrheal illness in NYC. The City has also utilized two systems for monitoring sales of anti-diarrheal medications: the Anti-Diarrheal Monitoring System (ADM) and the Over-the-Counter medication (OTC) system. These pharmacy systems were merged in 2012 as the OTC-ADM system. (NOTE: both the ADM and OTC systems track sales of non-prescription anti-diarrheal medications. The program names were chosen simply as a way to distinguish the two systems).

Other than the ED system, which is now 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 2016 is provided in the final section of this part, on pages 10 to 11 (and in Figures 7, 8, 9 and 10).

Program Components – Overviews and Updates

A. Nursing Home Sentinel Surveillance

The nursing home surveillance system began in March 1997 and was substantially modified in August 2002. Under the current protocol, when a participating nursing home notes an outbreak of gastrointestinal illness that is legally reportable to the New York State

Department of Health (NYSDOH), the nursing home also notifies designated WDRAP team members working in the DOHMH BCD. 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 the 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*, viruses, and *Clostridium difficile* toxin testing. Though *C. difficile* is not a waterborne pathogen, *C. difficile* toxin testing was added in April 2010 in order 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 City's Public Health Laboratory. Testing for culture and sensitivity occurs at the Public Health Laboratory. On May 1, 2011 the DOHMH Public Health Laboratory discontinued parasitology testing. Specimens for ova and parasites and *Cryptosporidium*, as well as for viruses and *C. difficile* toxin testing, are currently being sent to NYSDOH Wadsworth Center. 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 Waterborne Disease Risk Assessment Program annual reports.

WDRAP team members made site visits to six of eight nursing homes participating in the Nursing Home Sentinel Surveillance system in 2016. The remaining two nursing homes were visited in January and February 2017. During the site visits, the DOHMH staff members reviewed with nursing administration or infection control staff the rationale for the program and program protocol. In addition, the DOHMH staff members verified that the nursing homes had adequate stool collection supplies on hand. All participating nursing homes are visited on an annual basis to help ensure compliance with the program protocol.

B. Clinical Laboratory Monitoring System

The number of stool specimens submitted to clinical laboratories for bacterial and parasitic testing also provides information on gastrointestinal illness trends in the population. NYC's Clinical Laboratory Monitoring program 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 two 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.*

Clinical Laboratory Monitoring results are reviewed upon receipt. Beginning in August 2004, DOHMH started implementation of a computer model to establish statistical cut-offs for significant increases in clinical laboratory submissions. The model uses the entire historical dataset, that is, since 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 L, Maloney E, Bean N, Slutsker L, Martin S. Using Laboratory-Based Surveillance Data for Prevention: An Algorithm for Detecting *Salmonella* Outbreaks. *Emerging Infectious Diseases*. 1997; 3[3]: 395-400.)

C. Anti-Diarrheal Medication Monitoring

NYC began tracking anti-diarrheal drug sales as an indicator of gastro-intestinal illness trends in 1995, via a system operated by DEP.[1] Major modifications/enhancements to NYC's anti-diarrheal medication surveillance program have been made over the years, including: initiation and then expansion of DEP's ADM program; initiation of DOHMH's OTC program in 2002; and most recently, the merger of the ADM and the OTC systems. The ADM and OTC systems were merged in order to simplify the processing and analysis of pharmacy data, and combine the strengths of the two systems. The merger took effect in April 2012 and the combined OTC-ADM system is operated by DOHMH.

The first full year of operation of the merged OTC-ADM system was 2013. Enhancements of the combined system include: an increased number of stores providing data into one database for analysis, broader geographic coverage in a single database, new analytic methods, and separate analyses for citywide increases in sales of over-the-counter, non-bismuth-containing anti-diarrheal medications and of bismuth subsalicylate medications. At the time of the merger, an average of 345 pharmacies (range of 340-350) was providing daily sales reports. DOHMH conducted an evaluation of the impact of the merger of the two systems, and a final report on the evaluation was prepared, and sent to NYSDOH and USEPA on June 18, 2014. In late 2015, one participating pharmacy chain declared bankruptcy and began decommissioning their files. This pharmacy began 2015 with 49 stores submitting data. Decommissioning began on October 8, 2015 at a rate of 3-5 stores per week. The last day of data submission was November 30, 2015.

Offsetting this loss of data is the addition of two other pharmacy chains to the OTC-ADM system, resulting in the submission of data from over 300 new stores. Submission of files from one pharmacy chain began on November 9, 2015; the second chain began on February 9, 2016. Because a 56 day baseline is needed for the current statistical models, analysis with both additional pharmacies began on April 7, 2016. Data are now received from approximately 570 stores.

D. Hospital Emergency Department Monitoring

NYC initiated monitoring of hospital emergency department (ED) visits as a public health surveillance system in 2001. Throughout most of 2016, DOHMH received electronic data from all of New York City's 53 EDs reporting, approximately 11,500 visits per day. Hospitals

[1] The first NYC anti-diarrheal medication tracking system, involving data from a regional distributor serving independent pharmacies, was implemented in 1995. This system was discontinued in 2000 due to a diminishing data stream. This summary of NYC anti-diarrheal medication monitoring programs therefore begins with discussion of the ADM system which began operation in 1996.

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 gastrointestinal illness are vomiting syndrome and 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 fourteen days. Spatial analyses scan the data for geographic clustering in syndrome visits on the most recent day 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 set at P<.01, indicating that fewer than 1 out of every 100 analyses would generate a cluster due to chance alone. Beginning March 11, 2005, the threshold of significance for spatial signals was changed to P<.005, while the threshold of significance for citywide signals remained at P<.01. (The system is described further in: Heffernan R, Mostashari F, Das D, Karpati A, Kulldorf M, Weiss D. Syndromic Surveillance in Public Health Practice, New York City. *Emerging Infectious Diseases*. 2004; 10[5]: 858-864.)

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 anti-diarrheal medication 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 see whether or not there are concurrent signals. In this report, Figures 7 to 10 summarize GI disease signals from NYC's syndromic surveillance systems. Figures 7 and 8 summarize ED system trends and signals for 2016. Figures 9 and 10 summarize signal results from all syndromic surveillance systems operated by DOHMH during 2016.

Figure 7 shows a graphic representation of the ratio of daily ED visits for the vomiting syndrome to all other daily ED visits for syndromes not tracked by ED syndromic surveillance ("other visits") from January 1 to December 31, 2016. The graph also indicates the occurrence of citywide signals and of the spatial residential zip code and hospital signals. Figure 8 is the same graph for the syndrome of diarrhea. Figures 7 and 8 indicate that citywide signals for vomiting and/or diarrhea occurred in January, February, March, June, September, October, November and December. There were sustained (i.e., > 1-day) citywide vomiting signals from January 16-19, February 1-2, 15-16, March 5-7, 13-14, June 25-27, September 18-20, October 29-31, November 6-7, 13-15, 19-29, and December 10-20, 22-27; and citywide diarrhea signals January 17-19, March 6-8, November 7-11, 14-17, 24-29 and December 18-28. ED signals for vomiting and diarrhea in January, February, March, September, October, November and December are consistent with historical experience showing a seasonal increase in viral gastroenteritis due to norovirus and/or rotavirus.

Figures 9 and 10 are time-series plots of signals from NYC syndromic surveillance systems for the gastrointestinal syndrome covering the period January 1 to June 30, and July 1 to

December 31, 2016, respectively. Results from all of the GI syndromic surveillance systems are included (i.e., the ED, clinical laboratory, OTC-ADM, and sentinel nursing home systems). As discussed above, there was sustained citywide ED system signaling in January, February, March, June, September, October, November and December, likely representing the seasonality of rotavirus and norovirus. There was one GI outbreak in sentinel nursing homes in December that was caused by Norovirus Type II. The GI outbreak occurred in a sentinel nursing home in Manhattan beginning in December 2016. Five patients on two units were affected with symptoms of diarrhea and vomiting. There were no deaths or hospitalizations. The facility sent three stool specimens from one patient to the NYC Public Health Laboratory for testing. A viral specimen was tested at the NYC Public Health Laboratory and was positive for Norovirus Genotype II by polymerase chain reaction. No specimens were positive for parasitic or bacterial pathogens.

In the clinical laboratory system, there was sustained signaling May 20-21, 23-25, July 14-16 and September 8-9. During these periods when the clinical laboratory surveillance signaled due to changes in laboratory test volume, there was no evidence of an outbreak based on the number of positive *Cryptosporidium* cases.

In the OTC system there were sustained signals for non-bismuth containing anti-diarrheal sales from August 2-5. An investigation was conducted, and there were no spatial clustering of sales or increase in promotional sales. A review of ED diarrheal visits did not find a corresponding increase. There were sustained signals for bismuth subsalicylate sales January 1-4, March 28-31, April 1-8, July 31, August 1-10, and November 1-8. Investigations were conducted, for each signal, and the increases was determined to be driven by a promotional sales at one of the participating pharmacies.

In summary, for the period January through December 2016, there were multiple citywide signals for gastrointestinal illness in the ED system in January, February, March, June, September, October, November and December. One GI outbreak in a sentinel nursing home in December, which was caused by Norovirus Genotype II and sustained citywide signals in the ED system in the beginning and end of the year are consistent with annual gastrointestinal viral trends. There was no evidence of a drinking water-related outbreak in New York City in 2016.

PART III: INFORMATION SHARING AND PUBLIC EDUCATION

Information pertaining to NYC's Waterborne Disease Risk Assessment Program and related issues continue to be 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*
  http://www1.nyc.gov/site/doh/health/health-topics/giardiasis.page

- *Cryptosporidiosis fact sheet*
  http://www1.nyc.gov/site/doh/health/health-topics/cryptosporidiosis.page

DEP Webpages:

- *DEP Water Supply Testing Results for Giardia and Cryptosporidium*
  (Data are collected and entered on the website each week. Historical data are also included.)
  http://www.nyc.gov/html/dep/html/drinking_water/pathogen.shtml

- *Waterborne Disease Risk Assessment Program's Annual Reports, 1997- Present*
  http://www.nyc.gov/html/dep/html/drinking_water/wdrap.shtml

- *New York City Drinking Water Supply and Quality Statement, 1997- Present*
  http://www.nyc.gov/html/dep/html/drinking_water/wsstate.shtml

Figure 1: Giardiasis, number of cases by month of diagnosis, New York City, July 1993 - December 2016

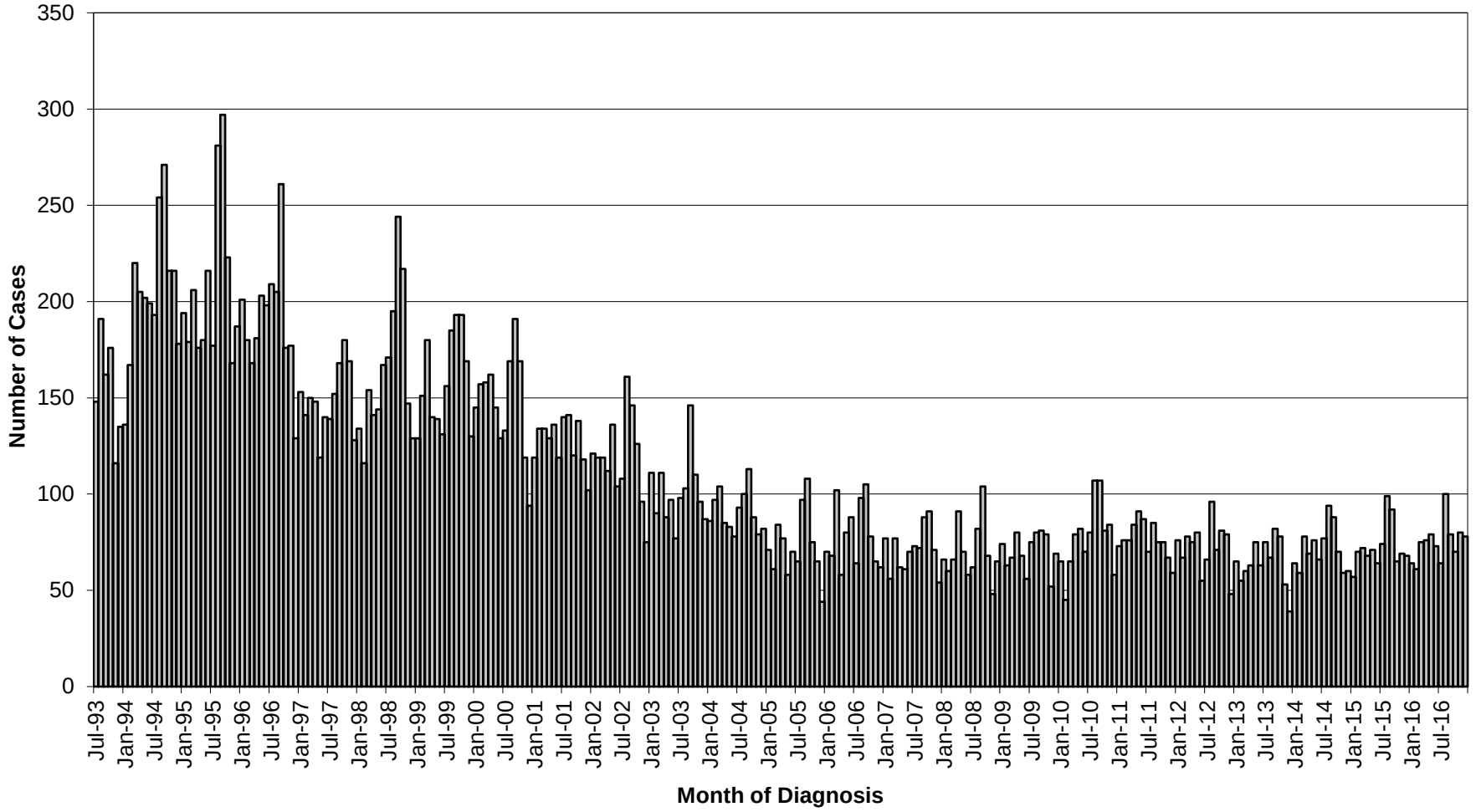


TABLE 1: **Giardiasis**, number of cases and case rates, New York City, 1994 - 2016

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	19.0
2002	1,423	17.6
2003	1,214	15.0
2004	1,088	13.4
2005	875	10.7
2006	938	11.4
2007	852	10.3
2008	840	10.0
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

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 case numbers as they appear in the NYC Department of Health and Mental Hygiene Bureau of Communicable Disease surveillance databases for the years 1989-2016, and rates have been accordingly adjusted. Yearly case numbers and rates in this table may therefore differ from case numbers and rates that appeared in prior WDRAP reports.

TABLE 2: **Giardiasis**, number of cases and annual case rate per 100,000 population by sex and borough of residence, New York City, 2016

	Borough of residence					
Sex	Citywide number (rate)	Manhattan number (rate)	Bronx number (rate)	Brooklyn number (rate)	Queens number (rate)	Stat Is number (rate)
Male	665 (16.3)	281 (36.1)	82 (11.9)	182 (14.6)	106 (9.3)	14 (6.1)
Female	234 (5.2)	54 (6.2)	43 (5.6)	77 (5.6)	54 (4.5)	6 (2.5)
Total	899 (10.5)	335 (20.4)	125 (8.6)	259 (9.8)	160 (6.8)	20 (4.2)

Map 1

Giardiasis annual case rate per 100,000 population
by UHF neighborhood - New York City (2016)

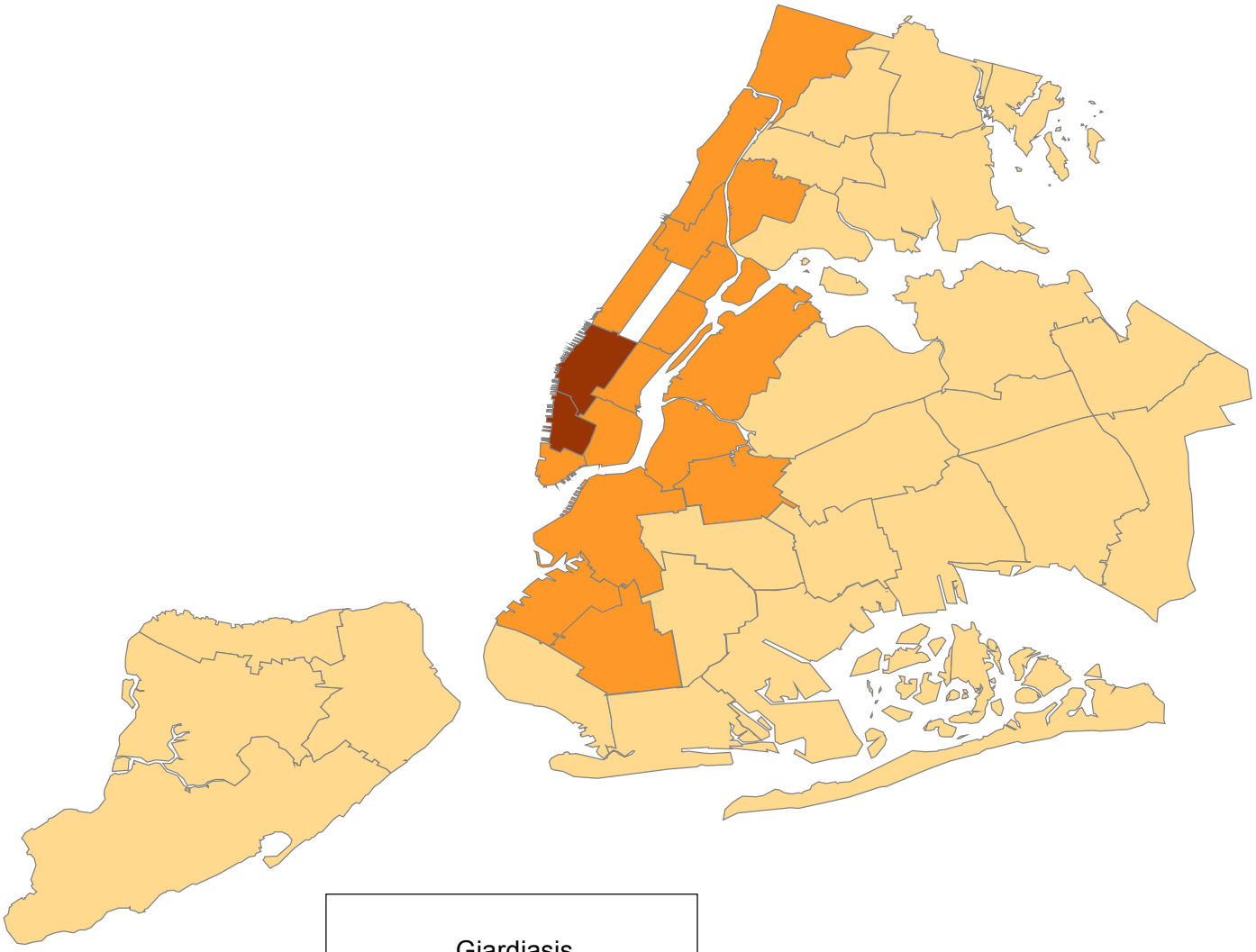


Table 3: Giardiasis, number of cases and annual case rate per 100,000 by UHF neighborhood of residence, New York City, 2016

UHF Neighborhood	Borough	Number	Population	Rate
Chelsea-Clinton	Manhattan	86	161270	53.3
Greenwich Village-Soho	Manhattan	30	85809	35.0
Gramercy Park-Murray Hill	Manhattan	31	136373	22.7
C.Harlem-Morningside Hgts	Manhattan	30	164513	18.2
Long Island City-Astoria	Queens	40	226999	17.6
Downtown-Heights-Slope	Brooklyn	42	239227	17.6
Greenpoint	Brooklyn	25	144839	17.3
Upper West Side	Manhattan	39	226864	17.2
Williamsburg-Bushwick	Brooklyn	35	214864	16.3
Washington Heights-Inwood	Manhattan	38	256405	14.8
Union Sq-Lower East Side	Manhattan	30	205715	14.6
Sunset Park	Brooklyn	19	138479	13.7
Upper East Side	Manhattan	30	226820	13.2
Borough Park	Brooklyn	46	356166	12.9
Kingsbridge-Riverdale	Bronx	12	93562	12.8
Borough Park	Brooklyn	45	356166	12.6
East Harlem	Manhattan	14	114059	12.3
Lower Manhattan	Manhattan	7	57846	12.1
High Bridge-Morrisania	Bronx	26	221726	11.7
Ridgewood-Forest Hills	Queens	24	248572	9.7
Northeast Bronx	Bronx	19	197082	9.6
Bed Stuyvesant-Crown Hgts	Brooklyn	31	321808	9.6
West Queens	Queens	47	515169	9.1
Hunts Point-Mott Haven	Bronx	13	145162	9.0
Pelham-Throgs Neck	Bronx	24	312151	7.7
Fordham-Bronx Park	Bronx	19	266173	7.1
Fresh Meadows	Queens	7	100340	7.0
Port Richmond	Stat Is	5	72468	6.9
Coney Island-Sheepshead Bay	Brooklyn	19	306915	6.2
Crotona-Tremont	Bronx	12	216963	5.5
East Flatbush-Flatbush	Brooklyn	16	301932	5.3
Canarsie-Flatlands	Brooklyn	10	198202	5.0
Stapleton-St. George	Stat Is	6	126916	4.7
Bayside-Littleneck	Queens	4	90938	4.4
Rockaway	Queens	5	115525	4.3
South Beach-Tottenville	Stat Is	8	188010	4.3
East New York	Brooklyn	8	189115	4.2
Flushing-Clearview	Queens	11	276030	4.0
Southwest Queens	Queens	11	276156	4.0
Bensonhurst-Bay Ridge	Brooklyn	8	225188	3.6
Jamaica	Queens	7	299467	2.3
Southeast Queens	Queens	4	201398	2.0
Willowbrook	Stat Is	1	87163	1.1

TABLE 4: Giardiasis, number of cases and annual case rate per 100,000 population by age group and sex, New York City, 2016

	Sex		
Age group	Male number (rate)	Female number (rate)	Total number (rate)
<5 years	31	36	67
	(10.6)	(12.9)	(11.7)
5-9 years	34	38	72
	(13.7)	(15.9)	(14.8)
10-19 years	37	19	56
	(7.8)	(4.1)	(6.0)
20-44 years	371	87	458
	(23.0)	(5.1)	(13.8)
45-59 years	149	20	169
	(19.0)	(2.3)	(10.2)
≥ 60 years	43	34	77
	(6.4)	(3.7)	(4.9)
Total	665	234	899
	(16.3)	(5.2)	(10.5)

TABLE 5: Giardiasis, number of cases and annual case rate per 100,000 population by age group and borough of residence, New York City, 2016

	Borough of residence					
Age group	Citywide number (rate)	Manhattan number (rate)	Bronx number (rate)	Brooklyn number (rate)	Queens number (rate)	Stat Is number (rate)
<5 years	67	9	15	24	18	1
	(11.7)	(10.6)	(13.7)	(12.0)	(12.1)	(3.6)
5-9 years	72	8	26	27	10	1
	(14.8)	(12.6)	(25.6)	(16.3)	(7.8)	(3.5)
10-19	56	8	19	17	11	1
years	(6.0)	(6.3)	(9.6)	(5.6)	(4.4)	(1.7)
20-44	458	193	39	138	78	10
years	(13.8)	(26.3)	(7.3)	(13.4)	(9.0)	(6.5)
45-59	169	86	17	37	24	5
years	(10.2)	(28.2)	(6.1)	(7.8)	(4.9)	(4.8)
≥ 60	77	31	9	16	19	2
years	(4.9)	(9.4)	(3.8)	(3.5)	(4.1)	(2.0)
Total	899	335	125	259	160	20
	(10.5)	(20.4)	(8.6)	(9.8)	(6.8)	(4.2)

Table 6: Giardiasis, number of cases and case rates by census tract poverty level, New York City, 2016

Census Tract Poverty Level	Number of Cases	Case Rate per 100,000	Age adjusted rates
Low[a]	244	11.5	16.4
Medium[b]	265	10.2	15.2
High[c]	210	11.4	14.2
Very high[d]	177	8.9	12.0

[a] Low poverty: <10% of residents have household incomes that are below 100% of the federal poverty level, per American Community Survey 2010-2014.
[b] Medium poverty: 10-19% of residents have household incomes that are below 100% of the federal poverty level, per American Community Survey 2010-2014.
[c] High poverty: 20-29% of residents have household incomes that are below 100% of the federal poverty level, per American Community Survey 2010-2014
[d] Very high poverty: >=30% of residents have household incomes that are below 100% of the federal poverty level, per American Community Survey 2010-2014.
[e] Two cases (0.3%) were excluded from the total 2016 case count because geolocating information for census tract identification was unavailable.

Table 7: Cryptosporidiosis, number of cases and case rates, New York City, 1994 – 2016

Year	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	1.0
2010	107	1.3
2011	86	1.1
2012	125	1.5
2013	80	1.0
2014	102	1.2
2015	133	1.6
2016	192	2.2

Note:

- Active disease surveillance for cryptosporidiosis began in November 1994. Starting January 2011, active laboratory surveillance was discontinued as it had been replaced by an electronic reporting system.
- Case numbers in this table conform to case numbers as they appear in the NYC Department of Health and Mental Hygiene Bureau of Communicable Disease surveillance databases for the years 1989-2016, and rates have been accordingly adjusted. Yearly case numbers and rates in this table may therefore differ from case numbers and rates that appeared in prior WDRAP reports.

Figure 2: Cryptosporidiosis, number of cases by month of diagnosis, New York City, November 1994 - December 2016

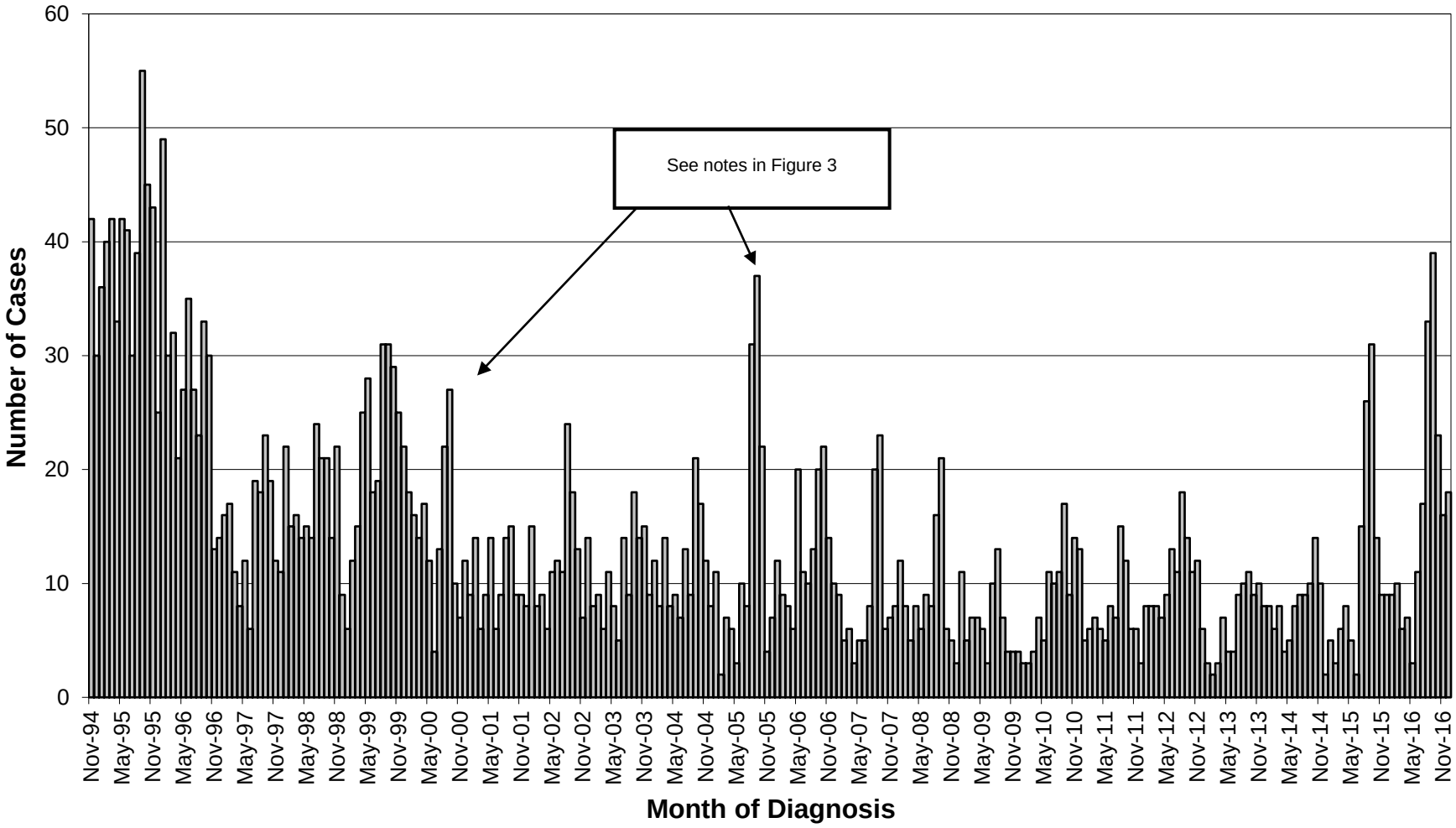
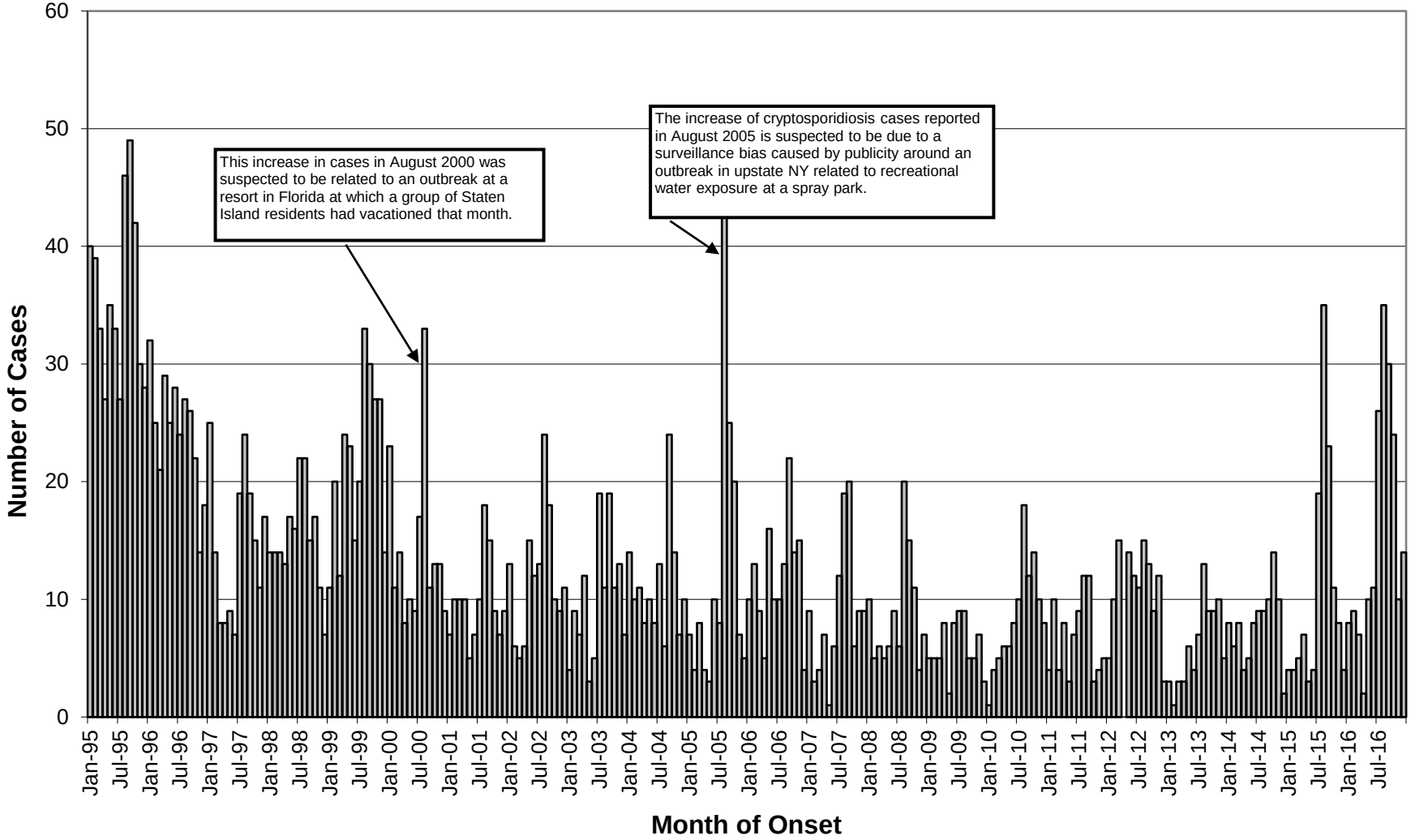


Figure 3: Cryptosporidiosis, number of cases by month of onset, New York City, January 1995 - December 2016*



The date of onset can be used more accurately than date of diagnosis to estimate when case-patients were likely exposed to Cryptosporidium.

TABLE 8: Cryptosporidiosis, number of cases and annual case rate per 100,000 population by sex and borough of residence, New York City, 2016

	Borough of residence					
Sex	Citywide number (rate)	Manhattan number (rate)	Bronx number (rate)	Brooklyn number (rate)	Queens number (rate)	Stat Is number (rate)
Male	127	55	26	35	10	1
	(3.1)	(7.1)	(3.8)	(2.8)	(0.9)	(0.4)
Female	65	28	15	11	10	1
	(1.5)	(3.2)	(2.0)	(0.8)	(0.8)	(0.4)
Total	192	83	41	46	20	2
	(2.2)	(5.0)	(2.9)	(1.8)	(0.9)	(0.4)

Map 2

Cryptosporidiosis annual case rate per 100,000 population
by UHF neighborhood - New York City (2016)

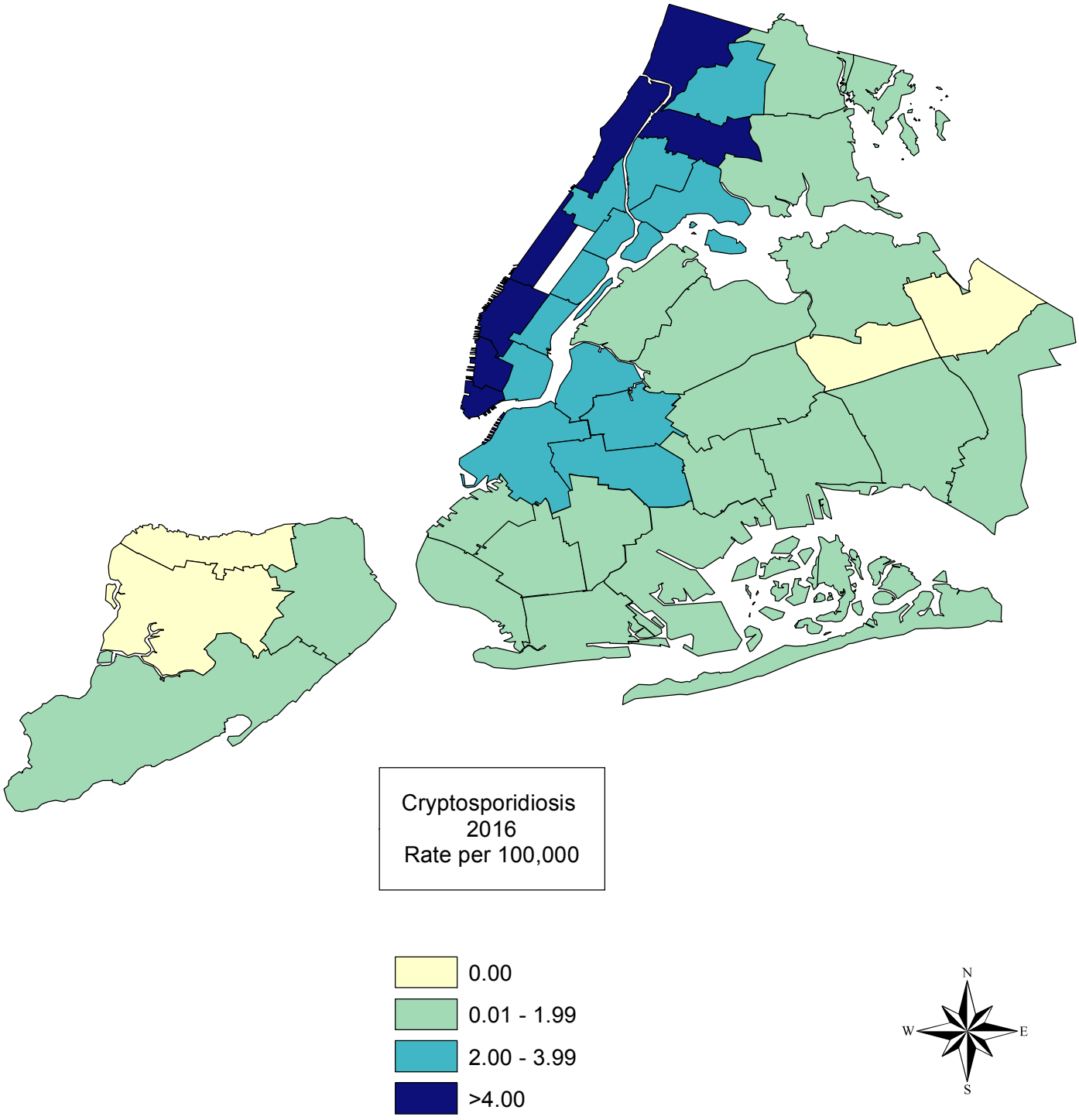


TABLE 9: Cryptosporidiosis, number of cases and annual case rate per 100,000 population by UHF neighborhood of residence, New York City, 2016

UHF Neighborhood	Borough	Number	Population	Rate
Chelsea-Clinton	Manhattan	15	161270	9.3
Washington Heights-Inwood	Manhattan	20	256405	7.8
Upper West Side	Manhattan	16	226864	7.1
Kingsbridge-Riverdale	Bronx	6	93562	6.4
Lower Manhattan	Manhattan	3	57846	5.2
Greenwich Village-Soho	Manhattan	4	85809	4.7
Crotona-Tremont	Bronx	9	216963	4.1
Gramercy Park-Murray Hill	Manhattan	5	136373	3.7
East Harlem	Manhattan	4	114059	3.5
Downtown Heights-Slope	Brooklyn	8	239227	3.3
Williamsburg-Bushwick	Brooklyn	7	214864	3.3
High Bridge-Morisania	Bronx	7	221726	3.2
Upper East Side	Manhattan	7	226820	3.1
Fordham-Bronx Park	Bronx	7	266173	2.6
C Harlem-Morningside Hgts	Manhattan	4	164513	2.4
Union Sq-Lower East Side	Manhattan	5	205715	2.4
Bed Stuyvesant-Crown Hgts	Brooklyn	7	321808	2.2
Greenpoint	Brooklyn	3	144839	2.1
Hunts Point-Mott Haven	Bronx	3	145162	2.1
Pelham-Throgs Neck	Bronx	6	312151	1.9
Long Island City-Astoria	Queens	4	226999	1.8
Borough Park	Brooklyn	6	356166	1.7
East New York	Brooklyn	3	189115	1.6
Northeast Bronx	Bronx	3	197082	1.5
Sunset Park	Brooklyn	2	138479	1.4
Coney Island-Sheepshead Bay	Brooklyn	4	306915	1.3
Southwest Queens	Queens	3	276156	1.1
Canarsie-Flatlands	Brooklyn	2	198202	1.0
East Flatbush-Flatbush	Brooklyn	3	301932	1.0
Southeast Queens	Queens	2	201398	1.0
Rockaway	Queens	1	115525	0.9
Ridgewood-Forest Hills	Queens	2	248572	0.8
Stapleton-St.George	Stat Is	1	126916	0.8
West Queens	Queens	4	515169	0.8
Flushing-Clearview	Queens	2	276030	0.7
Jamaica	Queens	2	299467	0.7
South Beach-Tottenville	Stat Is	1	188010	0.5
Bensonhurst-Bay Ridge	Brooklyn	1	225188	0.4

TABLE 10: Cryptosporidiosis, number of cases and annual case rate per 100,000 population by age group and sex, New York City, 2016

Age group	Male number (rate)	Female number (rate)	Total number (rate)
<5 years	11 (3.8)	6 (2.2)	17 (3.0)
5-9 years	4 (1.6)	5 (2.1)	9 (1.8)
10-19 years	10 (2.1)	13 (2.8)	23 (2.5)
20-44 years	75 (4.6)	28 (1.6)	103 (3.1)
45-59 years	19 (2.4)	11 (1.3)	30 (1.8)
≥ 60 years	8 (1.2)	2 (0.2)	10 (0.6)
Total	127 (3.1)	65 (1.5)	192 (2.2)

TABLE 11: Cryptosporidiosis, number of cases and annual case rate per 100,000 population by age group and borough, New York City, 2016

	Borough of residence					
Age group	Citywide number (rate)	Manhattan number (rate)	Bronx number (rate)	Brooklyn number (rate)	Queens number (rate)	Stat Is number (rate)
<5 years	17 (3.0)	4 (4.7)	5 (4.6)	5 (2.5)	3 (2.0)	0
5-9 years	9 (1.9)	3 (4.7)	3 (3.0)	1 (0.6)	2 (1.6)	0
10-19 years	23 (2.4)	11 (8.6)	7 (3.5)	2 (0.7)	2 (0.8)	1 (1.7)
20-44 years	103 (3.1)	44 (6.0)	18 (3.4)	29 (2.8)	11 (1.3)	1 (0.6)
45-59 years	30 (1.8)	15 (4.9)	6 (2.2)	7 (1.5)	2 (0.4)	0
≥ 60 years	10 (0.6)	6 (1.8)	2 (0.9)	2 (0.4)	0	0
Total	192 (2.2)	83 (5.0)	41 (2.8)	46 (1.7)	20 (0.9)	2 (0.4)

TABLE 12: Cryptosporidiosis, number of cases and annual case rate per 100,000 population by race/ethnicity and borough of residence, New York City, 2016

	Borough of residence					
Race/Ethnicity	Citywide number (rate)	Manhattan number (rate)	Bronx number (rate)	Brooklyn number (rate)	Queens number (rate)	Stat Is number (rate)
Hispanic	63 (2.5)	25 (5.9)	24 (3.0)	5 (1.0)	9 (1.4)	0
White, non-Hispanic	60 (2.2)	36 (4.7)	1 (0.7)	21 (2.2)	2 (0.3)	0
Black, non-Hispanic	41 (2.1)	14 (6.7)	9 (2.1)	15 (1.9)	2 (0.5)	1 (2.2)
Asian, non-Hispanic	15 (1.2)	3 (1.5)	2 (3.4)	5 (1.6)	4 (0.7)	1 (2.5)
Pacific Islander, Native Hawaiian, non-Hispanic	0	0	0	0	0	0
American Indian, non-Hispanic	0	0	0	0	0	0
Two or more races, non-Hispanic	1 (0.7)	1 (3.2)	0	0	0	0
Unknown	12	4	5	0	3	0
Total	192 (2.2)	83 (5.0)	41 (2.8)	46 (1.7)	20 (0.9)	2 (0.4)

TABLE 13: Cryptosporidiosis, number of cases and annual case rate per 100,000 population by race/ethnicity and age group, New York City, 2016

	Age group						
Race /ethnicity	< 5 years number (rate)	5-9 years number (rate)	10-19 years number (rate)	20-44 years number (rate)	45-59 years number (rate)	≥ 60 years number (rate)	Total number (rate)
Hispanic	7 (3.5)	3 (1.7)	13 (3.9)	25 (2.5)	10 (2.2)	5 (1.4)	63 (2.5)
White, non-Hispanic	6 (3.8)	3 (2.3)	3 (1.3)	37 (3.4)	7 (1.4)	4 (0.6)	60 (2.2)
Black, non-Hispanic	1 (0.8)	1 (0.9)	5 (2.2)	24 (3.5)	9 (2.2)	1 (0.3)	41 (2.1)
Asian, non-Hispanic	3 (4.1)	1 (1.7)	2 (1.7)	7 (1.4)	2 (0.8)	0	15 (1.2)
Pacific Islander, Native Hawaiian, non-Hispanic	0	0	0	0	0	0	0
American Indian, non-Hispanic	0	0	0	0	0	0	0
Two or more races, non-Hispanic	0	0	0	1 (1.9)	0	0	1 (0.7)
Unknown	0	1	0	9	2	0	12
Total	17 (3.0)	9 (1.9)	23 (2.4)	103 (3.1)	30 (1.8)	10 (0.6)	192 (2.2)

Table 14: Cryptosporidiosis, number of cases and case rates by census tract poverty level, New York City, 2016

Census Tract Poverty Level	Number of Cases	Case Rate per 100,000	Age adjusted rates per 100,000
Low[a]	42	2.0	2.6
Medium[b]	60	2.3	2.8
High[c]	34	1.8	2.2
Very high[d]	56	2.8	4.0

[a] Low poverty: <10% of residents have household incomes that are below 100% of the federal poverty level, per American Community Survey 2010-2014.
[b] Medium poverty: 10-19% of residents have household incomes that are below 100% of the federal poverty level, per American Community Survey 2010-2014.
[c] High poverty: 20-29% of residents have household incomes that are below 100% of the federal poverty level, per American Community Survey 2010-2014.
[d] Very high poverty: >=30% of residents have household incomes that are below 100% of the federal poverty level, per American Community Survey 2010-2014.

Figure 4: Cryptosporidiosis, number of cases among persons living with HIV/AIDS by month of diagnosis, New York City, January 1995 - December 2016

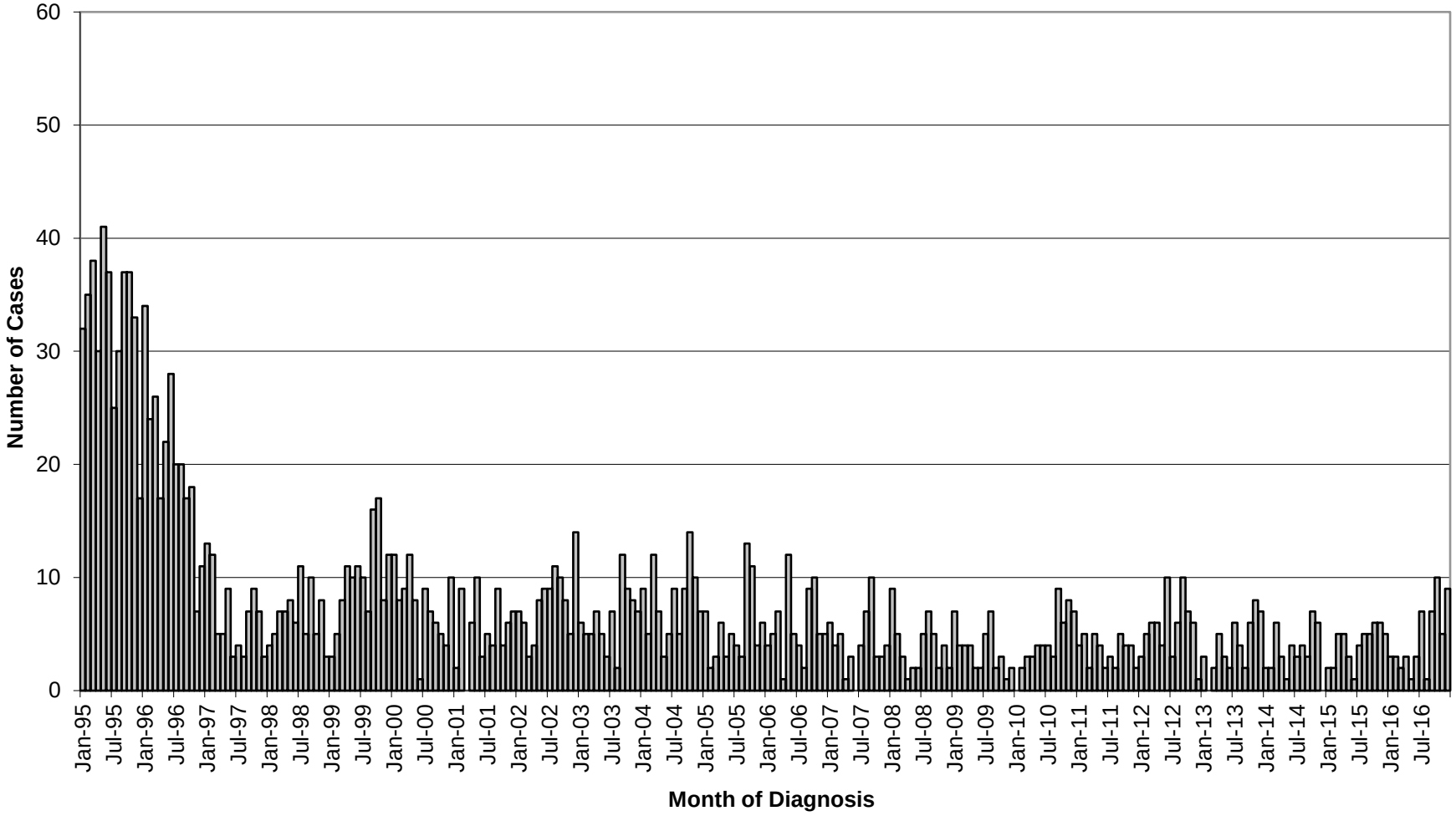


Figure 5: Cryptosporidiosis, number of cases among immunocompetent persons by month of diagnosis, New York City, January 1995 - December 2016

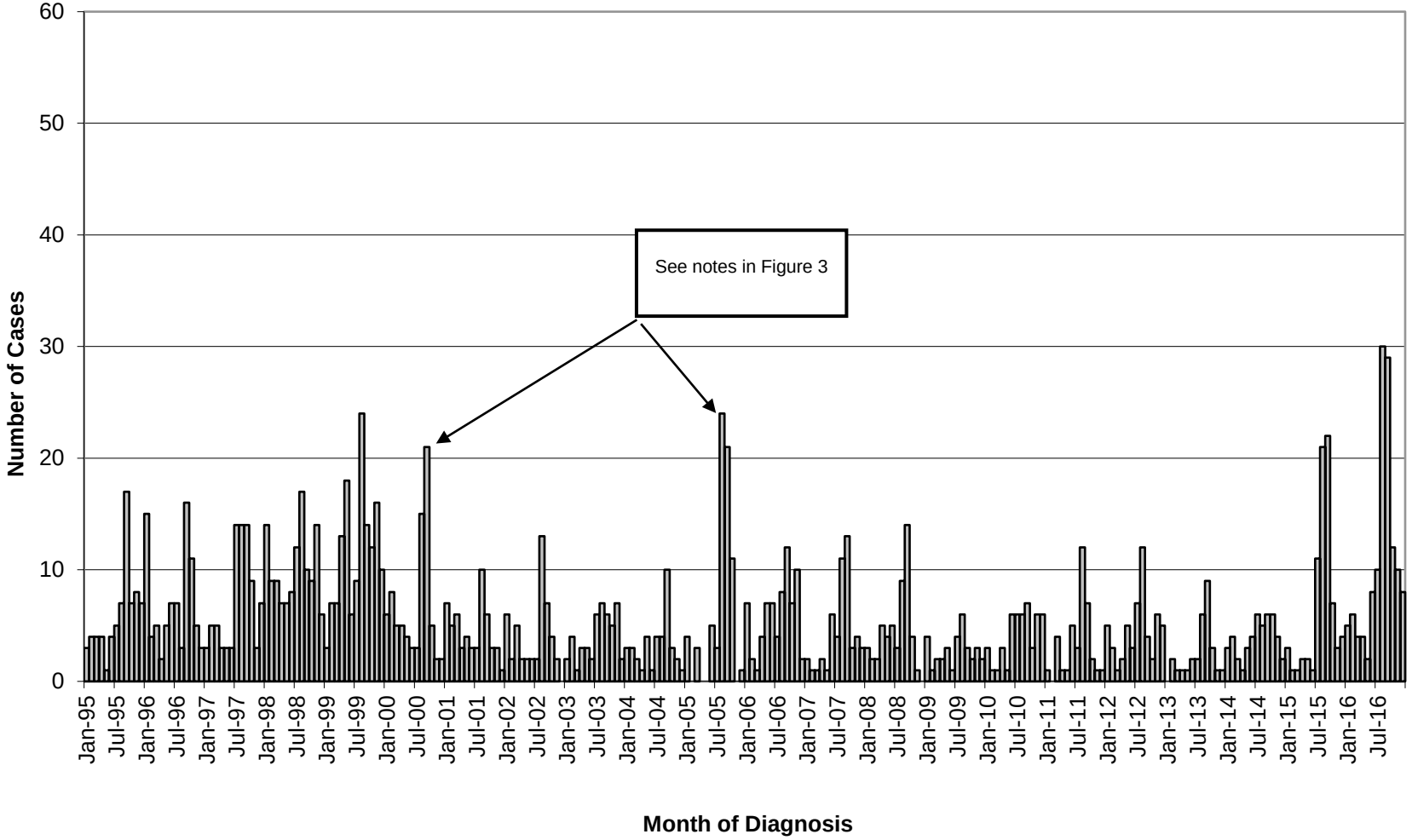


Figure 6: Cryptosporidiosis, number of cases by year of diagnosis and immune status, New York City, 1995 - 2016

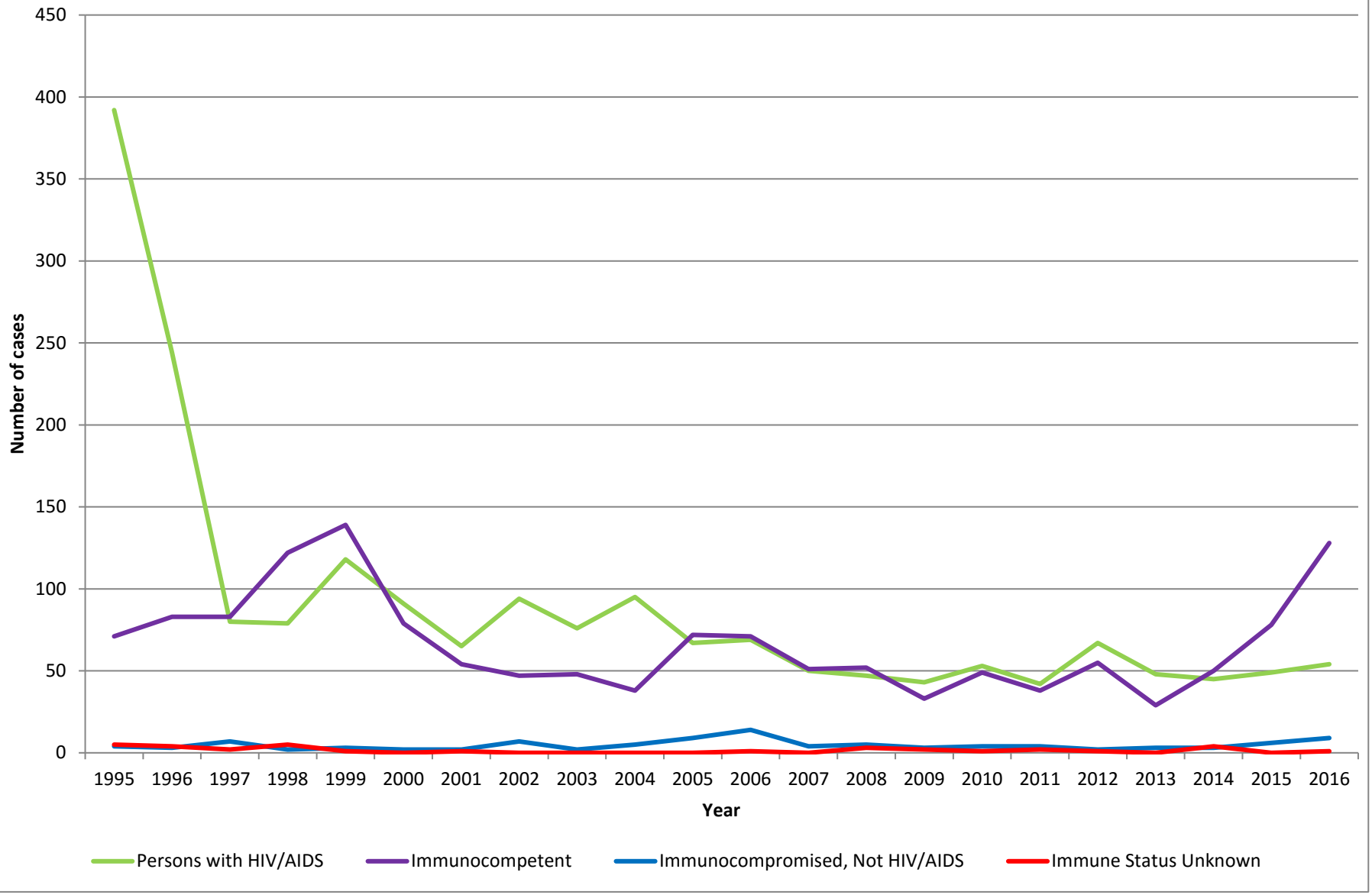


Table 15: Percentage of interviewed c**ryptosporidiosis** case-patients reporting selected potential risk exposures before disease onset,[a] persons with HIV/AIDS, New York City, 1995 – 2016. Value shown: median with range for five years in brackets

Exposure Type	Persons with HIV/AIDS					
	1995-1999	2000-2004	2005-2009	2010-2014	2015	2016
Contact with an Animal[b]	35% (33%-36%)	40% (24%-43%)	38% (31%-44%)	34% (20%-43%)	45%	30%
High-risk Sexual Activity[c] (≥ 18 years old)	20% (9%-22%)	24%(16% - 34%)	31% (21%-39%)	17% (7%-25%)	32%	21%
International Travel[d]	9% (9%-18%)	13% (10%-15%)	8% (6%-17%)	6% (4%-13%)	11%	9%
Recreational Water Contact[e]	16% (8%-16%)	13% (8%-21%)	14% (5%-18%)	10% (4%-14%)	13%	12%

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).**

- Format of case interview form changed on 1/1/1997, 5/11/2001, 8/21/2002, and 4/26/2010. Details regarding changes made to the interview form and Exposure Types from 1995-2016 are noted below.
  - [a] From 1/1/1995 to 4/25/2010, case-patients were asked about potential risk exposures during the month before disease onset. Starting 4/26/2010, case-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: or visiting a pet store or veterinarian office (1997-2012); or other animal exposure (2016).
  - [c] High-risk Sexual Activity - Includes having a penis, finger or tongue in sexual partner's anus (1995-2016).
  - [d] International Travel - Travel outside the United States (1995-2016).
  - [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: or swimming in the ocean or visiting a recreational water park (1997-2012); or swimming in a hot tub or swimming or drinking water from a pond or body of water (2016).

Table 16: Percentage of interviewed **Cryptosporidiosis** case-patients reporting selected potential risk exposures before disease onset,[a] immunocompetent persons , New York City, 1995 – 2016. Value shown: median with range for five years in brackets

Exposure Type	Immunocompetent Persons					
	1995-1999	2000-2004	2005-2009	2010-2014	2015	2016
Contact with an Animal[b]	35% (7%-41%)	34% (23%-37%)	36% (28%-40%)	34% (18%-41%)	34%	41%
High-risk Sexual Activity[c] (≥ 18 years old)	12%(10%25%)	23% (13%-31%)	17% (7%-19%)	8% (4%-11%)	29%	14%
International Travel[d]	28% (26%-30%)	45% (33%-47%)	45% (37%-52%)	44% (35%-62%)	41%	42%
Recreational Water Contact[e]	24% (21%-40%)	34% (32%-35%)	40% (28%-52%)	35% (32%-48%)	35%	39%

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).**

- Format of case interview form changed on 1/1/1997, 5/11/2001, 8/21/2002, and 4/26/2010. Details regarding changes made to the interview form and Exposure Types from 1995-2016 are noted below.
  - [a] From 1/1/1995 to 4/25/2010, case-patients were asked about potential risk exposures during the month before disease onset. Starting 4/26/2010, case-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: or visiting a pet store or veterinarian office (1997-2012); or other animal exposure (2016).
  - [c] High-risk Sexual Activity - Includes having a penis, finger or tongue in sexual partner's anus (1995-2016).
  - [d] International Travel - Travel outside the United States (1995-2016).
  - [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: or swimming in the ocean or visiting a recreational water park (1997-2012); or swimming in a hot tub or swimming or drinking water from a pond or body of water (2016).

Table 17: Percentage of interviewed **cryptosporidiosis** case-patients by type of tap water exposure before disease onset,[a] persons with HIV/AIDS, New York City, 1995 – 2016. Value shown: median with range for five years in brackets

Exposure Type	Persons with HIV/AIDS					
	1995-1999	2000-2004	2005-2009	2010-2014	2015	2016
Plain Tap[b]	69% (64%-71%)	55% (49%-77%)	67% (58%-76%)	63% (50%-71%)	63%	55%
Filtered Tap[c]	12% (9%-20%)	20% (13%-22%)	14% (7%-18%)	11% (8%-25%)	13%	15%
Boiled Tap[d]	5% (3%-7%)	6% (0%-6%)	7 % (0%-11%)	4% (2%-11%)	0%	0%
Incidental Plain Tap Only[e]	15% (8%-16%)	15% (4%-19%)	10% (4%-17%)	18% (8%-20%)	24%	24%
No Tap[f]	2% (0%-5%)	4% (2%-6%)	2% (0%-6%)	4% (0%-4%)	0%	6%

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).**

- Format of case interview form changed on 1/1/1997, 5/11/2001, 8/21/2000, and 4/26/2010. Details regarding changes made to the interview form and Tap Water Exposure Types from 1995-2016 are noted below.

  [a] From 1/1/1995 to 4/25/2010, case-patients were asked about Tap Water Exposure during the month before disease onset. Starting 4/26/2010, case-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 (5/11/2001-12/31/2012).

  [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 (5/11/2001-12/31/2016

  [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 (5/11/2001-12/31/2016).

  [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: or to make juice from concentrate (1997-2016)

  [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 (1995-1999): expanded to include: or to make juice from concentrate (1997-2016).

Table 18: Percentage of interviewed **cryptosporidiosis** case-patients by type of tap water exposure before disease onset,[a] immunocompetent persons, New York City, 1995 – 2016. Value shown: median with range for five years in brackets

Exposure Type	Immunocompetent Persons					
	1995-1999	2000-2004	2005-2009	2010-2014	2015	2016
Plain Tap[b]	58% (56%-67%)	36% (27%-56%)	30% (27%-47%)	33% (29%-48%)	39%	38%
Filtered Tap[c]	21% (17%-25%)	31% (17%-44%)	23% (20%-30%)	24% (17%-27%)	26%	19%
Boiled Tap[d]	8% (3%-11%)	2% (0%-7%)	5% (0%-14%)	2% (0%-7%)	6%	5%
Incidental Plain Tap Only[e]	9% (7%-12%)	16% (8%-21%)	25% (14%-28%	15% (11%-22%)	14%	25%
No Tap[f]	4% (2%-7%)	9% (2%-21%)	14% (3%-27%)	21% (11%-29%)	13%	14%

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).**

- Format of case interview form changed on 1/1/1997, 5/11/2001, 8/21/2000, and 4/26/2010. Details regarding changes made to the interview form and Tap Water Exposure Types from 1995-2016 are noted below.

  [a] From 1/1/1995 to 4/25/2010, case-patients were asked about Tap Water Exposure during the month before disease onset. Starting 4/26/2010, case-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 (5/11/2001-12/31/2012).

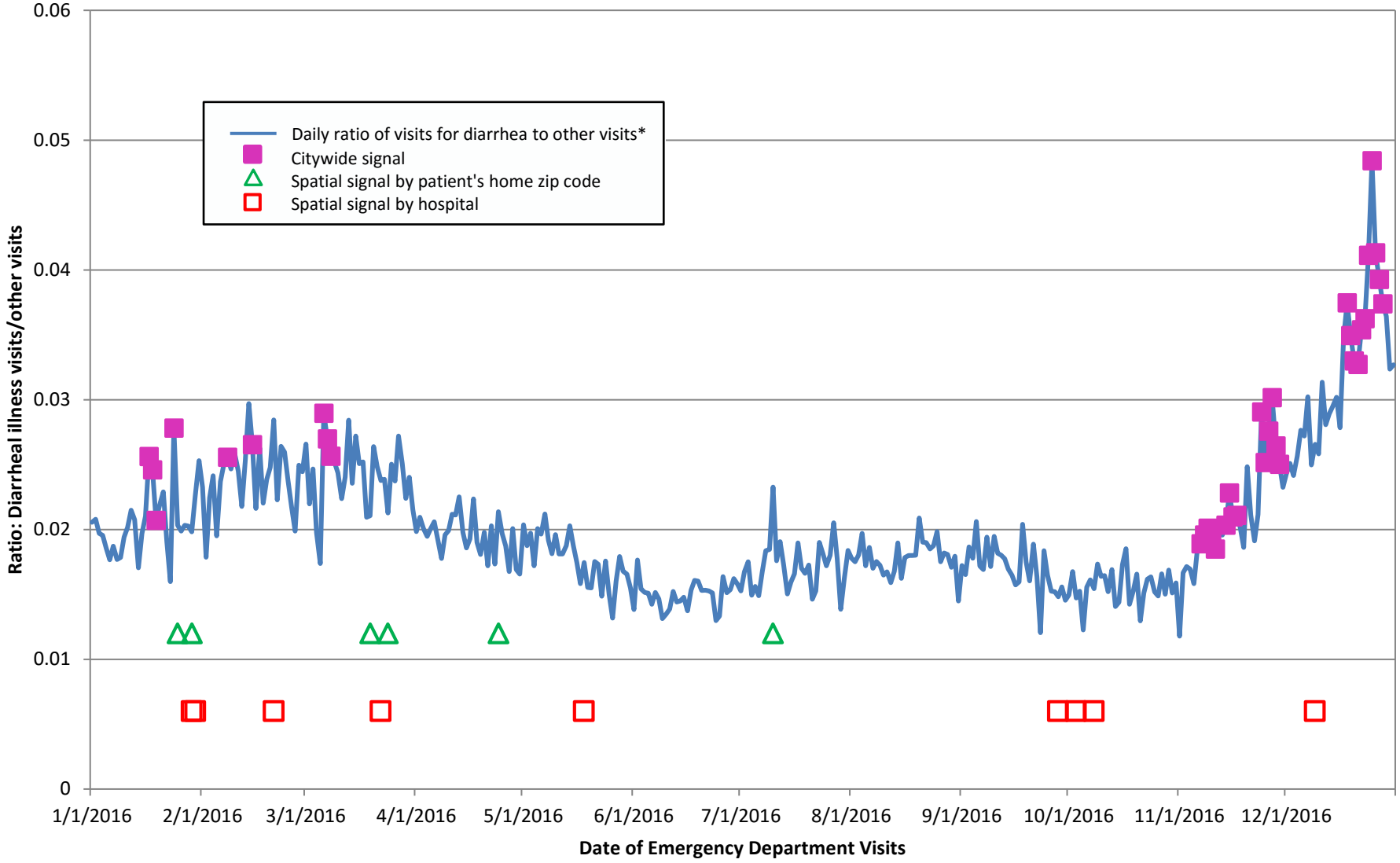
  [c] Filtered Tap - Drank filtered NYC tap water (1995-5/10/2001); or drank greater than 0 cups of filtered NYC tap water, and 0 or more cups of boiled NYC tap water, and no unboiled /unfiltered NYC tap water (5/11/2001-12/31/2016

  [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 (5/11/2001-12/31/2016).

  [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: or to make juice from concentrate (1997-2016)

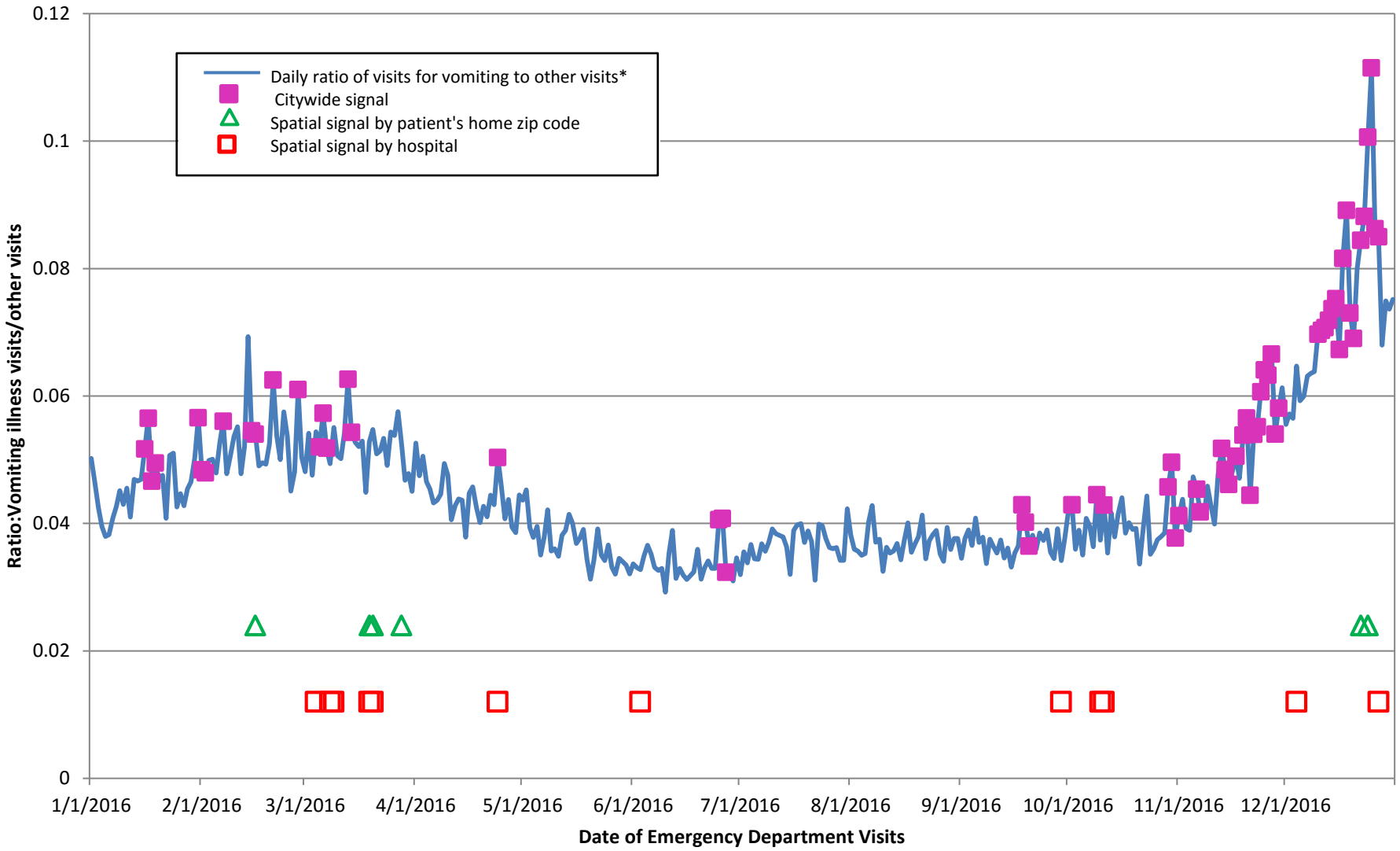
  [f] No Tap - Did not drink any NYC tap water and did not use unboiled/unfiltered NYC tap water to brush teeth, or to wash vegetables/fruits, or to make ice (1995-1996); expanded to include: or to make juice from concentrate (1997-2016).

Figure 7: Emergency Department Syndromic Surveillance, Trends in visits for the diarrhea syndrome, New York City, January 1, 2016 - December 31, 2016



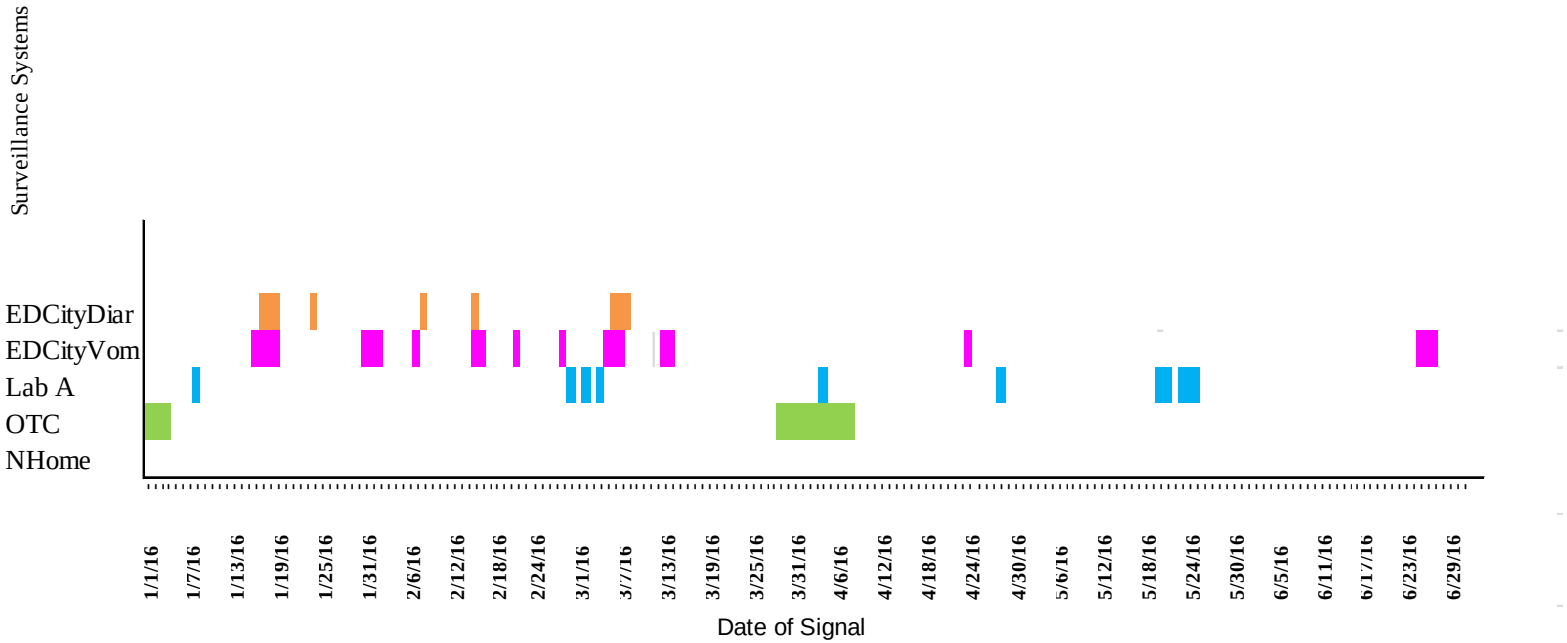
*Other visits=visits to participatiing ED for conditions that do not fit in to one of the eight tracked syndromes (diarrhea, vomiting, respiratory, fever/influenza, asthma, sepsis, cold, rash).

Figure 8: Emergency Department Syndromic Surveillance, Trends in visits for the vomiting syndrome, New York City, January 1, 2016 -December 31, 2016



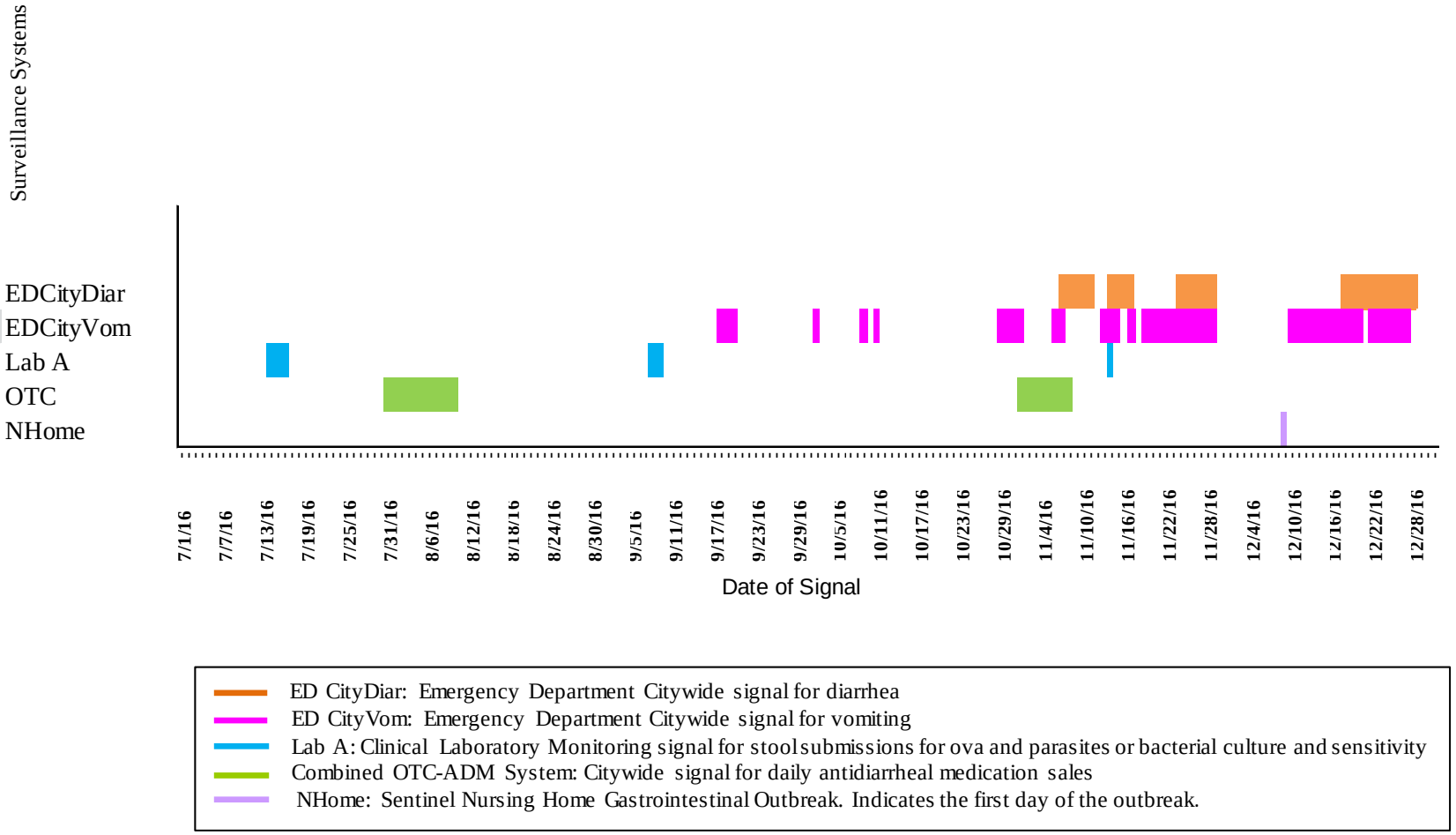
*Other visits=visits to participating ED for conditions that do not fit in to one of the eight tracked syndromes (diarrhea, vomiting, respiratory, fever/influenza, asthma, sepsis, cold, , rash).

Figure 9: Signals for Gastrointestinal Illness, Syndromic Surveillance Systems
New York City, January 1, 2016 - June 30, 2016



ED CityDiar: Emergency Department Citywide signal for diarrhea
ED CityVom: Emergency Department Citywide signal for vomiting
Lab A: Clinical Laboratory Monitoring signal for stool submissions for ova and parasites or bacterial culture and sensitivity
Combined OTC-ADM System: Citywide signal for daily antidiarrheal medication sales
NHome: Sentinel Nursing Home Gastrointestinal Outbreak. Indicates the first day of the outbreak.

Figure 10: Signals for Gastrointestinal Illness, Syndromic Surveillance Systems
New York City, July 1, 2016 - December 31, 2016



ED CityDiar: Emergency Department Citywide signal for diarrhea
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Lab A: Clinical Laboratory Monitoring signal for stool submissions for ova and parasites or bacterial culture and sensitivity
Combined OTC-ADM System: Citywide signal for daily antidiarrheal medication sales
NHome: Sentinel Nursing Home Gastrointestinal Outbreak. Indicates the first day of the outbreak.

Appendix A
Supplemental Information

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[1]. For the years 2001 through 2009 and 2013 through 2015, 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.[2] Because rates for the years 2001 through 2009 and the rates for the years 2013 through 2015, were calculated for this report using intercensal population estimates, they may differ from previously reported rates based on year 2000 and 2010 NYC Census data. Other variations in data between this report and previous reports may be due to 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 case-patient residence was used. New York City is divided on the basis of zip code into 42 UHF neighborhoods. Maps illustrating annual rates by UHF neighborhood are included in this report

Race-Ethnicity Categories

In this report, race/ethnicity-specific case rates for 2015 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 2011WDRAP 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 case-patient residence 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 6 & 14). Further explanation of how SES designations were made was provided 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 (<24 years old, 25-44 years old, and >=45 years old). Klein RJ, Schoenborn CA. *Age Adjustment Using the 2000 Projected US Population*, Vol 20. Hyattsville, MD: National Center for Health Statistics: 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 (CDC) through the National Electronic Telecommunications System for Surveillance.

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 the grouping and summarizing of prior years’ data in 5-year sets (e.g., 1995-1999, 2000-2004, etc.). This change was made in order to continue providing historical data for comparison, and allow for easier comprehension of trends. Potential risk exposure data for individual year, rather than grouped years, can be viewed in the earlier WDRAP Annual Reports.