Public Health Ontario
PARTNERS FOR HEALTH

Santé publique Ontario
PARTENAIRES POUR LA SANTÉ

Monthly infectious diseases surveillance report

March 2017

Ontario
Agency for Health Protection and Promotion
Agence de protection et de promotion de la santé

In Focus

Invasive *Haemophilus influenzae* type b (Hib)

Haemophilus influenzae (Hi) is a bacterium that can be differentiated by capsular antigenic serotyping into six types (a-f) or non-typeable strains, all of which can cause invasive disease. While all invasive Hi diseases are reportable at the national level, only confirmed and probable cases of invasive Hi type b (Hib) are currently reportable in Ontario.[1] Prior to routine vaccination, Hib was the leading cause of bacterial meningitis in children, and caused other severe diseases such as pneumonia and epiglottitis.[2-4]

In 1987, Ontario introduced a routine one-dose schedule of polysaccharide Hib vaccine for two-year olds. In 1988, the schedule was replaced with a more effective conjugate vaccine administered at 18 months of age. As of 1992, a four-dose routine schedule was implemented and is recommended to be administered as a primary series at two, four, and six months of age, with a booster dose at 18 months of age, thereby protecting those at greatest risk of disease.[5] Numerous studies have reported a decline in disease incidence in all age groups following the introduction of the infant Hib vaccination program, including those not targeted by vaccination.[4, 6-9]

In Ontario, reportable diseases are reported through the integrated Public Health Information System (iPHIS). A suspected case of Hib may be entered in iPHIS upon suspicion of the disease and/or isolation of Hi, pending further laboratory serotyping. Public health units (PHUs) are subsequently notified if serotype b is identified while other serotypes and non-typeable isolates are often not reported to PHUs. Thus in order to identify confirmed cases of Hib that may not have been notified to PHUs and to help rule out incorrectly classified Hib cases, Hib cases identified through iPHIS have been linked with Public Health Ontario Laboratory (PHOL) Hi records. Since Public Health Ontario (PHO) assumed the responsibility of vaccine-preventable disease (VPD) surveillance in 2012, any discrepancy between iPHIS data and PHOL records have been investigated for reconciliation. The purpose of this report is to provide a ten-year epidemiologic summary of invasive Hib disease in Ontario using data obtained jointly from iPHIS and PHOL.

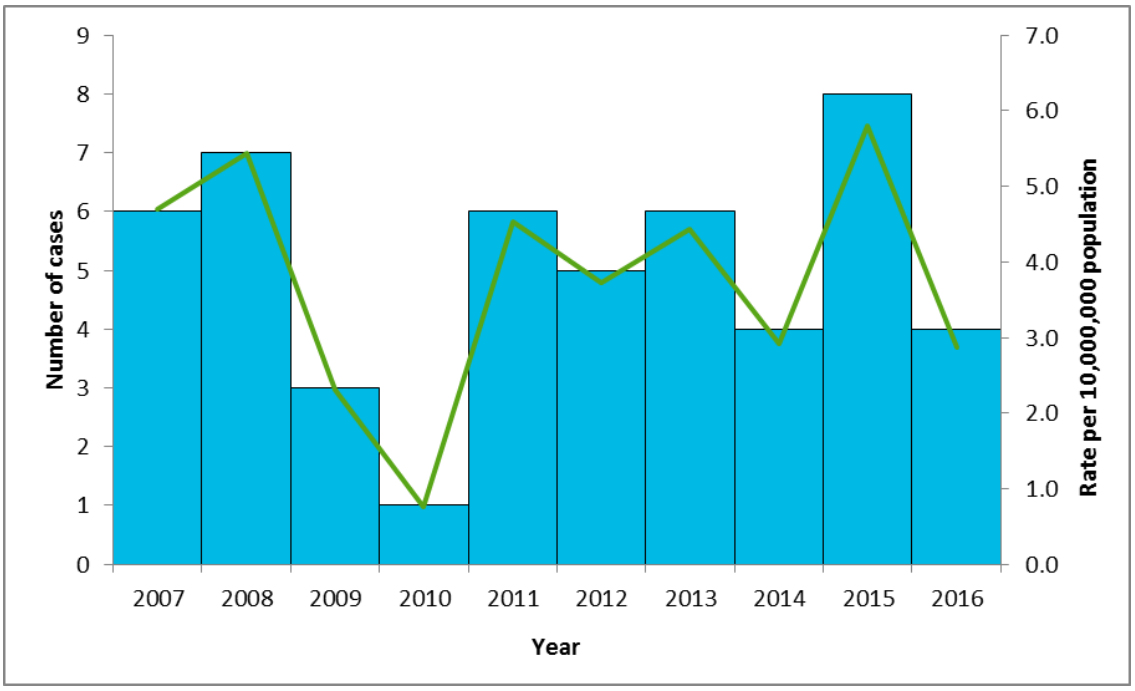
The data for this analysis are comprised of isolates from invasive sites received at PHOL for Hi confirmation and typing, as well as all Hib cases reported in iPHIS, regardless of case classification, between 2007 and 2016. The two datasets were deterministically linked to identify individuals in both data sources and to validate their case classification in iPHIS. iPHIS was considered the source of truth for demographic and immunization details of the cases; for those cases that were only identified through laboratory records without an iPHIS record, demographic information was collected from the laboratory records if available (immunization data are absent in laboratory records). Immunization status was determined by reviewing immunization information entered in iPHIS and assessed in accordance with the Ontario publicly funded immunization schedule and the Canadian Immunization Guide.[5, 10] Persons were classified as eligible or not eligible for the immunization program based on birth year and age at disease acquisition, and those eligible were assessed according to whether they had

documentation of receipt of Hib-containing vaccine and the number of doses received. Those born on or after 1983 are eligible to have received publicly-funded Hib vaccination (either a one-dose or four-dose schedule, depending on the year of birth).

Between 2007 and 2016, 50 cases of Hib were identified among Ontario residents. Of these, 45 were identified in both iPHIS and PHOL (linked cases), three cases were only identified in iPHIS (unlinked iPHIS cases) while an additional two cases were only identified through PHOL records (unlinked lab cases). The two unlinked lab cases were reported before the transfer of VPD surveillance responsibility to PHO in 2012. Of the three unlinked iPHIS cases, two were reported before 2012 while one case was reported in 2013.

Between 2007 and 2016, the annual incidence rate of invasive Hib in Ontario varied and ranged between 0.8 (2010) and 5.8 (2015) cases per 10,000,000 population (Figure 1). Among cases for whom geographic information was available (n=48), annualized incidence rates by health region were lowest in Central West region and Toronto (2.3 and 2.6 cases per 10,000,000 population, respectively) and highest in the North West and North East regions (16.9 and 10.6 cases per 10,000,000 population, respectively).

Figure 1. Number and rate of Hib cases by year: Ontario, January 1, 2007 to December 31, 2016 (n=50).



Data Sources:

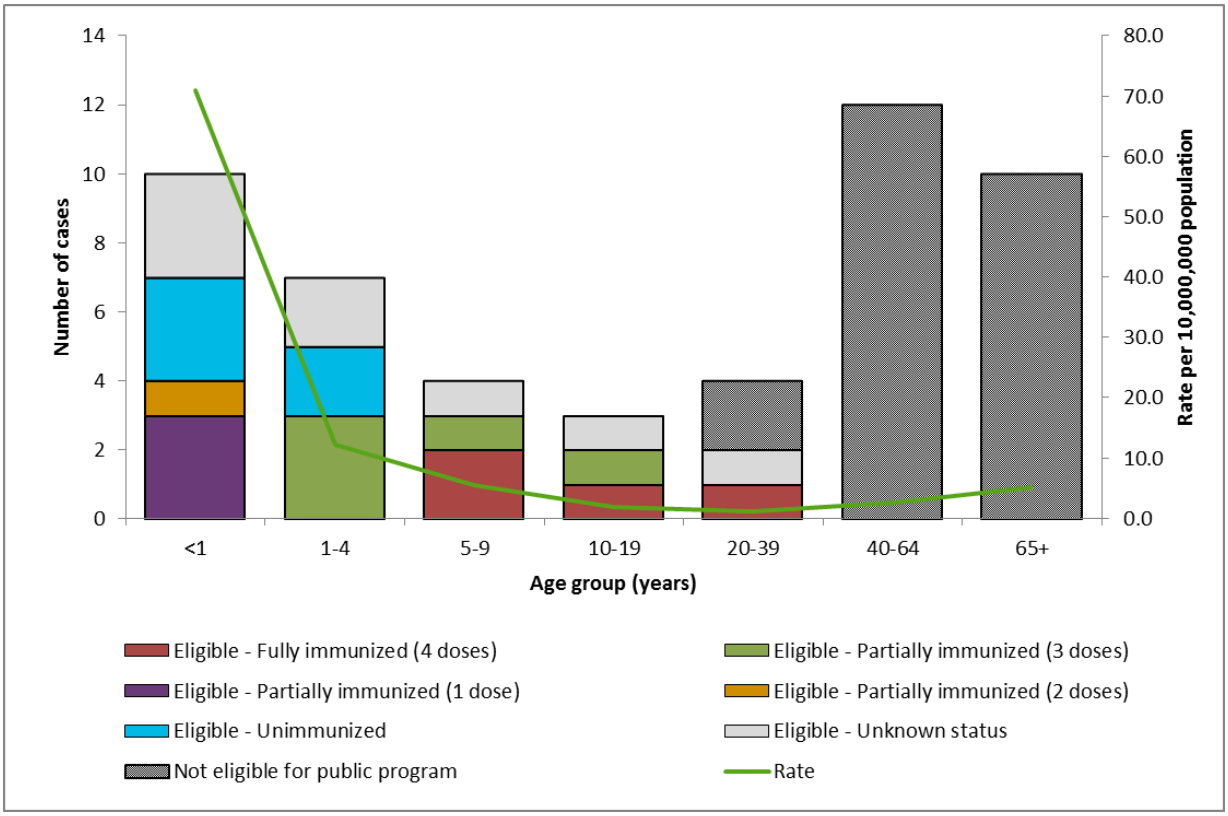
Ontario Cases: Ontario Ministry of Health and Long-Term Care, integrated Public Health Information System (iPHIS) database, extracted [2017/01/10]. **Ontario Specimens:** Public Health Ontario Laboratory (PHOL), extracted from the Laboratory Information Management System [2017/02/06].

Ontario Population: Population Estimates [2005-2015]: Ontario Ministry of Health and Long-Term Care, IntelliHEALTH ONTARIO, extracted [2016/09/02]. Population Projections [2016]: Ontario Ministry of Health and Long-Term Care, IntelliHEALTH ONTARIO, extracted [2016/09/02].

Over the ten year period, the median age of cases was 24 years, ranging from three months to 92 years. The highest annualized age-specific incidence rate occurred among infants <1 year (70.9 cases per 10,000,000 population [n=10 cases]) and children 1-4 years (12.3 cases per 10,000,000 population [n=7 cases]), with lowest occurring among those 20-39 years (1.1 cases per 10,000,000 population [n=4 cases]) (Figure 2). There was a slight predominance among males (54.0%). Among cases reported through iPHIS (n=48), 38 (79.2%) reported being hospitalized.

Of the 50 Hib cases reported during the ten-year period, 26 cases (52.0%) were eligible for the Hib vaccination program (Figure 2). Of those eligible, one case was eligible for the toddler single dose program but had unknown immunization status. The remaining 25 cases were eligible for the four-dose infant program, of which immunization status could be assessed for 18 cases (72.0%). Among those 18, five cases (27.8%) were unimmunized and 13 cases (72.2%) were immunized with at least one dose of Hib-containing vaccine. Of the 13 immunized cases, four cases did not complete the three-dose primary series (i.e., received one or two doses), thus were not considered vaccine-preventable. Five of the remaining nine cases had completed the primary series, but of these, three developed illness at or before 18 months of age, which is the age when the booster dose is recommended for full protection against Hib. A total of four cases over the ten year period developed illness after receiving the primary series and the booster dose, which would be consistent with vaccine failure. These four cases were between five and 25 years of age, and the interval between the administration of the last dose of Hib-containing vaccine and disease onset ranged between 18 months and 23 years.

Figure 2. Age distribution and annualized age-specific rate of Hib cases by immunization status: Ontario, January 1, 2007 to December 31, 2016 (n=50).



Data Sources:

Ontario Cases: Ontario Ministry of Health and Long-Term Care, integrated Public Health Information System (iPHIS) database, extracted [2017/01/10].

Ontario Specimens: Public Health Ontario Laboratory (PHOL), extracted from the Laboratory Information Management System [2017/02/06].

Ontario Population: Population Estimates [2005-2015]: Ontario Ministry of Health and Long-Term Care, IntelliHEALTH ONTARIO, extracted [2016/09/02]. Population Projections [2016]: Ontario Ministry of Health and Long-Term Care, IntelliHEALTH ONTARIO, extracted [2016/09/02].

Invasive Hib disease remains rare in Ontario. The epidemiologic profile of cases is consistent with previous studies conducted during the post-conjugate vaccination era.[7, 11] High rates observed in northern Ontario may be attributable to a greater density of aboriginal populations, with historically high rates of Hi disease.[3, 12]

These analyses support the importance of incorporating laboratory data when conducting provincial level analyses for Hib to improve data quality, most noteworthy being to rule out serotype b disease among reported cases with invasive Hi. Although the quality of immunization data improved slightly over time, challenges still remain as demonstrated by the number of cases with unknown immunization information, making it challenging to determine if cases were a result of vaccine failure or failure to vaccinate. Vaccine series completion and administration at the recommended intervals is essential to achieve optimal protection against disease.

While the focus of this analysis was on invasive Hib disease, the inclusion of other serotypes would have contributed to the understanding of the epidemiology of invasive Hi in the province. With the decreasing incidence of Hib disease, studies, including those from Ontario, have reported an increase in diseases due to non-type b Hi.[7, 13-14] Having all invasive Hi reportable in Ontario would allow for more comprehensive assessment of the burden of disease from all Hi serotypes and align with national reporting guidelines.

References

1. Ontario. Ministry of Health and Long-Term Care. Infectious Diseases Protocol, 2014. Appendix A: Disease-specific chapters. Chapter: *Haemophilus influenzae* type b disease, invasive. Revised January 2014 [Internet]. Toronto, ON: Queen's Printer for Ontario; 2014 [cited 2017 Jan 10]. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/hib_chapter.pdf
2. Watt JP, Wolfson LJ, O'Brien KL, Henkle E, Deloria-Knoll M, McCall N, Lee E, Levine OS, Hajjeh R, Mulholland K, Cherian T. Burden of disease caused by *Haemophilus influenzae* type b in children younger than 5 years: global estimates. The Lancet. 2009. 374(9693):903-11.
3. Peltola H. Worldwide *Haemophilus influenzae* type b disease at the beginning of the 21st century: global analysis of the disease burden 25 years after the use of the polysaccharide vaccine and a decade after the advent of conjugates. Clinical Microbiology Reviews. 2000. 302-317.
4. Scheifele DW, Jadavji TP, Law BJ, et al. Recent trends in pediatric *Haemophilus influenzae* type b infections in Canada. Can Med Assoc J. 1996. 154:1041-1047.
5. Publicly funded immunization schedules for Ontario – December 2016. Available from: http://www.health.gov.on.ca/en/pro/programs/immunization/docs/immunization_schedule.pdf
6. Public Health Agency of Canada. Notifiable Diseases On-Line—Invasive *Haemophilus influenzae*, type b disease. Available from: http://dsol-smed.phac-aspc.gc.ca/dsol-smed/ndis/charts.php?c=pl
7. Adam HJ, Richardson SE, Jamieson FB, Rawte P, Low DE, Fisman DN. Changing epidemiology of invasive *Haemophilus influenza* in Ontario, Canada: Evidence for herd effects and strain replacement due to Hib vaccination. Vaccine. 2010. 28:4073-4078.
8. McConnell A, Tan B, Scheifele D, Halperin S, Vaudry W, Law B, Embree J. Invasive infections caused by *Haemophilus influenza* serotypes in twelve Canadian IMPACT Centers, 1996-2001. Pediatric Infectious Disease Journal. 2007. 26:1025-1031.
9. Wenger JD. Epidemiology of *Haemophilus influenzae* type b disease and impact of Haemophilus influenzae type b conjugate vaccines in the United States and Canada. The Pediatric infectious disease journal. 1998. 17(9):S132-6.
10. National Advisory Committee on Immunization; Public Health Agency of Canada. Canadian immunization guide [Internet]. Evergreen ed. Ottawa, ON: Her Majesty the Queen in Right of Canada; 2012 [cited 2017 Jan 11]. Part 4: active vaccines: *Haemophilus influenzae* type B vaccine. Available from: http://www.phac-aspc.gc.ca/publicat/cig-gci/p04-hea-eng.php
11. Tsang RS, Mubareka S, Sill ML, Wylie J, Skinner S, Law DK. Invasive *Haemophilus influenzae* in Manitoba, Canada, in the postvaccination era. Journal of clinical microbiology. 2006. 44(4):1530-5.
12. Ulanova M, Tsang RS. Invasive Haemophilus influenzae disease: changing epidemiology and host–parasite interactions in the 21st century. Infection, Genetics and Evolution. 2009. 9(4):594-605.

13. Berndsen MR, Erlendsdottir H, Gottfredsson M. Evolving epidemiology of invasive *Haemophilus infections* in the post-vaccination era: results from a long-term population-based study. Clinical Microbiology and Infection. 2012. 18(9):918-23.

14. Desai S, Jamieson FB, Patel SN, Seo CY, Dang V, Fediurek J, Navaranjan D, Deeks SL. The epidemiology of invasive *Haemophilus influenzae* non-serotype B disease in Ontario, Canada from 2004 to 2013. PloS one. 2015. 10(11):e0142179.

Reportable disease cases by month in Ontario, 2017

Table 1. Confirmed cases of reportable diseases, and probable cases of select reportable diseases, by month: Ontario, 2017

Reportable disease	2017 Case counts by month												2017 Year-to-month (Jan)		2012-2016 avg Year-to-month (Jan)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Count	Rate ŧ	Count	Rate ŧ
Acute Flaccid Paralysis	1	-	-	-	-	-	-	-	-	-	-	-	1	0.1	n/a	n/a
AIDS	5	-	-	-	-	-	-	-	-	-	-	-	5	0.4	9.6	0.7
Amebiasis	70	-	-	-	-	-	-	-	-	-	-	-	70	5.0	65.2	4.8
Botulism	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0
Brucellosis	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0
Campylobacter enteritis	176	-	-	-	-	-	-	-	-	-	-	-	176	12.5	194.6	14.2
Chlamydial Infections	3892	-	-	-	-	-	-	-	-	-	-	-	3892	275.4	3306.6	241.7
Cholera	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0
Cryptosporidiosis	18	-	-	-	-	-	-	-	-	-	-	-	18	1.3	16.0	1.2
Cyclosporiasis	3	-	-	-	-	-	-	-	-	-	-	-	3	0.2	1.6	0.1
Encephalitis	4	-	-	-	-	-	-	-	-	-	-	-	4	0.3	3.4	0.2
Encephalitis/Meningitis	15	-	-	-	-	-	-	-	-	-	-	-	15	1.1	8.8	0.6
Food Poisoning, All Causes	13	-	-	-	-	-	-	-	-	-	-	-	13	0.9	5.6	0.4
Giardiasis	81	-	-	-	-	-	-	-	-	-	-	-	81	5.7	105.6	7.7
Gonorrhoea (All Types)	554	-	-	-	-	-	-	-	-	-	-	-	554	39.2	470.6	34.4
Group A Streptococcal Disease, Invasive	91	-	-	-	-	-	-	-	-	-	-	-	91	6.4	71.0	5.2
Group B Streptococcal Disease, Neonatal	6	-	-	-	-	-	-	-	-	-	-	-	6	0.4	4.8	0.4
Haemophilus Influenzae B Disease, Invasive	2	-	-	-	-	-	-	-	-	-	-	-	2	0.1	0.4	0.0
Hepatitis A	5	-	-	-	-	-	-	-	-	-	-	-	5	0.4	8.2	0.6

Reportable disease	2017 Case counts by month												2017 Year-to-month (Jan)		2012-2016 avg Year-to-month (Jan)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Count	Rate ŧ	Count	Rate ŧ
Hepatitis B (Acute)	10	-	-	-	-	-	-	-	-	-	-	-	10	0.7	10.4	0.8
Hepatitis B (Chronic)	94	-	-	-	-	-	-	-	-	-	-	-	94	6.7	192.0	14.0
Hepatitis C	402	-	-	-	-	-	-	-	-	-	-	-	402	28.4	370.2	27.1
HIV	60	-	-	-	-	-	-	-	-	-	-	-	60	4.2	62.8	4.6
Influenza	4607	-	-	-	-	-	-	-	-	-	-	-	4607	326.0	2428.6	177.6
Legionellosis	6	-	-	-	-	-	-	-	-	-	-	-	6	0.4	6.8	0.5
Leprosy	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.4	0.0
Listeriosis	3	-	-	-	-	-	-	-	-	-	-	-	3	0.2	3.2	0.2
Lyme Disease	1	-	-	-	-	-	-	-	-	-	-	-	1	0.1	3.4	0.2
Malaria	19	-	-	-	-	-	-	-	-	-	-	-	19	1.3	13.6	1.0
Measles	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	#	#
Meningitis	10	-	-	-	-	-	-	-	-	-	-	-	10	0.7	8.0	0.6
Meningococcal Disease, Invasive	4	-	-	-	-	-	-	-	-	-	-	-	4	0.3	3.6	0.3
Mumps	9	-	-	-	-	-	-	-	-	-	-	-	9	0.6	1.4	0.1
Ophthalmia neonatorum	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.2	0.0
Paralytic Shellfish Poisoning	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	n/a	n/a
Paratyphoid Fever	2	-	-	-	-	-	-	-	-	-	-	-	2	0.1	4.0	0.3
Pertussis (Whooping Cough)	35	-	-	-	-	-	-	-	-	-	-	-	35	2.5	34.6	2.5
Q Fever	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	1.8	0.1
Rabies	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0
Rubella	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	#	#
Rubella, Congenital Syndrome	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	#	#
Salmonellosis	176	-	-	-	-	-	-	-	-	-	-	-	176	12.5	211.8	15.5
Shigellosis	22	-	-	-	-	-	-	-	-	-	-	-	22	1.6	27.0	2.0
Streptococcus Pneumoniae, Invasive	113	-	-	-	-	-	-	-	-	-	-	-	113	8.0	121.4	8.9
Syphilis, Early Congenital	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0

Reportable disease	2017 Case counts by month												2017 Year-to-month (Jan)		2012-2016 avg Year-to-month (Jan)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Count	Rate ŧ	Count	Rate ŧ
Syphilis, Infectious	91	-	-	-	-	-	-	-	-	-	-	-	91	6.4	85.2	6.2
Syphilis, Other	43	-	-	-	-	-	-	-	-	-	-	-	43	3.0	58.0	4.2
Tetanus	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.2	0.0
Tuberculosis	43	-	-	-	-	-	-	-	-	-	-	-	43	3.0	42.8	3.1
Tularemia	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0
Typhoid Fever	7	-	-	-	-	-	-	-	-	-	-	-	7	0.5	7.2	0.5
Verotoxin Producing E. coli Including HUS	4	-	-	-	-	-	-	-	-	-	-	-	4	0.3	7.4	0.5
West Nile Virus Illness	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0
Yellow Fever	0	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.2	0.0
Yersiniosis	11	-	-	-	-	-	-	-	-	-	-	-	11	0.8	17.6	1.3

ŧ Rates are for cases per 1,000,000 population.

n/a Acute Flaccid Paralysis and Paralytic Shellfish Poisoning became reportable in Ontario in December 2013; therefore, five-year historical data are not yet available for comparisons (n/a).

Historical comparison data are not provided for measles, rubella, and congenital rubella syndrome because these diseases have been eliminated in Canada. However, as these diseases remain endemic in other countries, imported and import-related cases continue to occur in Ontario.

Ontario Cases: Ontario Ministry of Health and Long-Term Care, integrated Public Health Information System (iPHIS) database, extracted by Public Health Ontario [2017/03/01].
Ontario Population: Population Projections [2016-2017] and Estimates [2012-2015], Ontario Ministry of Health and Long-Term Care, IntelliHEALTH Ontario, Date Extracted: [2016/09/02].

Data notes and caveats

- iPHIS is a dynamic reporting system which allows ongoing updates to data previously entered. As a result, data extracted from iPHIS represent a snap shot at the time of extraction and may differ from previous or subsequent reports. The data only represent cases reported to public health and recorded in iPHIS, that meet the Ontario Ministry of Health and Long-Term Care's confirmed and/or probable surveillance case definitions in place at the time that the case was reported. The potential for underreporting and unresolved duplicates exists.
- Case counts for amebiasis, Lyme disease, mumps, pertussis, and West Nile Virus illness are based on the sum of confirmed and probable cases as reported in iPHIS. All other diseases reported in the table are based on confirmed cases only.
- Chronic and acute hepatitis B case counts are not mutually exclusive and should not be added to obtain a total for hepatitis B cases in Ontario.
- A case is reported as encephalitis and/or meningitis when an agent is not specifically identified through laboratory testing or is not reportable.
- Table 1 is not an exhaustive list of all reportable diseases in Ontario. Historical annual counts and rates for most reportable diseases are available in the Reportable Disease Trends in Ontario reports. The following reportable diseases/outbreaks are omitted from the table:
- Counts of Creutzfeldt-Jakob disease, which are not updated frequently enough for monthly publication as a result of an additional data reconciliation step that is required.
- Diseases that are extremely rare or have zero incidence in recent years: anthrax, chancroid, diphtheria, hantavirus pulmonary syndrome, hemorrhagic fevers and Lassa fever, plague, acute poliomyelitis, psittacosis/ornithosis, severe acute respiratory syndrome (SARS), smallpox, and trichinosis.
- Diseases that are only reportable in outbreak situations or as a combination of individual and aggregate counts: chickenpox (varicella), *Clostridium difficile* infection (CDI) outbreaks in public hospitals, and institutional outbreaks of gastroenteritis and respiratory infections.
- Detailed reporting on institutional outbreaks of respiratory infections is available in the Ontario Respiratory Pathogen Bulletin.
- Information on CDI outbreaks in public hospitals is available in the Reportable Disease Trends in Ontario reports.
- Cases that do not reside in Ontario or for whom the Disposition Status was reported as entered in error, does not meet definition, or as a duplicate record have been excluded.
- Case counts for tuberculosis and AIDS are based on diagnosis date, HIV case counts are based on encounter date, congenital rubella syndrome cases are based on the date of birth, and case counts for all other diseases are based on episode date. The episode date is an estimate of the onset date

of disease for a case. In order to determine this date, the following hierarchy is in place in iPHIS: Onset Date > Specimen Collection Date > Lab Test Date > Reported Date. If an onset date exists ,it will be used as the episode date. If not available, then the next available date in the hierarchy will be used.