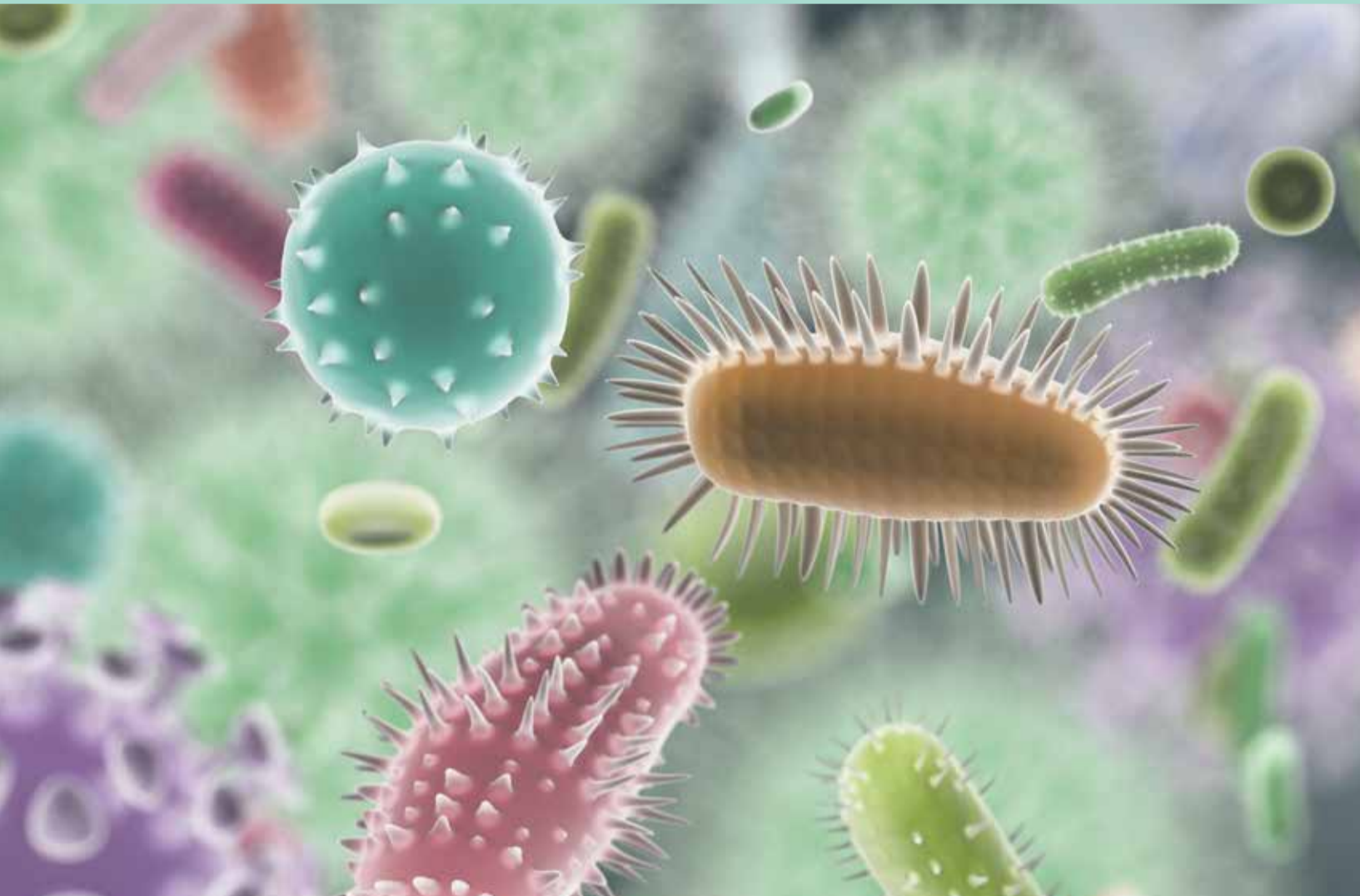
York Region

Reportable Diseases

in York Region **2000** to **2015**



Reportable Diseases in York Region 2000 to 2015

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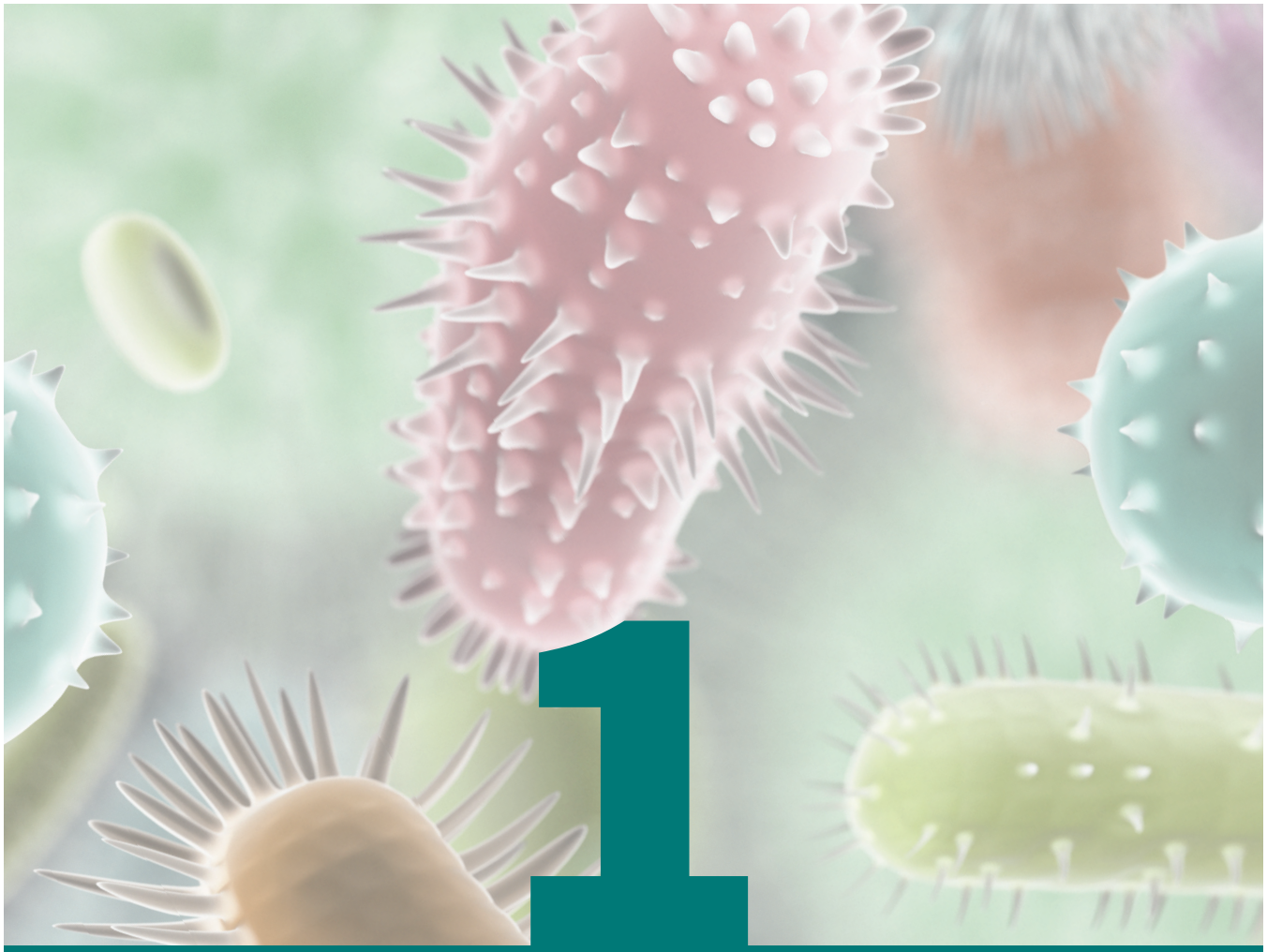

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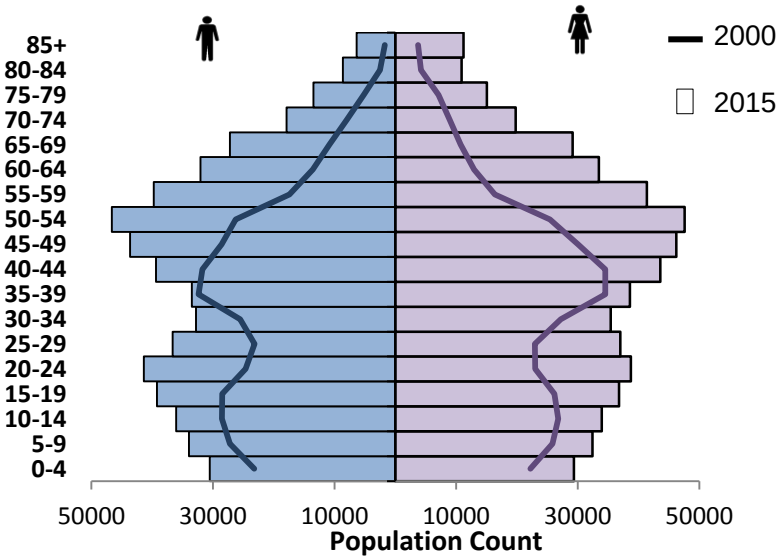
Introduction

York Region is one of the fastest growing municipalities in Canada

The Regional Municipality of York is made up of nine local municipalities: the City of Markham, the City of Vaughan, the Town of Richmond Hill, the Town of Newmarket, the Town of Aurora, the Town of Whitchurch-Stouffville, the Town of East Gwillimbury, the Town of Georgina and the Township of King. It is comprised of over 1,700 square kilometres, spanning the geographic area located between Lake Simcoe, the City of Toronto, Peel and Durham Regions.

Figure 1.0.1 displays the age distribution of York Region by sex in 2000 and 2015. York Region's population was estimated to be 1,140,024 in 2015, which is 1.6 times the 2000 population of 722,066.[1] York Region's growth rate between the 2006 and 2011 Census was the highest in Ontario.[2] Not only has the population grown substantially from 2000 to 2015, the distribution has shifted—where there were peak populations in the age groups of 35 to 39 years old and 10 to 14 years old in 2000, there were corresponding peaks in the age groups of 50 to 54 years old and 20 to 24 years old in 2015.

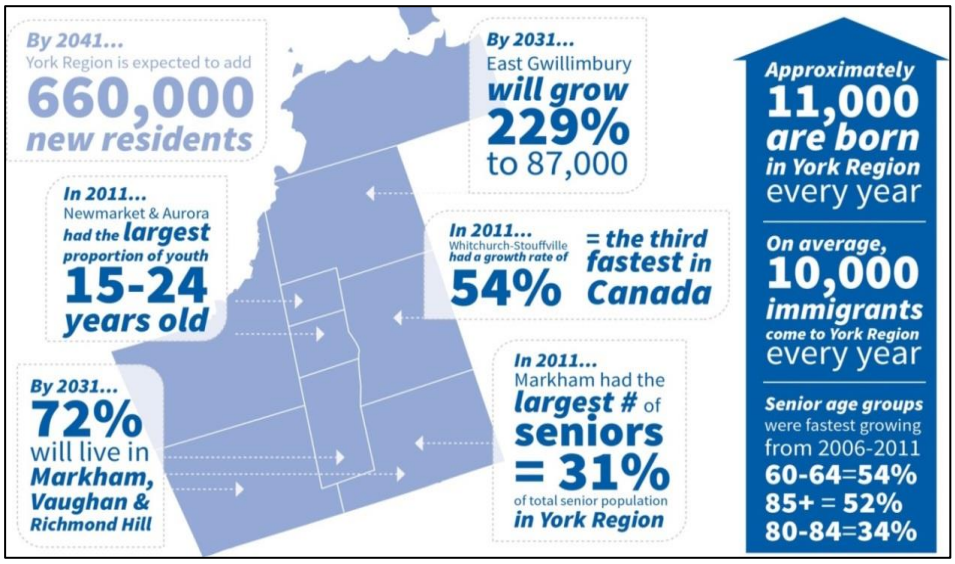
Figure 1.0.1 York Region, 2000 and 2015:
Population distribution by age group and sex



A growing population has a variety of impacts on York Region Public Health's programs and services

With a growing population, increasing numbers of reportable disease reports are expected. Rapid growth in age groups who tend to be more susceptible to illness, such as seniors, may also contribute to an increase in reportable disease reports. Key highlights of the rapid growth are depicted in Figure 1.0.2. In addition, increased population mobility, through both travel and immigration, can lead to the import of infectious diseases that we have not seen before within our borders. This report will provide a summary of the different reportable diseases across York Region and their changing patterns over time.

Figure 1.0.2.



This report provides a summary of reportable disease data in York Region between 2000 and 2015

Reportable Diseases in York Region 2000 to 2015 is a resource for York Region residents, public health practitioners and health professionals involved in the management and control of infectious diseases. This report is an update of the last report, *Infectious Diseases in York Region, 2006*, released in 2008.

This report contains a summary of descriptive epidemiology for reportable diseases for the 16-year period between 2000 and 2015, including relevant comparisons to provincial data where available. Data within the report are presented for diseases designated as reportable under Regulation 559/51 of the *Health Protection and Promotion Act,* R.S.O 1990. As a health unit, York Region Public Health is responsible for controlling the spread of these diseases.

The data presented in this report represent the most current disease counts and rates in York Region and they supersede all previously reported statistics. The data within the report reflect disease case counts in York Region as of December 2016.

The information in the report is summarized in chapters by disease category. A detailed description of the methodology and data sources used in this report is included in Chapter 9: Technical notes.

Contact information

Any questions, suggestions, requests for further information or any accessibility requests pertaining to this report may be directed to:

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Tel: 1-877-464-9675 ext. 74856

[1] Statistics Canada. Population Estimates. Statistics Canada, CANSIM Table 051-0062 – Estimates of population by census division, sex and age group for July 1 based on the Standard Geographic Classification (SGC) 2011, annual (person) table, CANSIM (database), extracted February 2016.

[2] Regional Municipality of York. Turning the Curve Indicator Report. Newmarket (ON): Regional Municipality of York; 2012. Available from: http://www.yorkwelcome.ca/wps/wcm/connect/immigration/a997a6e5-2963-496c-b19e-982ce6907c52/LIP%2BIndicator%2BWorkbook.pdf?MOD=AJPERES&useDefaultText=0&useDefaultDesc=0

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Enteric diseases

Table 2.0 Enteric diseases:

Annual cases, York Region, 2000–2015

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	NOTES
Amebiasis	40	28	34	27	26	24	18	31	38	33	32	38	37	24	25	24	
Botulism	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No cases reported since 1991[†]
Campylobacter enteritis	490	487	504	453	421	348	435	400	339	304	297	349	360	380	387	320	
Cholera	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
Cryptosporidiosis	9	7	8	8	16	13	33	27	18	26	22	17	15	9	11	24	
Cyclosporiasis			8	2	7	16	17	5	13	6	16	7	5	6	13	24	Became reportable in 2001
Giardiasis	105	108	93	68	85	75	70	87	73	75	77	77	87	68	82	83	
Hepatitis A	10	8	12	11	4	5	12	7	5	5	11	6	13	4	4	6	
Listeriosis	1	3	3	6	3	1	2	1	5	5	7	4	2	3	3	4	
Paralytic shellfish poisoning															0	0	Became reportable December 2013
Paratyphoid fever	1	1	0	0	4	7	3	3	6	3	7	3	0	3	0	4	
Salmonellosis	212	225	220	193	194	210	200	260	220	256	266	223	277	231	304	334	
Shigellosis	10	13	27	19	25	32	20	25	18	19	14	27	56	17	34	24	
Trichinosis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Last case in 1993
Typhoid fever	2	2	2	3	4	3	5	5	5	5	5	6	2	3	0	4	
Verotoxin-producing E. coli	29	23	36	33	30	29	30	17	12	8	8	12	18	5	16	18	
Yersiniosis	44	47	87	60	48	59	57	54	52	42	43	43	27	32	32	33	

[†]Electronic reporting started in 1991.

Enteric diseases refer to gastrointestinal illnesses that result from ingesting bacteria, viruses or other parasitic microorganisms that may be traced back to food, water, animals or an infected person.[1] The true burden of these diseases is hard to estimate, as they are generally under-reported. Many infected persons do not experience symptoms or experience mild symptoms and may not seek medical care. [2] In addition individuals who do seek medical care may not be asked to submit stool samples for laboratory testing or be willing to submit stool samples, in which case reportable diseases would not be diagnosed and reported.

Table 2.0 highlights the York Region cases of reportable enteric diseases.

- Botulism, cholera, paralytic shellfish poisoning and trichinosis are very rarely reported in York Region.
- Typhoid fever—caused by *Salmonella* Typhi—and paratyphoid fever—caused by *Salmonella* Paratyphi—are bacterial infections which are only found in human hosts.[3] Typhoid fever and paratyphoid fever are not endemic in Ontario and the majority of York Region cases are acquired during travel to endemic countries. There were a few cases of local household transmission of these illnesses between 2000 and 2015 in York Region.

This report focuses on the more commonly reported enteric diseases in York Region.

Highlights

- Most enteric diseases are seasonal with a peak in the summer months, especially infections that are likely locally-acquired.
- Most enteric infections occur more frequently in the very young. Exceptions include amebiasis, cyclosporiasis, hepatitis A and listeriosis.
- Many of the enteric diseases occur in clusters arising from a common source. Public Health has identified and mitigated multiple sources of reportable enteric diseases.
- York Region reported lower incidence rates of amebiasis and giardiasis than Ontario. The incidence rates of *Campylobacter* enteritis, salmonellosis, shigellosis and yersiniosis are greater than Ontario's.
- Amebiasis, verotoxin-producing *E. coli* and yersiniosis are decreasing in incidence.
- Botulism, cholera, paralytic shellfish poisoning and trichinosis are very rarely reported in York Region.

2.1 Amebiasis

Amebiasis is an intestinal illness caused by the protozoan parasite *Entamoeba histolytica.*[4] *E. histolytica* is one of several *Entamoeba* parasites that can infect the human intestine. Not all *E. histolytica* strains are equally virulent. A person may become infected with amebiasis by consuming contaminated food or water or by direct exposure to feces containing *E. histolytica* cysts, the infective form of the parasite. *E. histolytica* can persist for weeks in soil or water in the cyst form.

Humans are the primary reservoir for *E. histolytica,* typically spread via chronically ill or asymptomatic individuals.[5] The infection occurs most commonly in individuals travelling from developing countries with poor sanitary conditions, individuals in mental health institutions and individuals who may be at risk of exposure to the infection though fecal-oral transmission.[4]

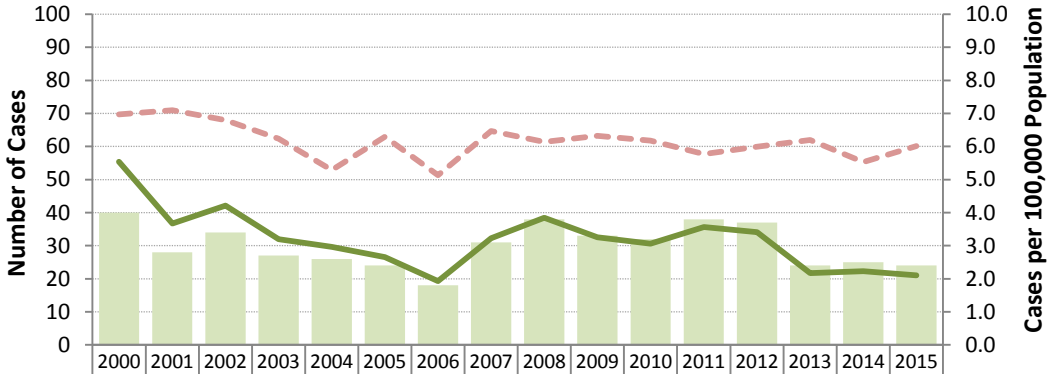
The incubation period of amebiasis can range from a few days to several months or even years, however two to four weeks is most common.[4]

People of all ages are susceptible to amebiasis infection.[5] The majority of infections are asymptomatic, with 10 to 20 per cent resulting in disease. However, people 20 to 50 years of age and males are more likely to develop invasive disease.

Counts of amebiasis may include cases of the non-reportable species *Entamoeba dispar,* as most routine testing does not differentiate this species from *Entamoeba histolytica.*

Amebiasis incidence in York Region was lower than in Ontario as a whole (Figure 2.1.1). Although, incidence in Ontario has remained relatively stable since 2008, the rate in York Region has decreased.

Figure 2.1.1 Amebiasis, York Region and Ontario, 2000–2015:
Cases and rates

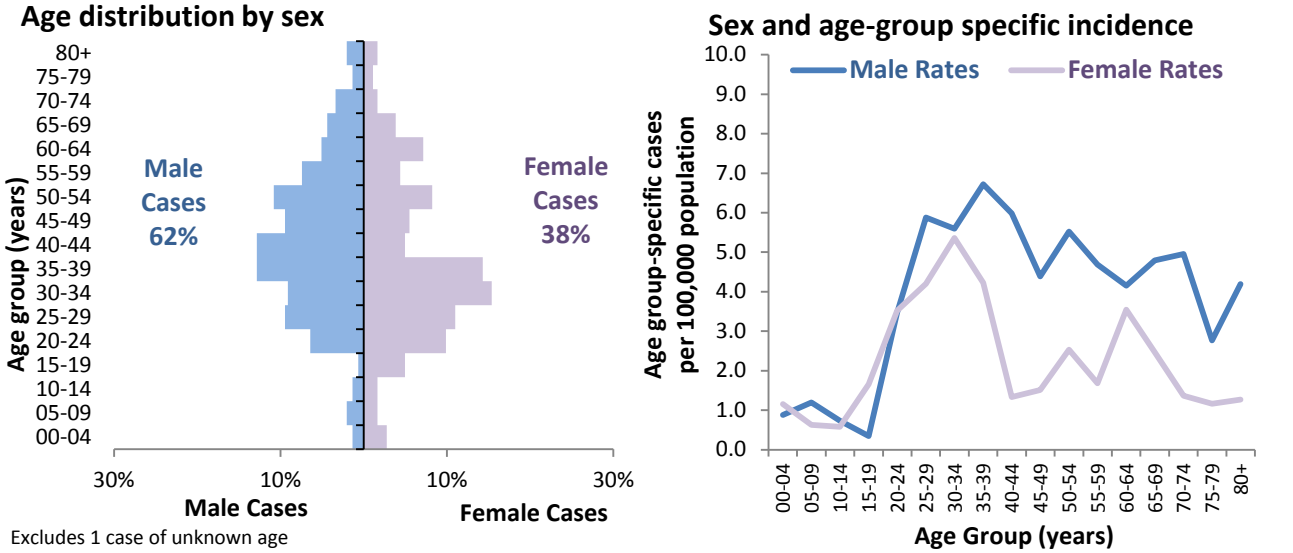


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	40	28	34	27	26	24	18	31	38	33	32	38	37	24	25	24
YR Incidence Rate	5.5	3.7	4.2	3.2	3.0	2.7	1.9	3.2	3.8	3.3	3.1	3.6	3.4	2.2	2.2	2.1
ON Incidence Rate	7.0	7.1	6.8	6.2	5.3	6.3	5.1	6.5	6.1	6.3	6.2	5.8	6.0	6.2	5.5	6.0

Age-specific amebiasis rates were substantially higher in the adult population 20 to 64 years of age compared to the young and old (Figure 2.1.2); rates among females were substantially higher in the

20 to 39 year age group compared to other ages. Rates in the younger age groups were similar between males and females, however the rates among females were substantially lower than males in those over 34 years.

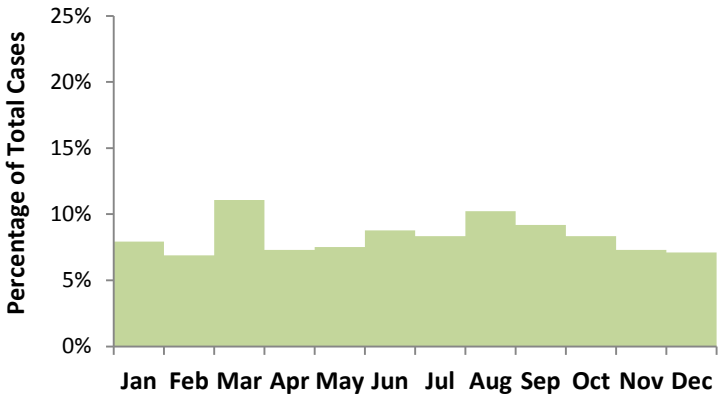
Figure 2.1.2 Amebiasis, York Region, 2000–2015:



Excludes 1 case of unknown age

Amebiasis had the highest incidence in March and the summer months (Figure 2.1.3). This may correspond to time periods of increased travel.

Figure 2.1.3 Amebiasis, York Region, 2000–2015:



The vast majority of cases of amebiasis are not confirmed as *Entamoeba histolytica*, meaning the isolates were not distinguished from *E. dispar* (Figure 2.1.1).

Table 2.1.1 Amebiasis, York Region, 2010–2015:

Confirmed *Entamoeba histolytica*

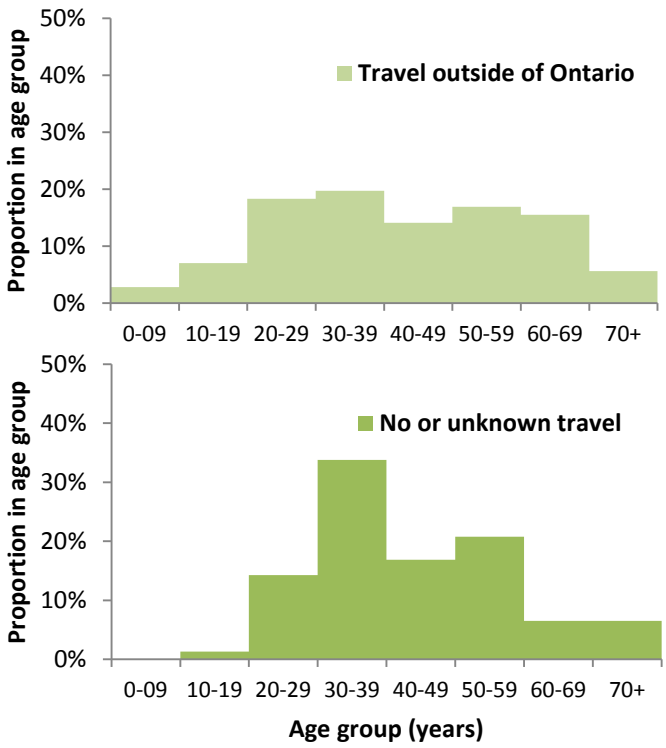
Agent *(180 isolates)*	**% of isolates**
Confirmed *E. histolytica*	7%
E. histolytica not distinguished from *E. dispar*	93%

Locally-acquired amebiasis and sexual transmission

In temperate regions, the primary risk factor for amebiasis is travel to, or recent immigration from, tropical or subtropical regions.[5] More than half of York Region amebiasis cases did not report travel out of the province during their exposure period; it is likely many infections were locally-acquired. Amebiasis can be transmitted sexually and males having sex with males (MSM) are known to be at higher risk for the disease.[6]

Among those cases who did not report travel, 13 per cent reported sexual contact as a risk factor. Also, the age distribution of amebiasis cases differs between those who reported travel during their exposure period and those who did not (Figure 2.1.4) with the latter cases more concentrated in the 20 to 59 year old ages which resembles the age distribution of a sexually transmitted infection (see *Chapter 4*). During the time period of 2011 to 2015 and among 15 to 64 year olds who did not travel, the rate of amebiasis among males was 1.6 times that among females. These findings are suggestive of sexual transmission of the disease, in particular among MSM.

Figure 2.1.4 Amebiasis, York Region, 2011–2015:
Age distribution by travel



2.2 *Campylobacter* enteritis

Campylobacter enteritis is a bacterial infection of the intestines and is the most commonly reported cause of gastroenteritis worldwide.[7] Symptoms include diarrhea, which may be bloody, abdominal pain, fever, malaise, nausea and sometimes vomitting.[4] Symptoms usually persist for several days to two weeks. Most infections are self-limiting. *Campylobacter jejuni* and *Campylobacter coli* are most commonly the cause of *Campylobacter* enteritis. Other *Campylobacter* species, such as *C. lari, C. fetus* and *C. upsaliensis* have also been associated with illness.

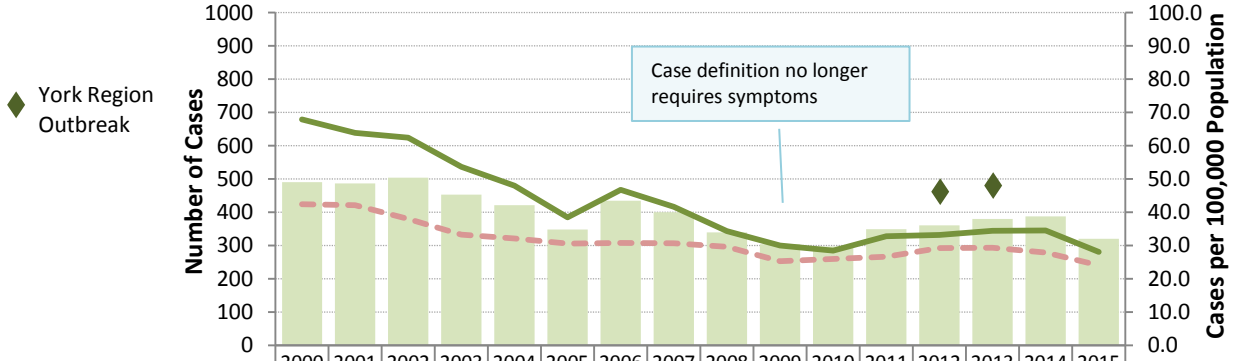
The incubation period of *Campylobacter* is two to five days, with a range of one to 10 days depending on dose ingested.[4] Exposure to as little as 500 organisms can cause illness in humans.

Animals are the reservoir for *Campylobacter*, frequently cattle and poultry, but also include puppies, kittens, swine, sheep, rodents and birds.[4] *Campylobacter* bacteria can spread to humans through eating raw or undercooked meat (especially poultry), contact with infected animals (especially puppies, kittens and farm animals), drinking unpasteurized milk or consuming food or water contaminated with animal feces.

Residence in rural farming communities is a risk factor for *Campylobacter* enteritis,[7,8] where there is a higher likelihood of contact with farm animals and their environments. Although person-to-person transmission is uncommon,[4] it may occur when an infected person does not practice good hand-washing, especially after using the toilet.

Campylobacter enteritis incidence rates in Ontario and York Region decreased between 2000 and 2009 (Figure 2.2.1); this decrease was more marked in York Region. Between 2009 and 2015, rates have been quite stable, with York Region rates remaining higher than Ontario's.

Figure 2.2.1 *Campylobacter* enteritis, York Region and Ontario, 2000–2015:
Cases and rates



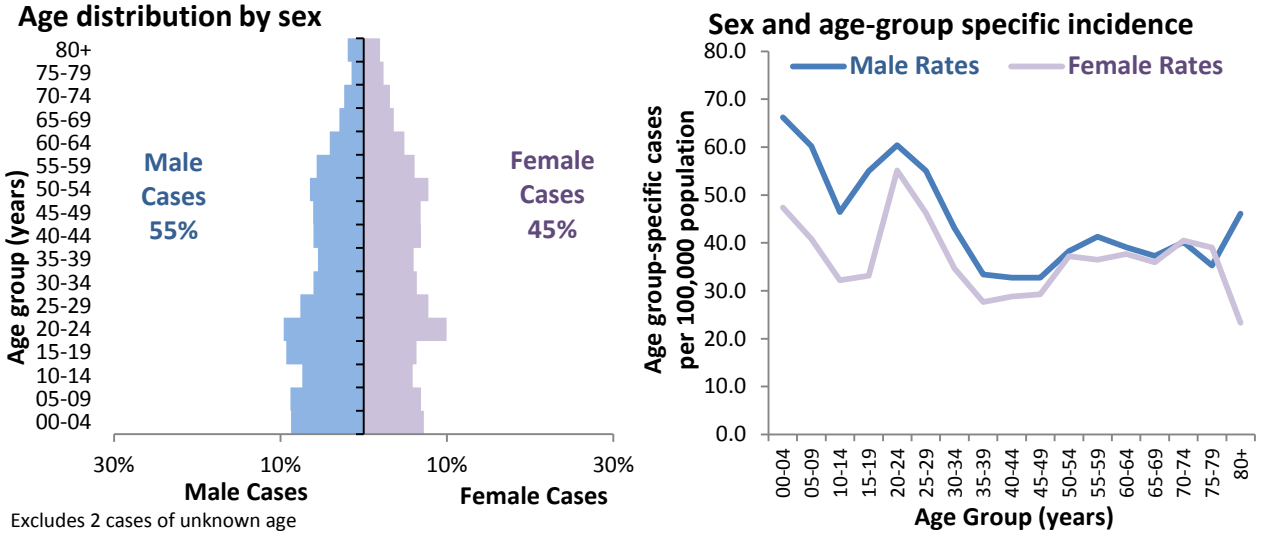
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	490	487	504	453	421	348	435	400	339	304	297	349	360	380	387	320
YR Incidence Rate	67.9	63.8	62.4	53.7	48.0	38.5	46.7	41.6	34.3	30.0	28.5	32.8	33.1	34.4	34.5	28.1
ON Incidence Rate	42.4	42.1	37.9	33.2	32.1	30.6	30.7	30.7	29.6	25.2	25.9	26.6	29.2	29.3	27.8	24.0

Outbreaks:

- ***2012***—Thirteen cases were reported in a York Region outbreak associated with a restaurant.
- ***2013***—Twenty-seven cases were reported in a York Region outbreak associated with a restaurant.

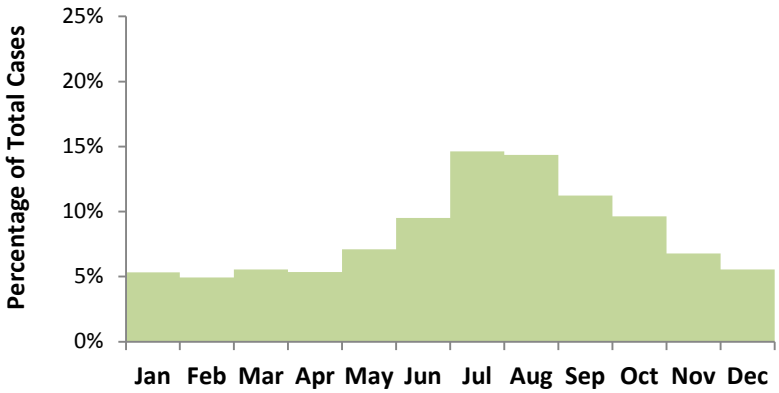
Campylobacter enteritis occurs among individuals of all ages (Figure 2.2.2), with highest rates among young children and young adults and higher rates among males of almost all age groups, especially the young.

Figure 2.2.2 *Campylobacter* enteritis, York Region, 2000–2015:



Campylobacter enteritis cases show a seasonal pattern, with more cases seen in the summer months (Figure 2.2.3). In Canada, most cases of *Campylobacter* enteritis occur in the summer months when there is a significant rise in the *Campylobacter* prevalence in chicken.[4]

Figure 2.2.3 *Campylobacter* enteritis, York Region, 2000–2015:



Although many isolates were not speciated and some were not distinguished between *Campylobacter jejuni* and *coli*, almost all agents with a species designated were *C. jejuni* (Table 2.2.1).

Table 2.2.1 *Campylobacter* enteritis, York Region, 2000–2015:

Agents isolated

Agent *(5345 isolates)*	**% of isolates**
Campylobacter jejuni	90%
Campylobacter coli	1%
Campylobacter jejuni or coli	8%
Campylobacter fetus	<1%
Campylobacter laridis	<1%
Campylobacter upsaliensis	<1%

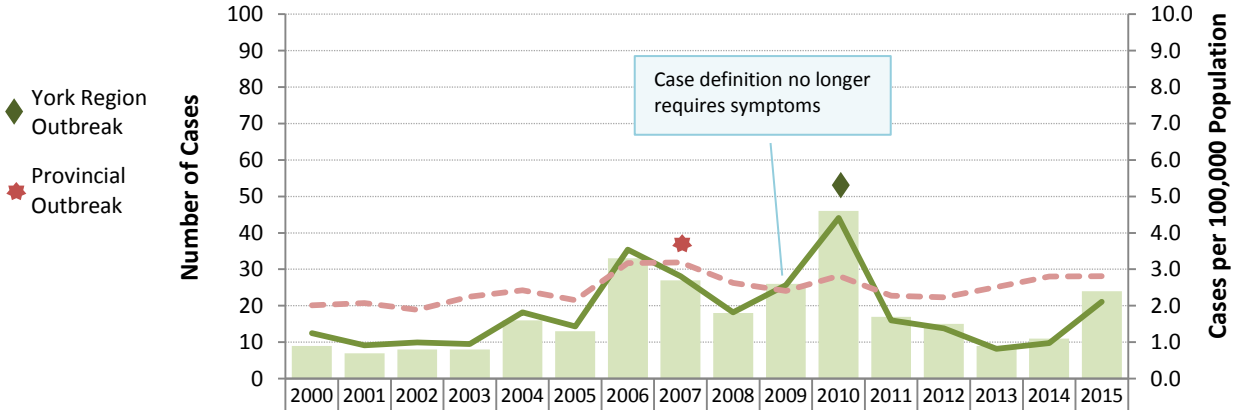
2.3 Cryptosporidiosis

Cryptosporidiosis is an illness caused by the parasite *Cryptosporidium*, typically characterized by diarrhea and abdominal cramps.[4] *Cryptosporidium* is shed in the feces of infected humans and animals and infection occurs when the organism is transmitted via the fecal-oral route from person-to-person or animal-to-person transmission, or by consuming contaminated food or water.

Cryptosporidium oocysts are capable of surviving outside of the body for two to six months, or longer in a moist environment.[9] Oocysts are small in size, allowing contamination to pass through some water filtration systems. They are also resistant to chlorine-based disinfectants, causing recreational swimming pools to be a common source of infection among children.

The incubation period for cryptosporidiosis varies from one to 12 days, with an average of seven days.[4] Symptoms can wax and wane and can last up to 30 days in healthy people. Infected individuals can shed infective parasites for several weeks after their symptoms resolve. Groups at higher risk of cryptosporidiosis infection include children less than two years old, animal handlers, men who have sex with men, travelers to developing countries and close contacts of infected individuals.[9]

Figure 2.3.1 Cryptosporidiosis, York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	9	7	8	8	16	13	33	27	18	26	46	17	15	9	11	24
YR Incidence Rate	1.2	0.9	1.0	0.9	1.8	1.4	3.5	2.8	1.8	2.6	4.4	1.6	1.4	0.8	1.0	2.1
ON Incidence Rate	2.0	2.1	1.9	2.2	2.4	2.2	3.2	3.2	2.6	2.4	2.8	2.3	2.2	2.5	2.8	2.8

Outbreaks:

- ***2007***—Eight York Region cases reported in an outbreak associated with an Ontario outbreak associated with the Toronto Zoo Splash Park.
- ***2010***—Fifty-seven cases* were reported in total, 24 of which were York Region cases. Cases were found to be students of a college veterinary technician program. The outbreak was possibly linked to ill calves cared for at the college.

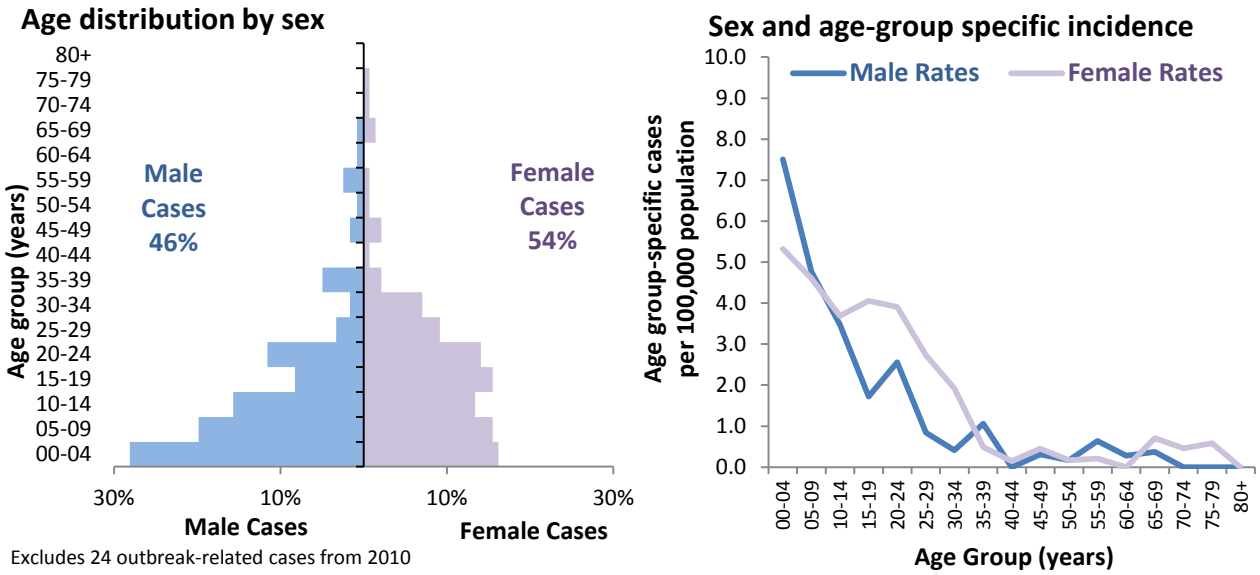
** Count includes 30 cases not recorded in provincial database.*

Although the incidence rate of cryptosporidiosis has remained fairly stable in Ontario (Figure 2.3.1), the rate in York Region fluctuated over the 2000 to 2015 time period. This pattern is expected as

cryptosporidiosis is an uncommonly reported disease that can occur in clusters. Most years the York Region rate was below that of Ontario; however there were outbreaks of the disease with York Region cases, most notably in 2010 when there was a very large outbreak associated with a veterinary technician college.

Cryptosporidiosis was most common among the very young and displayed a steady decrease in rate with increasing age among youth (Figure 2.3.2). There were more female cases than male cases in York Region among the young adult population, a finding seen in other jurisdictions[10] and has been speculated to being a result of caregiving to ill children.

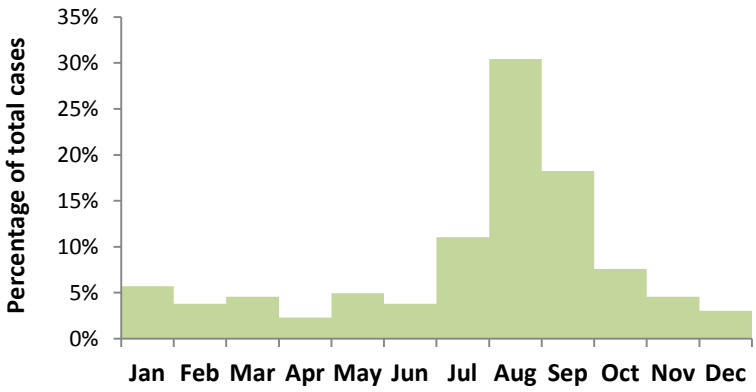
Figure 2.3.2 Cryptosporidiosis, York Region, 2000–2015:



Excludes 24 outbreak-related cases from 2010

Cryptosporidiosis occurred with a distinct seasonal pattern, peaking in August (Figure 2.3.3). This finding is consistent with use of recreational water venues during the summer.[10]

Figure 2.3.3 Cryptosporidiosis, York Region, 2000–2015:



Excludes 24 outbreak-related cases from 2010

Selected cryptosporidiosis risks 2011–2015

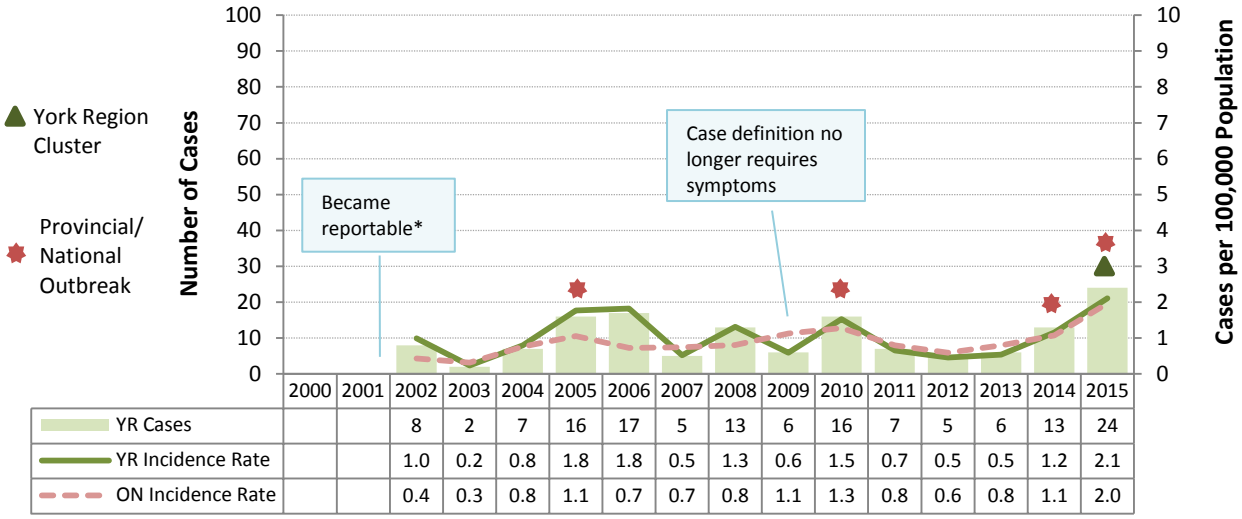
Travel to developing countries is a risk factor for cryptosporidiosis.[9] In York Region, 58 per cent of cryptosporidiosis cases reported travel outside of Ontario during their likely exposure time period. The literature speculates that higher incidence seen in rural areas could be due to exposure to livestock.[11] This is consistent with the finding that the rate of cryptosporidiosis in the more rural areas of Georgina, East Gwillimbury and King was 1.8 times greater than the rate for the more urban municipalities of Markham, Richmond Hill and Vaughan. Exposure to contaminated recreational water is also a risk factor for the illness,[4] and 36 per cent of York Region cases reported recreational water exposure.

2.4 Cyclosporiasis

Cyclosporiasis is an illness resulting from infection of the upper small bowel with the parasite *Cyclospora cayetanensis* and results in watery diarrhea, nausea, anorexia, abdominal cramps, fatigue, myalgia and weight loss.[4] Some infected people may have few or no symptoms. *Cyclospora* is commonly found in developing countries and in particular, tropical and sub-tropical countries.

People of all ages are at risk for infection.[4] Humans are the only known reservoir for *Cyclospora cayetanensis*.[12] *Cyclospora* oocysts in freshly excreted stool require days to weeks outside the host to become infectious, making person-to-person transmission unlikely.[4] The infection is acquired by eating foods, drinking water or swimming in water contaminated with feces containing the parasite. The incubation period is approximately one week. Cyclosporiasis is not endemic to Ontario,[13] thus it is expected that all York Region cases are either travel-related or associated with a contaminated imported food. Foodborne outbreaks of cyclosporiasis in Canada are most commonly associated with consumption of contaminated fruits and vegetables imported from countries where *Cyclospora* is common.[12] Cyclosporiasis became reportable in Ontario in 2001. Cyclosporiasis incidence among York Region residents was close to the Ontario incidence over the time period examined (Figure 2.4.1).

Figure 2.4.1 Cyclosporiasis, York Region and Ontario, 2002–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases			8	2	7	16	17	5	13	6	16	7	5	6	13	24
YR Incidence Rate			1.0	0.2	0.8	1.8	1.8	0.5	1.3	0.6	1.5	0.7	0.5	0.5	1.2	2.1
ON Incidence Rate			0.4	0.3	0.8	1.1	0.7	0.7	0.8	1.1	1.3	0.8	0.6	0.8	1.1	2.0

*Thought to be underreported in initial years being reportable.

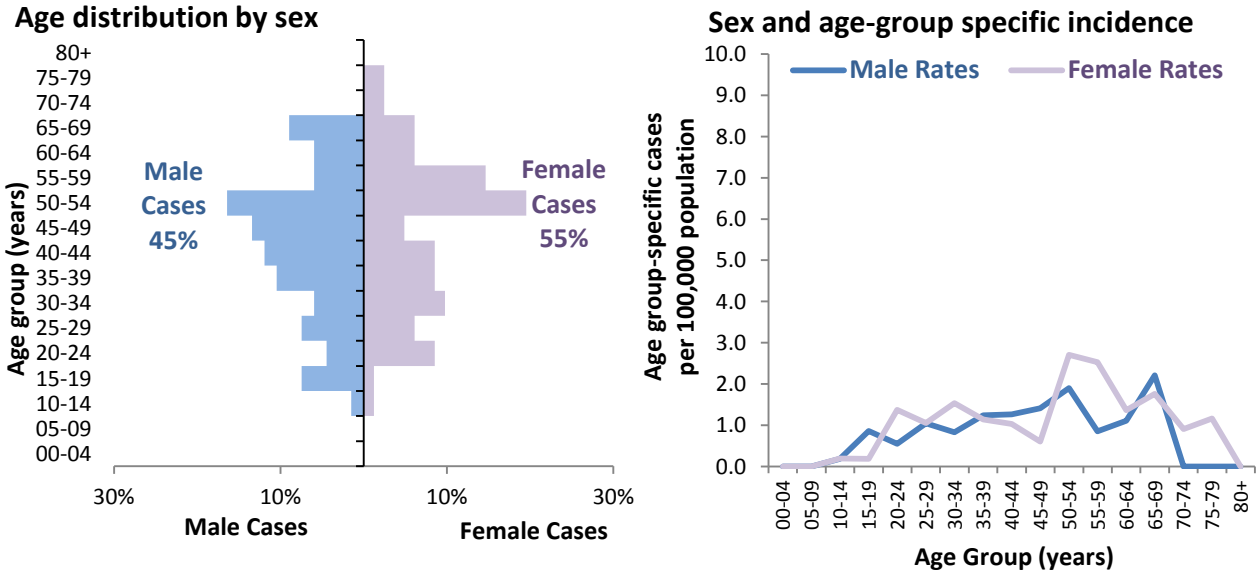
Outbreaks and cluster:

- ✸ ***2005***—An Ontario outbreak was linked to fresh basil used to make pesto.[12]
- ✸ ***2010***—An Ontario outbreak was linked with fresh basil in pesto that was used to make gourmet sandwiches.[12]
- ✸ ***2014***—A large national outbreak involved an increase in non-travel related cases of cyclosporiasis. York Region reported four cases.
- ✸ ***2015***—A large national outbreak involved 97 Canadian cases, of which 84 cases were reported in Ontario; York Region reported five cases. Imported snap peas purchased from a single supplier were identified as the source of the outbreak and a voluntary recall of this product was issued.[14]
- ▲ ***2015***—Fifteen cases reported travel to the Mexican Riviera.

The year-to-year variability in York Region rates is expected for diseases that are not commonly reported and are influenced by clusters. There were non-travel related case clusters in 2014 and 2015 in Ontario, as well as a substantial number of cases in 2015 reporting travel to the Mexican Riviera, suggesting that there was an outbreak in that locale.

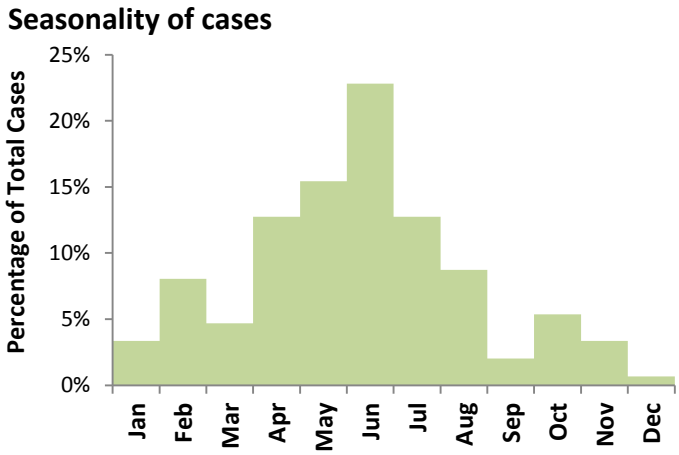
The highest age-specific incidence rates of Cyclosporiasis were among adults and slightly more of the cases were female (Figure 2.4.2).

Figure 2.4.2 Cyclosporiasis, York Region, 2002–2015:



Cyclosporiasis followed a seasonal pattern with the peak of cases in June (Figure 2.4.3).

Figure 2.4.3 Cyclosporiasis, York Region, 2002–2015:



2.5 Giardiasis

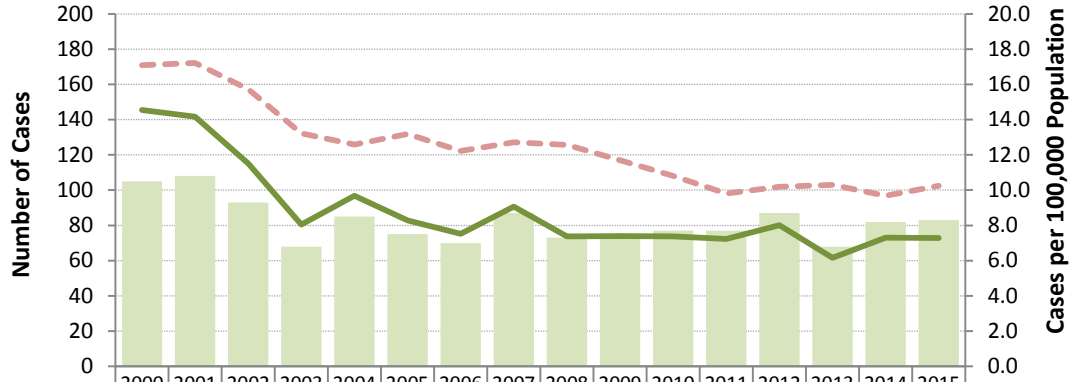
Giardiasis is an intestinal illness caused by the parasite *Giardia lamblia*,[4] and the most common intestinal parasite of humans identified in North America.[15] Symptoms can include chronic diarrhea, abdominal cramps, bloating, frequent loose and/or pale greasy stools, fatigue and malabsorption. Many people with giardiasis do not experience any symptoms.[4]

Anyone is at risk of acquiring giardiasis, but it occurs most often in children and its occurrence is higher in locations with poor sanitation.[4] The infection can be carried by humans, wild and domestic animals such as cats, dogs and cattle and other vertebrates.

Giardiasis is transmitted via the fecal-oral route and most often occurs through person-to-person contact or consumption of fecally-contaminated water or food.[4] The incubation period ranges from three to 25 days, with a median of seven to 10 days.

Incidence of giardiasis has decreased over the 2000 to 2009 time period, becoming stable in recent years (Figure 2.5.1). The rate in York Region was lower than in Ontario as a whole.

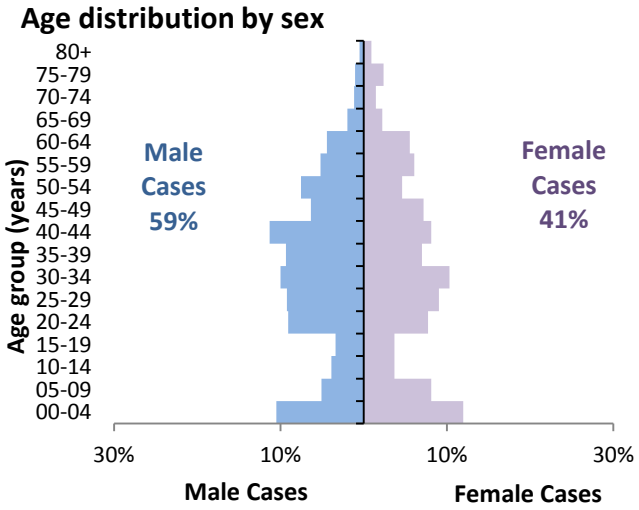
Figure 2.5.1 Giardiais, York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	105	108	93	68	85	75	70	87	73	75	77	77	87	68	82	83
YR Incidence Rate	14.5	14.2	11.5	8.1	9.7	8.3	7.5	9.1	7.4	7.4	7.4	7.2	8.0	6.2	7.3	7.3
ON Incidence Rate	17.1	17.2	15.7	13.2	12.6	13.2	12.2	12.7	12.6	11.7	10.8	9.8	10.2	10.3	9.7	10.2

Age group specific giardiasis incidence rates were highest among young children and young adults (Figure 2.5.2). Among adults, the incidence rate for males was higher than that of females; infection among men who have sex with men may contribute to this difference.[16]

Figure 2.5.2 Giardiasis, York Region, 2000–2015:



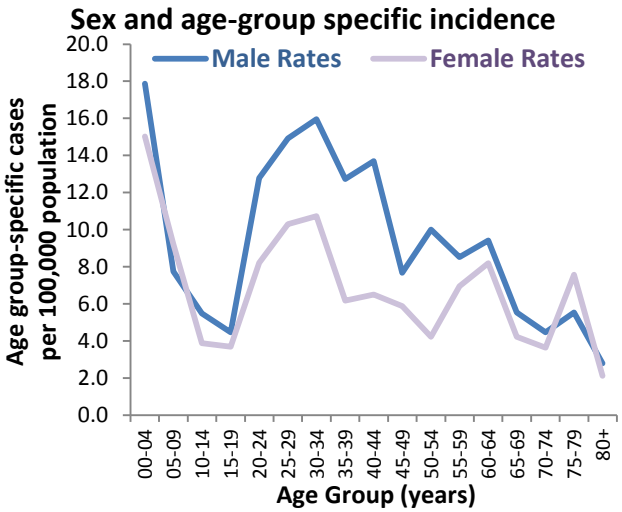
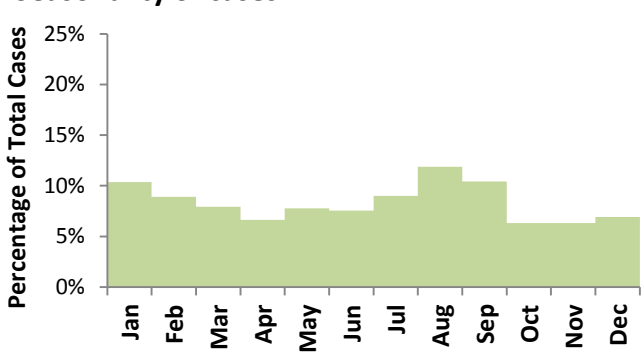


Figure 2.5.3 Giardiasis, York Region, 2000–2015:

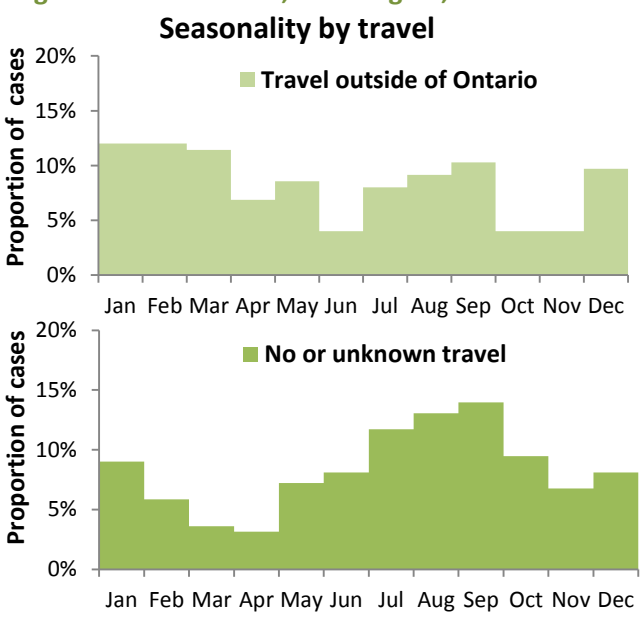
Giardiasis in York Region showed a subtle seasonal pattern with the highest proportion of cases in August and September (Figure 2.5.3).



Giardiasis, travel and seasonality

Over 40 per cent of giardiasis cases between 2011 and 2015 reported travel outside of Ontario during their likely exposure period. These cases do not appear to be strongly seasonal, with the highest proportion of cases from January to March (Figure 2.5.4). On the other hand, cases without known travel displayed a marked seasonal pattern, with a peak in September. This is consistent with environmental exposure during the summer to fall months. Increased outdoor activities during the summer months, including recreational water use and social gatherings, are thought to contribute to a higher incidence of giardia.[17]

Figure 2.5.4 Giardiasis, York Region, 2011–2015:



2.6 Hepatitis A

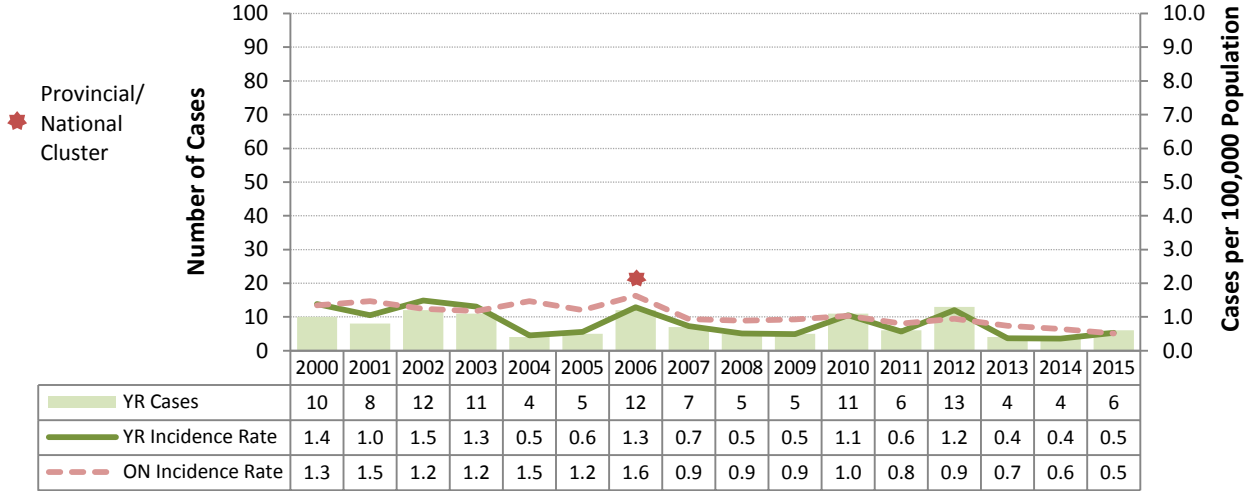
Hepatitis A is a liver infection caused by the hepatitis A virus,[4] and infection results in life-long immunity.[18] Children who are infected are typically asymptomatic or undiagnosed. Infection in adults can be severe, with 25 per cent of adults requiring hospitalization.

Humans are the primary reservoir for hepatitis A and infected individuals pass the virus in their stool.[18] Fecal-oral transmission to close household or sexual contacts is common. Infection may also result from exposure to items that have been contaminated with the virus or by ingesting contaminated food or water.[4] The virus reaches peak communicability one or two weeks before the onset of symptoms, then decreases rapidly once symptoms appear. Once shed, the virus can persist in an infectious state for up to two to four weeks at room temperature.[18]

The incubation period for hepatitis A averages 28 to 30 days, but can range from 15 to 50 days.[4]

Hepatitis A infections are uncommon in York Region. The incidence of hepatitis A in York Region was similar to that for Ontario, which decreased over the time period examined (Figure 2.6.1).

Figure 2.6.1 Hepatitis A, York Region and Ontario, 2000–2015:
Cases and rates



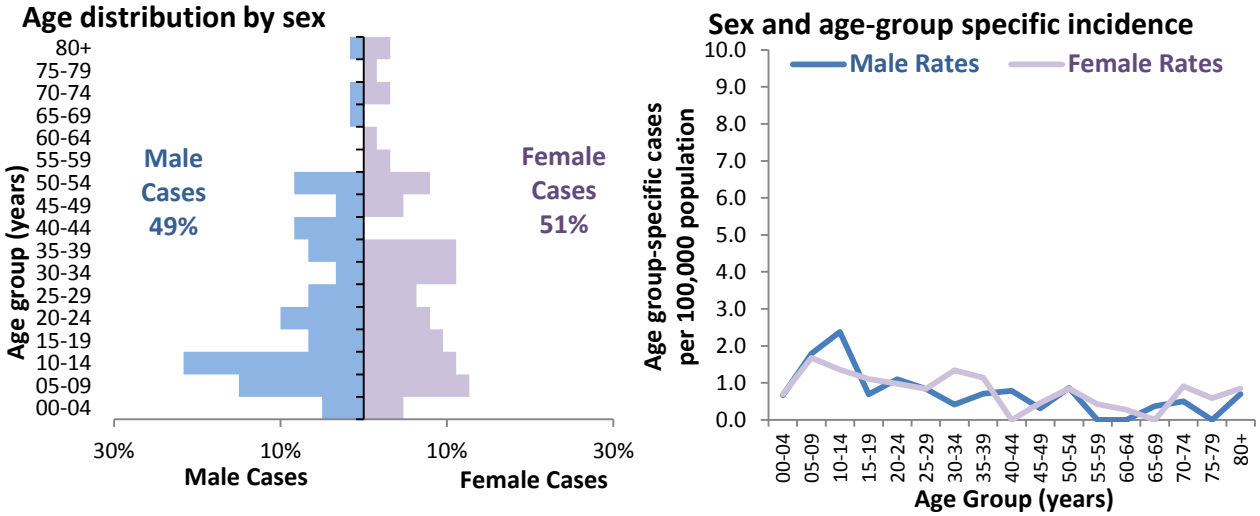
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	10	8	12	11	4	5	12	7	5	5	11	6	13	4	4	6
YR Incidence Rate	1.4	1.0	1.5	1.3	0.5	0.6	1.3	0.7	0.5	0.5	1.1	0.6	1.2	0.4	0.4	0.5
ON Incidence Rate	1.3	1.5	1.2	1.2	1.5	1.2	1.6	0.9	0.9	0.9	1.0	0.8	0.9	0.7	0.6	0.5

Cluster:

- ***2006***—A cluster of cases was identified and possibly linked to a national investigation of contaminated frozen berries.[19]

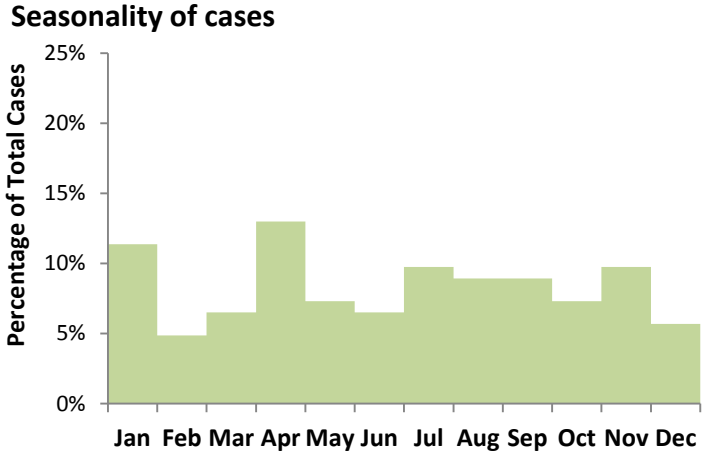
Hepatitis A infection was slightly more common among youth and similar between males and females (Figure 2.6.2).

Figure 2.6.2 Hepatitis A, York Region, 2000–2015:



There was no clear seasonal pattern to Hepatitis A infections in York Region (Figure 2.6.3).

Figure 2.6.3 Hepatitis A, York Region, 2000–2015:



2.7 Listeriosis

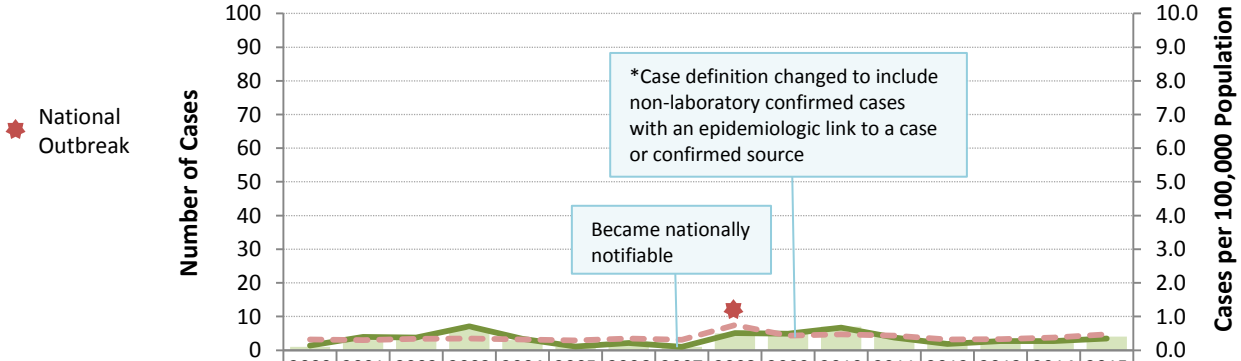
Listeria is a bacterium that is widespread in nature and can be found in the feces of animals and humans. [4] Infection with *Listeria* can cause listeriosis, a serious but rare illness that in certain cases can lead to infection in the brain and possibly death. Those most susceptible to infection include the elderly, pregnant women and immunocompromised persons. Newborns have a high mortality rate if infected.

The incubation period of listeriosis is typically two to three weeks, but can range from 24 hours to up to 70 days.[20] With the exception of trans-placental transmission, *Listeria* bacteria are not commonly passed from person-to-person.[4] Listeriosis has been found in soil, dust, water and sewage. Nearly all cases of listeriosis are caused by eating food items contaminated with *Listeria*, such as unpasteurized dairy products, raw vegetables and ready-to-eat meats. *Listeria* can grow in refrigerated foods.[20]

Listeriosis incidence was stable between 2000 and 2015, except for an increase in Ontario in 2008 due to an outbreak attributed to ready-to-eat deli meats (Figure 2.7.1). York Region rates for listeriosis closely matched Ontario rates.

Figure 2.7.1 Listeriosis, York Region and Ontario, 2000–2015:

Cases and rates



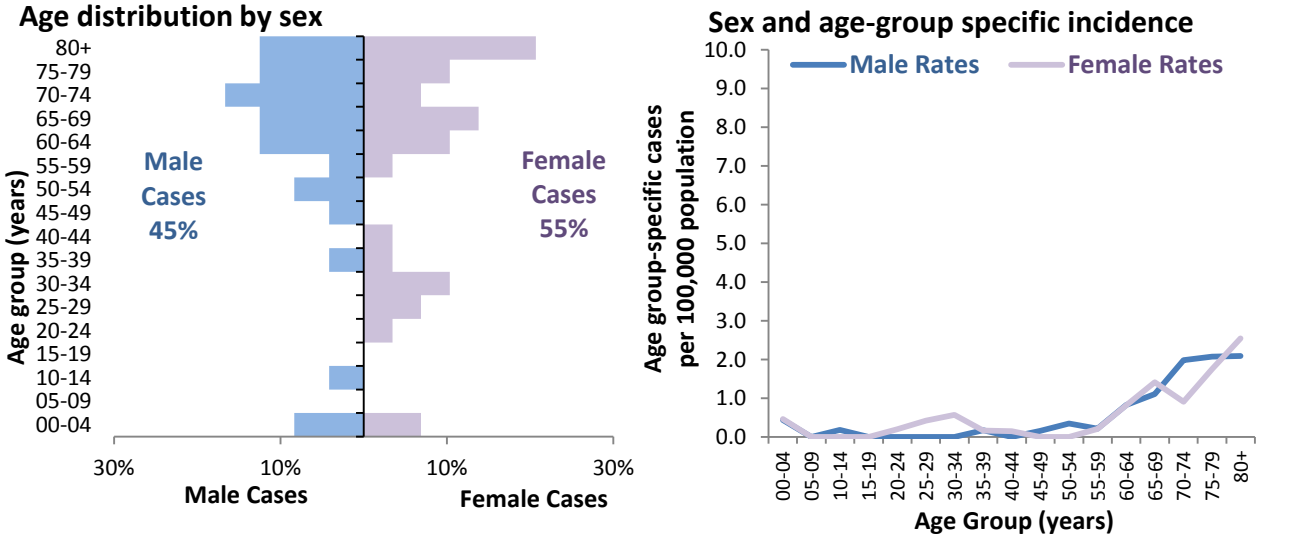
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	1	3	3	6	3	1	2	1	5	5	7	4	2	3	3	4
YR Incidence Rate	0.1	0.4	0.4	0.7	0.3	0.1	0.2	0.1	0.5	0.5	0.7	0.4	0.2	0.3	0.3	0.4
ON Incidence Rate	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.7	0.4	0.5	0.4	0.3	0.3	0.4	0.5

Outbreak:

- ***2008***—A national outbreak was reported with 56 cases and 21 deaths across seven provinces. Of the cases, 41 were reported in Ontario. Three York Region cases were associated with the outbreak. The source was identified as a deli meat packaging facility located in Toronto, Ontario.[21]

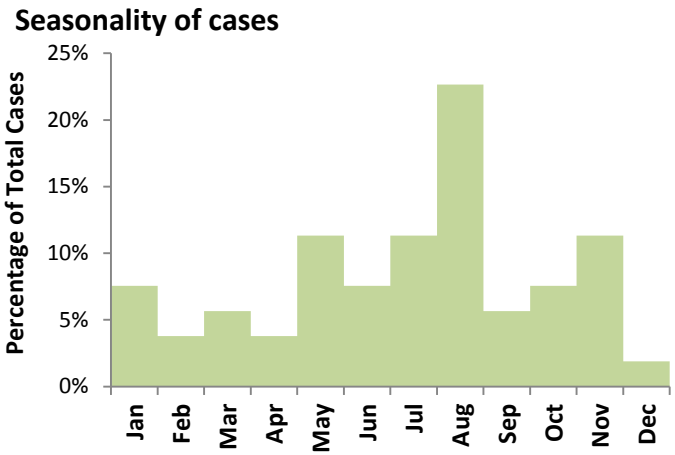
Listeriosis was reported more frequently among seniors (Figure 2.7.2) and a slightly higher proportion of cases were female, likely due to a higher number of female seniors.

Figure 2.7.2 Listeriosis, York Region, 2000–2015:



A large proportion of listeriosis cases occurred in August (Figure 2.7.3). In Ontario, listeriosis has increased incidence in the warmer months.[20]

Figure 2.7.3 Listeriosis, York Region, 2000–2015:



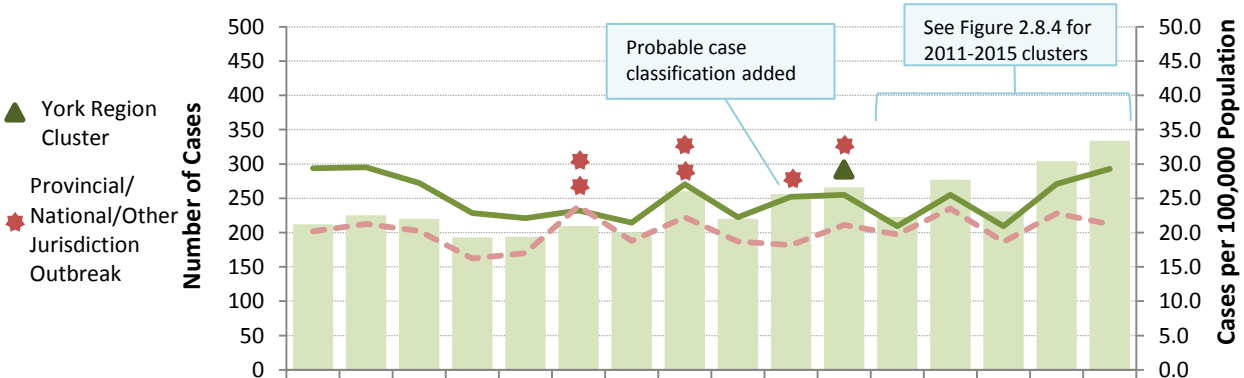
2.8 Salmonellosis

Salmonellosis is a bacterial infection causing a range of gastrointestinal illness. Common symptoms include diarrhea, abdominal pain, fever, nausea and vomiting.[4] Infection may occur from the consumption of contaminated food items that have not been properly cooked, exposure to infected animals and through person-to-person transmission through the fecal-oral route.[22]

Infection can occur in humans, wild animals and domestic animals, including poultry, swine, cattle, rodents, reptiles and pets such as cats and dogs.[4] The most common food vehicles include poultry and poultry products, unpasteurized (raw) milk and raw milk products, contaminated water, meat and meat products, raw/undercooked eggs and egg products and raw fruits/vegetables.[23] The incubation period of salmonellosis is generally six to 72 hours, though incubation periods of up to 16 days have been reported and may not be uncommon.[4]

Figure 2.8.1 Salmonellosis,York Region and Ontario, 2000–2015:

Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	212	225	220	193	194	210	200	260	220	256	266	223	277	231	304	334
YR Incidence Rate	29.4	29.5	27.2	22.9	22.1	23.2	21.5	27.1	22.3	25.2	25.5	20.9	25.5	20.9	27.1	29.3
ON Incidence Rate	20.2	21.3	20.2	16.2	17.0	23.9	18.8	22.3	18.7	18.2	21.1	19.7	23.5	18.6	22.8	21.2

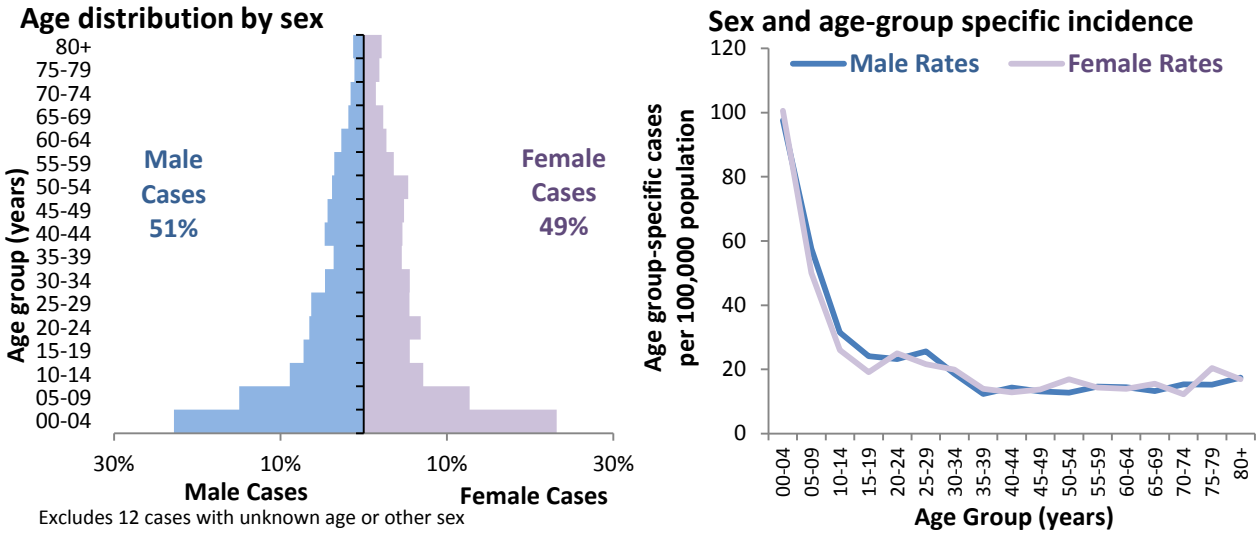
Outbreaks:

- ***2005***—Forty-five cases of *Salmonella* Typhimurium were identified as a provincial outbreak, for which York Region had multiple cases. The source of the outbreak was suspected to be certain deli meats from a specific producer, although laboratory tests never confirmed the source.[24]
- ***2005***—A large outbreak was identified in Ontario with 552 cases of *Salmonella* Enteritidis. Thirty-five York Region cases were associated with the outbreak. The outbreak was linked to consumption of contaminated mung bean sprouts.[25]
- ***2007***—An outbreak of *Salmonella* Typhimurium was identified at the University of Western Ontario in London, Ontario. Ninety laboratory confirmed cases were associated with the outbreak. There were no York Region cases associated with the outbreak.[26]
- ***2007***—Seventeen York Region cases of *Salmonella* Typhimurium were linked to an Ontario outbreak.
- ***2009***—Twenty-four York Region cases of *Salmonella* Typhimurium were linked to an outbreak in Toronto, Ontario.
- ***2010***—A cluster of 17 *Salmonella* Heidelberg cases were investigated in York Region.
- ***2010***—A provincial cluster of *Salmonella* Montevideo cases were investigated, including nine York Region cases.

The incidence of salmonellosis was fairly high and varied from year to year, but there was no clear trend in the rate between 2000 and 2015 (Figure 2.8.1). Salmonellosis incidence rate was generally higher in York Region than in Ontario.

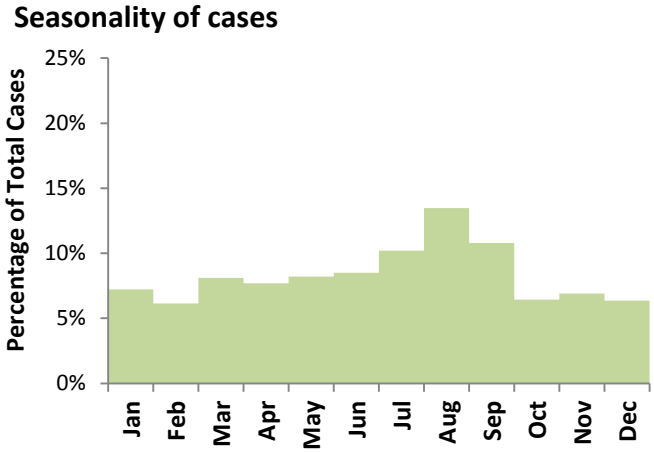
Although salmonellosis occurs among all ages, rates were highest among children, especially the very young (Figure 2.8.2). The age distributions were similar between males and females.

Figure 2.8.2 Salmonellosis, York Region, 2000–2015:



Salmonellosis displayed a modest seasonal pattern with a peak in August (Figure 2.8.3). It has been speculated that this is due to increased social gatherings where food is served and due to warmer temperatures that promote pathogen growth.[17]

Figure 2.8.3 Salmonellosis, York Region, 2000–2015:



There are many serovars of *Salmonella* that cause human illness. Serovars *S.* Enteritidis, *S.* Typhimurium and *S.* Heidelberg were the three most common in York Region (Table 2.8.1). There were more than 50 other serovars isolated from York Region cases. A very small proportion of isolates were non-typeable.

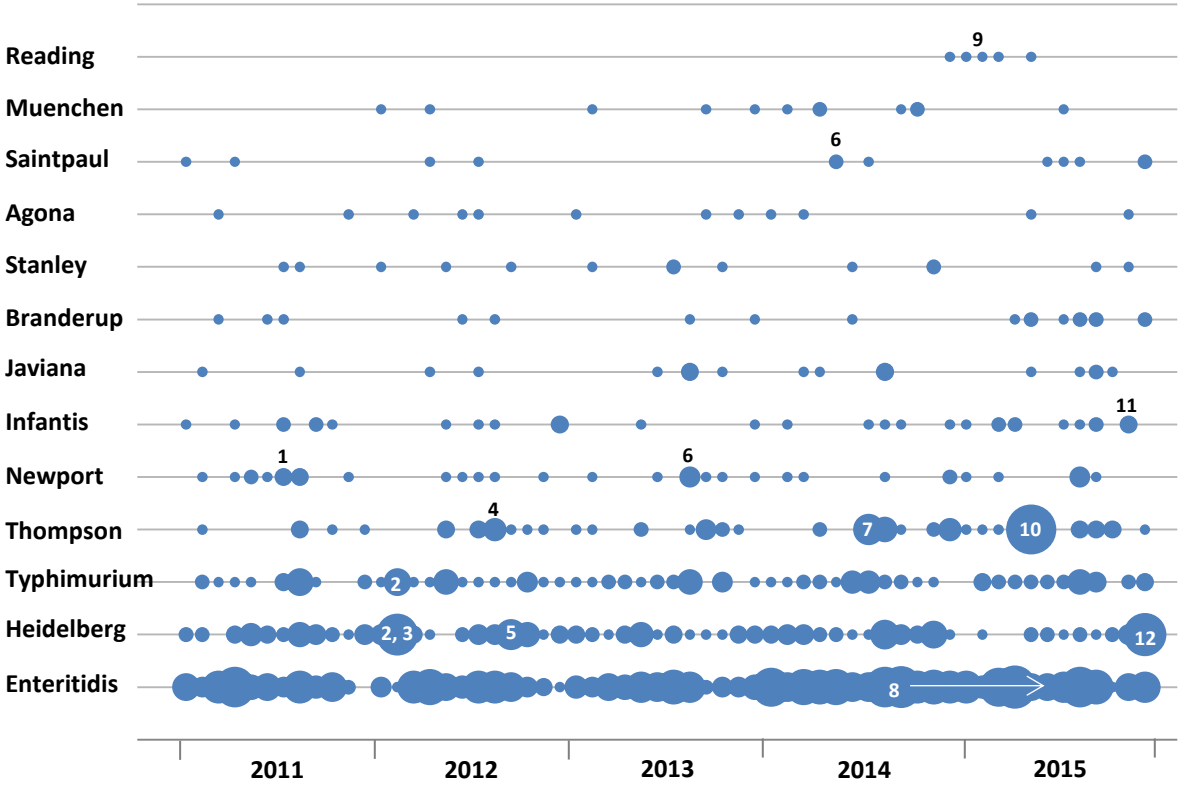
Table 2.8.1 Salmonellosis, York Region, 2000–2015:
Serovars isolated

Agent *(3311 isolates)*	**% of isolates**
S. Enteritidis	32%
S. Typhimurium	16%
S. Heidelberg	13%
S. Thompson	6%
S. Hadar	3%
S. Infantis	3%
S. Newport	3%
Other *Salmonella* serovars	24%

Salmonellosis clusters in time

Salmonellosis tends to occur in clusters of cases of the same serovar (Figure 2.8.4). The cases that form these clusters were possibly related to a common source. Although sometimes these clusters were not recognized or a common source could not be found, there were clusters that were traced to a common source or event.

Figure 2.8.4 Salmonellosis, York Region, 2011–2015:
Monthly cases by selected serovars



Outbreaks:

1. **2011 ON**—An outbreak of *Salmonella* Newport was identified with cases in Ontario and Quebec. There were 24 cases identified, one of them was a York Region case. The source of the outbreak was not identified.[27]
2. **2012 YR**—An outbreak was identified after a social event. Of the 540 attendees, 183 were interviewed and 123 of those interviewed reported illness. Fifty-two cases were lab confirmed with either *S.* Typhimurium, *S.* Heidelberg, or co-infected with both. There were 10 York Region cases associated with the outbreak.[15]
3. **2012 ON**—There were 75 cases of *Salmonella* Heidelberg in two months in Ontario which prompted an outbreak investigation. The source of the outbreak was not identified, although the increase in cases was partly attributed to several sub-clusters in Ontario.[15]
4. **2012 ON**—A provincial outbreak of *Salmonella* Thompson was identified in Ontario with 69 cases. Three cases were hospitalized and no deaths were reported. There were eight York Region cases related to this outbreak. No common source was identified.[28]
5. **2012 ON**—A provincial outbreak of *Salmonella* Heidelberg was identified, including 12 York Region cases. No common source was identified, although consumption of chicken was found to be a common exposure.[29]
6. **2013/2014 CA**—A national outbreak was identified including cases of *S.* Newport, *S.* Hartford, *S.* Oranienburg and *S*. Saintpaul. British Columbia, Alberta, Quebec and Ontario experienced a total of 63 cases. There were five York Region cases associated with this outbreak. The source of the outbreak was identified in a sprouted chia seed powder and food recall warnings were issued.[30]
7. **2014 CA**—A national outbreak of *Salmonella* Thompson was identified and continued as an Ontario provincial outbreak that included 156 cases. Eleven York Region cases were associated with this outbreak. There were four separate chicken shawarma restaurant clusters associated with the Ontario outbreak. Chicken was identified as a common exposure in the outbreak, although no common source of contaminated chicken was identified.[31]
8. **2014/2015 CA**—There were national and provincial outbreak investigations as a result of increases in the number of *S.* Enteriditis cases. Frozen, breaded chicken was identified as a risk factor and could have contributed to the increase. A total of 40 York Region cases were associated with this group of outbreak investigations.[32]
9. **2014/2015 CA**—A national outbreak of *S*. Reading was identified with cases in Ontario, Alberta and New Brunswick. There were a total of 34 cases associated with the outbreak, including five York Region cases. Many cases were of Eastern Mediterranean origin but no common exposure or source was identified.[33]
10. **2015 YR**—A York Region outbreak of *Salmonella* Thompson was identified involving 28 cases with a common exposure setting.
11. **2015 CA**—A national outbreak of *Salmonella* Infantis involving nine provinces was identified with a total of 110 cases, including six cases from York Region.[34]
12. **2015 YR**—A York Region outbreak was identified and extended into 2016. A total of 60 confirmed cases of *Salmonella* Heidelberg were associated with this outbreak, of which 17 cases had symptom onset in 2015.

2.9 Shigellosis

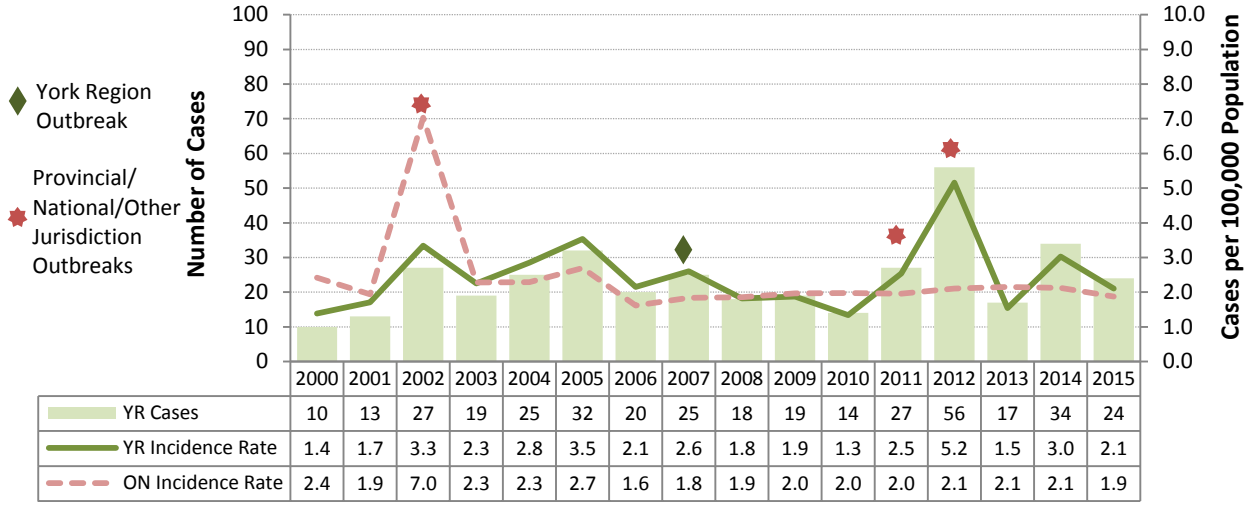
Shigellosis is an infectious disease caused by *Shigella* bacteria.[4] Infections occur most commonly in children, travelers and individuals who may be at risk of exposure to the infection though fecal-oral transmission. Humans are the only significant reservoir of *Shigella*.[4]

Outbreaks occur in childcare centres and among people living in institutions.[4] Transmission via drinking or recreational water is also possible as the result of direct fecal contamination. *Shigella* bacteria are extremely infectious and can cause illness with as little as 10 to 100 organisms. Infection may occur through the ingestion of contaminated food or water or through person-to-person transmission, which is common in households.

The incubation period of Shigellosis is typically one to three days, but can range from 12 to 96 hours.[4] The period of communicability continues during acute infection until *Shigella* is no longer present in feces, up to four weeks after symptoms resolve.

Shigellosis incidence was relatively stable in Ontario between 2000 and 2015, with the exception of 2002, where the incidence was greatly elevated due to a large outbreak (Figure 2.9.1). Incidence has shown no clear trend in York Region, with the exception of an increase in 2012. In recent years, the incidence rate of shigellosis in York Region was higher than Ontario's.

Figure 2.9.1 Shigellosis,York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	10	13	27	19	25	32	20	25	18	19	14	27	56	17	34	24
YR Incidence Rate	1.4	1.7	3.3	2.3	2.8	3.5	2.1	2.6	1.8	1.9	1.3	2.5	5.2	1.5	3.0	2.1
ON Incidence Rate	2.4	1.9	7.0	2.3	2.3	2.7	1.6	1.8	1.9	2.0	2.0	2.0	2.1	2.1	2.1	1.9

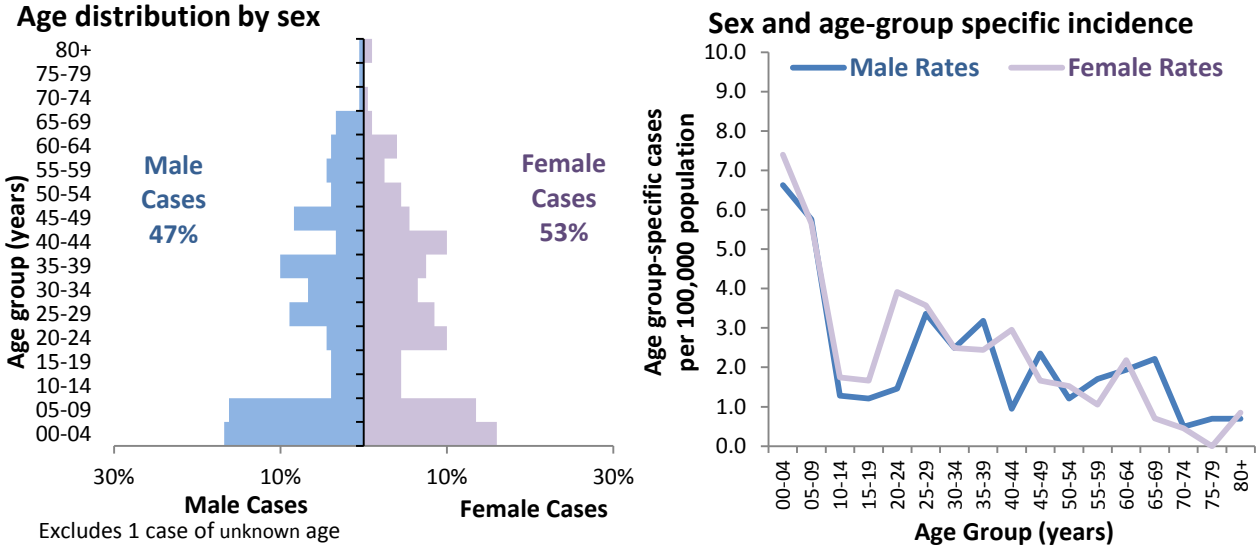
Outbreaks:

- ***2002***—A large provincial outbreak was reported with more than 420 cases. The outbreak was associated with Greek style pasta salad.[35]
- ***2007***—An outbreak in York Region was reported with nine cases. No source was identified.
- ***2011***—Fifteen York Region cases were reported as associated with a Toronto outbreak.
- ***2012***—Thirty-seven cases were reported in a Toronto outbreak, 19 of which were York Region cases. The infection was spread mainly by person-to-person transmission.[36]

Shigellosis in York Region was most common among young children, with a decrease in age-specific incidence among older youth (Figure 2.9.2) and occurred relatively frequently among adults with

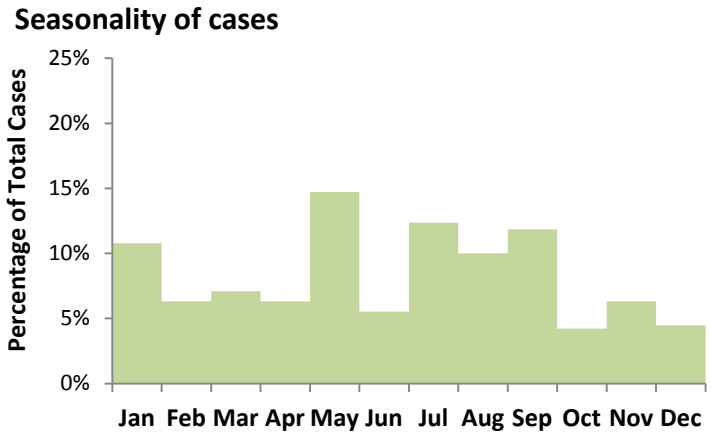
decreasing frequency in the older age groups. There were slightly more female cases than male cases. This age-sex distribution may be partially explained by a greater risk to young children, particularly those in childcare and their caregivers.[36]

Figure 2.9.2 Shigellosis, York Region, 2000–2015:



Shigellosis appeared to have a seasonal pattern with increased cases from July to September; however there was also a peak of cases that occurred in May (Figure 2.9.3).

Figure 2.9.3 Shigellosis, York Region, 2000–2015:



Almost three quarters of the cases had *S. sonnei* isolated and *S. flexneri* was the next most frequently reported species in York Region (Table 2.9.1). Global distribution of *Shigella* species is variable; *S. sonnei* accounts for the majority of isolates reported from developed countries.[36]

Table 2.9.1 Shigellosis, York Region, 2000–2015:
Agents isolated

Agent *(363 isolates)*	**% of isolates**
Shigella sonnei (Group D)	74%
Shigella flexneri (Group B)	20%
Shigella boydii (Group C)	4%
Shigella dysenteriae (Group A)	1%
Other *Shigella spp.*	1%

2.10 Verotoxin-producing *E. coli* infection (VTEC)

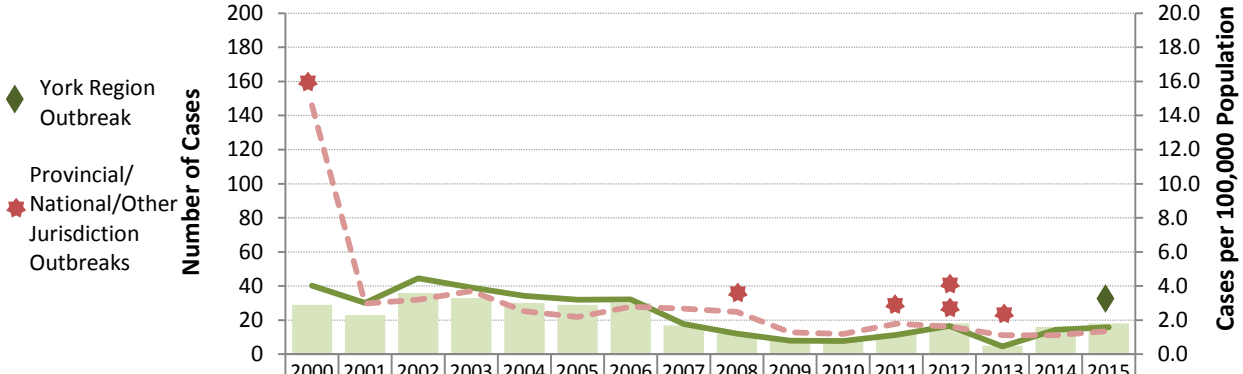
E. coli are bacteria commonly found in the intestines of humans and animals. Certain strains of *E. coli* produce toxins (verotoxin, also known as shiga toxin) and can cause serious illness, including hemolytic uremic syndrome (HUS).[4] The most commonly diagnosed strain of VTEC in North America is *E. coli* O157, which is primarily found in the intestines of sheep, goats and cattle, though it does not generally cause illness in these animals.[37]

Transmission of the disease can occur through the ingestion of food or water contaminated with the bacteria, animal contact or person-to-person through the fecal-oral route.[4] Outbreaks of VTEC have been linked to contaminated foods such as ground beef; produce such as lettuce, spinach and sprouts; unpasteurized dairy products and raw nuts.[37] Outbreaks have also been linked to animal contact, primarily related to petting zoos or contact with farm animals. Person-to-person transmission often involves childcare settings, household contact and institutions.

The incubation period for VTEC ranges from one to 10 days, with a median of three to four days.[37] People of any age are susceptible, but children under five years old, the elderly and immunocompromised individuals are at higher risk of severe illness.

The incidence of VTEC in York Region was similar to Ontario between 2000 and 2015 (Figure 2.10.1) with the exception of 2000, when there was a large waterborne outbreak in Walkerton, Ontario which substantially raised Ontario's annual rate without affecting York Region's. Although there have been clusters of cases over the time period examined, overall VTEC incidence has decreased.

Figure 2.10.1 Verotoxin-producing *E. coli* Infections,York Region and Ontario, 2000–2015:
Cases and rates



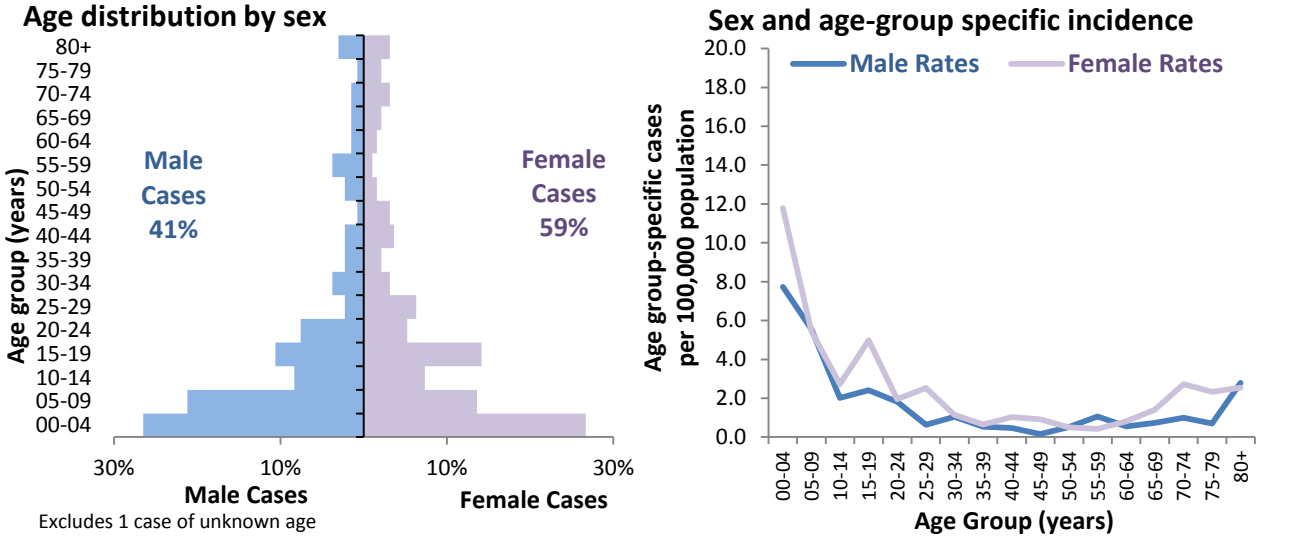
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	29	23	36	33	30	29	30	17	12	8	8	12	18	5	16	18
YR Incidence Rate	4.0	3.0	4.5	3.9	3.4	3.2	3.2	1.8	1.2	0.8	0.8	1.1	1.7	0.5	1.4	1.6
ON Incidence Rate	14.6	3.0	3.2	3.7	2.5	2.2	2.8	2.7	2.5	1.3	1.2	1.8	1.6	1.1	1.1	1.3

Outbreaks:

- ***2000***—A large local outbreak was reported in Walkerton, Ontario associated with contaminated municipal water. Proper water testing and disinfection procedures were not followed. An inquiry found negligence by municipal water operations staff and a lack of support in training and expertise from the Ministry of the Environment. There were 2,300 cases associated with the outbreak, including seven deaths.[38] There were no York Region cases.
- ***2008***—A provincial outbreak was reported with 235 cases. One York Region case was associated with the outbreak.
- ***2011***—A large international outbreak was reported in Germany. There were a total of 855 cases of hemolytic uremic syndrome and 2,987 cases of gastroenteritis associated with the outbreak. Contaminated sprouts were identified as the source of the outbreak. There was one case in Canada and no cases in York Region.[39]
- ***2012***—A national outbreak was reported with a total of 18 cases. The source was linked to contaminated beef from a processing plant in Alberta. No York Region cases were associated with the outbreak.[40]
- ***2012***—A national outbreak was reported with a total of eight cases across multiple provinces. The outbreak was linked to contaminated frozen beef burgers. Two York Region cases were associated with this outbreak.[41]
- ***2013***—A national outbreak was reported, affecting Ontario and the Maritime provinces. Thirty cases were associated with the outbreak. No York Region cases were reported. The source of the outbreak was linked to contaminated shredded lettuce.[42]
- ***2015***—An outbreak in York Region was reported with seven cases. The source of the outbreak was not identified, although there was a common exposure location.

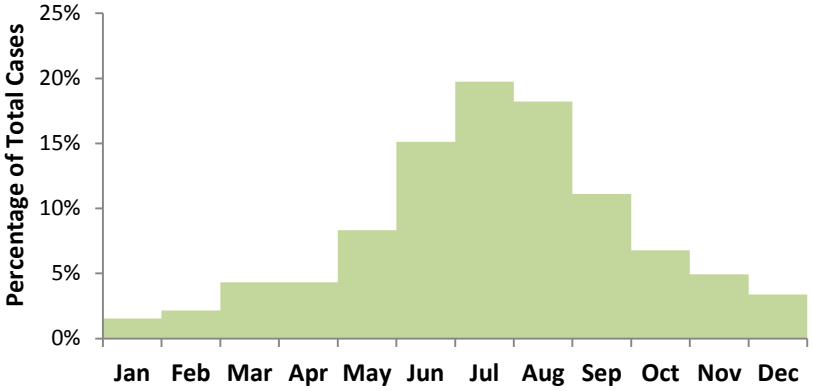
The highest age-specific incidence occurred among the very young, decreased with age to a very low incidence among adults and increased a small amount among the elderly (Figure 2.10.2). In York Region, there were slightly more female cases than male cases.

Figure 2.10.2 Verotoxin-producing *E .coli* infections, York Region, 2000–2015:



VTEC had a strong seasonal pattern with a peak in July (Figure 2.10.3). This is consistent with the peak shedding of VTEC by cattle in the summer and early fall.[43] Also, as with other enteric infections, there are additional risk factors in the summer months, such as an increase in cooking outdoors with less facilities for sanitation and social gatherings.[17,44]

Figure 2.10.3 Verotoxin-producing *E. coli*, York Region, 2000–2015



In York Region, 31 per cent of the VTEC isolates had serogoups specified, of which the vast majority were *E. coli* O157. This is expected, as most laboratories in Ontario do not routinely test for non-O157 *E. coli* serogroups of VTEC.[37] Non-O157 VTEC is under-diagnosed and underreported in York Region.

Table 2.10.1 Verotoxin-producing *E. coli*, York Region, 2000–2015:
Serogroups isolated

Agent *(100 isolates)*	**% of isolates**
E. coli O157	98%
Non-O157 VTEC	2%

VTEC and hemolytic uremic syndrome

Although the literature states that 15 per cent of young children with *E. coli* O157 infection can develop HUS,[4] only six per cent of York Region cases of VTEC under five years old (of which the vast majority are O157) reported the complication (Table 2.10.2); however the numbers are small. HUS was rarely seen among those over nine years of age.

Table 2.10.2 Verotoxin-producing *E. coli*, York Region, 2006–2015: Hemolytic uremic syndrome by age

Age Group	Number with HUS	% of total cases
0 to 4 years	2	6%
5 to 9 years	2	7%
10 to 19 years	1	3%
20+ years	1	2%

2.11 Yersiniosis

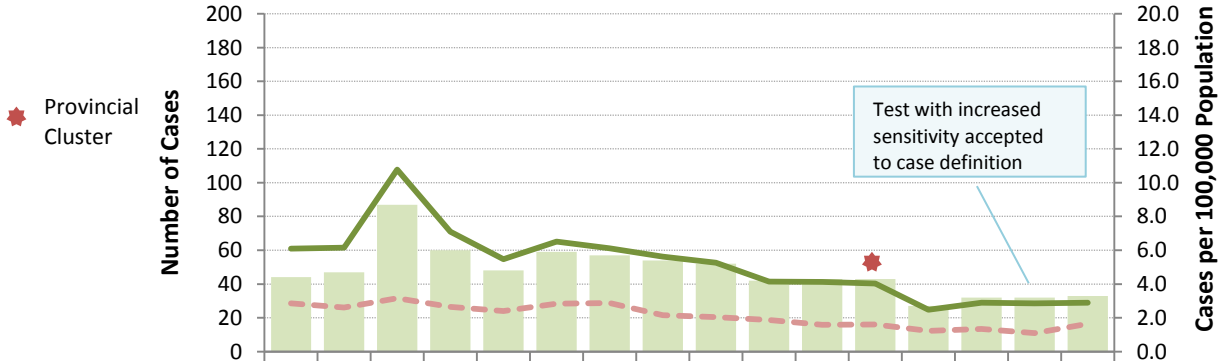
Yersiniosis is an intestinal infection caused by *Yersinia* bacteria.[4] In rare cases, the bacteria may spread to the bloodstream causing infection. The infection occurs most commonly in infants and children.

The reservoir for yersiniosis is animals.[45] The pig is the primary reservoir for *Yersinia enterocolitica* while birds, rodents and small mammals are the primary reservoirs for *Yersinia pseudotuberculosis.* Infection occurs through the consumption of contaminated food, particularly raw or undercooked pork products, drinking unpasteurized milk or contaminated water, or by person-to-person transmission. Transmission can also occur due to direct contact with feces of contaminated animals, particularly puppies and kittens.

Fecal shedding of the bacteria may continue as long as symptoms exist, typically for two to three weeks.[45] Untreated cases can shed bacteria for up to three months.

The incidence rate of yersiniosis was higher in York Region than in Ontario (Figure 2.11.1). The annual rates in both jurisdictions decreased over the time period examined; however the decrease was greater in York Region. There was a peak of cases in 2002.

Figure 2.11.1 Yersiniosis,York Region and Ontario, 2000–2015:
Cases and rates



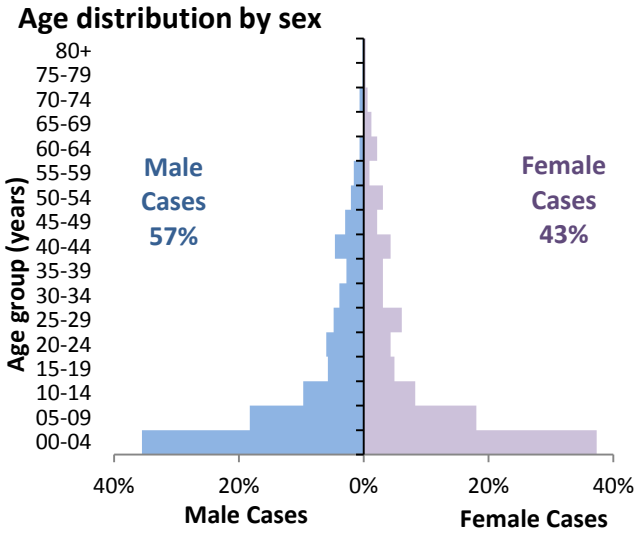
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	44	47	87	60	48	59	57	54	52	42	43	43	27	32	32	33
YR Incidence Rate	6.1	6.2	10.8	7.1	5.5	6.5	6.1	5.6	5.3	4.1	4.1	4.0	2.5	2.9	2.8	2.9
ON Incidence Rate	2.9	2.6	3.2	2.6	2.4	2.8	2.9	2.2	2.0	1.9	1.6	1.6	1.2	1.3	1.1	1.6

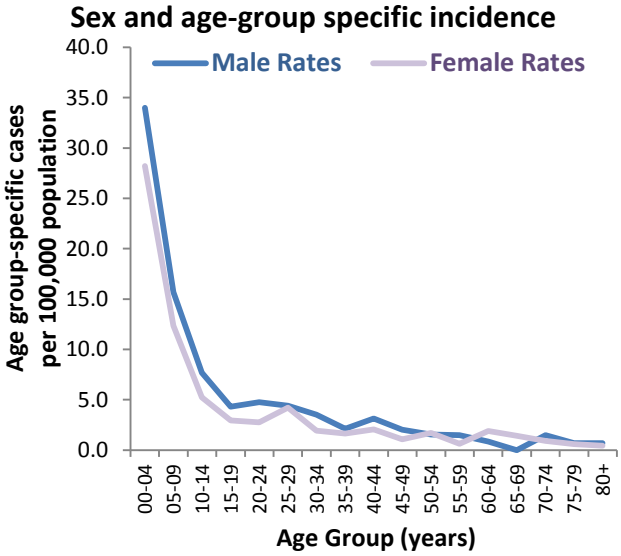
Cluster:

- ***2011***—A provincial cluster of Yersiniosis was identified. The groups considered at risk in the provincial cluster were cases under the age of three and cases who reported travel to Cuba. There were York Region cases at the time of this provincial cluster.

The highest age-specific incidence rates of yersiniosis were among the very young and rates decreased with increasing age (Figure 2.11.2). There were more male cases than female cases.

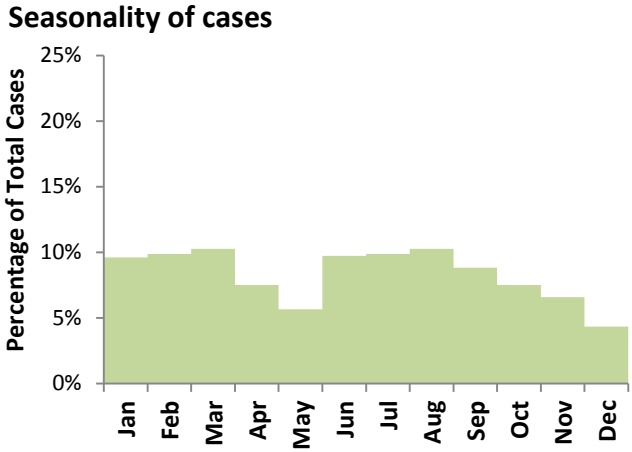
Figure 2.11.2 Yersiniosis, York Region, 2000–2015:





No clear seasonal trend was evident for yersiniosis in York Region (Figure 2.11.3); however, the distribution of cases was higher in January to March and again in June to August.

Figure 2.11.3 Yersiniosis, York Region, 2000–2015:



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3

Diseases transmitted by direct contact and respiratory routes

Table 3.0 Diseases transmitted by direct contact and respiratory Routes:

Annual cases, York Region, 2000–2015

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	NOTES
Cytomegalovirus (congenital)	0	0	1	0	0	1	0	2	0	0	1	1	0				No longer reportable since 2013
Encephalitis/ Meningitis	15	33	41	45	47	34	37	26	29	27	30	30	35	31	40	33	
Legionellosis	0	1	0	1	0	0	2	2	4	3	5	4	5	14	7	2	
Leprosy	0	0	0	1	1	1	0	0	2	0	0	1	0	1	0	1	
Severe Acute Respiratory Syndrome (SARS)	0	0	0	88	0	0	0	0	0	0	0	0	0	0	0	0	
Group A Streptococcal disease, invasive	20	17	28	20	11	20	15	15	16	25	24	37	24	34	27	34	
Group B Streptococcal disease, neonatal	2	2	7	1	2	5	3	3	5	2	2	5	5	3	3	5	
Tuberculosis (active)	37	40	48	39	64	45	70	70	53	61	62	53	53	49	41	49	

Respiratory infections may be caused by a variety of viruses or bacteria, typically causing symptoms such as coughing, sneezing, runny nose, sore throat and fever.[1] These infections are spread from person-to-person through droplet transmission (i.e., coughing or sneezing) or through contact with contaminated items. Persons most susceptible to acquiring respiratory infections include the very young and the elderly. Other infections are transmitted when there is direct physical contact from an infected person to a susceptible person. For example, infection may be transmitted through contact with infectious respiratory secretions and skin lesions.[2] Infection may also occur from a mother to a child through an infected birth canal or from infection in the uterus.[3]

Table 3.0 highlights York Region cases of the provincially reportable diseases that are transmitted through the respiratory or direct contact routes.

- Congenital cytomegalovirus infection, neonatal Group B Streptococcal disease and leprosy are uncommonly reported in York Region.

A number of infections transmitted by these routes are included in routine vaccination programs in Ontario and are described in *Chapter 5: Vaccine Preventable Diseases*. SARS is further discussed in *Chapter 8: The Impact of Global Disease Events on York Region*. This chapter focuses on invasive group A streptococcal disease, legionellosis and active tuberculosis.

Highlights

- Invasive group A streptococcal disease, legionellosis and active tuberculosis occur more frequently in the elderly.
- Legionellosis and invasive group A streptococcal disease have seasonal distributions.
- The incidence of active tuberculosis is decreasing.
- Encephalitis/meningitis conditions caused by communicable infectious agents often occur in clusters.
- Congenital cytomegalovirus infection, neonatal Group B Streptococcal disease and leprosy are uncommonly reported in York Region.
- There was an outbreak of SARS in 2003; York Region has not had any further cases of the disease.

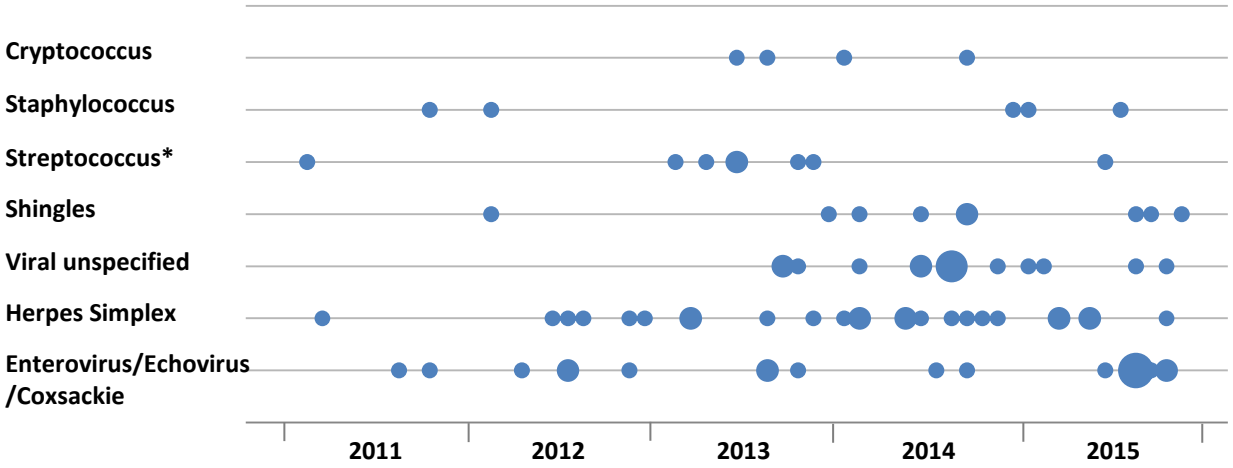
Encephalitis/meningitis syndrome and clusters in time

Encephalitis is an acute infection and inflammation of the brain that can be caused by a variety of communicable agents (viruses, bacteria, fungi and protozoa).[4] Meningitis is a serious and rare infection of the lining of the brain and the spinal cord, which may be caused by bacteria, viruses or fungi. Bacterial infection of the meninges is referred to as bacterial meningitis and viral infection of the meninges is referred to as viral meningitis. Viral meningitis is the most common type of meningitis and usually results in a mild infection.

In Ontario, these infections are reported within a group of conditions classified as encephalitis/meningitis.[5] If an organism which causes a reportable disease has a complication of encephalitis/meningitis, the case is only counted in the reportable disease category and not included in the encephalitis/meningitis category. There is a wide variety of non-reportable etiologic agents which may cause these infections; the most commonly reported are shown in Figure 3.0.1 below. Cases of encephalitis/meningitis tended to occur in clusters and may indicate that the etiologic agent was circulating in the community at increased levels. This may not be true of shingles which is a reactivation of latent varicella/herpes zoster virus that causes chickenpox (varicella) as the primary infection.[4]

Figure 3.0.1 Encephalitis/Meningitis syndrome, York Region, 2011–2015:

Monthly cases by selected non-reportable agents



**Does not include Group A Streptococcus, neonatal Group B Streptococcus or Streptococcus pneumoniae.*

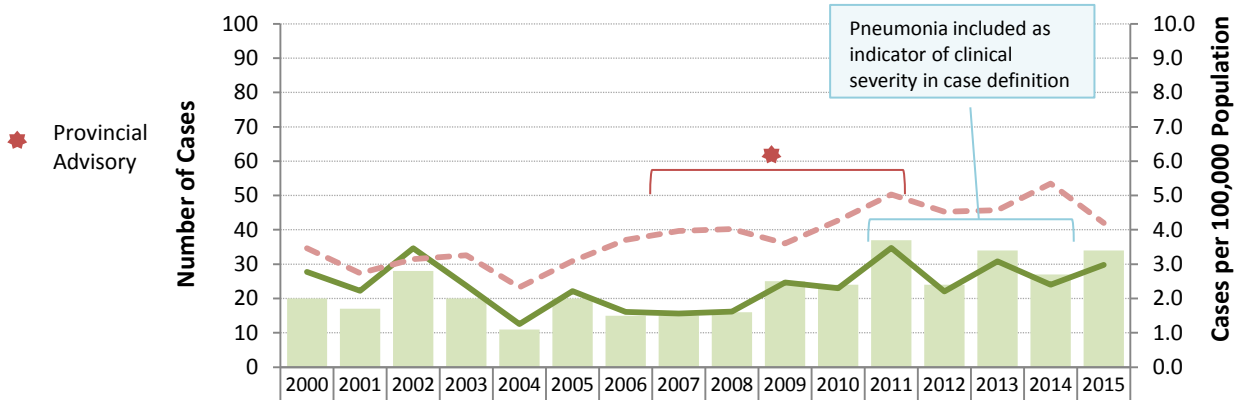
3.1 Group A streptococcal disease, invasive (iGAS)

Group A streptococcal disease describes an infection that is caused by the bacteria *Streptococcus pyogenes*, group A (also known as *Streptococcus* A), commonly found on the skin and in the throat.[4] A common non-reportable condition caused by this agent is strep throat. Severe and rare life-threatening invasive disease occurs when these bacteria infect parts of the body where bacteria are not usually found (e.g., blood, muscle, lungs). Individuals with skin breakdown, chronic underlying conditions, pregnant women, the very young and the elderly are at greater risk of invasive GAS. Clusters of infections have been known to occur in close contact groups, such as long-term care homes, childcare centres and homeless shelters.

Individuals can carry group A streptococcal (GAS) disease strains in their throat and/or skin without any symptoms.[6] This is thought to be the primary reservoir for the organism. The incubation period for iGAS is one to three days, with a period of communicability of 10 to 21 days. Transmission occurs through large respiratory droplets or direct contact with the respiratory secretions of an infected person.

The annual incidence rates of iGAS in York Region and Ontario varied from year to year but the overall trend was upward over the recent 10 year time period (Figure 3.1.1). The rate in York Region was lower than that of Ontario.

Figure 3.1.1 Group A streptococcal disease (invasive),York Region and Ontario, 2000–2015:
Cases and rates



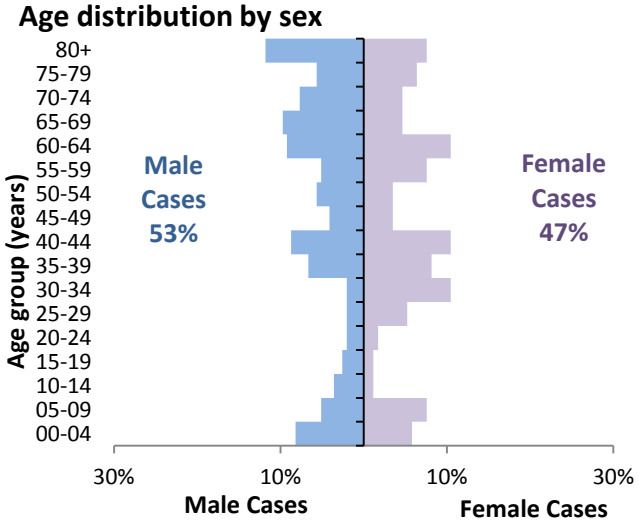
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	20	17	28	20	11	20	15	15	16	25	24	37	24	34	27	34
YR Incidence Rate	2.8	2.2	3.5	2.4	1.3	2.2	1.6	1.6	1.6	2.5	2.3	3.5	2.2	3.1	2.4	3.0
ON Incidence Rate	3.5	2.7	3.2	3.3	2.3	3.1	3.7	4.0	4.0	3.6	4.3	5.0	4.5	4.6	5.3	4.2

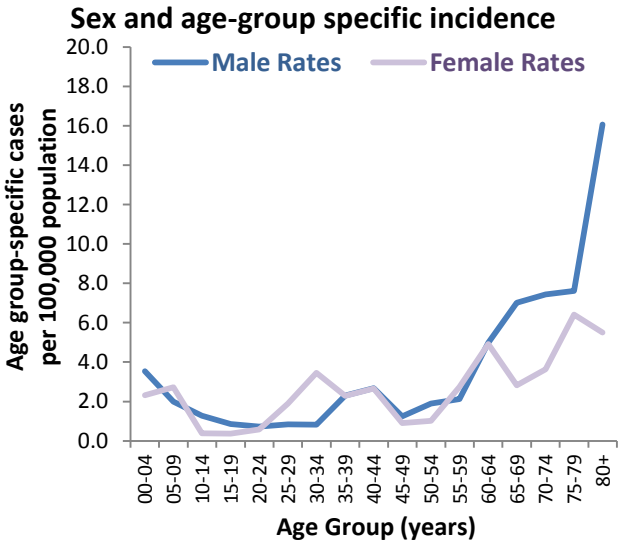
Advisories:

- ***2007-2011***—A large increase in the number of invasive group A streptococcal disease cases was reported in Thunder Bay, associated with an uncommon *emm* type (*emm59).* Alcohol and drug abuse, homelessness and being infected with hepatitis C were common identified risk factors for these cases. Geographic clusters were reported at the city centre, shelters and drug houses.[7]

The age-specific incidence of iGAS was highest in the very young and those aged 50 and over with a dramatically higher incidence among the elderly, especially among males (Figure 3.1.2).

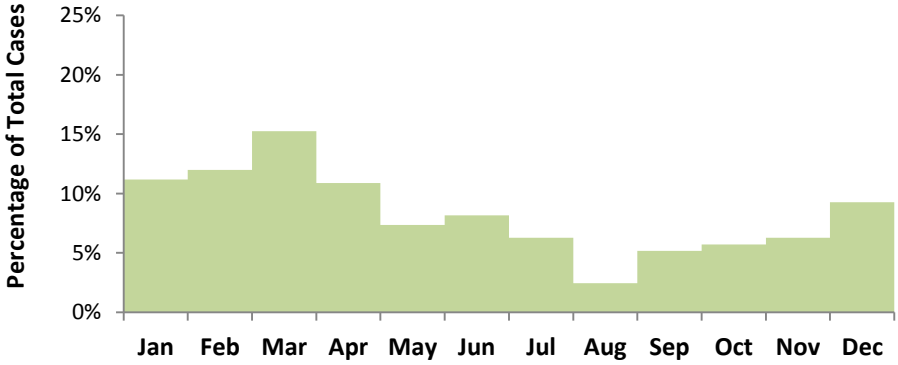
Figure 3.1.2 Group A streptococcal disease (invasive), York Region, 2000–2015:





iGAS in York Region had a distinct seasonal pattern with higher proportion of cases occurring in the winter and early spring (Figure 3.1.3).

Figure 3.1.3 Group A *streptococcus* disease (invasive), York Region, 2000–2015:



Laboratory testing for iGAS cases may include further differentiation of circulating strains by emm type.[8] In York Region, an emm type was available for 22 per cent of iGAS cases (Table 3.1.1). Among iGAS cases for which an emm type was specified, emm type 1, 12 and 3 were the three most commonly reported.

Table 3.1.1 Group A *streptococcus* disease (invasive), York Region, 2000–2015:

Emm types isolated

Emm Type *(79 isolates)*	**% of isolates**
Emm 1	33%
Emm 12	14%
Emm 3	11%
Emm 89	8%
Other emm types	34%

iGAS complications

iGAS causes many conditions. Some of the more serious complications of the disease include soft-tissue necrosis, meningitis, a toxic-shock like syndrome and death.[4] When these conditions are present, the case is classified as "clinically severe" and is a constituent of the case definition for invasive disease. In the five-year period between 2011 and 2015, streptococcal toxic shock syndrome (STSS) was a fairly frequent condition of the reported iGAS cases (Table 3.1.2). This differs from the literature which reports that only six to seven per cent of iGAS cases develop STSS;[4] however, York Region iGAS numbers are small.

Table 3.1.2 Group A *streptococcus* (invasive), York Region, 2011–2015: Complications

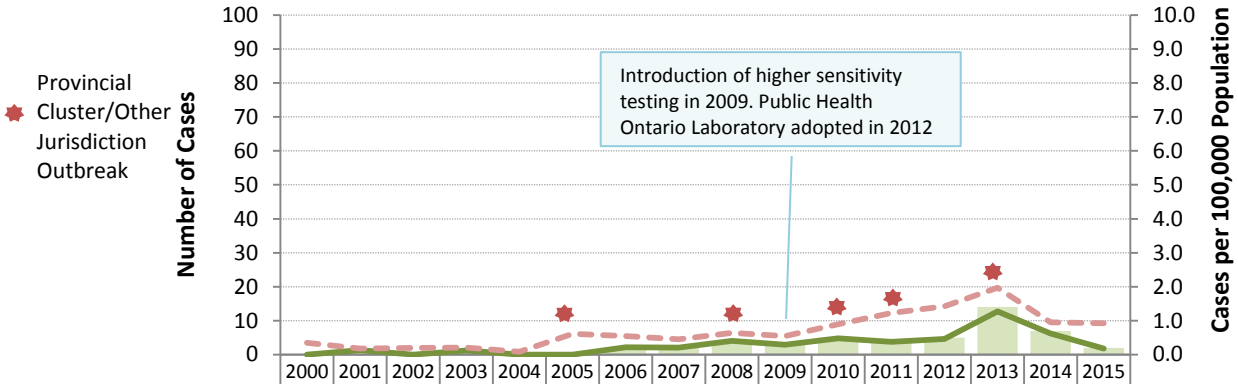
Condition	Number of cases	% of invasive cases
Death	25	16%
Soft tissue necrosis	16	10%
Meningitis	1	1%
Streptococcal toxic shock syndrome	26	17%
One or more of the above	58	37%
Shock unspecified	29	18%

3.2 Legionellosis

Legionellosis is a respiratory disease that occurs in two forms: "Legionnaires' disease" (a more severe illness) and "Pontiac fever" (a milder illness).[4] The disease is caused by *Legionella* bacteria, which thrive in warm stagnant water (e.g., cooling towers, fountains, sprinkler systems and hot tubs). Legionellosis occurs most often in people over 50 years of age and particularly among those who smoke heavily or have underlying medical conditions (e.g., diabetes, or kidney dysfunction) that lower their immune system resistance to infection.[9] Cases of legionellosis tend to occur more frequently in urban settings.[10] Person-to-person transmission of legionellosis has not been documented.[4]

Before 2006, legionellosis was rarely reported in York Region or Ontario (Figure 3.2.1). Starting in 2009, a more sensitive laboratory test for legionellosis was introduced and more cases may have been detected. Between 2006 and 2015, York Region had lower annual incidence rates than Ontario. Both jurisdictions had a peak incidence in 2013 and, to a lesser extent, 2014.

Figure 3.2.1 Legionellosis, York Region and Ontario, 2000–2015:
Cases and rates



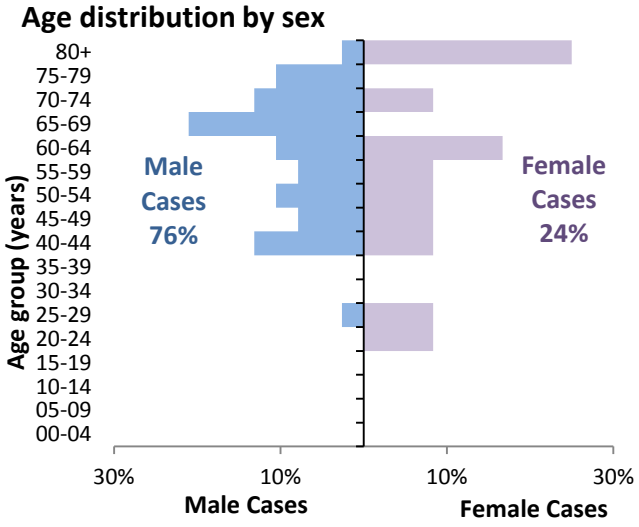
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	0	1	0	1	0	0	2	2	4	3	5	4	5	14	7	2
YR Incidence Rate	0.0	0.1	0.0	0.1	0.0	0.0	0.2	0.2	0.4	0.3	0.5	0.4	0.5	1.3	0.6	0.2
ON Incidence Rate	0.4	0.2	0.2	0.2	0.1	0.6	0.5	0.5	0.6	0.5	0.9	1.2	1.4	2.0	1.0	0.9

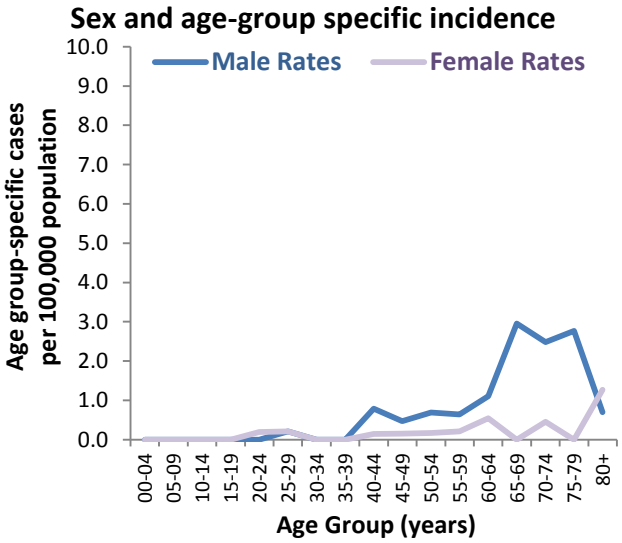
Outbreaks and Clusters:

- ***2005***—An outbreak was reported in Toronto associated with a long-term care home.[11] A total of 127 cases were identified, including 20 deaths. No York Region cases were linked to the outbreak.[12]
- ***2008, 2010, 2011***—Clusters were identified in the Greater Toronto Area. No common sources were found. There were two York Region cases within the time period of the 2011 provincial cluster (August 1 to November 9).[13]
- ***2013***—A provincial increase was observed with clusters identified in the Golden Horseshoe area. A high number of cases were reported in Toronto, Peel Region and Niagara Region. York Region had 12 cases within the time period of the provincial cluster (June 1 to October 22).[10]

More than three quarters of legionellosis cases were male (Figure 3.2.2). Higher rates among males are expected for the disease.[4] Age-specific incidence rates were higher among male seniors 65 to 79 years and among females 80 years and older.

Figure 3.2.2 Legionellosis, York Region, 2000–2015:

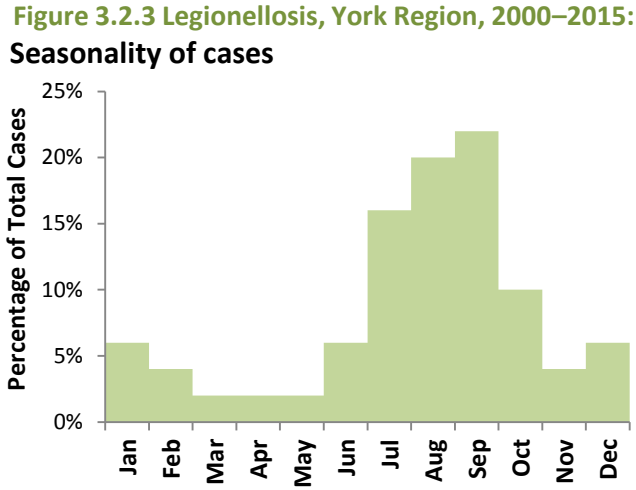




As expected, legionellosis was highly seasonal, with a peak proportion of cases in September (Figure 3.2.3).

Of the 32 legionellosis cases reported in the five year period between 2011 and 2015, 69 per cent (22 cases) had one or more exposure locations reported. Of these 22 cases, 32 per cent reported travel outside of Canada during their likely exposure period.

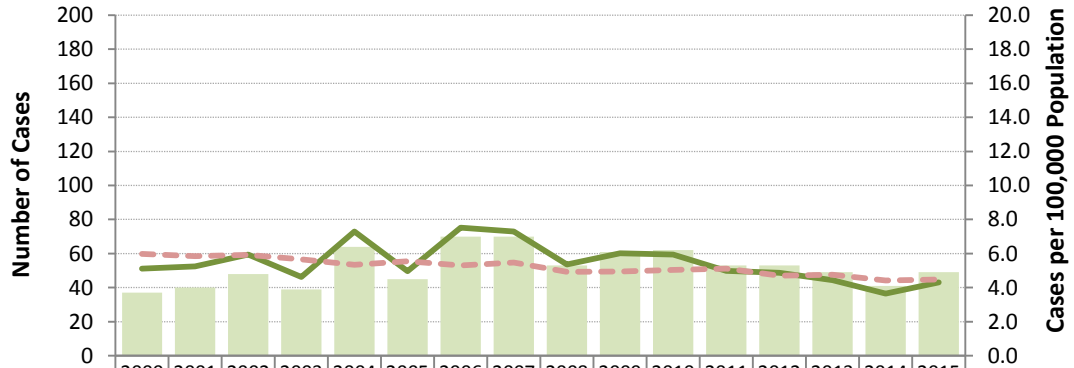
Figure 3.2.3 Legionellosis, York Region, 2000–2015:



3.3 Tuberculosis, active

Tuberculosis (TB) is a bacterial infection caused by *Mycobacterium tuberculosis.*[14] The TB bacteria usually affects the lungs (pulmonary TB), but can also affect other parts of the body (extra-pulmonary TB). Not everyone infected with TB will become ill. As a result, two TB related conditions exist: latent TB infection and active TB disease. TB disease is almost exclusively spread by the airborne route when a person with pulmonary TB sneezes, coughs or talks. Extra-pulmonary TB is not considered infectious in most cases. Ontario continues to have the most TB cases of any province.[15] With the exception of 2004 and 2006 to 2007, the annual incidence rates of tuberculosis in York Region were very similar to Ontario's (Figure 3.3.1). The rates in both jurisdictions declined over the time period.

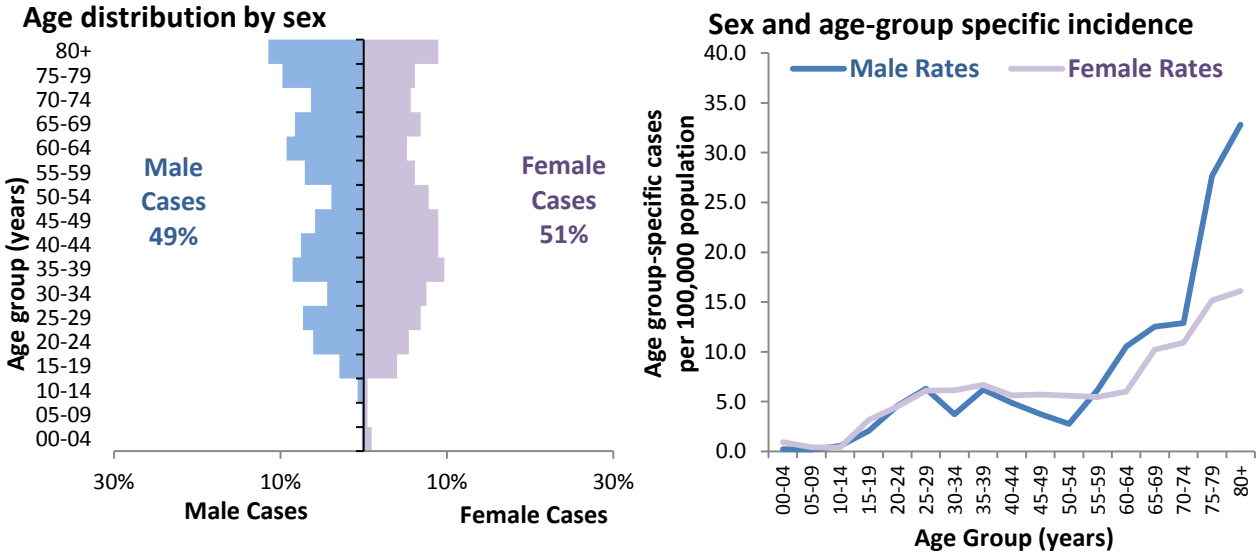
Figure 3.3.1 Tuberculosis,York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	37	40	48	39	64	45	70	70	53	61	62	53	53	49	41	49
YR Incidence Rate	5.1	5.2	5.9	4.6	7.3	5.0	7.5	7.3	5.4	6.0	5.9	5.0	4.9	4.4	3.7	4.3
ON Incidence Rate	6.0	5.8	5.9	5.7	5.3	5.5	5.3	5.5	4.9	5.0	5.0	5.1	4.7	4.8	4.4	4.5

Tuberculosis is very rare among York Region children and although cases occurred across adulthood, rates were highest among the elderly. There were similar numbers of male and female cases; however, the age-specific incidence rates among males aged 75 years and over were much higher than among females.

Figure 3.3.2 Tuberculosis (active), York Region, 2000–2015:



In the 10-year period between 2006 and 2015, 63 per cent of York Region active tuberculosis cases had pulmonary involvement (i.e., infectious tuberculosis). This corresponds to a median of 34 cases per year. Although the majority of York Region's active TB cases were pulmonary, a substantial proportion were extra-pulmonary only (Table 3.1.1).

Table 3.3.1 Tuberculosis (active), York Region, 2006–2015:

Body site

Site	% of cases
Extra-pulmonary only*	37%
Pulmonary and extra-pulmonary	6%
Pulmonary only†	57%

*Includes pleural TB with no pulmonary involvement

†Includes infectious upper respiratory TB

From 2006 to 2015, seven active TB cases were infected with HIV prior to or concurrent with their TB diagnosis; four of these cases were diagnosed with active TB in 2014.

Drug resistant tuberculosis

Drug resistant TB continues to be of great concern as it has the potential to hinder TB prevention and control efforts.[16] There are two forms of drug resistance that may develop; primary and acquired. Primary resistance occurs when an individual has been infected with a resistant strain of tuberculosis. Acquired drug resistance occurs during treatment if the treatment regimen does not include enough active medication or if there are problems with the length or consistency of treatment.

Table 3.3.2 Tuberculosis (active), York Region, 2011–2015: Resistance to medications

Type of Resistance	% of 212 cases tested
MDR-TB *(resistant to at least isoniazid and rifampicin)*	0.9%
Isoniazid without rifampicin resistance *(+/- other drug resistance)*	9.4%
Other resistance patterns *(one or more drugs other than isoniazid)*	1.4%
Total *(resistant to one or more drugs)*	11.8%

Between 2006 and 2015, a total of 51 cases were resistant to tuberculosis medications, including five cases resistant to isoniazid and rifampicin (multidrug resistant cases or MDR-TB[17]). In the five-year period from 2011 to 2015, one in 10 cases were resistant to isoniazid for York Region (Table 3.3.2). In 2003, York Region had one extensively drug resistant[17] case (XDR-TB) which met the definition of resistance to isoniazid, rifampicin, any fluoroquinolone and any of the three second-line injectable drugs (amikacin, capreomycin and kanamycin).

Canadian and foreign-born cases of tuberculosis

In the five-year period from 2006 to 2010, six per cent of the active TB cases were born in Canada. This decreased slightly to five per cent in the following five years from 2011 to 2015. Of these 12 Canadian-born TB cases, half reported travel to an endemic area and a further two cases reported both close contact to a case and travel to an endemic area. One case in the five-year period reported only close contact with a non-household source case. Exposures were unknown for three cases. During the entire 10-year period (2006 to 2015) there was no active TB among indigenous Canadians in York Region. China, the Philippines and India were the most frequent birth countries reported for active TB cases (Table 3.3.3).

Table 3.3.3 Tuberculosis (active), York Region, 2006–2015: Birth country

Country	% of 297 cases 2006-2010	% of 233 cases 2011-2015
China/Hong Kong	30%	33%
Philippines	12%	15%
India	15%	12%
Vietnam	6%	7%
Sri Lanka	6%	7%
Pakistan	6%	4%
South Korea	3%	3%
Other Countries	21%	20%

Excludes Canadian-born cases

[1] Ministry of Health and Long-Term Care, Ontario Public Health Standards, Infectious Diseases Protocol; Appendix A: Disease Specific Chapters – Respiratory Infection Outbreaks in Institutions. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/respiratory_outbreaks_chapter.pdf

[2] Ministry of Health and Long-Term Care, Ontario Public Health Standards, Infectious Diseases Protocol; Appendix A: Disease Specific Chapters – Group A Streptococcal disease, invasive (iGAS). Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/gas_chapter.pdf

[3] Ministry of Health and Long-Term Care, Ontario Public Health Standards, Infectious Diseases Protocol; Appendix A: Disease Specific Chapters – Group B Streptococcal disease, neonatal. Available online from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/group_b_strep_chapter.pdf

[4] Heymann DL. Control of Communicable Diseases Manual, 20th Edition. Washington D.C.: American Public Health Association Press; 2014.

[5] Ministry of Health and Long-Term Care, Ontario Public Health Standards, Infectious Diseases Protocol; Appendix A: Disease Specific Chapters – Encephalitis. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/encephalitis_chapter.pdf

[6] Ontario Agency for Health Protection and Promotion (Public Health Ontario). January 2013 Monthly Infectious Diseases Surveillance Report [Government report online]. Toronto: Ontario Agency for Health Protection and Promotion (Public Health Ontario); 2013. Available from: http://www.publichealthontario.ca/en/DataAndAnalytics/Documents/2013_January_PHO_Monthly_Report.pdf

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[9] Ministry of Health and Long-Term Care, Ontario Public Health Standards, Infectious Diseases Protocol; Appendix A: Disease Specific Chapters – Legionellosis. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/legionellosis_chapter.pdf

[10] Ontario Agency for Health Protection and Promotion (Public Health Ontario). Epidemiology of legionellosis in Ontario, 2013. Toronto: Ontario Agency for Health Protection and Promotion (Public Health Ontario); 2014. Available from: https://www.publichealthontario.ca/en/eRepository/Epidemiology_Legionellosis_Ontario_Report_2013.pdf

[11] Ontario Agency for Health Protection and Promotion (Public Health Ontario). May 2014 Monthly Infectious Diseases Surveillance Report [Government report online]. Toronto: Ontario Agency for Health Protection and Promotion (Public Health Ontario); 2014. Available from: https://www.publichealthontario.ca/en/DataAndAnalytics/Documents/PHO_Monthly_Infectious_Diseases_Surveillance_Report_-_May_2014.pdf

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[13] Ontario Agency for Health Protection and Promotion (Public Health Ontario). December 2011 Monthly Infectious Diseases Surveillance Report [Government report online]. Toronto: Ontario Agency for Health Protection and Promotion (Public Health Ontario); 2011. Available from: https://www.publichealthontario.ca/en/DataAndAnalytics/Documents/2011_November_PHO_Monthly_Report_final_Dec%2023.pdf

[14] Centers for Disease Control and Prevention [Internet]. Atlanta, GA. Tuberculosis (TB). 2016 Mar [Last accessed: 2017 May 26]. Available from: https://www.cdc.gov/tb/topic/basics/default.htm

[15] Ontario Lung Association. Tuberculosis Information for Health Care Providers, Fourth Edition. [Report Online]. Toronto, ON: The Lung Association; 2009.. Available from: https://www.on.lung.ca/document.doc?id=475

[16] World Health Organization. Drug-resistant TB: Totally drug-resistant TB FAQ. Geneva: World Health Organization, N.D. [last accessed 2017 Mar 3]. Available from: http://www.who.int/tb/areas-of-work/drug-resistant-tb/totally-drug-resistant-tb-faq/en/

[17] Public Health Agency of Canada. Canadian Tuberculosis Standards, 7th edition. Ottawa: Public Health Agency of Canada; 2013 [last accessed 2016 Jan 27]. Available from: http://strauss.ca/OEMAC/wp-content/uploads/2013/11/Canadian_TB_Standards_7th-edition_English.pdf

4

Sexually transmitted and blood-borne infections

Table 4.0 Sexually transmitted and blood-borne infections:

Annual cases, York Region, 2000–2015

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	NOTES
Chancroid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No cases reported since 1991[†]
Chlamydial infections	560	590	752	801	866	973	922	1131	1303	1482	1734	1821	1885	1871	1860	2060	
Gonorrhea	61	80	73	83	88	93	93	102	119	106	132	159	202	209	297	259	
Hepatitis B (acute)	10	6	5	10	15	8	4	5	2	7	9	5	9	4	5	3	
Hepatitis B (chronic)	546	535	588	575	583	558	461	430	390	378	410	406	416	436	413	374	
Hepatitis C	238	280	312	274	261	258	190	229	236	227	197	168	183	180	163	160	
Hepatitis D	1	1	1	0	0	1	0	1	1	1	0	1	1				No longer reportable since 2013
Herpes (neonatal)	0	0	1	0	0	0	1	0	1	0	1	1	0				No longer reportable since 2013
HIV/AIDS	14	22	24	10	21	13	19	16	15	13	25	34	18	17	21	20	
Ophthalmia neonatorum	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
Syphilis (infectious)	2	3	4	10	14	7	16	13	12	15	25	29	25	27	19	36	
*Syphilis (non-infectious)**	12	13	21	10	12	59	111	83	62	60	47	37	42	43	44	32	

*Includes syphilis infections that could not be staged. [†]Electronic reporting started in 1991.

Sexually transmitted infections (STIs) and blood-borne infections (BBIs) are transmitted through unprotected sexual contact and/or direct contact with infected blood or bodily fluids. This generally occurs through contact with mucosal surfaces or through non-intact skin. Reportable STIs can have long-term health outcomes, especially if untreated.[1]

Many people infected with STIs and BBIs are asymptomatic and their infections may go unreported.[1] Therefore, it is difficult to quantify the burden of illness attributed to these infections.

Table 4.0 highlights the York Region cases of reportable sexually transmitted or blood-borne diseases in Ontario.

- Chancroid, an STI caused by the bacterium *Haemophilus ducreyi*,[2] was not seen in York Region from 2000 to 2015 and neonatal infections with the herpes virus were rare.
- Ophthalmia neonatorum, an ocular disease of infants born to gonorrhea or chlamydia infected mothers,[2] was also rare in York Region.

This report focuses on the more commonly reported STIs and BBIs in York Region.

Sexually transmitted infections highlights

- The incidence of sexually transmitted infections (STIs) increased in York Region.
- For each STI disease the York Region incidence rates were lower than Ontario's.
- The proportion of STI cases who reported higher risk sexual behaviours increased over time.
- Most STI cases were between 15 and 59 years of age, with highest rates between 15 and 29 years. STIs case age distribution for females tended to skew younger than for males.
- Chlamydia incidence was higher among females than males but the difference decreased over time.
- The proportion of chlamydia cases that were reinfections increased.
- A rapid increase in gonorrhea from 2012 was primarily among males.
- Infectious syphilis and HIV infection were more often reported in males and a large proportion of these cases reported sex with males.
- About 13 per cent of HIV cases had AIDS at the time of virus detection.
- Although rare, sexually transmitted infections were reported among infants.

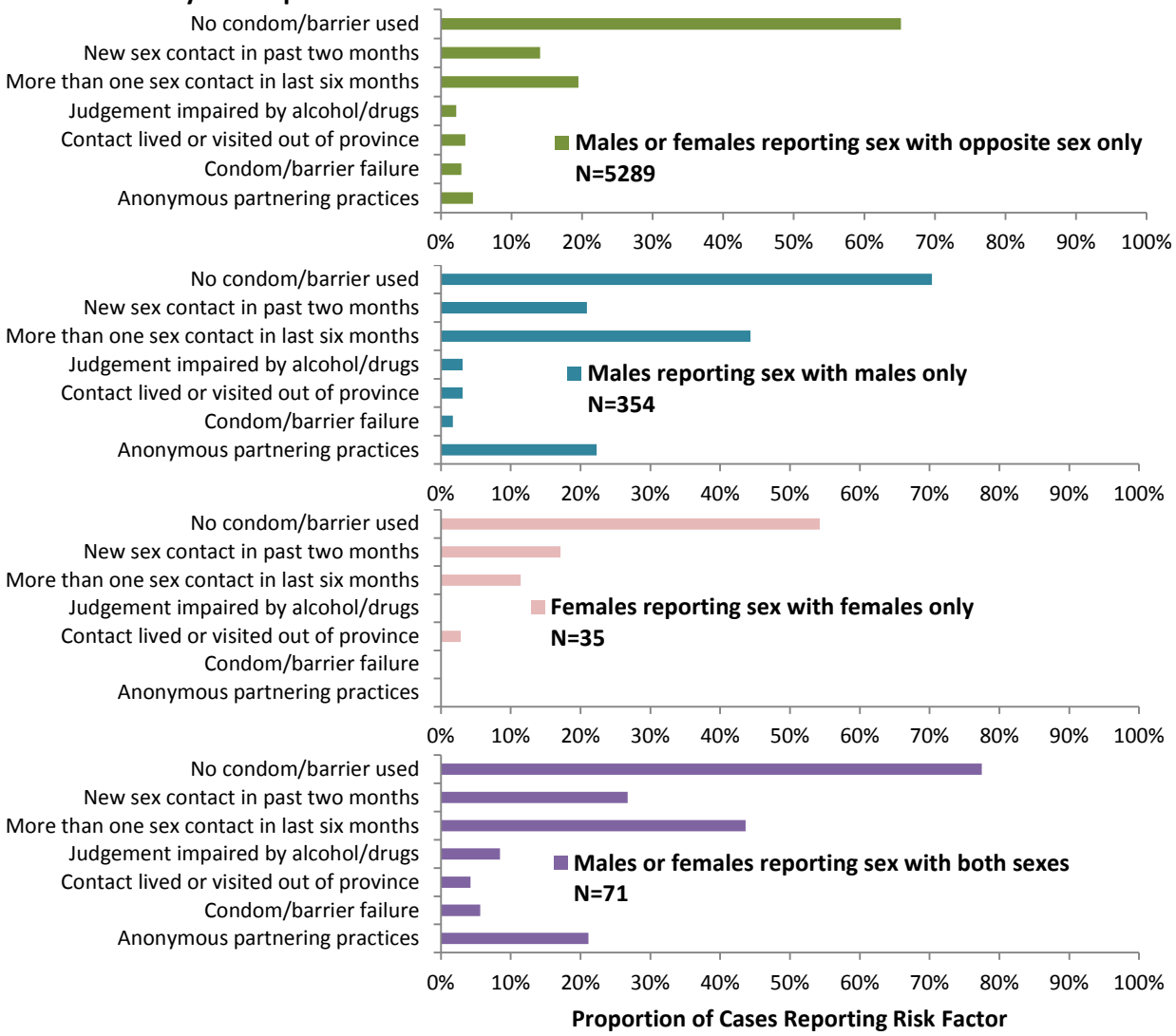
Blood-borne infections highlights

- Incidence of hepatitis B and C decreased in York Region.
- There were more male cases of hepatitis B and C than female cases.
- Although rare, blood-borne infections were reported among infants.

Risk factors for sexually transmitted infections

Most STIs are preventable.[1] Sexually active individuals are at risk of contracting an STI, but there are factors that influence the risk. The correct and successful use of barriers, such as condoms, greatly decreases the risk of acquiring an STI from a sexual act.[3] Individuals with new or multiple sex partners are also at higher risk, as are those who engage in anonymous sexual partnering (e.g., at parties or other social venues, or through social media) or associating alcohol or drugs with sex. Subgroups of the populations at risk for STIs include sex workers and their clients, the homeless, correctional facility inmates, victims of sexual assault and those exchanging sex for survival means (e.g., food or money). Type of sexual practice (e.g., male cases that report sex with males) may influence risk behaviours reported.[4]

Figure 4.0.1 STI infections, age 15+, York Region, 2011–2015:
Risk factors by sexual practice

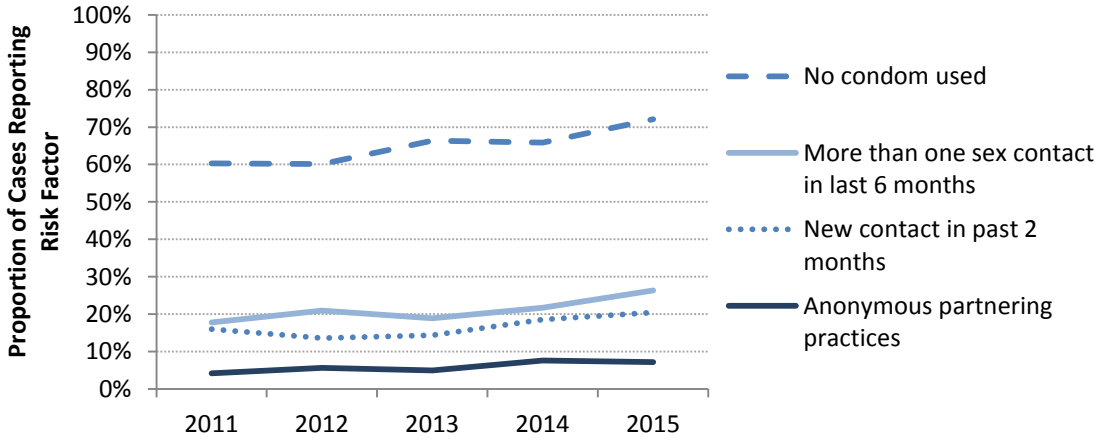


STI infections included: *Chlamydia trachomatis*, gonorrhea, infectious syphilis, and HIV
Other selected risk factors reported by <1% of clients: sex for drugs/food/shelter, engaging in sex trade, sex with sex trade worker, sexual assault, correctional facility inmate, homeless

Figure 4.0.1 describes the proportion of cases of *Chlamydia trachomatis*, gonorrhea, infectious syphilis or HIV between 2011 and 2015 who reported various risk factors, grouped by their reported sexual practice. Information must be offered by the client during a public health investigation or to the physician, who in turn provides public health with the information. Thus, risk factor information is likely underreported and should be interpreted with caution. The risk factor provided is mapped to the best fit category in the reporting system. The most commonly reported risk factor across all sexual practice groups was no condom or barrier use; however this was most often reported among individuals who reported having sex with both sexes. Other commonly reported risk behaviours were multiple sex contacts, new sex contacts and anonymous sexual partnering practices. These were substantially more often reported among males reporting sex with males and those reporting sex with both sexes than those only reporting sex with the opposite sex.

The proportion of STI cases reporting the risk behaviours of no condom use, multiple sex contacts, new sex contacts and anonymous sexual partnering practices increased from 2011 to 2015 (Figure 4.0.2).

Figure 4.0.2 STI infections, age 15+, York Region, 2011–2015:
Risk factors over time



STI infections included: *Chlamydia trachomatis*, gonorrhea, infectious syphilis and HIV
Proportion is out of cases who reported at least one risk factor

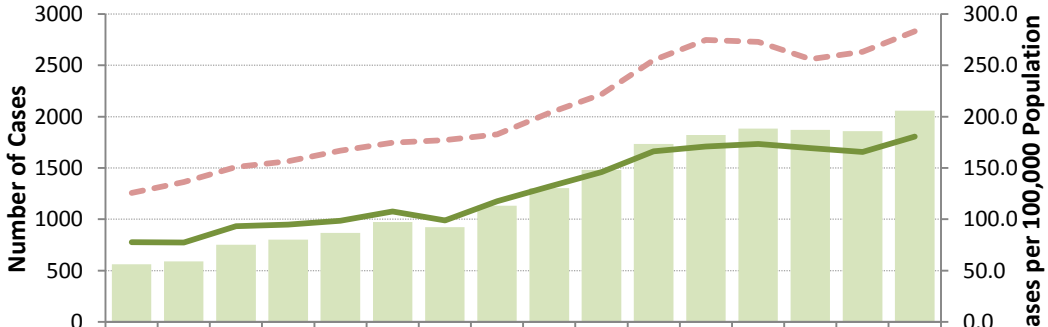
4.1 *Chlamydia trachomatis* infection (chlamydia)

Chlamydia is one of the most common STIs and is caused by the *Chlamydia trachomatis* bacteria.[2] It can affect the cervix, urethra and other reproductive organs as well as the throat and rectum. Most infected individuals do not have symptoms, but can still transmit the infection.[5] If the infected person is not treated, it can lead to serious health complications such as infertility and pelvic inflammatory disease.[2] Pregnant women can pass on their infection to their baby during delivery, which can cause an eye infection or pneumonia. Some invasive *Chlamydia trachomatis* genotypes can cause lymphogranuloma venereum (LGV),[4] a distinct form of chlamydial infection.

The incidence rate of chlamydia is high and more than doubled between 2000 and 2015 in York Region (Figure 4.1.1). A similar increase was seen in Ontario. The large increase in chlamydia incidence may be partially due to increased sensitivity of detection tests, increased screening practices and less invasive tests[5] (that may be more acceptable to clients) as well as an increase in cases in the community. The annual incidence rates in York Region were consistently lower than those for Ontario as a whole.

Figure 4.1.1 Chlamydial infections, York Region and Ontario, 2000–2015:

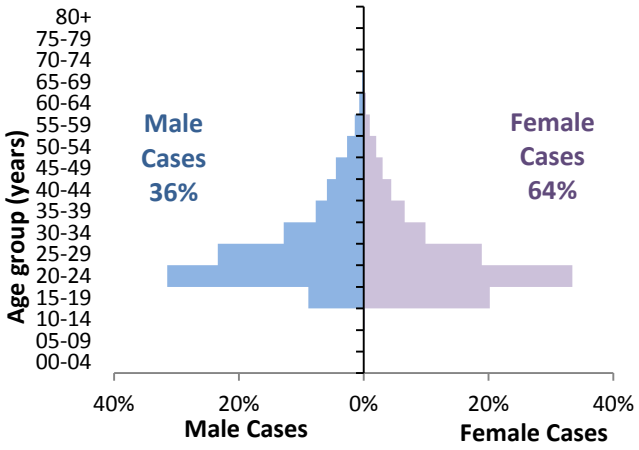
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	560	590	752	801	866	973	922	1131	1303	1482	1734	1821	1885	1871	1860	2060
YR Incidence Rate	77.6	77.3	93.1	94.9	98.7	107.5	98.9	117.7	131.8	146.0	166.2	170.9	173.6	169.4	165.6	180.7
ON Incidence Rate	125.7	136.4	150.8	156.5	166.8	174.7	177.2	182.6	203.6	221.8	255.2	274.7	272.8	256.1	263.4	283.3

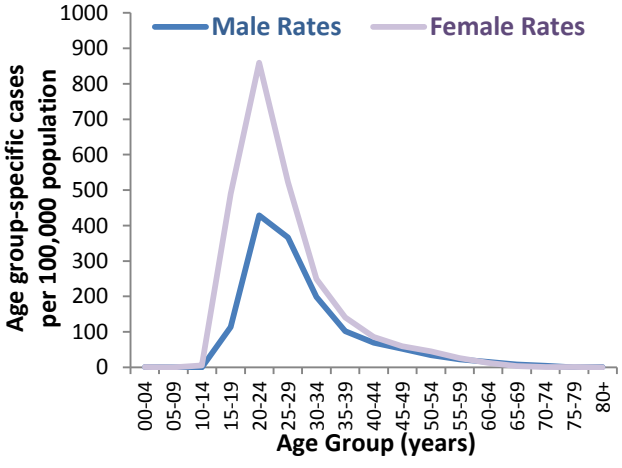
Figure 4.1.2 Chlamydial infections, York Region, 2000–2015:

Age distribution by sex



Excludes 4 cases with other or unknown sex

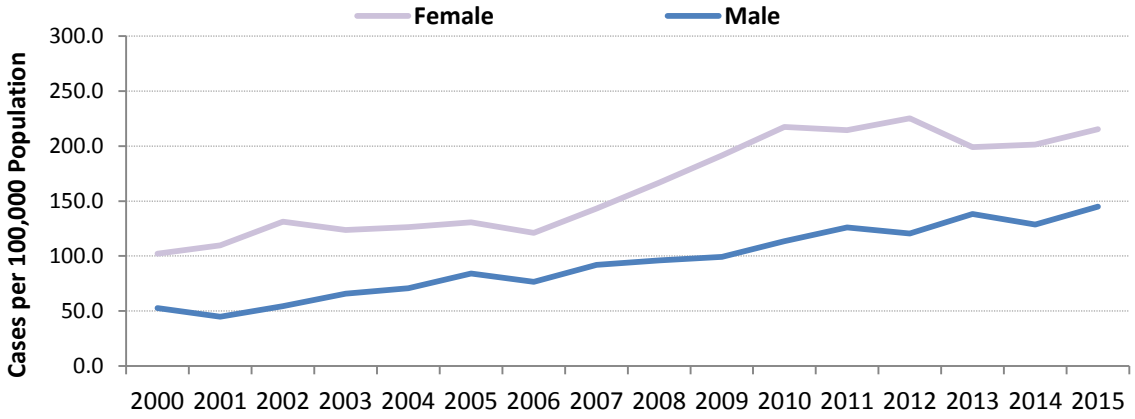
Sex and age-group specific incidence



The vast majority of cases were among older adolescents and adults under 60 years of age. Although the age distribution of female cases tended to skew younger than that of male cases (Figure 4.1.2), the greatest proportion of cases was in the 20 to 24 year old age group for both sexes. There were six cases of chlamydia acquired at birth.

The incidence of reported chlamydia among females was 1.7 times higher than that among males over the period 2000 to 2015 (Figure 4.1.3). The female to male disparity in incidence may be partially a result of a higher degree of care-seeking behaviour among females.[6] Although incidence rates increased among both males and females, this increase was greater among males, which may be partially due the newer tests being differentially more acceptable to male clients (i.e., urine test replacing urethral swab).[5]

Figure 4.1.3 Chlamydia, York Region, 2000–2015:
Incidence for males and females over time



Excludes 4 cases with other or unknown sex

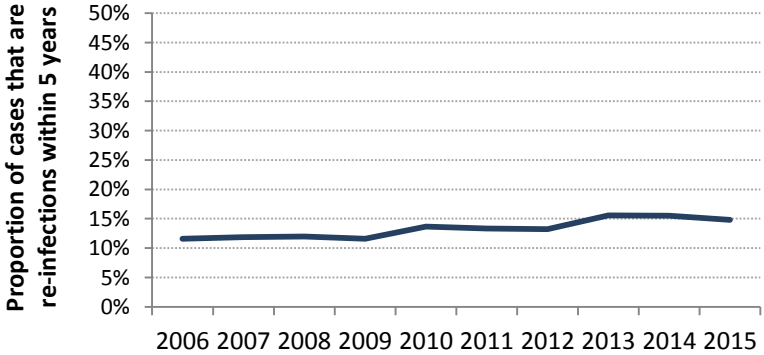
Two per cent of chlamydia cases were co-infected with gonorrhea between 2006 and 2015.

There were three cases of LGV between 2006 and 2015, one each in 2007, 2008 and 2011.

Chlamydia reinfections

The proportion of cases that had a chlamydia infection in the previous five years increased slightly from 2006 to 2015 (Figure 4.1.4).

Figure 4.1.4 Chlamydia, York Region, 2006–2015:
Repeat infections over time



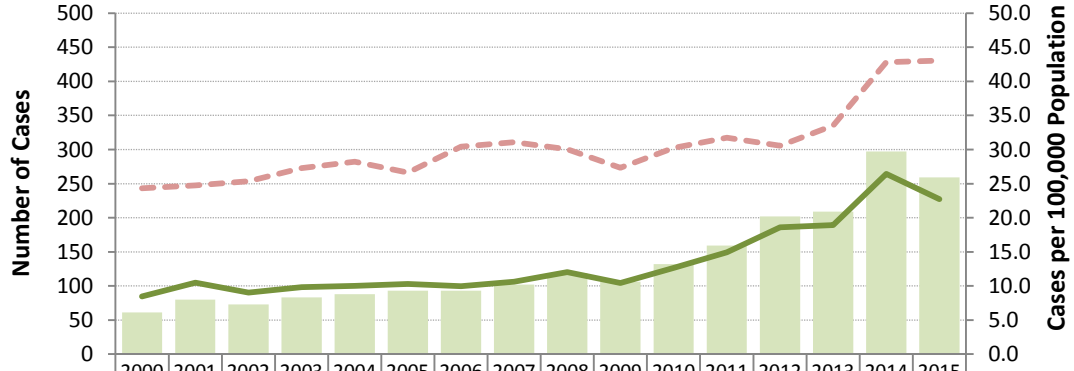
4.2 Gonorrhea

Gonorrhea is a sexually transmitted infection caused by the *Neisseria gonorrhoeae* bacteria.[2] It can affect the cervix, urethra and other reproductive organs. The bacteria can also infect the throat and rectum. Symptoms can differ between men and women and many infected people do not have symptoms. Even without symptoms, gonorrhea can still be transmitted. If the infected person is not treated, it can lead to serious health complications such as infertility and pelvic inflammatory disease.[2]

In recent years, drug-resistant gonorrhea has also been on the rise provincially, nationally and globally, which prompted the World Health Organization to release an action plan to control the spread of gonorrhea and to minimize the impact of antimicrobial resistance.[7,8,9] In April 2013, Public Health Ontario released a guidance document, *Guidelines for Testing and Treatment of Gonorrhea in Ontario*,[10] outlining recommendations on appropriate testing and treatment of gonorrhea in order to address the increasing concern of antibiotic resistance. Prompt and effective treatment of all cases of gonorrhea is very important for preventing its transmission to contacts and controlling the incidence of the infection.

In Ontario, gonorrhea's annual incidence rates increased between 2000 and 2015, with a more rapid increase in the more recent years (Figure 4.2.1). York Region's gonorrhea incidence rates were substantially lower than Ontario's. Like Ontario, the incidence rate in York Region increased between 2009 and 2015 (on average 20 per cent per year). In addition, there was a peak of cases in 2014.

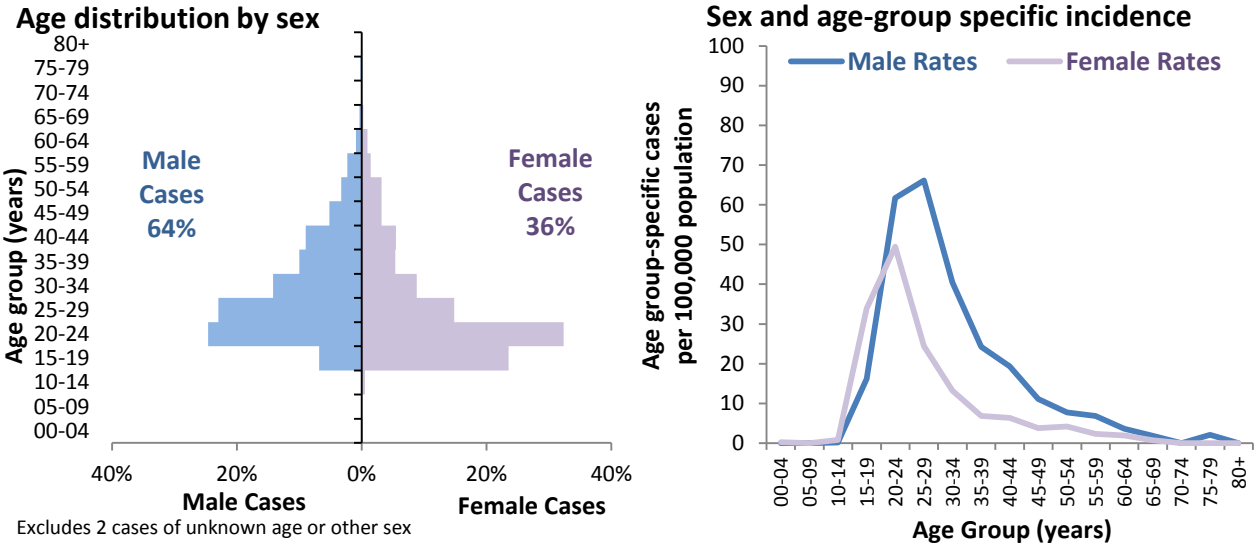
Figure 4.2.1 Gonorrhea, York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	61	80	73	83	88	93	93	102	119	106	132	159	202	209	297	259
YR Incidence Rate	8.4	10.5	9.0	9.8	10.0	10.3	10.0	10.6	12.0	10.4	12.6	14.9	18.6	18.9	26.4	22.7
ON Incidence Rate	24.3	24.7	25.4	27.3	28.2	26.6	30.4	31.1	30.0	27.3	30.2	31.7	30.6	33.5	42.8	43.0

The majority of gonorrhea cases were male (Figure 4.2.2). Although the largest proportion of cases fall in the 20 to 24 year old age category for both males and females, the age distribution for female cases skews younger, with a much higher proportion of older adolescent cases and a much lower proportion falling in the 25 to 44 year old age groups. The age-specific incidence rate for females 15 to 19 years old is higher than for males in that age group, but for all other age groups, incidence among males is higher.

Figure 4.2.2 Gonorrhea, York Region, 2000–2015:

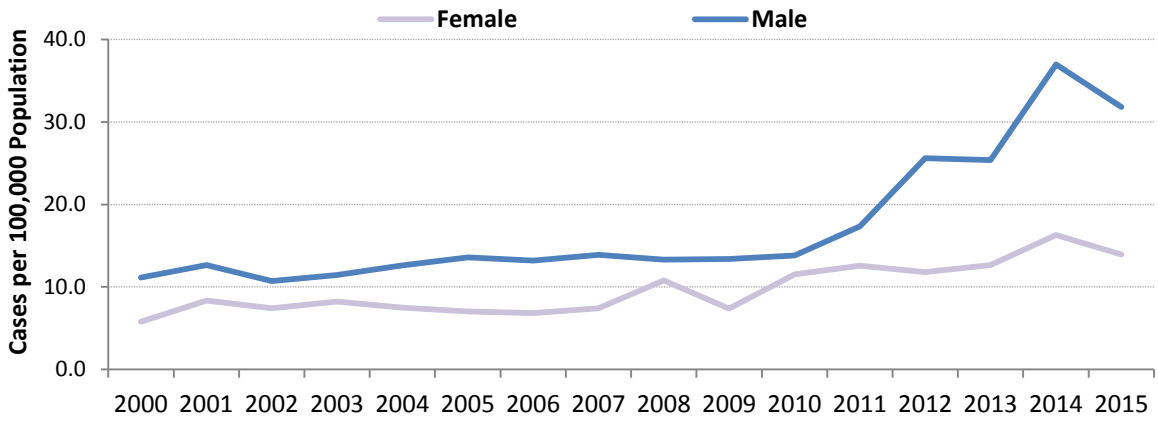


Excludes 2 cases of unknown age or other sex

The annual incidence rates of gonorrhea were higher among males than among females over the entire time period (Figure 4.2.3); however, starting in 2012, the incidence among males increased dramatically whereas the incidence rate among females rose more modestly.

Figure 4.2.3 Gonorrhea, York Region, 2000–2015:

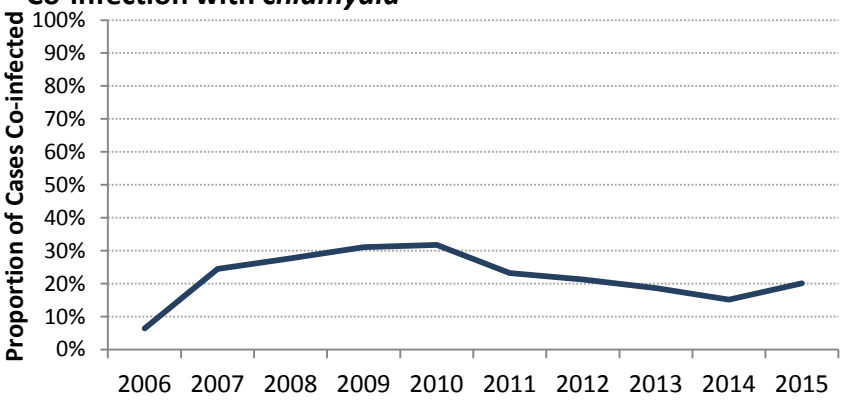
Incidence for males and females over time



Excludes 1 case with other or unknown sex

The proportion of gonorrhea cases that were co-infected with chlamydia was variable between 2006 and 2015 (Figure 4.2.4).The per cent of co-infected cases decreased slightly in recent years.

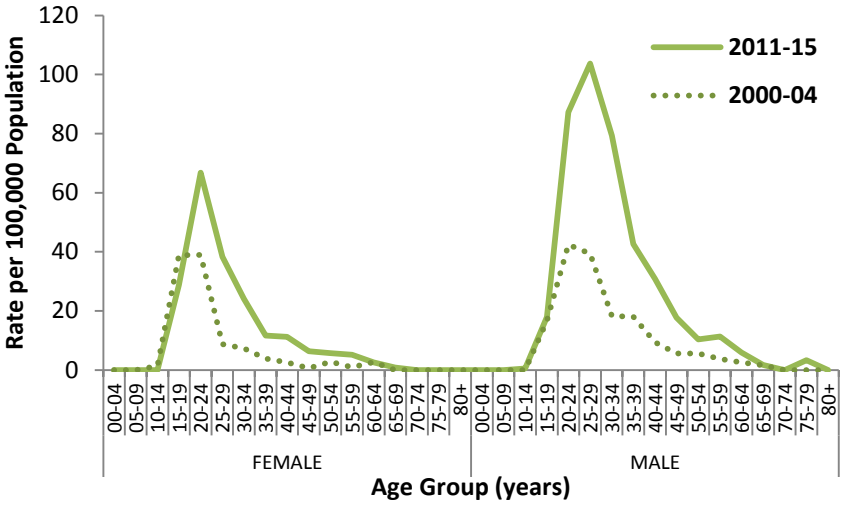
Figure 4.2.4 Gonorrhea, York Region, 2006–2015:
Co-infection with *chlamydia*



Gonorrhea—age shift over time

From 2011 to 2015, increases in age-specific rates were greater among older age groups than younger age groups when compared to the time period of 2000 to 2004 (Figure 4.2.5). This is particularly evident among female cases, where the rate of cases in the 15 to 19 year old age group did not increase whereas there were large rate increases in older age groups. For males, the age group with the highest rate shifted from 20 to 24 year olds to 25 to 29 year olds.

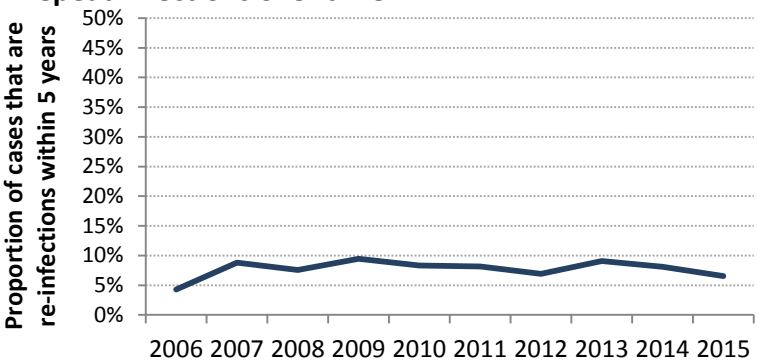
Figure 4.2.5 Gonnorhea, York Region, 2000–2004 and 2011–2015:
Change in age-specific rates over time



Gonorrhea reinfections

A fair proportion of gonorrhea cases had an earlier gonorrhea infection within the previous five years (Figure 4.2.6). The annual proportion varied between six and nine per cent over the time period of 2006 to 2015.

Figure 4.2.6 Gonorrhea, York Region, 2006–2015:
Repeat infections over time



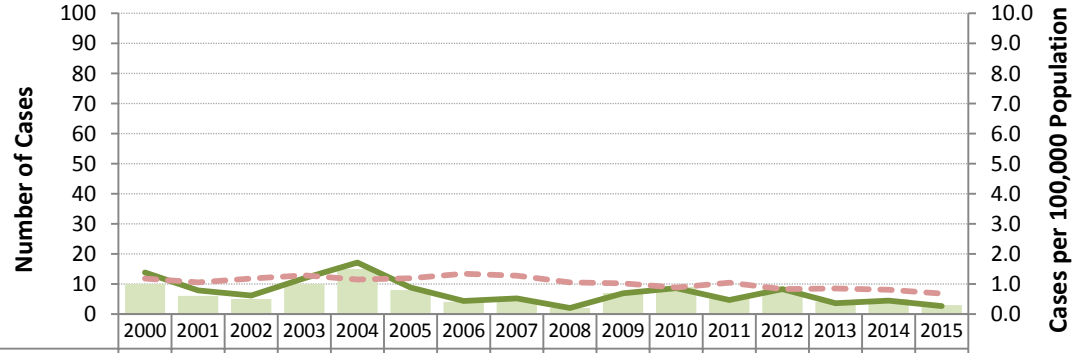
4.3 Hepatitis B, acute and chronic

Hepatitis B is a viral infection that attacks the liver and can cause both acute and chronic disease.[2] The acute illness is usually brief and can present with fatigue, loss of appetite, vomiting and jaundice. A small percentage of individuals who get acute hepatitis B will develop chronic hepatitis B, which can lead to cirrhosis (liver scarring) and/or liver cancer later in life. However, 95 per cent of adults with chronic infection have inactive disease and will remain healthy.[11] As the risk of developing chronic hepatitis B is inversely related to age, about 90 per cent of infants infected with hepatitis B will develop chronic infection.[2]

Since the early 1990s, the universal school-based hepatitis B virus immunization program has been available in Ontario. More recently the hepatitis B vaccine has been available to high-risk persons, such as infants born to hepatitis B positive carrier mothers, household and sexual contacts of chronic carriers and acute cases, individuals with a history of a sexually transmitted infection, men who have sex with men, individuals with multiple sex partners and intravenous drug users, as part of the provincial immunization program.[12] Coinciding with use of the hepatitis B vaccine, the national incidence of hepatitis B has been decreasing.[13]

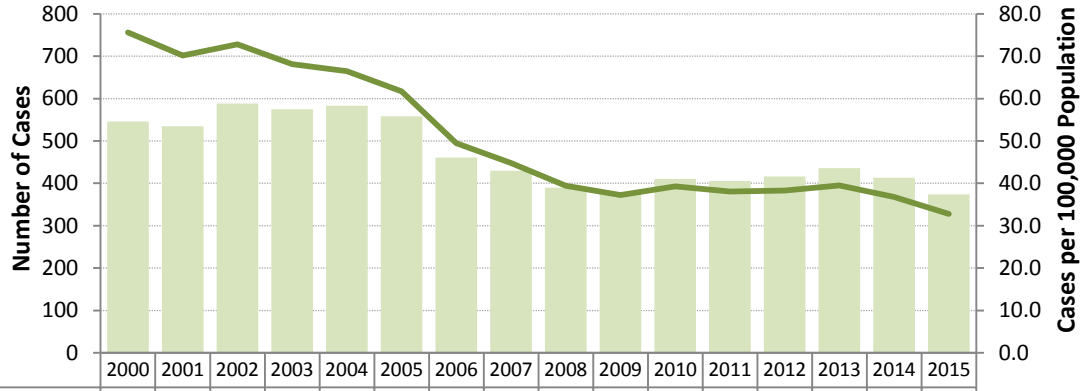
Figure 4.3.1a Hepatitis B (acute infections), York Region and Ontario, 2000–2015:

Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	10	6	5	10	15	8	4	5	2	7	9	5	9	4	5	3
YR Incidence Rate	1.4	0.8	0.6	1.2	1.7	0.9	0.4	0.5	0.2	0.7	0.9	0.5	0.8	0.4	0.4	0.3
ON Incidence Rate	1.2	1.1	1.2	1.3	1.1	1.2	1.3	1.3	1.1	1.0	0.9	1.0	0.8	0.8	0.8	0.7

Figure 4.3.1b Hepatitis B (chronic infections), York Region, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	546	535	588	575	583	558	461	430	390	378	410	406	416	436	413	374
YR Incidence Rate	75.6	70.1	72.8	68.1	66.4	61.7	49.5	44.8	39.4	37.3	39.3	38.1	38.3	39.5	36.8	32.8

In general, the incidence of hepatitis B decreased between 2000 and 2015 (Figures 4.3.1a and b). Over this period the incidence of acute infections was low in Ontario and slightly lower in York Region. The number of individuals recognized to have had a chronic infection was much higher than acute infection. The annual incidence rates of chronic infection decreased substantially over the time period (Figure 4.3.1b).

The majority of acute cases of hepatitis B were male (Figure 4.3.2a) and the age distribution of cases differed between the sexes. Age-specific incidence rates among males were higher than females for ages 30 through 55 years, with a peak among 30 to 34 year old males. A small majority of chronic hepatitis B cases were male (Figure 4.3.2b) and the age distribution of male chronic cases occurred primarily among adults with a small peak among 35 to 39 year olds. The age distribution of female cases skewed younger with a sharper peak at 25 to 29 years old. The declining trend in incidence rates of chronic hepatitis B cases was similar between males and females over the 2000 to 2015 time period (Figure 4.3.3).

Figure 4.3.2a Hepatitis B (acute), York Region, 2000–2015:

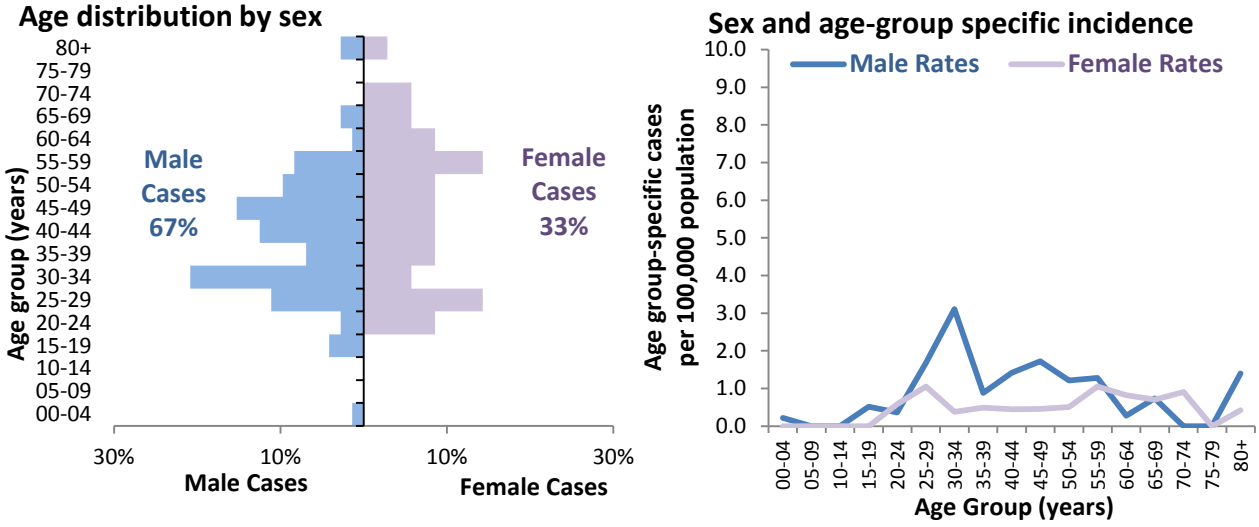
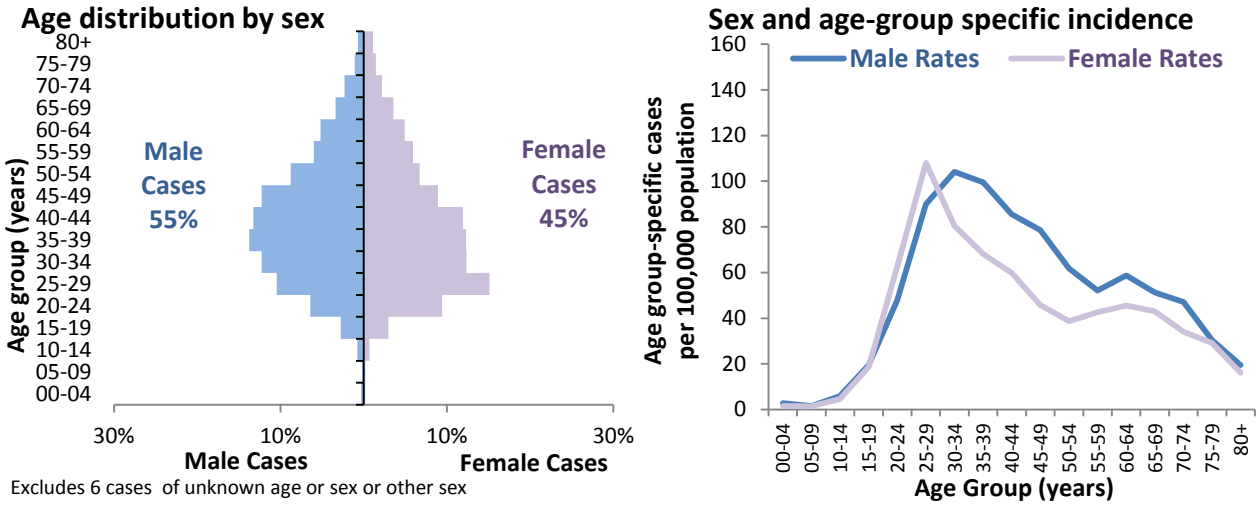
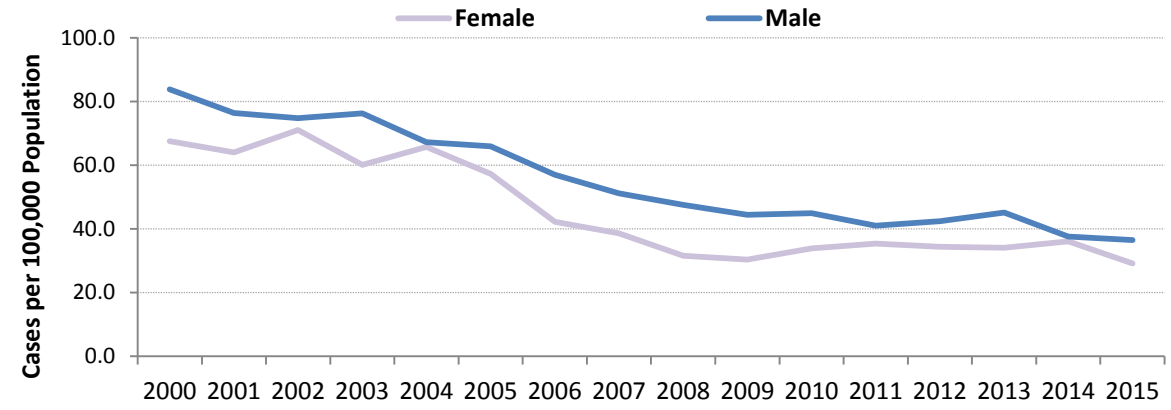


Figure 4.3.2b Hepatitis B (chronic), York Region, 2000–2015:



Excludes 6 cases of unknown age or sex or other sex

Figure 4.3.3 Hepatitis B, chronic, York Region, 2000–2015:



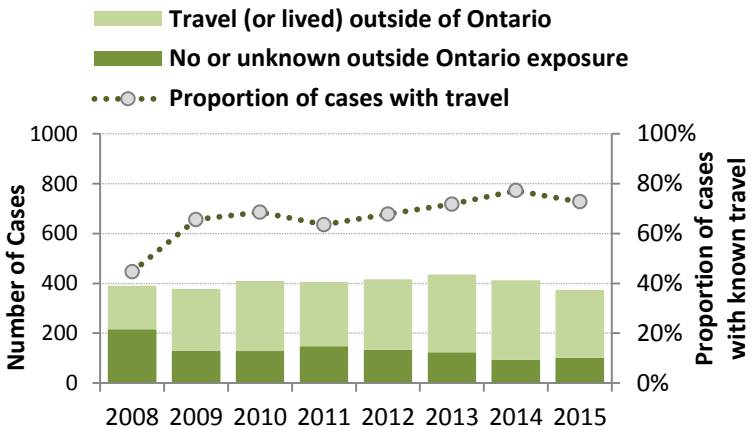
Excludes 2 cases with other or unknown sex

Hepatitis B and exposure outside of Ontario

A large proportion of chronic hepatitis B cases reported living in, or visiting locations outside of Ontario and this proportion increased between 2008 and 2015 (Figure 4.3.4).

Although, the risk of acquiring hepatitis B is not the same for travel to an endemic country as having lived there, these risks are not distinguished in the available data.

Figure 4.3.4 Hepatitis B (chronic), York Region, 2008–2015: Exposure outside of Ontario



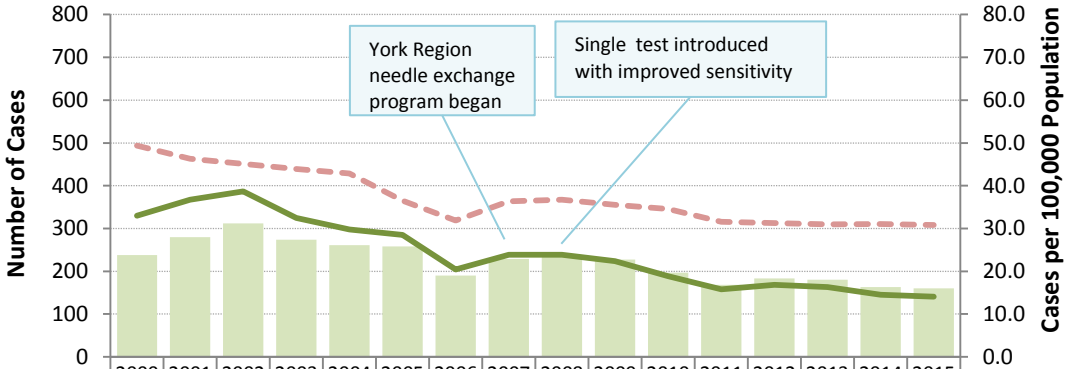
4.4 Hepatitis C

Hepatitis C is a viral infection that attacks the liver and can cause both acute and chronic disease.[2] The acute illness is usually brief and can present with fatigue, loss of appetite and jaundice. If the individual is not able to clear the virus on their own, they may develop chronic hepatitis C, which can lead to cirrhosis (liver scarring), liver failure and/or liver cancer later in life. Over three quarters of infected individuals progress to chronic infection. The *Ontario Burden of Infectious Disease* Study lists hepatitis C as one of the most burdensome infectious diseases in Ontario.[14]

The test that defines a case of hepatitis C virus does not distinguish between newly acquired, chronic and resolved infections.[2] Most reported hepatitis C cases likely were chronic cases, or infected in the past and newly diagnosed rather than newly acquired.[15]

The annual incidence rates of hepatitis C decreased over the 2000 to 2015 time period in both Ontario and York Region (Figure 4.4.1). The incidence of hepatitis C was lower in York Region than Ontario.

Figure 4.4.1 Hepatitis C, York Region and Ontario, 2000–2015:
Cases and rates

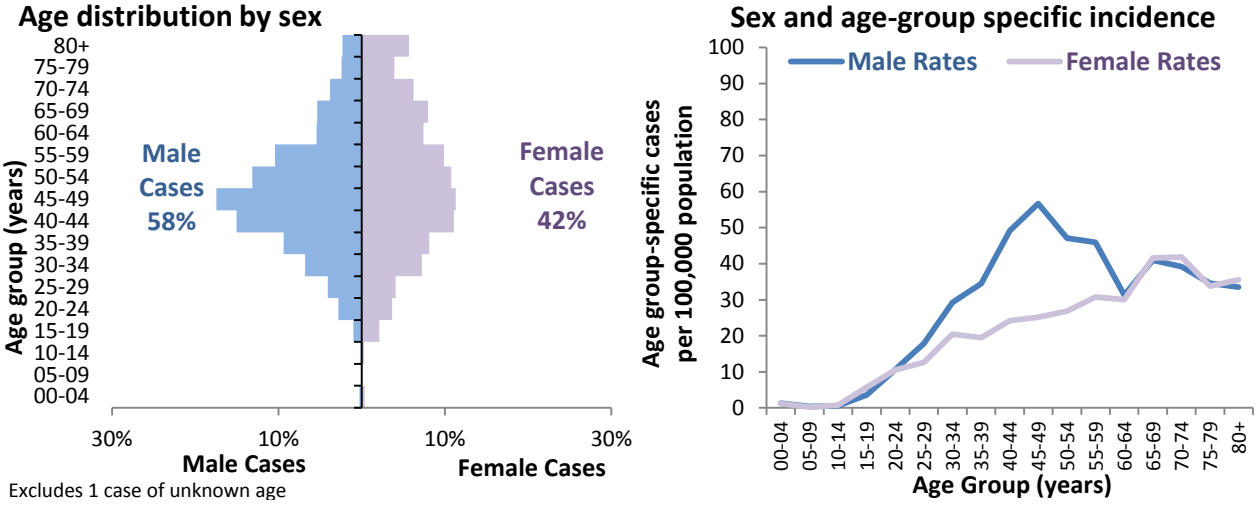


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	238	280	312	274	261	258	190	229	236	227	197	168	183	180	163	160
YR Incidence Rate	33.0	36.7	38.6	32.5	29.7	28.5	20.4	23.8	23.9	22.4	18.9	15.8	16.8	16.3	14.5	14.0
ON Incidence Rate	49.4	46.3	45.1	43.9	42.8	36.5	31.9	36.4	36.7	35.6	34.5	31.6	31.3	31.0	31.0	30.8

There were more male hepatitis C cases than female cases (Figure 4.4.2) and these excess cases occurred in the 30 to 59 year old age groups. The age-specific rates of hepatitis C infection for females increased from very low among children to a peak among seniors, whereas rates among males peaked in the 45 to 49 year old age group. There were 10 cases under the age of one year old, likely due to mother-to-child transmission.

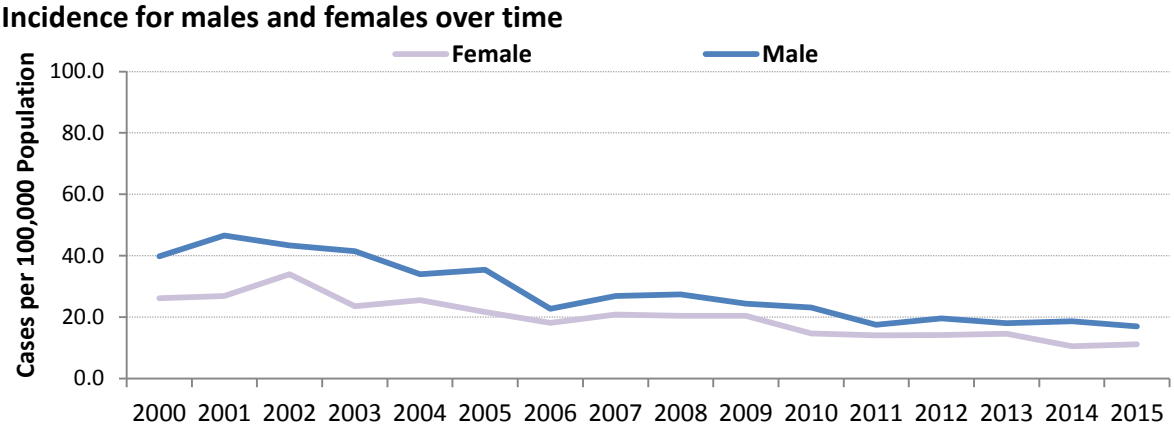
From 2000 to 2006, the decrease in male incidence rates was slightly greater than females resulting in a smaller difference in sex-specific rates in the more recent time period (Figure 4.4.3).

Figure 4.4.2 Hepatitis C, York Region, 2000–2015:



Excludes 1 case of unknown age

Figure 4.4.3 Hepatitis C, York Region, 2000–2015:

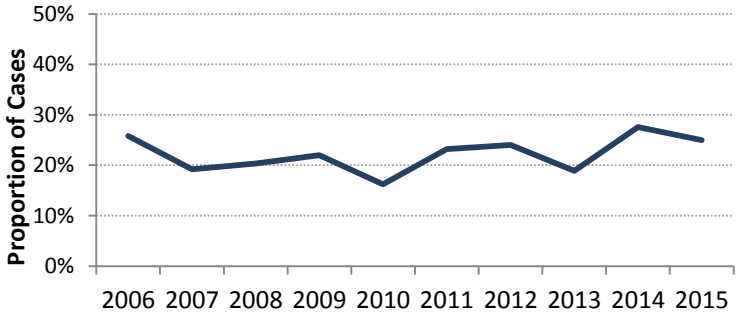


Between 2011 and 2015, only 17 per cent of hepatitis C cases reported travelling to or living in an area outside of Ontario.

Hepatitis C and drug use

Injection drug use (IDU) is a risk factor for hepatitis C infection, as the virus can spread through sharing of equipment.[2] There was no clear trend in the proportion of cases that reported IDU or sharing of equipment from 2006 to 2015 (Figure 4.4.4); however there appears to be an increase between 2010 and 2015. Between 2011 and 2015, the incidence rates of hepatitis C was not uniform across York Region, which could be related to various risk factors, including IDU.

Figure 4.4.4 Hepatitis C, York Region, 2006–2015:



Prior to 2012 injection and intranasal drug use could not be distinguished in the dataset.

4.5 Human immunodeficiency virus including AIDS (HIV infection)

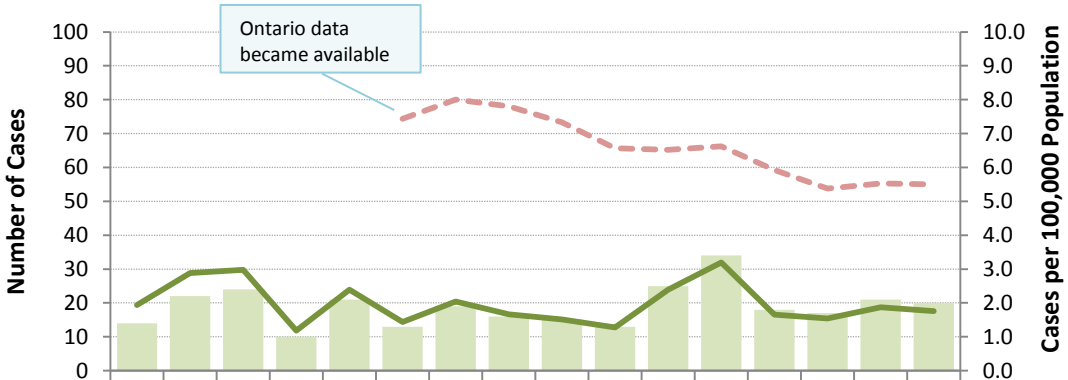
Human immunodeficiency virus (HIV) is a virus that attacks and weakens the body's immune system.[2] HIV is the virus that causes Acquired Immune Deficiency Syndrome (AIDS). AIDS is diagnosed when the HIV infection has resulted in immune suppression so that the case develops one or more AIDS-defining conditions such as opportunistic infections or cancers.[3] However, with close follow-up with their healthcare provider and treatment, a person with HIV can stay healthy for many years.[16]

In Ontario, AIDS is a reportable condition, whereas HIV infection is not a reportable disease. However, most cases are reported as newly diagnosed HIV infections and not AIDS cases. For the purposes of this report, the count of clients with HIV infections includes clients who have also been diagnosed with AIDS.

In Ontario, the incidence of HIV infection decreased between 2005 and 2015 (Figure 4.5.1). Although annual incidence rates are much lower in York Region than Ontario, rates were relatively stable over this time period with a peak in 2011.

Figure 4.5.1 HIV Infection, York Region and Ontario, 2000–2015:

Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	14	22	24	10	21	13	19	16	15	13	25	34	18	17	21	20
YR Incidence Rate	1.9	2.9	3.0	1.2	2.4	1.4	2.0	1.7	1.5	1.3	2.4	3.2	1.7	1.5	1.9	1.8
ON Incidence Rate						7.4	8.0	7.8	7.3	6.6	6.5	6.6	5.9	5.4	5.5	5.5

During the period between 2000 and 2015, more than three quarters of the HIV infections in York Region were among males (Figures 4.5.2 and 4.5.3). Cases were primarily aged 20 to 49; however, there were infections newly recognized in seniors. There were no infections in infants.

Figure 4.5.2 HIV, York Region, 2000–2015:

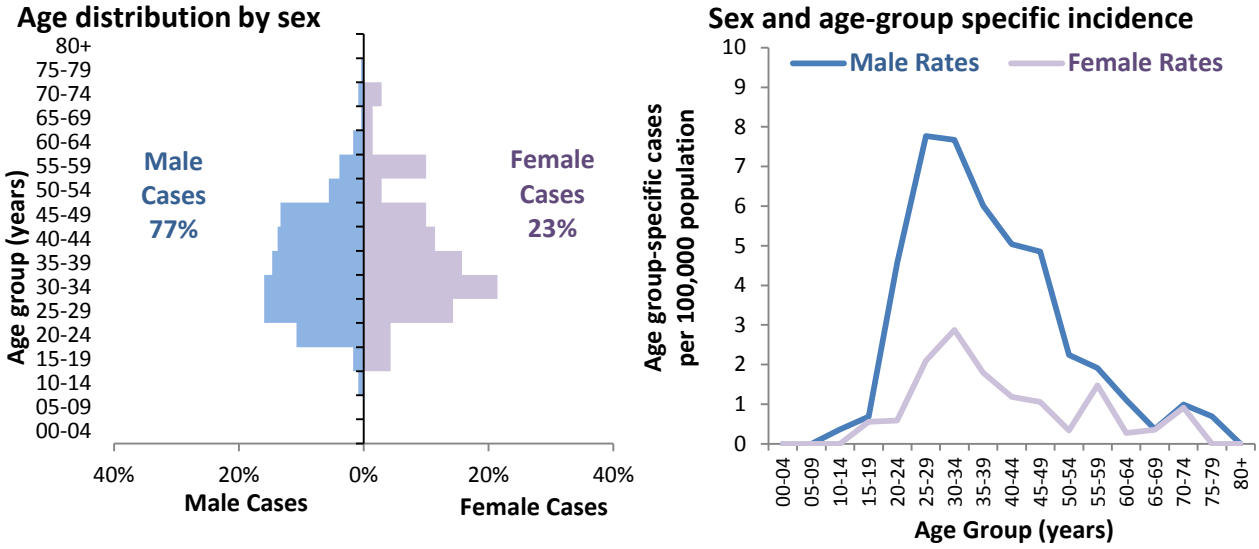
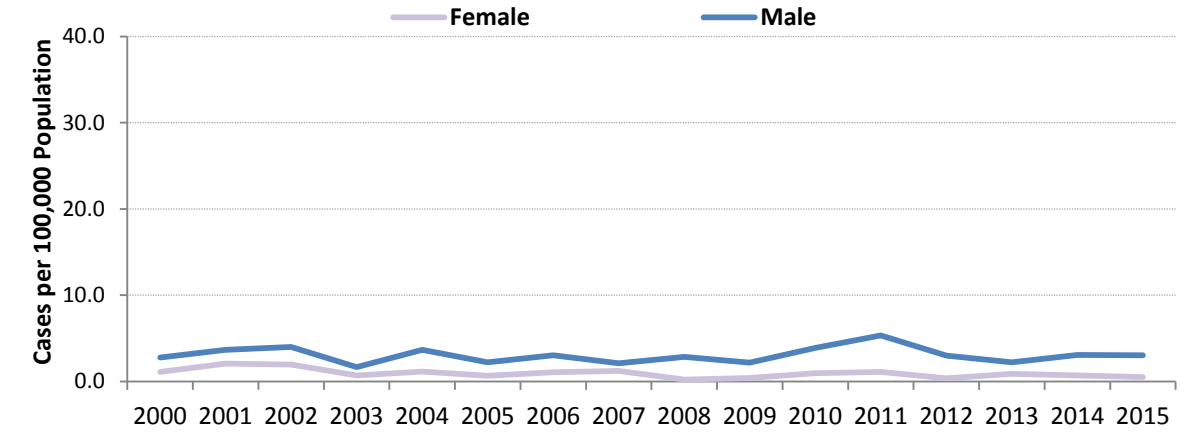


Figure 4.5.3 HIV infection, York Region, 2000–2015:



More than half of the HIV cases were among males who reported having sex with males (MSM) and this proportion increased from 2008 to 2015 (Figure 4.5.4).

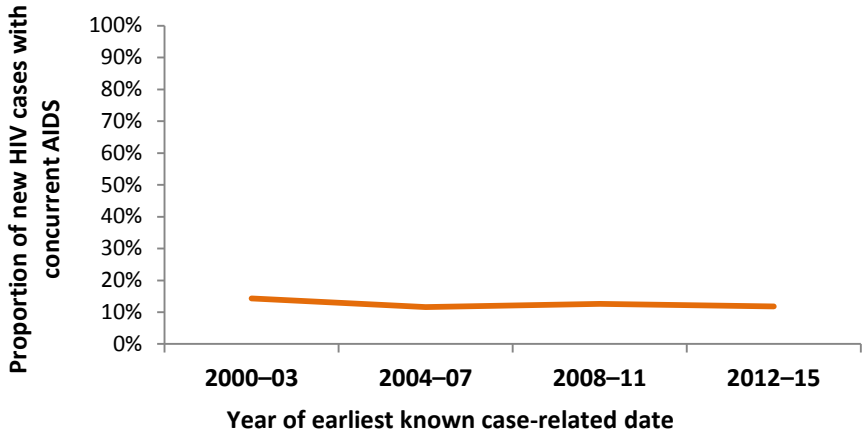
The proportion of HIV infected cases that reported anonymous partnering practices (including anonymous sex or having met partner through internet, bathhouse or other social venue) jumped from 25 per cent in 2011 to 2013 to 57 per cent in 2014 to 2015.

Figure 4.5.4 HIV Infection, York Region, 2008–2015:

AIDS at time of HIV detection

Some individuals living with HIV infection are not reported to public health until they have developed indicator conditions that suggest they have AIDS. From 2000 to 2015, 13 per cent of cases were recognized to have AIDS at the time of HIV diagnosis. The proportion of newly reported cases that have AIDS at the time of HIV reporting has decreased only very slightly from 2000 to 2015 (Figure 4.5.5).

Figure 4.5.5 HIV infections, York Region, 2000–2015:
Proportion of new cases with AIDS at time of HIV detection diagnosis

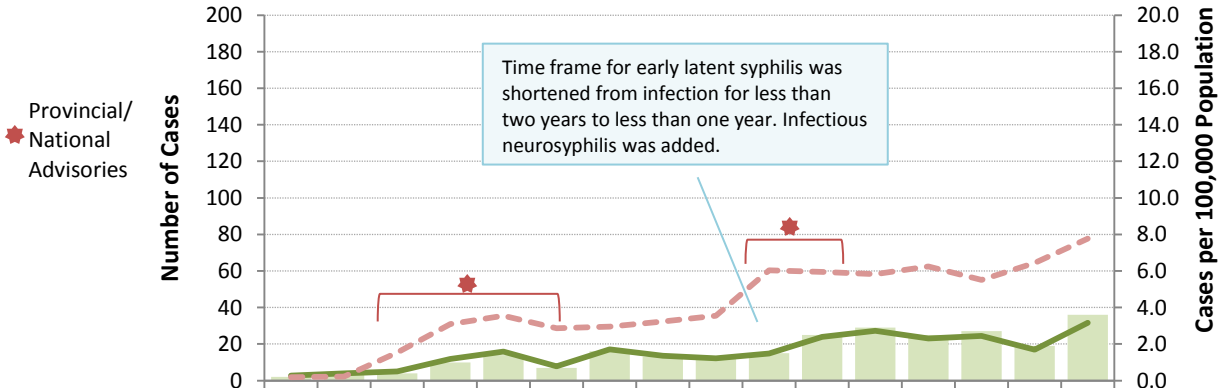


4.6 Syphilis, infectious and non-infectious

Syphilis is an STI caused by the bacterium *Treponema pallidum*. If not treated, syphilis can cause serious damage within the body.[2] The disease progresses through four stages. The first three stages (primary, secondary and early latent) are infectious and symptoms may go unnoticed. An individual may progress to the fourth stage of infection (tertiary or late latent), which is not infectious to others, but may result in more serious health problems.

Infectious syphilis includes primary syphilis (genital and other sites), secondary syphilis, early latent syphilis, early congenital syphilis and infectious neurosyphilis. Infectious syphilis is of primary importance due to the associated risk of transmission. The non-infectious syphilis category includes late latent syphilis and neurosyphilis. Syphilis cases that were not staged at the time of diagnosis were reviewed and all were categorized as non-infectious for the purposes of this report.

Figure 4.6.1a Syphilis (infectious), York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	2	3	4	10	14	7	16	13	12	15	25	29	25	27	19	36
YR Incidence Rate	0.3	0.4	0.5	1.2	1.6	0.8	1.7	1.4	1.2	1.5	2.4	2.7	2.3	2.4	1.7	3.2
ON Incidence Rate	0.2	0.2	1.5	3.1	3.5	2.9	2.9	3.2	3.5	6.0	5.9	5.8	6.2	5.5	6.4	7.8

Advisories:

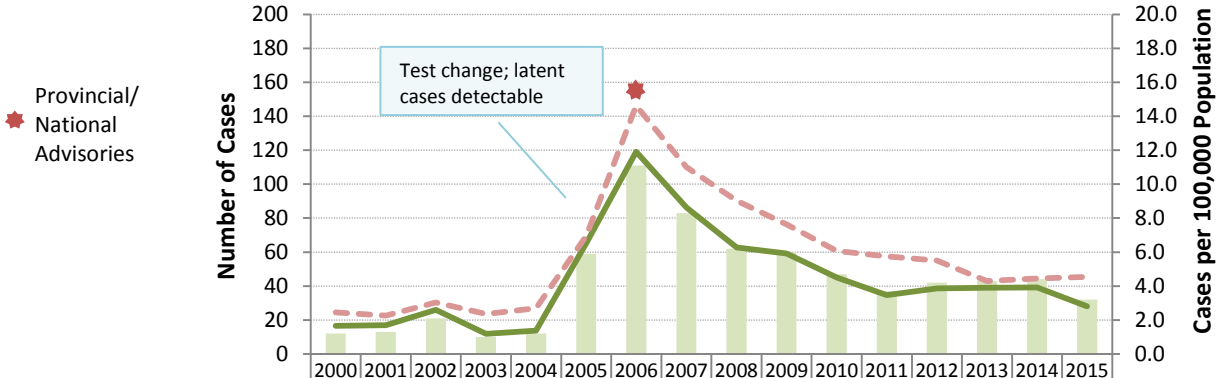
- ***2002–2004***—A large increase in the number of infectious syphilis cases and outbreaks was reported provincially, primarily among MSM populations in urban centres.[17]
- ***2009***—A substantial increase in the number of infectious syphilis cases was reported provincially.[17]

Infectious syphilis was rare in Ontario in the early 2000s (Figure 4.6.1a), but the annual incidence rates greatly increased from 2000 to 2015. Although York Region's annual incidence rates were substantially lower than Ontario's, the increasing trend was also seen in York Region, with an 18-fold increase in annual cases over the time period. These increases occurred in waves, starting in 2002, 2009 and 2014 in Ontario and one year later (2003, 2010 and 2015) in York Region. The 2002 and 2009 increases in Ontario were attributed to outbreaks of infectious syphilis among males who have sex with males (MSM).[18]

Non-infectious syphilis cases were reported in York Region in the early 2000s (Figure 4.6.1b). There was an increase in the annual incidence rates in both Ontario and York Region corresponding with

the introduction of new more sensitive testing methods in 2005, with a peak incidence in 2006. Following this peak, the incidence declined until 2011 and then became relatively stable. A second possible contributor to this peak is a delayed detection of infectious syphilis for an outbreak in the few years prior, discussed below. York Region's rates of non-infectious syphilis were lower than Ontario's.

Figure 4.6.1b Syphilis (non-infectious), York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases Non-infectious	12	13	21	10	12	59	111	83	62	60	47	37	42	43	44	32
YR Incidence Rate	1.7	1.7	2.6	1.2	1.4	6.5	11.9	8.6	6.3	5.9	4.5	3.5	3.9	3.9	3.9	2.8
ON Incidence Rate	2.5	2.3	3.0	2.4	2.7	7.0	14.6	11.0	9.0	7.6	6.1	5.7	5.5	4.3	4.4	4.5

Advisories:

2006—A large increase in the number of non-infectious syphilis cases was reported locally and provincially.

Over 80 per cent of infectious syphilis cases in York Region were male (Figure 4.6.2a). The majority of the cases were between the ages of 20 and 54 years, with the age distribution of female cases skewed a bit younger than male cases. The peak age-specific incidence rate among males was in the 25-29 year old age group. Thirty-five cases of infectious syphilis were among women of child-bearing age (15 to 44 years) and there were two infections in very young children that likely reflect mother-to-child transmission. In contrast, there were only slightly more cases of syphilis detected at the non-infectious stage in men than in women (Figure 4.6.2b) and seniors were at higher risk than younger adults among both men and women.

Figure 4.6.2a Syphilis (infectious), York Region, 2000–2015:

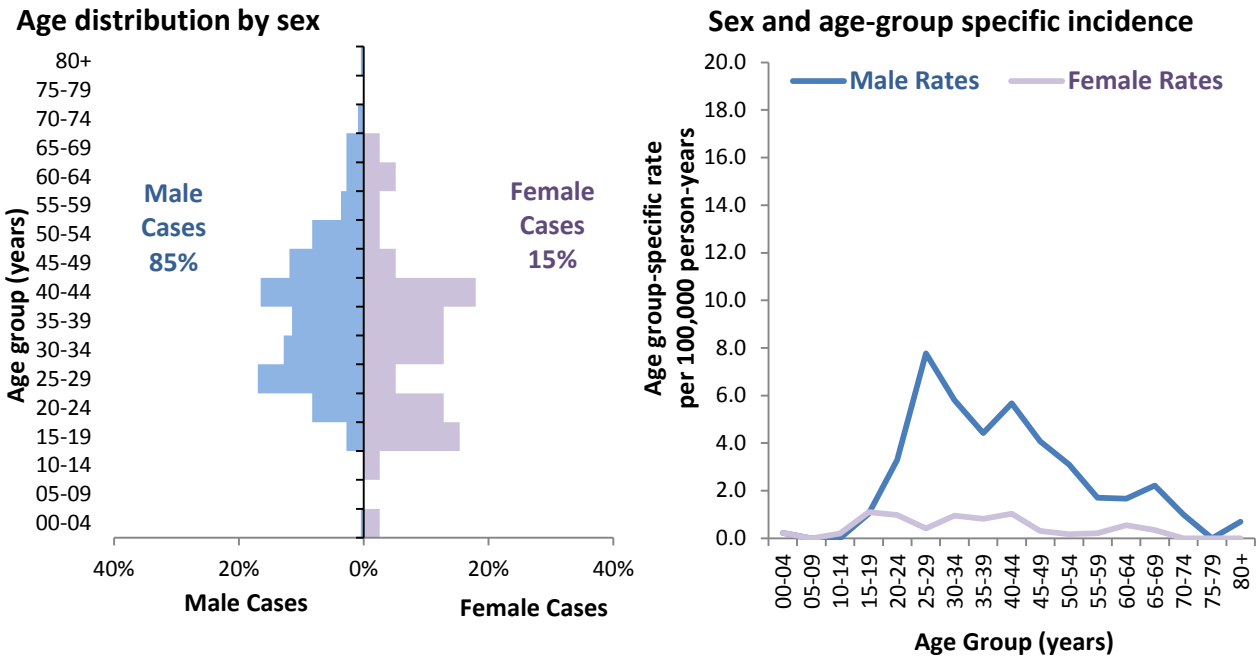
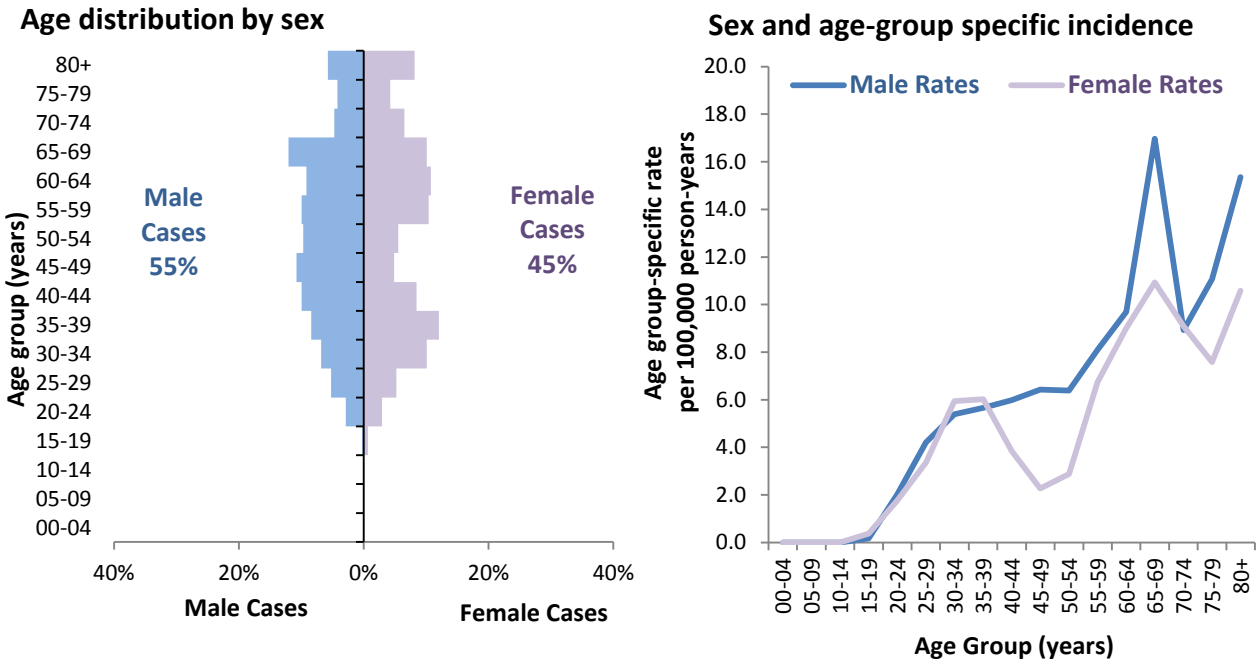


Figure 4.6.2b Syphilis (non-infectious), York Region, 2000–2015:



Although the annual rates of infectious syphilis cases among females was very low, they increased starting in 2004 (Figure 4.6.3a). This was subsequent to the increases observed among males. There was a rapid increase in the male annual incidence rate of non-infectious syphilis in 2006 that was not seen as strongly among females (Figure 4.6.3b). This pattern, taken with the rapid increase in infectious syphilis primarily among males starting in 2003 (Figure 4.6.3a), may be due to under-

recognition of an infectious syphilis outbreak which was reported to be primarily among the MSM community[18] for which some cases had delayed identification.

Figure 4.6.3a Syphilis, infectious, York Region, 2000–2015:
Incidence for males and females over time

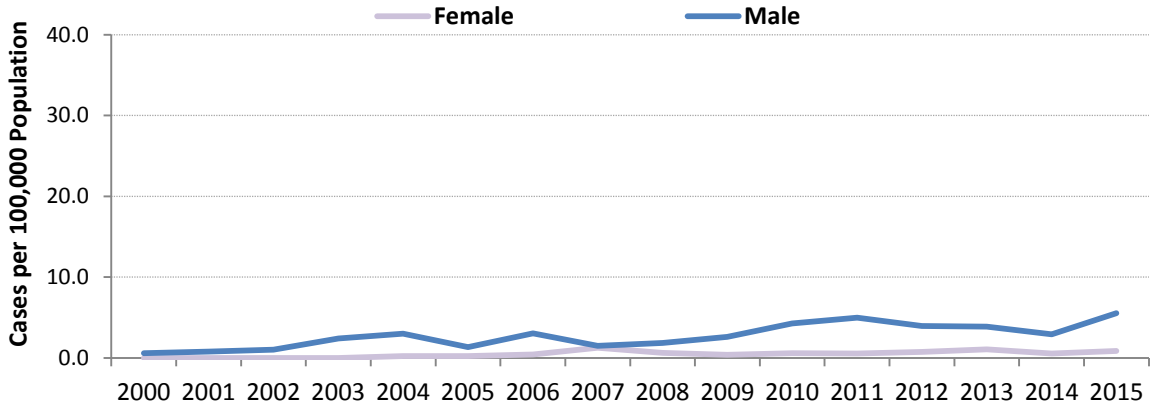
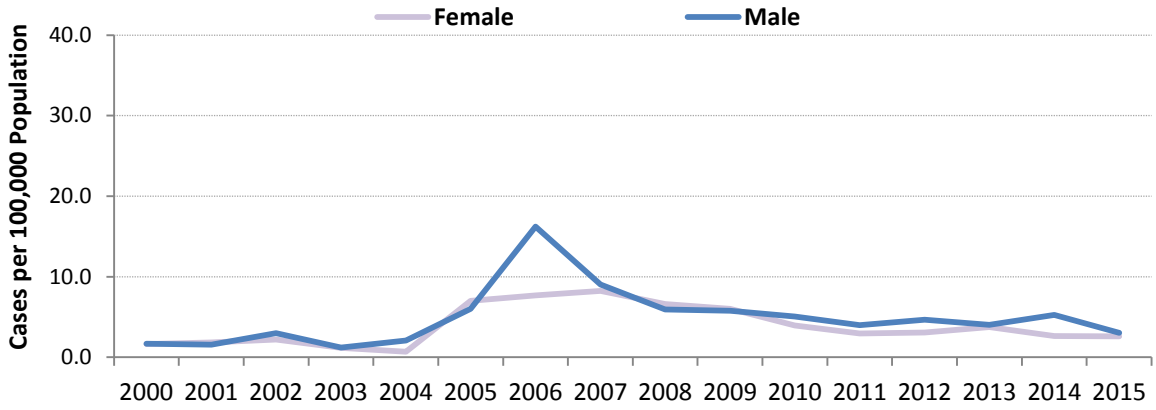


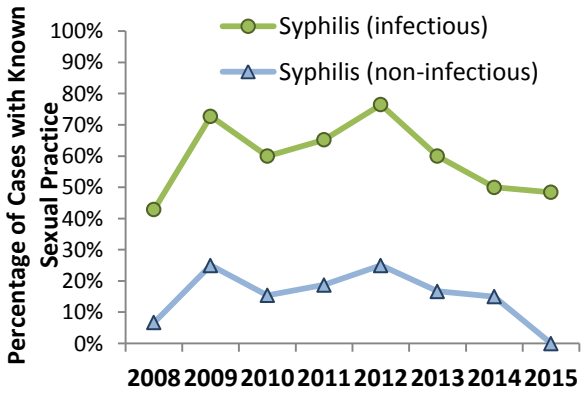
Figure 4.6.3b Syphilis, non-infectious, York Region, 2000–2015:
Incidence for males and females over time



A large proportion of infectious syphilis and a much smaller proportion of non-infectious syphilis male cases reported sex with males (Figure 4.6.4). There was a higher proportion of male cases who reported sex with males in 2009, corresponding to the provincial outbreak described above. There was also a peak in proportion reporting this risk factor in 2012. The trend for non-infectious syphilis mimics the trend seen in infectious syphilis.

There were 21 individuals who contracted infectious syphilis between 2006 and 2015 who also reported HIV infection, which represents 10 per cent of all individuals with infectious syphilis in those years.

Figure 4.6.4 Syphilis, York Region, 2000–2015:
Males who reported having sex with males



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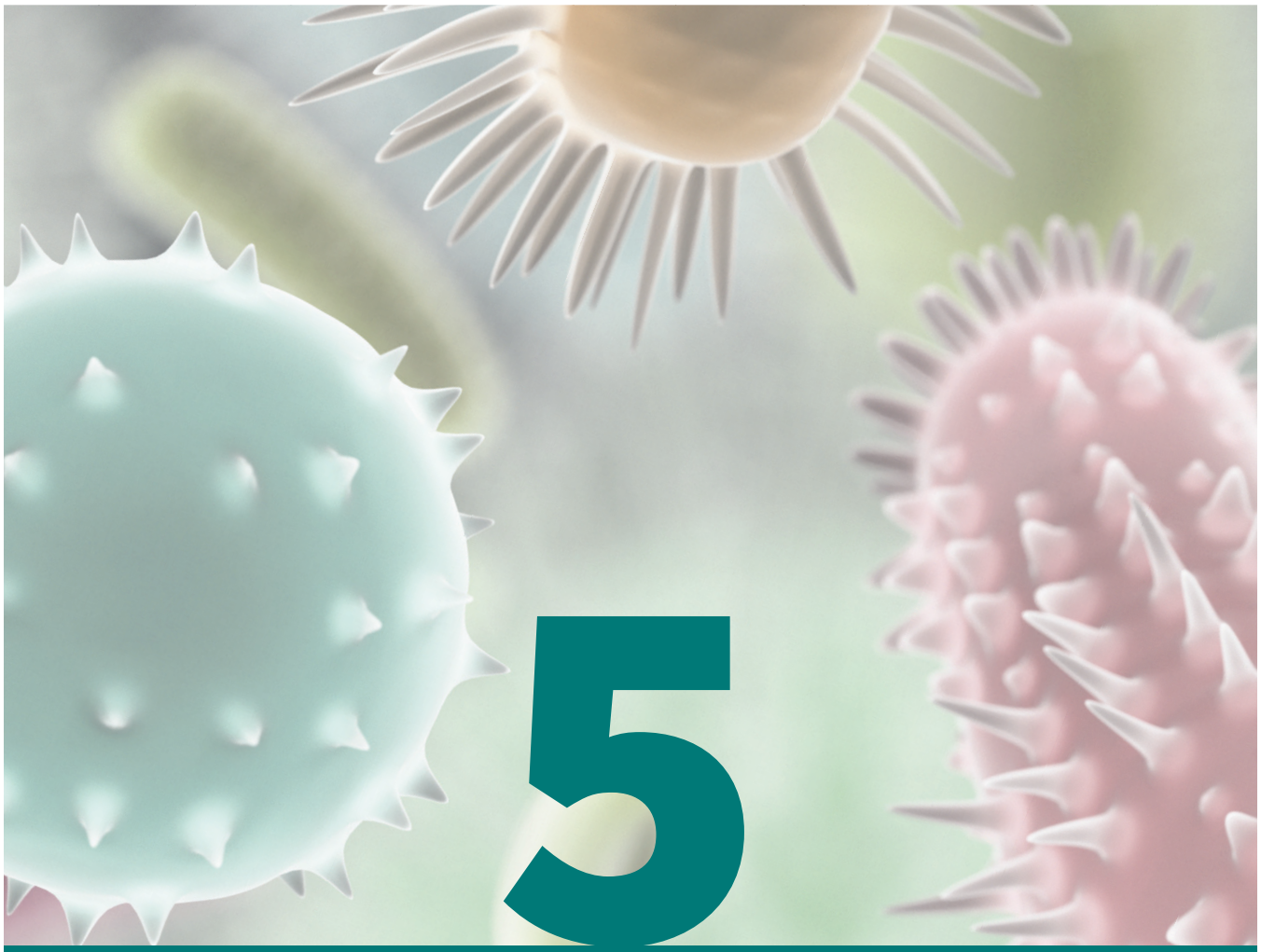


5

Vaccine preventable diseases

Table 5.0 Vaccine preventable diseases:

Annual cases, York Region, 2000–2015

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	NOTES
Acute Flaccid Paralysis															2	0	Syndrome became reportable December 2013
Diphtheria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Vaccine first introduced in 1926; no cases have been reported in Ontario since 1995
Haemophilus influenzae b disease, invasive	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	Vaccine first introduced in 1986
Influenza	43	38	90	269	134	485	135	131	200	1098	151	155	287	303	798	476	Vaccine first publicly-funded in 2000
Measles	0	0	0	0	0	1	0	0	1	0	0	0	0	0	5	1	Vaccine first introduced in 1963
Meningococcal disease, invasive	9	3	2	2	2	3	8	7	1	3	1	2	4	1	0	2	Vaccine first introduced in 1981. Routine in 2005.
Mumps	3	0	0	0	1	1	1	5	2	11	1	3	1	0	0	0	Vaccine first introduced in 1969
Pertussis	56	34	29	14	66	176	228	183	147	21	2	18	38	21	19	39	Vaccine first introduced in 1943
Poliomyelitis, Acute	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Vaccine first introduced in 1955; last indigenous case of wild poliovirus detected in Canada in 1977
Rubella	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	Vaccine first introduced in 1969; last indigenous cases of rubella in Canada reported in 2005
Rubella congenital syndrome	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Last York Region case reported in 1995
Smallpox	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Vaccine first introduced in 1885; last case of smallpox in Ontario in 1962; declared globally eradicated in 1980
Streptococcus pneumoniae, invasive			39	42	32	42	37	35	54	53	56	45	47	47	59	27	Vaccine first introduced in 1983
Tetanus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	Vaccine first introduced in 1940
Chickenpox (Varicella)	995	485	717	516	841	n/a*	n/a*	598	490	416	394	334	243	263	114	140	Vaccine publicly-funded in 2005

Chickenpox case counts were not available for 2005 and 2006. Vaccine introduction information sourced from the Canadian Immunization Guide[1], the CPHA immunization timeline[2] and Statistics Canada Health Reports[3].

Selected infectious diseases that are preventable by vaccination are presented in this chapter. Immunization has played an important role in reducing the burden of infectious diseases, saving more lives than any other public health intervention in the last 50 years.[1] The report *Vaccines: The Best Medicine* by the Chief Medical Officer of Health of Ontario details the history of vaccination in Ontario[4] and highlights the success of the various publicly-funded immunization programs. Ongoing surveillance of vaccine preventable disease incidence provides information regarding vaccination program effectiveness and their impact on the prevention and control of disease transmission. Some infections in this category, including polio, are considered surveillance priorities due to global and national disease eradication and control efforts. Information on diseases that are preventable by vaccination in Canada since 1924 can be obtained from the Public Health Agency of Canada's website.[5]

Surveillance has shown that vaccines that target serotypes or subtypes of a disease result in a reduction in the incidence of those serotypes or subtypes.[6] However, other serotypes or subtypes of a disease may then increase in prevalence, known as serotype replacement. For example, after the introduction of the *Haemophilus influenzae* serotype B vaccine, Ontario reported increases in *Haemophilus influenzae* infections due to non-serotype B strains.[7] Although the number is small within York Region, surveillance data suggests that a high proportion of *Haemophilus influenzae* infections are being caused by non-serotype B strains, specifically non-typeable strains. This reinforces the need for ongoing surveillance of vaccine preventable diseases to understand their changing epidemiology.

Table 5.0 highlights the York Region cases of reportable diseases under routine vaccination programs in Ontario.

- Smallpox was declared eradicated worldwide in 1979. The last known occurrence of a natural case was in Somalia in 1977. Nowadays, the concern is the use of smallpox as a potential bioterrorism weapon.[8]
- Canada is polio free[8] but remains under vigilant surveillance. Acute flaccid paralysis, a broad clinical syndrome which may or may not be the result of an infectious agent, has been reportable since December 2013 in order to obtain evidence to rule out poliomyelitis.[8] Two cases were reported in 2014; one was associated with enterovirus D68 which caused outbreaks of severe respiratory illness that year.[9,10] Details of the second case are unknown.
- Diphtheria, tetanus and rubella are very rarely reported in Ontario due to successful vaccination programs.[8]

Highlights

- Several diseases once common in Ontario are now very rare due to successful vaccination programs.
- The impact of recent vaccination programs can be seen in the incidence of varicella, invasive meningococcal disease and invasive pneumococcal disease.

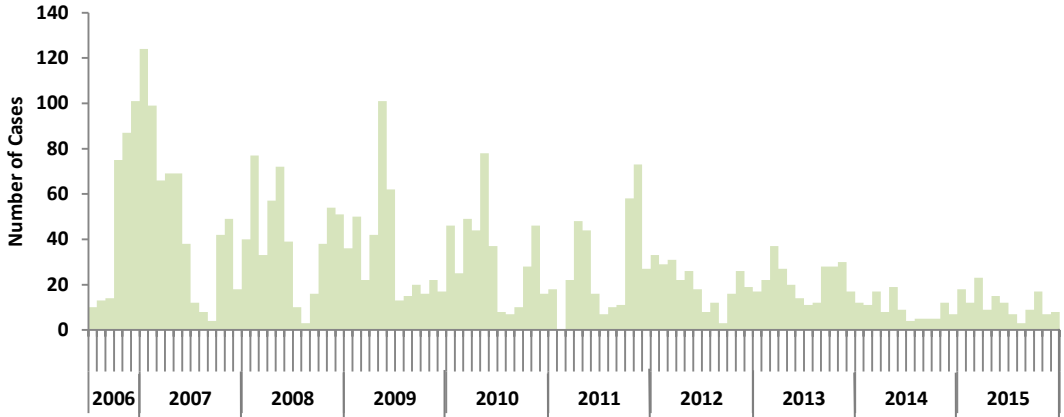
- Indigenous measles has been eliminated in Ontario, but imported cases continue to occur occasionally in York Region. Each case of measles results in a large public health response for contact identification and follow-up.
- Mumps cases tend to occur in cycles in Ontario. The few York Region cases were primarily in young adults.
- Influenza results in a high burden of illness in York Region, especially influenza A virus.
- Laboratory-confirmed influenza and invasive pneumococcal disease are more often isolated among seniors and the very young, whereas pertussis and meningococcal disease age-specific incidence is higher among the very young and adolescents.
- Influenza is highly seasonal, with peak incidence in the winter months. Although the seasonal pattern is less marked, invasive pneumococcal disease also peaks in the winter months, whereas pertussis peaks slightly in the fall.

Chickenpox (varicella) cases and hospitalizations

Varicella case counts provided by schools and childcare centres are reported to the province on a monthly basis as aggregate counts by age group. The aggregate counts presented in this report are approximate because individual cases were not investigated to remove duplicate records and varicella is under-reported.[11] Case reports obtained through laboratory test results or physician reporting, such as cases with complications or hospitalizations, were investigated individually but also included in aggregate counts. The publicly-funded varicella vaccine was introduced in Ontario in 2005 and in subsequent years reported cases of chickenpox dropped dramatically (Table 5.0 and Figure 5.0.1). Reported hospitalizations due to chickenpox were uncommon over this time period, but appear to have been stable. This is contrary to other jurisdictions which have reported decreases in hospitalization for varicella complications.[11]

Figure 5.0.1 Chickenpox, York Region, July 2006–2015:

Monthly cases



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number Hospitalized		2	0	2	2	2	4	3	2	2

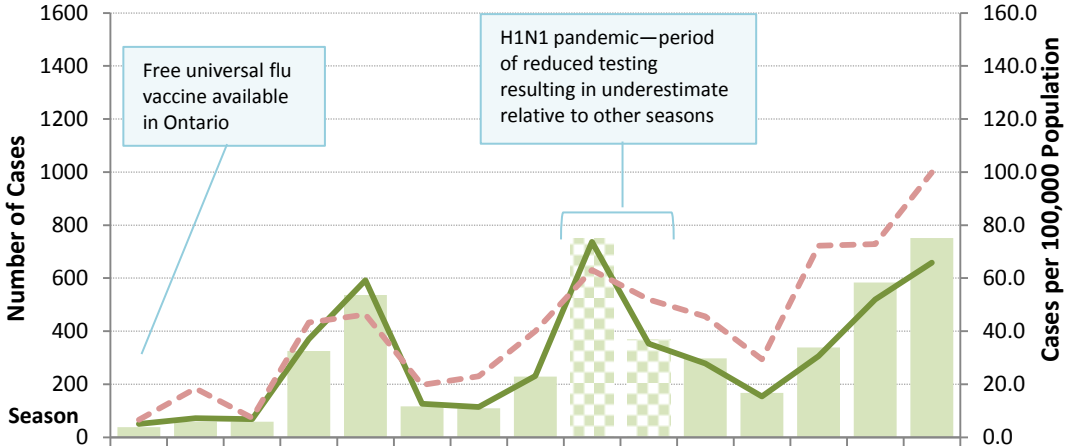
Data unavailable for February 2011

5.1 Influenza

Influenza, commonly known as the flu, is an acute viral disease of the respiratory tract that is characterized by fever, cough, headache, body pains, coryza and sore throat.[12] Infection is transmitted through the air from coughing and sneezing or through direct contact with contaminated surfaces. Influenza occurrence is seasonal with cases reported each year in the late fall and winter months. Those at increased risk of infection include young children and older adults. Unlike other vaccines, the influenza viruses in the seasonal influenza vaccine are selected each year based on the viral strain anticipated to be in circulation during that influenza season. The match between the vaccine and circulating viral strain affects vaccine effectiveness.

Influenza data are presented in this chapter by influenza season, as calendar year comparisons of influenza incidence are difficult to interpret. The influenza reporting period is defined as September 1 to August 31 of the following year. Reported cases are a small proportion of those infected with influenza as only laboratory-confirmed cases are reportable and the majority of influenza cases are not confirmed through laboratory testing.[13]

Figure 5.1.1 Influenza, York Region and Ontario, 2000–2015:
Cases and rates



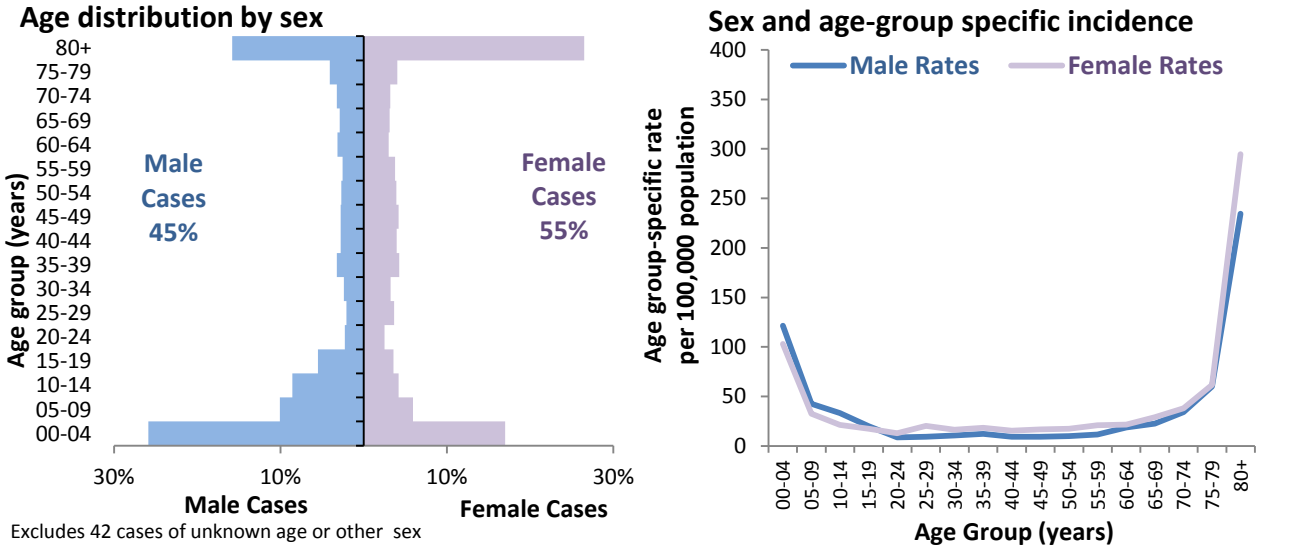
	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
YR Cases	38	58	58	325	536	117	109	229	748	368	297	167	338	584	751
YR Incidence Rate	5.0	7.2	6.9	37.0	59.2	12.6	11.3	23.2	73.7	35.3	27.9	15.4	30.6	52.0	65.9
ON Incidence Rate	6.6	18.4	7.3	43.3	46.3	19.8	23.0	40.0	63.1	52.0	45.6	29.4	72.2	72.8	99.8

Laboratory confirmed influenza incidence was highly variable in York Region and Ontario (Figure 5.1.1); however the patterns were similar with incidence peaks in the 2004–2005, 2013–2014 and 2014–2015 seasons. The largest peak in incidence was during the 2009 H1N1 pandemic which started with a wave in late spring 2009 (2008–2009 season) and had a second wave in fall 2009 (2009–2010 season). There were likely many more influenza cases in the second wave that were not reflected in the data, as laboratory testing recommendations changed. A seroprevalence study in Ontario estimated that the second wave was 2.6 times larger than the first,[14] and Canadian hospitalizations due to influenza in Canada were 4.8 times higher in the second wave.[15] See *Chapter 8* for further detail on the 2009 H1N1 influenza pandemic.

For most seasons, Ontario had a higher annual incidence rate of influenza than York Region (Figure 5.1.1); however this difference may be due to differing testing practices or health-seeking behaviour.[13]

Influenza occurred most frequently among the very old and the very young (Figure 5.1.2) with the highest age-specific incidence rates among individuals 80 years and older. There are more female cases than male cases, possibly due to a higher population of elderly females.

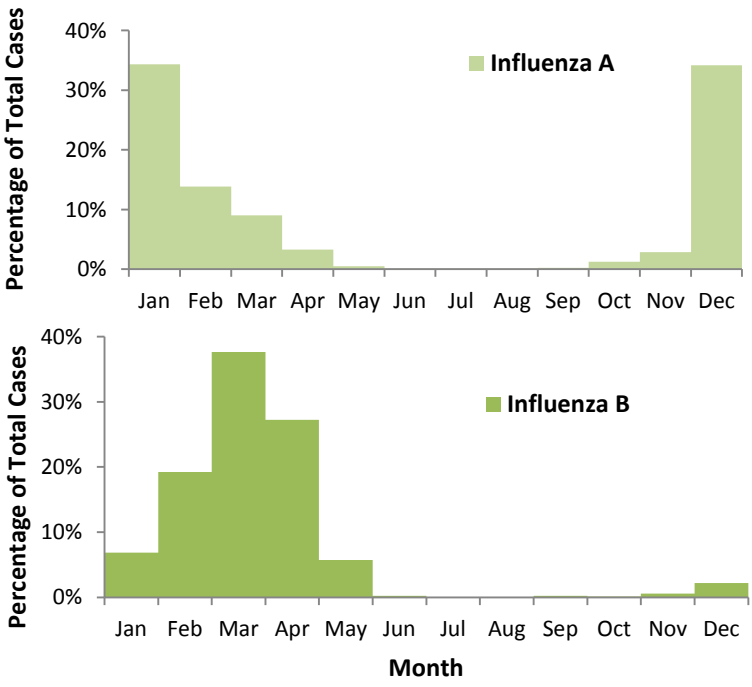
Figure 5.1.2 Influenza, York Region, 2000–2015:



Influenza was highly seasonal (Figure 5.1.3); the highest proportion of influenza A cases occurred in December and January. Influenza spreads more readily under cold, dry conditions.[16] The highest proportion of influenza B cases occurred later, in March and April.

Influenza A was isolated four times more often than influenza B. There was one case of influenza A and B co-infection.

Figure 5.1.3 Influenza, York Region, 2000–2008, 2010–2015:
Seasonality by agent



Predominant circulating strains and outbreaks of influenza

Season-specific details for the recent influenza seasons are summarized in Table 5.1.1. Each season in the five season period had a different predominant circulating strain, which may or may not have been a component of the vaccine available for the season. The relative susceptibility to illness for various age groups depends on the circulating strain[17] and differed between seasons. The duration of influenza outbreaks in institutions—the time between the symptom onset for the first case and that for the last case—appeared to be fairly consistent between seasons. Similarly, the attack rate—the proportion of at-risk residents in the facility who become ill—also varied little between seasons. Conversely, the number of outbreaks and the number of outbreak associated cases was highly variable between seasons.

Table 5.1.1 Influenza, York Region, 2010–11 to 2014–15 seasons:
Circulating strain and outbreak details

	2010–11	2011–12	2012–13	2013–14	2014–15
***Predominant Circulating Strain**[18]*	A H3N2 A/Perth/16/ 2009	B/Brisbane/60/2008-like and B/Wisconsin/01/ 2010-like	A H3N2 A/Victoria/ 361/2011-like	A(H1N1)pdm09	A H3N2 A/Switzerland/9715293/ 2013-like
Vaccine Components	Match† A/California/7/2009 (H1N1)-like virus; A/Perth/16/2009 (H3N2)-like virus; B/Brisbane/60/2008-like virus (B Victoria lineage)[19]	One B strain matched†–the other did not A/California/7/2009 (H1N1)-like virus; A/Perth/16/2009 (H3N2)-like virus; B/Brisbane/60/2008-like virus (B Victoria lineage)[19]	Match† A/California/7/2009 (H1N1)pdm09-like virus; A/Victoria/361/2011 (H3N2)-like virus; B/Wisconsin/1/2010-like virus (B Yamagata lineage)[20]	Match† A/California/7/2009 (H1N1)pdm09-like virus; A/Texas/50/2012 (H3N2)-like virus; B/Massachusetts/2/2012-like virus (Yamagata lineage); B/Brisbane/60/2008-like virus[21]	Did not match A/California/7/2009 (H1N1)pdm09-like virus; A/Texas/50/2012 (H3N2)-like virus; B/Massachusetts/2/2012-like virus.; B/Brisbane/60/2008-like virus.[22]
Age groups with highest incidence rate*‡	Very young and elderly[23]	Very young[24]	Very young and elderly[25]	Very young[26]	Elderly[27]
***Influenza A laboratory confirmed community cases** (number)*	187	53	263	298	534
Influenza B laboratory confirmed community cases** (number)	49	91	43	247	88
***Institutional Outbreaks** (number)*	24	8	14	10	40
***Outbreak-related Cases** (number)*	407‡	109	280	222	832
***Median Facility Attack Rate** (proportion of residents at risk)*	9%‡	11%	10%	9%	12%
***Median Outbreak Duration** (days)*	7	11	8	10	10

*Among community laboratory-confirmed cases in the predominant circulating strain ‡For 2010–11 and 2011–12 seasons, the age groups most affected were estimated by age group proportion †Predominant strain was component of season's vaccine. **Excludes case co-infected with A and B. ‡Case count missing for two outbreaks.

The highest incidence of laboratory-confirmed influenza since the 2009 pandemic occurred in the 2014–15 season in which the adjusted vaccine effectiveness was −8% (95% CI: −50 to 23%) against medically attended influenza A(H3N2) infection.[28] Among laboratory-confirmed cases, the highest age-specific incidence rate was among the elderly. These two factors likely contributed to the large number of outbreaks in long-term care homes and retirement homes with a large number of associated cases in this season. These factors also may have contributed to the slightly higher median outbreak attack rate.

The incidence was lowest in the 2011–2012 season, in which the predominate circulating strain was an influenza B strain. Influenza B typically has the highest incidence among the very young,[29] which likely contributed to the relatively low number of institutional outbreaks and associated cases in the 2011–12 season.

Similarly, the pandemic strain A (H1N1) circulating in the 2013–2014 season also has a lower incidence among seniors and York Region experienced a relatively small number of long-term care home and retirement home outbreaks in that season. For the 2013-14 influenza season, the influenza vaccine effectiveness for the A (H1N1) pdm09 subtype was estimated to be 71 per cent.[30]

5.2 Measles

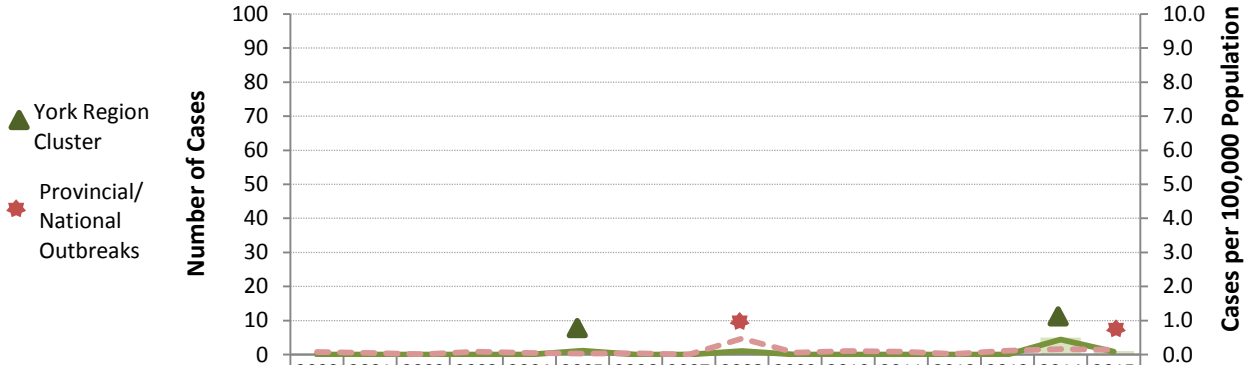
Measles is caused by the measles virus and is characterized by fever, coryza, conjunctivitis and rash and can cause serious complications including death.[12] Measles is one of the most communicable of all diseases and is a leading cause of vaccine-preventable disease deaths in children worldwide.

Transmission can be airborne by droplet spread as well as by direct contact. After exposure, rash onset ranges from seven to 21 days, with an average of 14 days. The period of communicability begins four days before the onset of rash and continues to four days after onset. Communicability is minimal after the second day of rash. Humans are the sole reservoir of measles.[12]

Immunization programs in Ontario have eliminated endemic measles, but importations continue to occur.[13]

Measles is rare in York Region (Figure 5.2.1); eight cases were reported between 2000 and 2015 including a cluster of five cases in 2014. Of the total cases, five were male and three were female. Two cases were older children 10 to 19 years of age and the remaining six were adults 20 to 39 years of age.

Figure 5.2.1 Measles, York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	0	0	0	0	0	1	0	0	1	0	0	0	0	0	5	1
YR Incidence Rate	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.1
ON Incidence Rate	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.5	0.1	0.1	0.1	0.0	0.1	0.2	0.1

Outbreaks and Clusters:

- ▲ ***2005***—The single York Region case was imported from India and resulted in 224 York Region contact investigations with public health follow-up.
- ✸ ***2008***—A local measles outbreak was reported in Toronto associated with attending the Ontario Science Centre. One York Region case was associated with this outbreak.[31]
- ▲ ***2014***—A cluster of five cases in York Region was identified. The index case was from China and the disease spread resulting in three secondary cases and one tertiary case. The investigation of this cluster involved 130 contact investigations by York Region.
- ✸ ***2015***—Ontario experienced an increased number of measles cases, some of which were acquired locally.[32] The single York Region case associated with this cluster resulted in public health follow-up of 224 York Region contacts.

5.3 Meningococcal disease, invasive

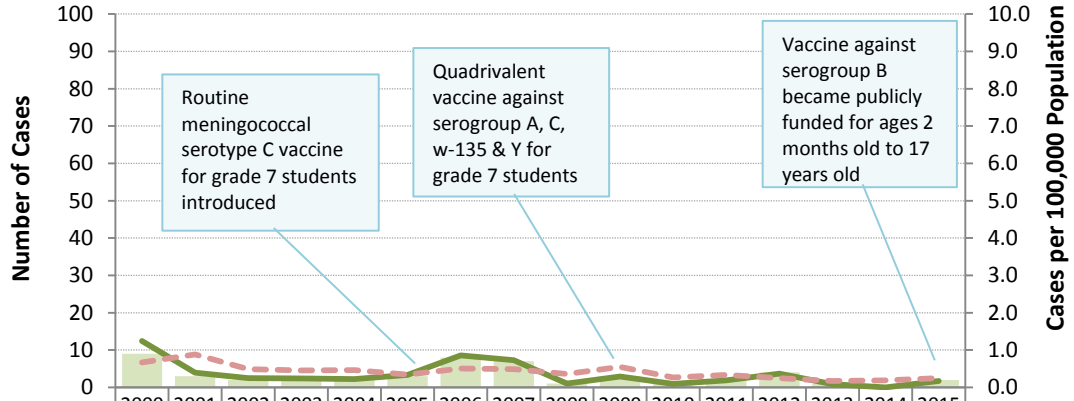
Invasive meningococcal disease is caused by infection with *Neisseria meningitidis* bacteria and results in sudden onset of fever, intense headache, nausea, vomiting, stiff neck and photophobia.[12] Asymptomatic nasopharyngeal carriage of the agent occurs in about five to 10 per cent of the population and approximately one per cent of those with meningococcal colonization progress to invasive disease.[12] Invasive meningococcal disease is a serious illness, causing death in eight to 15 per cent of cases and long-term health consequences in 10 to 25 per cent of those who survive the illness.

Meningococcal bacteria are spread by direct contact with respiratory droplets, mucous and/or saliva from an infected person.[12] Communicability continues until live meningococci are no longer present in discharges from the nose and mouth, usually disappearing 24 hours after starting appropriate antimicrobial treatment. Penicillin will temporarily suppress the organisms but does not eradicate them.

The incubation period of meningococcal disease is commonly three to four days, but can range from two to 10 days.[12] Humans are the sole reservoir.

Invasive meningococcal disease is not commonly reported in Ontario and the annual incidence rates in York Region were similar to the province's rates (Figure 5.3.1). Although there was an overall decrease during this time period, York Region had higher numbers of cases in 2000, 2006 and 2007.

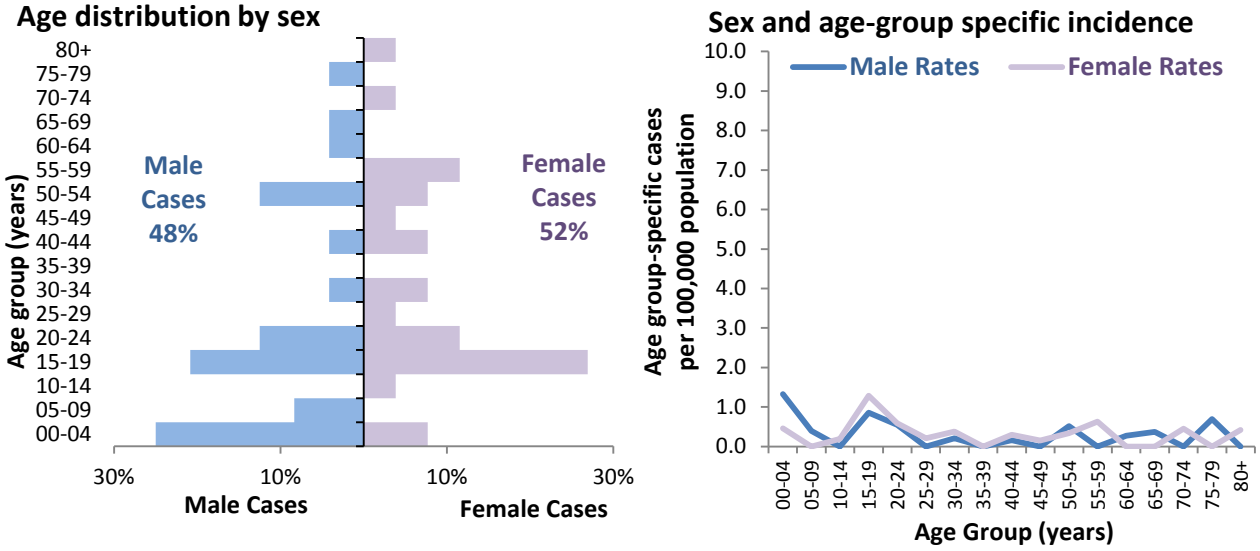
Figure 5.3.1 Meningococcal disease (invasive), York Region, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	9	3	2	2	2	3	8	7	1	3	1	2	4	1	0	2
YR Incidence Rate	1.2	0.4	0.2	0.2	0.2	0.3	0.9	0.7	0.1	0.3	0.1	0.2	0.4	0.1	0.0	0.2
ON Incidence Rate	0.7	0.9	0.5	0.5	0.5	0.3	0.5	0.5	0.4	0.5	0.3	0.3	0.3	0.2	0.2	0.2

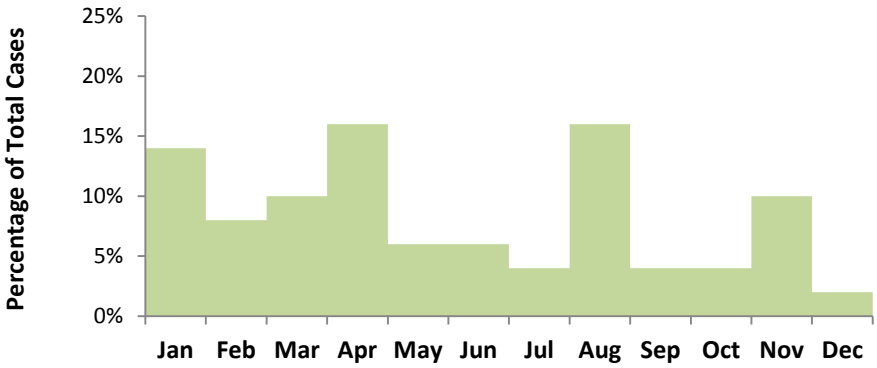
Invasive meningococcal disease case counts were similar for males and females and most common among very young children and adolescents aged 15 to 19 years (Figure 5.3.2).

Figure 5.3.2 Meningococcal disease (invasive), York Region, 2000–2015:



In York Region there was no clear seasonal pattern (Figure 5.3.3); however, there was a peak in the winter months seen for Ontario cases.[13] It has been suggested that infection with the influenza virus that circulates during the winter months enhances the risk of invasive meningococcal disease. [33]

Figure 5.3.3 Meningococcal disease (invasive),York Region, 2000–2015:



Group B was the most common serotype identified, followed by groups Y and C (Table 5.3.1). In Ontario, serogroup C incidence decreased, likely due to impact of the publicly-funded vaccination program first introduced in 2004.[34]

Table 5.3.1 Meningococcal disease (invasive), York Region, 2000–2015:

Serotypes isolated

Agent *(40 isolates)*	**% of isolates**
Group B	40%
Group Y	28%
Group C	25%
Group W-135	8%
Group A	0%

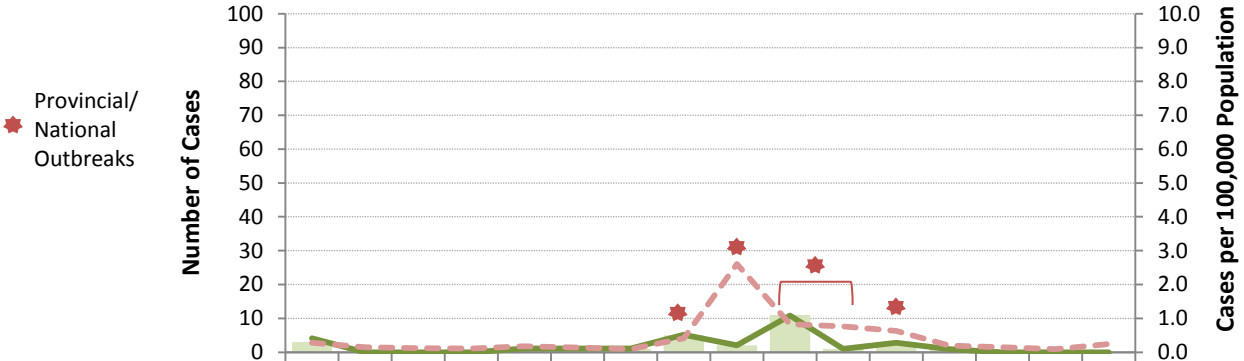
5.4 Mumps

Mumps is a viral illness (caused by paramyxovirus) characterized by fever, swelling and tenderness of one or more of the salivary glands around the cheeks and jaws.[12] The infection was common among infants, children and young adults before a vaccine became available in Canada in 1969 to prevent measles, mumps and rubella.[35] Most people born between 1970 and 1991 have received one dose of the mumps vaccine in the form of a trivalent mumps, measles, rubella (MMR) vaccine.

Mumps spreads easily from person-to-person, through the respiratory secretions of infected individuals when they talk, cough or sneeze. Infection may also be transmitted through sharing food, drinks and kissing.[12] A person with mumps is most infectious one to two days before the onset of salivary gland swelling to five days after. The incubation period ranges from 12 to 25 days, with an average of 16 to 18 days.

Mumps was rare in Ontario with peaks of incidence associated with outbreaks (Figure 5.4.1). There were multiple cases in York Region associated with a 2009 outbreak.

Figure 5.4.1 Mumps,York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	3	0	0	0	1	1	1	5	2	11	1	3	1	0	0	0
YR Incidence Rate	0.4	0.0	0.0	0.0	0.1	0.1	0.1	0.5	0.2	1.1	0.1	0.3	0.1	0.0	0.0	0.0
ON Incidence Rate	0.3	0.1	0.1	0.1	0.2	0.1	0.1	0.4	2.6	0.8	0.8	0.6	0.2	0.1	0.1	0.2

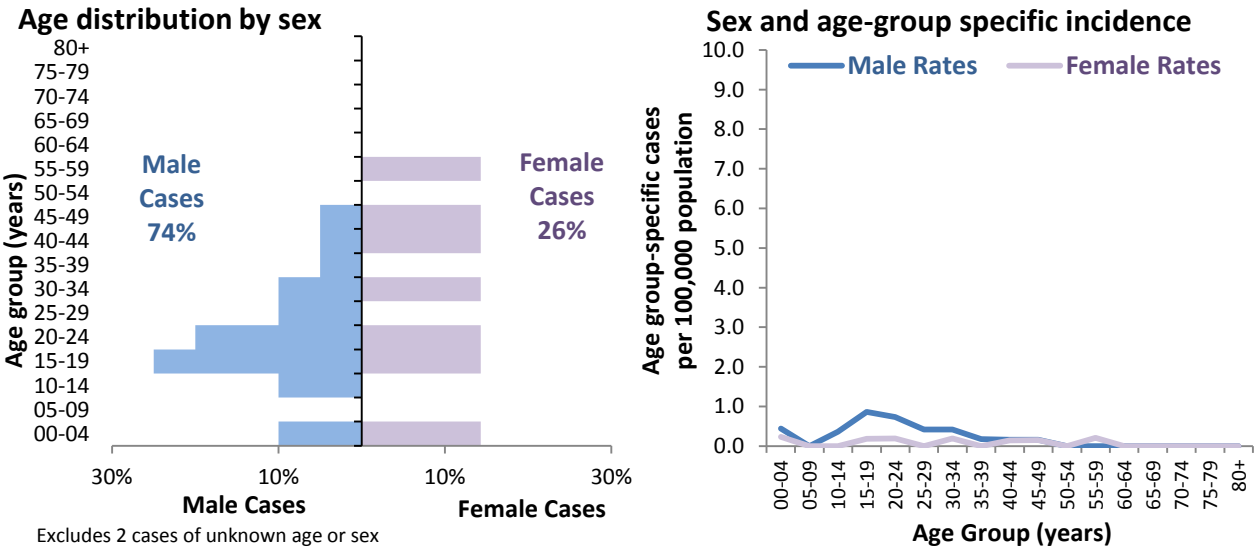
Outbreaks:

- ***2007***—Twenty-eight cases were reported in Ontario and were associated with outbreaks in Nova Scotia and New Brunswick.[36]
- ***2008***—A mumps outbreak was reported in an under-immunized community in Oxford County, where 324 cases were identified and which had links to outbreaks in the Netherlands and British Columbia.[36]
- ***2009–2010***—From September 2009 to June 2010, 167 cases were identified as linked to outbreaks in Quebec and the United States. Eleven York Region cases were linked to one of these outbreaks.[36]
- ***2011***—Thirty-nine cases from nine health units in Ontario were linked to a mumps case in Toronto.[36]

The majority of the mumps cases were male (Figure 5.4.2). The highest age-specific incidence rates were among males aged 15 to 24 years of age. There is a susceptible cohort of individuals born between approximately 1980 and 1992, who likely received only one dose of MMR vaccine and likely

did not acquire natural immunity through infection.[37] This cohort would have been between 17 and 29 years of age in 2009.

Figure 5.4.2 Mumps, York Region, 2000–2015:

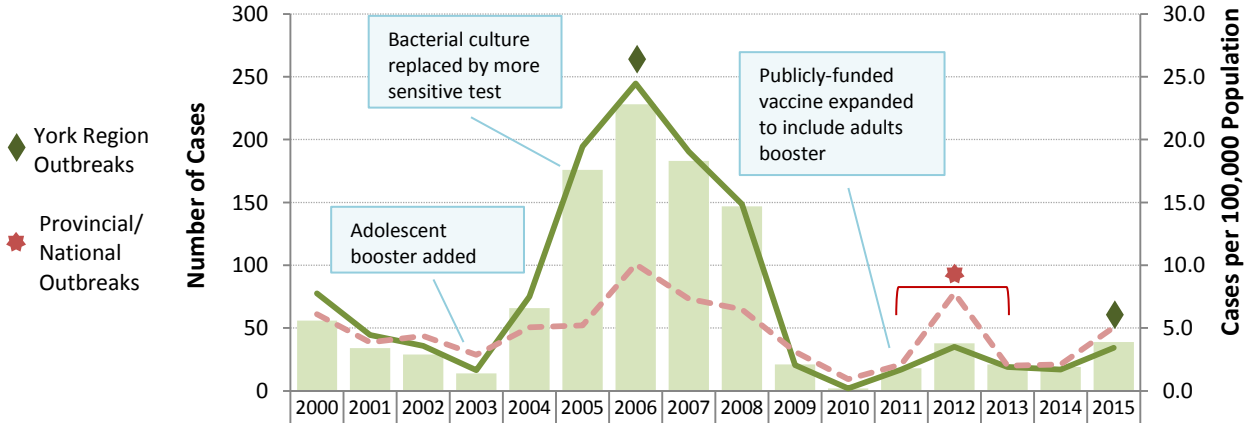


5.5 Pertussis

Pertussis is a highly contagious bacterial disease caused by *Bordetella pertussis* that affects the respiratory tract and is characterized by cough and a tell-tale "whoop" on inhalation.[12] People of any age can become ill with pertussis, but illness is particularly severe in the first year of life and may require hospitalization. The infection is transmitted when an infected person coughs or sneezes, or through direct contact with discharges from the nose or throat of an infected person. Pertussis occurrence is cyclical, with outbreaks of infection occurring every three to four years.[12] The average incubation for pertussis is nine to 10 days, but can range from six to 20 days. Pertussis is highly communicable in the first two weeks, then gradually declines and becomes negligible by three weeks despite persisting cough with "whoop". Patients are no longer considered contagious after five days of treatment with the appropriate antibiotic.

Under Ontario's publicly funded immunization program, an acellular pertussis vaccine is administered to children at two, four and six months of age, with booster doses given at 18 months and at four to six years. A booster at 14 to 16 years of age was introduced in 2003 but uptake was low, [38] and pertussis was not added to the *Immunization of School Pupils Act* as a disease requiring proof of immunization for school attendance until July 2014. In 2011, a single booster dose of pertussis-containing vaccine was introduced for adults 19 to 65 years of age who did not previously receive a dose of the vaccine in adolescence.[38] This was available to all adults over the age of 19 years since December 2014.[4]

Figure 5.5.1 Pertussis,York Region and Ontario, 2000–2015:
Cases and rates



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases	56	34	29	14	66	176	228	183	147	21	2	18	38	21	19	39
YR Incidence Rate	7.8	4.5	3.6	1.7	7.5	19.5	24.5	19.0	14.9	2.1	0.2	1.7	3.5	1.9	1.7	3.4
ON Incidence Rate	6.1	3.9	4.4	2.9	5.1	5.2	10.1	7.3	6.5	3.1	0.9	2.1	7.8	2.0	2.1	5.1

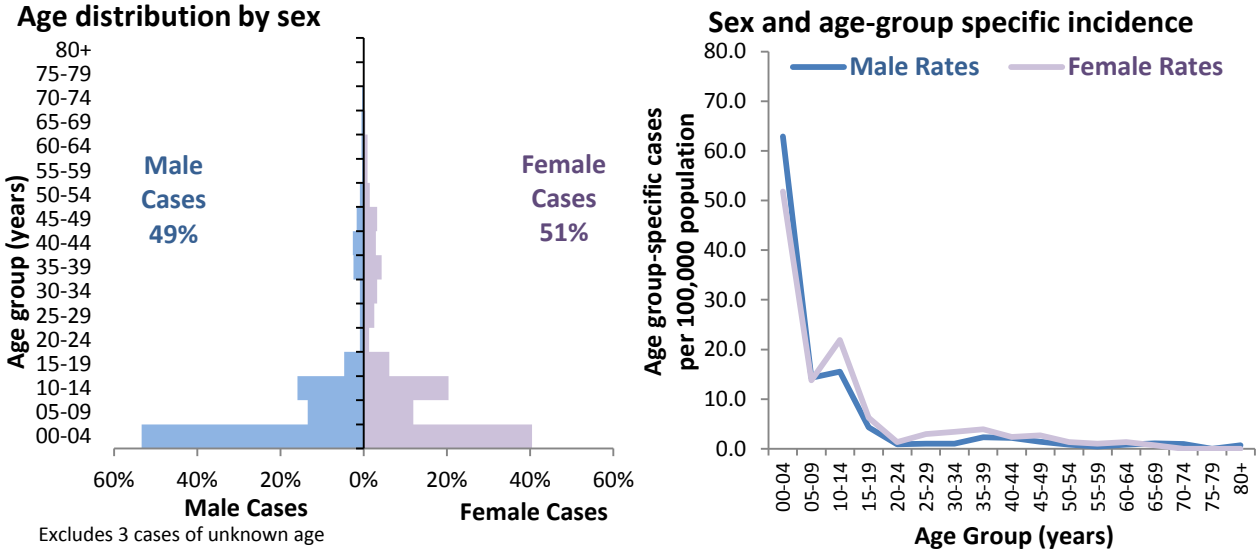
Outbreaks:

- ♦ ***2006***—Fifteen separate outbreaks in York Region were reported that had up to nine cases each.
- ✸ ***2011-2013***—An outbreak was identified in an under-immunized religious community and spread province-wide with 443 cases across seven health units. There were no York Region cases associated with the outbreak.[39]
- ♦ ***2015***—Twenty-seven cases were reported in a York Region outbreak.

Pertussis incidence was highly variable between 2000 and 2015 in York Region (Figure 5.5.1). The rates between 2000 and 2003 decreased, but started increasing again in 2004. Annual incidence rates were markedly high from 2005 to 2008 and substantially higher than Ontario rates. Researchers speculated that, in addition to a true underlying increase in pertussis risk for this time period, improved test sensitivity appeared to cause a rise in laboratory test submissions in the Greater Toronto Area including York Region.[40] From 2009 to 2015 rates were comparable to those seen prior to 2004, with peaks in 2012 and 2015, which were also observed in Ontario. In the 2011 to 2013 period many jurisdictions in Ontario, not including York Region, experienced cases associated with a large outbreak. York Region also had a substantial cluster of cases in 2015.

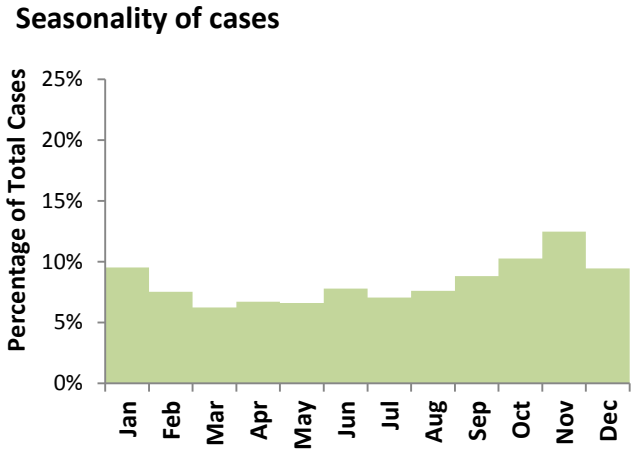
Pertussis cases were equally distributed between males and females (Figure 5.5.2). This is unexpected as incidence is usually higher among females.[12] The vast majority of cases were under 15 years old, with the highest age-specific incidence rates among very young children.

Figure 5.5.2 Pertussis, York Region, 2000–2015:



A moderate seasonal pattern was observed for pertussis with a peak in November (Figure 5.5.3).

Figure 5.5.3 Pertussis, York Region, 2000–2015:



5.6 Pneumococcal disease, invasive

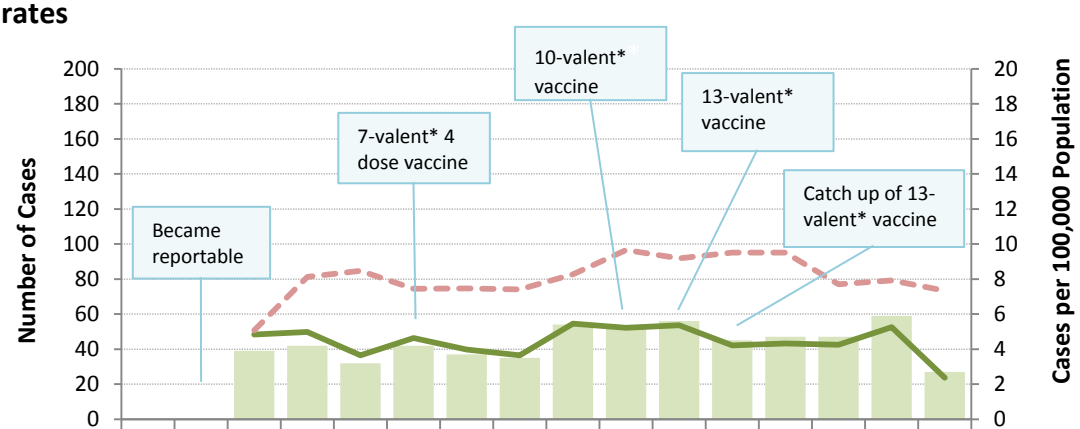
Pneumococcal disease is an infection caused by the bacteria *Streptococcus pneumonia* and results in sudden onset of high fever, rigors, chest pain and productive cough.[12] These bacteria are commonly found in the nose and throat of healthy people. A more serious form of the disease, invasive pneumococcal disease, occurs when the bacteria have infected the blood, lung or the lining of the brain or spinal cord. This infection is most common in the very young, the elderly and those with weakened immune systems.

Pneumococcal bacteria can spread through the air by coughing or sneezing, through direct contact with an infected person's saliva or through items contaminated by an infected person.[12] The incubation period of this disease is not well determined; it may be as short as one to three days. A number of *Streptococcus pneumonia* serotypes are vaccine preventable.

Invasive pneumococcal disease has been reportable in Ontario since 2001.

The incidence of invasive pneumococcal disease remained fairly stable from 2003 to 2014 in Ontario and York Region (Figure 5.6.1). A decline was observed in 2015 for York Region. Annual incidence rates of invasive pneumococcal disease were lower in York Region than Ontario.

Figure 5.6.1 Pneumococcal disease (invasive),York Region and Ontario, 2002–2015:
Cases and rates

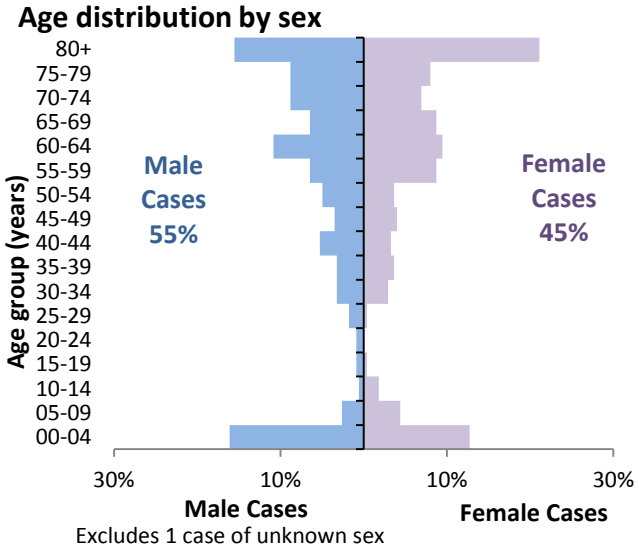


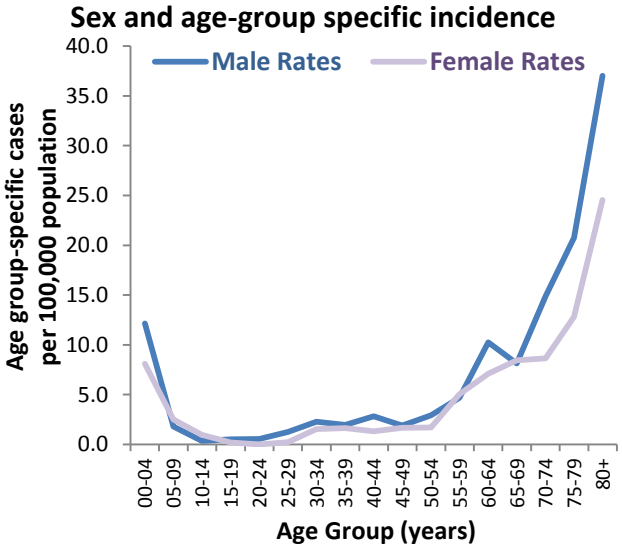
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases			39	42	32	42	37	35	54	53	56	45	47	47	59	27
YR Incidence Rate			4.8	5.0	3.6	4.6	4.0	3.6	5.5	5.2	5.4	4.2	4.3	4.3	5.3	2.4
ON Incidence Rate			5.1	8.1	8.5	7.4	7.5	7.4	8.3	9.7	9.2	9.5	9.5	7.7	7.9	7.3

* Valence number is the number of serotypes that are included in the vaccine (i.e., a 7-valent vaccine protects against seven serotypes of the bacteria).

Although cases occurred in all age groups, age-specific incidence rates were highest among children under five and seniors, with higher rates among males in these age groups (Figure 5.6.2).

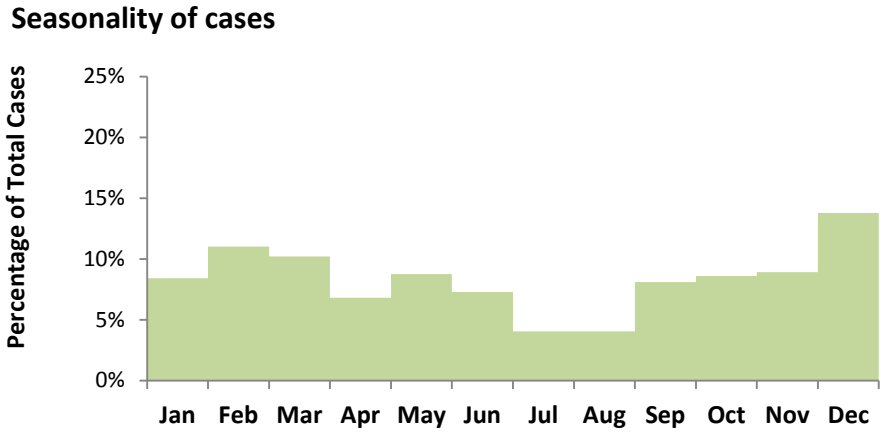
Figure 5.6.2 Pneumococcal disease (invasive), York Region, 2002–2015:





Invasive pneumococcal disease had a seasonal pattern with a peak in December and lows in July and August (Figure 5.6.3). This pattern may be influenced by influenza virus, as there is evidence that suggests influenza increases the risk of invasive disease in colonized individuals.[41]

Figure 5.6.3 Pneumococcal disease (invasive), York Region, 2002–2015:



For isolates that were further differentiated by serotype, 19A was the most common serotype encountered, followed by 22F, 3 and 7F (Table 5.6.1). Types 19A and 3 were added to the publicly-funded vaccine in 2010.

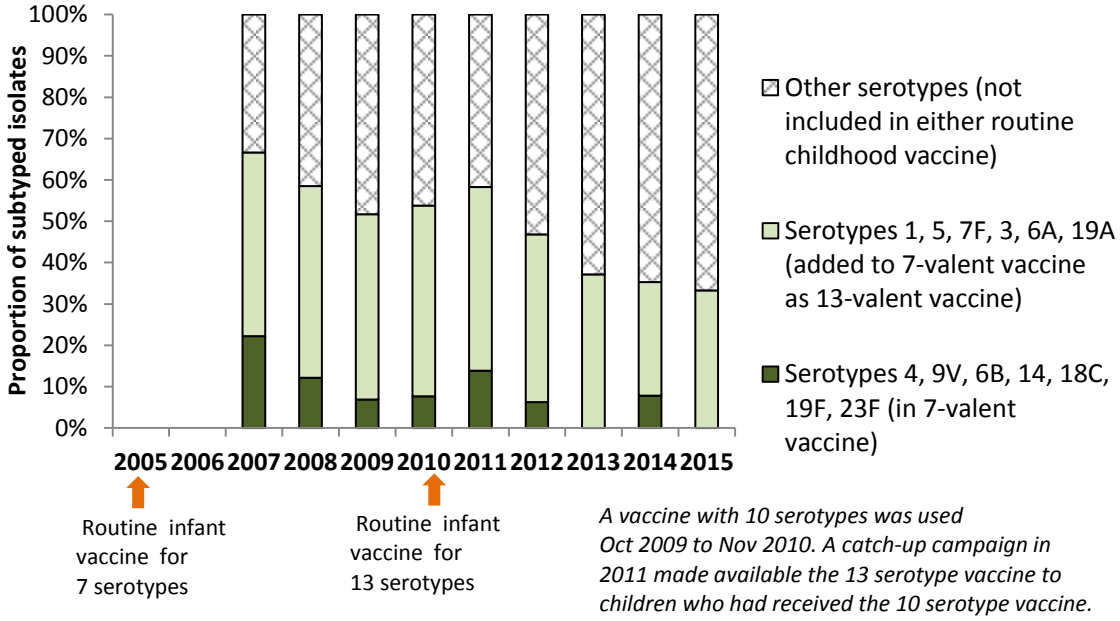
Table 5.6.1 Pneumococcal disease (invasive), York Region, 2002–2015: Serotypes isolated

Vaccine	Serotype *(340 isolates)*	% of isolates
In 7-valent, 10-valent; 13-valent and 23-valent vaccines	4	1%
	9V	1%
	6B	2%
	14	1%
	18C	<1%
	19F	2%
	23F	1%
In 10-valent; 13-valent and 23-valent vaccines	1	<1%
	5	0%
	7F	9%
In 13-valent and 23-valent vaccines	3	9%
	6A	2%
	19A	20%
In 23-valent vaccine	2	0%
	8	2%
	9N	3%
	10A	1%
	11A	4%
	12F	1%
	15B	3%
	17F	1%
	20	0%
	22F	10%
	33F	1%
Not in a vaccine	All other serotypes	27%

Impact of vaccination on pneumococcal serotypes

Although the overall incidence of invasive pneumococcal disease remained fairly stable from 2007 to 2014, the bacterial serotype-specific incidence did change (Figure 5.6.4). The proportion of cases attributed to serotypes covered by childhood vaccination decreased markedly over the time period. There is some evidence that childhood vaccination also affects the serotypes isolated from age groups not targeted for immunization through herd effects.[13]

Figure 5.6.4 Pneumococcal disease (invasive), York Region, 2007–2015:
Proportion of subtyped cases by vaccine componants



A vaccine with 10 serotypes was used Oct 2009 to Nov 2010. A catch-up campaign in 2011 made available the 13 serotype vaccine to children who had received the 10 serotype vaccine.

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6

Vector-borne and zoonotic diseases

Table 6.0 Vector-borne and zoonotic Diseases:

Annual cases, York Region, 2000–2015

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	NOTES
Anthrax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No cases in Ontario since 1991†
Brucellosis	0	0	0	0	0	2	0	0	1	0	0	0	0	1	0	0	
Creutzfeldt-Jakob Disease	0	0	0	0	0	1	0	0	1	2	0	1	0	2	3	0	
Hantavirus pulmonary syndrome		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Since becoming reportable in 2001 no cases have been reported in Ontario
Hemorrhagic fevers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No cases reported in Canada since 2002
Lyme Disease (confirmed)	3	2	4	1	5	4	0	2	2	2	1	3	2	13	6	7	
Lyme Disease (probable)								2*		0	1	2	2	3	3	2	Became reportable in 2009
Malaria	6	6	8	4	12	6	5	8	10	12	15	10	10	8	12	6	
Plague	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No York Region cases since 1991†
Psittacosis/ Ornithosis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No York Region cases since 1991†
Q fever	3	0	0	1	0	0	0	0	0	0	1	1	1	0	1	0	
Rabies (human)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Ontario's last domestic case in 1967
Tularemia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No York Region cases since 1991†
West Nile virus illness			14	3	1	5	3	2	4	0	0	1	17	1	1	1	Cases reported in York Region since 2002
Yellow fever	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No York Region cases since 1991†

*Symptom onset in 2007 for cases reported after probable case definition inclusion in 2009. †Electronic reporting started in 1991.

Vector-borne diseases are bacterial, viral or parasitic infections that are transmitted to humans by mosquitoes, ticks, fleas and flies (i.e., vectors), or from an infected host (e.g., birds, mice, other mammals). Zoonotic diseases are bacterial, viral or parasitic infections that are transmitted freely between species under natural conditions. These diseases are typically transmitted from animals to humans. Creutzfeldt-Jakob disease has been included in this chapter, as it is part of a group of rare progressive neurodegenerative (prion) disorders that affect both humans and animals.

Table 6.0 highlights the York Region cases of reportable vector-borne or zoonotic diseases in Ontario.

- Brucellosis occurs mainly among travelers to endemic areas and those handling infected animals.[1]
- Viral hemorrhagic fevers such as Ebola virus disease, Marburg virus disease and Lassa fever have never been reported in York Region. [2]
- Malaria, a protozoan-caused illness transmitted by mosquitoes,[3] occurs among individuals who travel from malaria endemic countries.[2] Similarly, all five cases of yellow fever reported in Ontario from 2005 to 2014 were travel-related.[2]
- Q fever is a bacterial illness usually transmitted to humans from infected sheep, goats and cattle, often through contact with placental tissue or birth fluids.[3] From 2000 to 2015, there were eight cases reported among York Region residents. In Ontario, there were peaks of incidence of Q fever in 2011 and 2012, thought to be attributed in part to increases in the recognition among farmers taking part in the Ontario Q fever study.[2]
- Indigenous rabies has not been reported in Ontario since 2000; however, there was a case from Toronto associated with out-of-country travel reported in 2012.[2,4] Rabies is endemic in some Ontario wildlife. There were 29 cases of animal rabies reported in Ontario in 2015.[5] The rabies strains isolated included bat rabies, raccoon rabies and fox rabies.

This report focuses on Lyme disease and West Nile virus.

Highlights

- Many of the reportable vector-borne and zoonotic diseases are very rare in York Region.
- Incidence of Lyme disease in York Region is increasing.
- Incidence of West Nile virus illness (WNV) peaked in 2002 and again in 2012.
- WNV and Lyme disease, both vector-borne diseases endemic in Ontario, are much more common in the summer months.
- Malaria does not circulate in Ontario, but imported cases of malaria occur amongst York Region residents.

6.1 Lyme disease

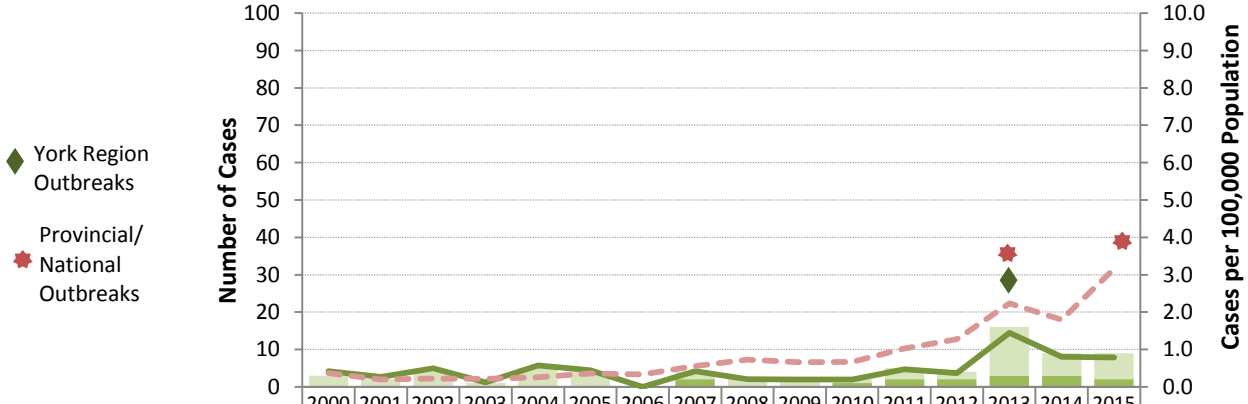
Lyme disease in North America is an illness spread through the bite of a blacklegged tick—also known as a deer tick—that is infected with the *Borrelia burgdorferi* bacteria.[6] Not all ticks are infected with the bacteria, so not all tick bites spread Lyme disease. Lyme disease does not spread from person-to-person. There are other species of *Borrelia* in Europe and Asia not endemic to Ontario that also cause Lyme disease.[3]

The case classification of Lyme disease in Ontario is unique in that some cases with inconclusive or no laboratory evidence of the organism are classified as confirmed if these cases present with clinical evidence of Lyme disease and were exposed to ticks in an area where Lyme disease is endemic, or the blacklegged tick has been found.[7] If there is no such known exposure the case is classified as probable. Therefore, a probable case of Lyme disease may suggest new locations of Lyme disease transmission.

The Ontario annual incidence rates of Lyme disease increased in recent years (Figure 6.1.1), whereas York Region rates increased to a lesser extent, with a peak of cases in 2013. Ontario has also had an increase of Lyme disease endemic areas and blacklegged tick populations.[8]

Figure 6.1.1 Lyme disease, York Region and Ontario, 2000–2015:

Cases and rates



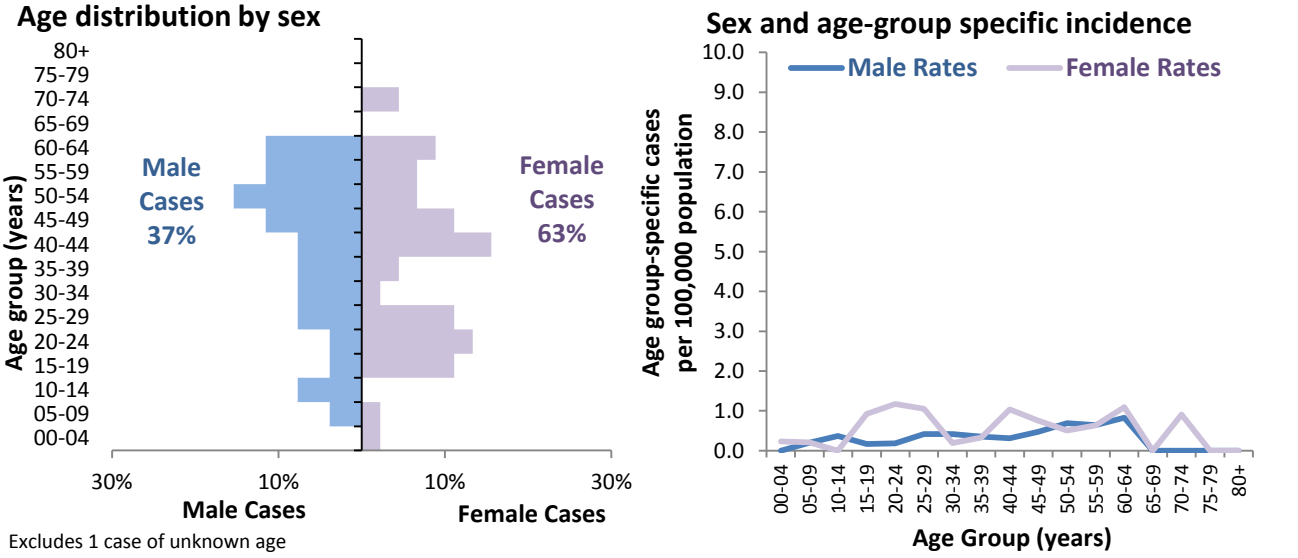
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases Confirmed	3	2	4	1	5	4	0	2	2	2	1	3	2	13	6	7
YR Cases Probable								2		0	1	2	2	3	3	2
YR Incidence Rate	0.4	0.3	0.5	0.1	0.6	0.4	0.0	0.4	0.2	0.2	0.2	0.5	0.4	1.4	0.8	0.8
ON Incidence Rate	0.4	0.2	0.2	0.2	0.3	0.4	0.3	0.6	0.7	0.7	0.7	1.0	1.3	2.2	1.8	3.2

Outbreaks:

- ***2013***—An increase in the number of York Region Lyme cases was identified and found to be associated with travel to blacklegged tick endemic areas.[9]
- ***2013***—An increase in the number of provincial Lyme cases was identified, with many cases being identified in eastern Ontario and other areas where blacklegged tick submissions are high.[10]
- ***2015***—An increase in the number of provincial Lyme cases was identified.[8] Also, there is evidence of vector spread, with a new risk area identified in Rouge Park.

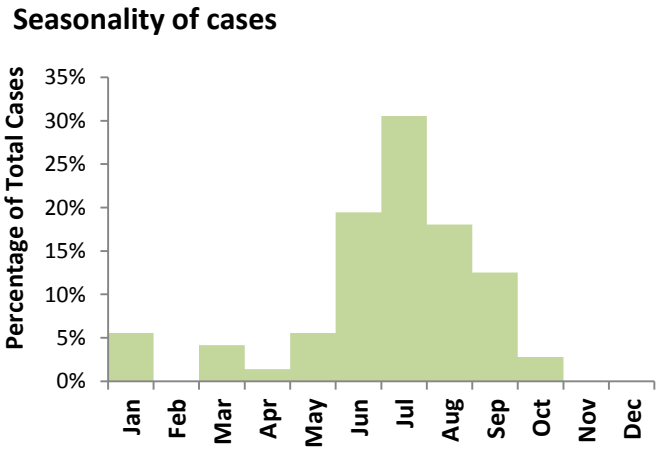
Lyme disease occurred more often in females and occurred across adult age groups but rarely among seniors or children (Figure 6.1.2).

Figure 6.1.2 Lyme disease, York Region, 2000–2015:



As expected, Lyme disease showed a strongly seasonal pattern with a peak in July (Figure 6.1.3), which aligns with the nymphal stage of the blacklegged tick's life cycle.[3]

Figure 6.1.3 Lyme disease, York Region, 2000–2015:



Almost all reported Lyme disease cases in York Region were attributed to *Borrelia burgdorferi* (Table 6.1.1), the species endemic in North America.

Table 6.1.1 Lyme disease, York Region, 2000–2015:

Agents isolated

Agent *(72 isolates)*	**% of isolates**
Borrelia burgdorferi	96%
Borrelia afzelii	4%

Lyme disease exposure locations

There are several endemic and risk areas currently identified in Ontario.[11] Endemic areas in Ontario include Point Pelee and Thousand Islands National Parks, Rondeau, Long Point and Turkey Point Provincial Parks, Wainfleet Bog and Prince Edward Point. Risk areas are defined as areas within a 20 kilometre radius from where blacklegged ticks are found through tick dragging. The risk areas

identified in Ontario include locations on the north eastern shore of Lake Ontario (i.e., Kingston area), St. Lawrence Valley, locations along the Ottawa River, northwestern Ontario near Lake of the Woods, Pinery Provincial Park on the eastern shore of Lake Huron and Rouge Valley in eastern Toronto. As of June 2016, the only risk area identified by Public Health Ontario in York Region is located at the southeast portion along the Toronto/Durham Region border. The reported exposures of York Region Lyme disease cases are described in Table 6.1.2.

Table 6.1.2 Lyme disease, York Region, 2008–2015:
Exposure within endemic/risk areas

Exposure Area *(47 confirmed and probable cases)*	**Number of Cases**	**Proportion of those with known exposure**
Travel to either an endemic or risk area in Ontario	13	28%
Travel to neighbouring provinces or states known to be endemic areas, but no travel within endemic/risk areas in Ontario	6	13%
Other travel outside of Ontario (e.g., Europe)	21	45%
Travel outside of York Region, only within non-endemic and non-risk areas in Ontario	5	11%
Only York Region exposure locations where the disease is not known to be circulating in the environment	2	4%

Excludes 2 cases with unknown exposure locations

Reported proportions do not sum to 100% due to rounding.

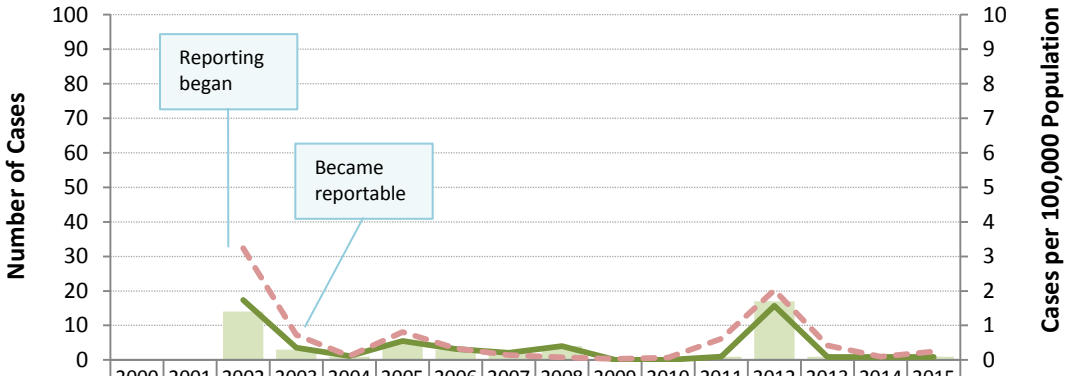
6.2 West Nile virus illness (WNV)

West Nile virus (WNV) is a mosquito-borne virus that can cause serious illness in humans.[3] WNV appeared in North America in 1999 and the first known human case of WNV in Ontario was reported in 2002.[8] The primary amplifying hosts of WNV are birds.[3] Mosquitoes become infected when they bite an infected bird and WNV is mainly passed to humans by the bite of an infected mosquito. Rarely, WNV can also be transmitted through infected blood during a transfusion but is not spread person-to-person otherwise.

WNV was added to the provincial reportable diseases in 2003.[8] While WNV became reportable in Ontario during 2003, cases have been reported in York Region since 2002 and are presented in this report.

The highest annual rates of WNV in Ontario and York Region occurred when first introduced in 2002 and in 2012, with a small peak in 2005 (Figure 6.2.1). For other years in York Region, there was a median of one case reported per year. WNV occurs episodically and factors that contribute to outbreaks of WNV are complex and interrelated.[12] Environmental factors, such as warmer temperatures, contribute to increases in WNV.

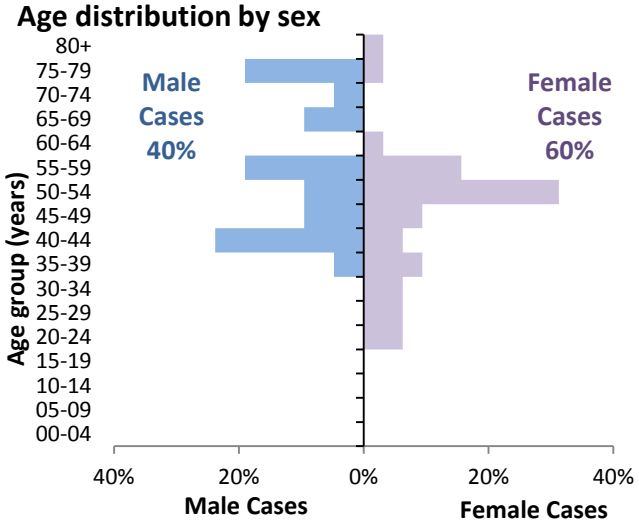
Figure 6.2.1 West Nile virus,York Region and Ontario, 2002–2015:
Cases and rates

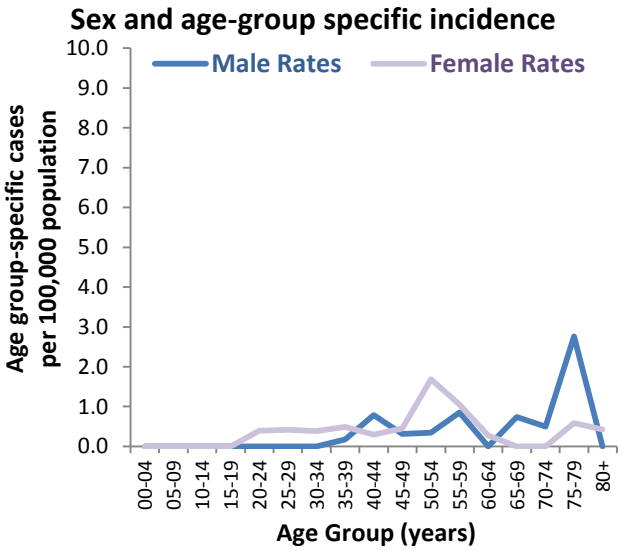


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
YR Cases			14	3	1	5	3	2	4	0	0	1	17	1	1	1
YR Incidence Rate			1.7	0.4	0.1	0.6	0.3	0.2	0.4	0.0	0.0	0.1	1.6	0.1	0.1	0.1
ON Incidence Rate			3.2	0.7	0.1	0.8	0.3	0.1	0.1	0.0	0.1	0.6	2.0	0.4	0.1	0.2

More WNV cases were female and there were no cases among children (Figure 6.2.2).

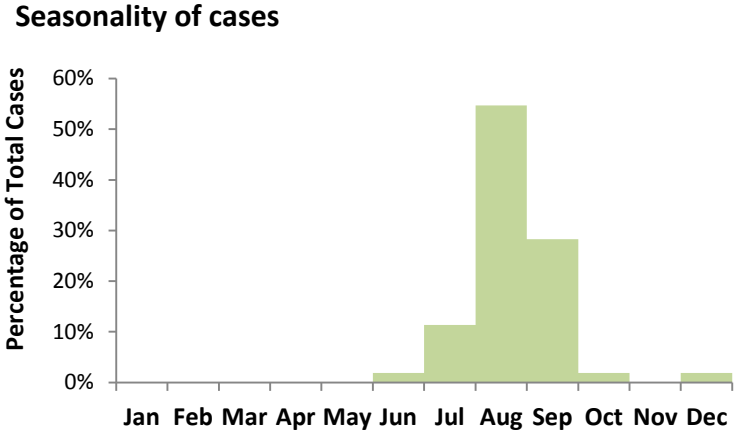
Figure 6.2.2 West Nile virus, York Region, 2002–2015:





WNV was highly seasonal; the peak of cases occurred in August (Figure 6.2.3).

Figure 6.2.3 West Nile virus illness, York Region, 2000–2015:



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7

Outbreaks

An outbreak can be defined as an increase in the number of cases of illness within a community that exceeds what can normally be expected.[1] Therefore, when determining if an outbreak exists, it is done relative to the usual frequency of the disease in the same area, among the same population, at the same season of the year.[1]

Outbreaks are generally under-reported for various reasons:

- Individuals may not know to report clusters of disease incidence to public health
- Outbreaks comprised of individuals with less severe symptoms may go unreported
- Outbreaks without individuals seeking medical care and subsequent testing may go unreported
- Outbreaks due to non-reportable organisms are not reported by laboratories

Outbreaks in the community are less likely to be reported because cases may not know about each other's illness whereas outbreaks in institutions are more easily detected when cases are located in the same place. Therefore, the number of reported outbreaks likely underestimates the true burden of outbreak-related illness in York Region.

Highlights

- York Region Public Health investigates approximately 100 outbreaks each year.
- Enteric and respiratory outbreaks are seasonal, occurring more often in the winter months.
- Organisms are isolated for just under half of the outbreaks with enteric symptoms.
- Organisms are isolated in over two-thirds of outbreaks with respiratory symptoms.

7.1 Enteric outbreaks

Enteric illnesses are frequently characterized by diarrhea, nausea, vomiting, abdominal cramps and fever. They can be transmitted by ingesting contaminated food or water, exposure to infected vomit or feces and direct or indirect contact with infected persons, animals or contaminated objects.[2] Examples of pathogens which cause enteric illnesses include norovirus and *Salmonella*. Young children, the elderly and those with weakened immune systems are at greater risk for complications from these pathogens.

York Region Public Health investigated approximately 60 outbreaks with enteric symptoms each year, but the number was variable from year to year (Figure 7.1.1).

The majority of these outbreaks occurred in institutions such as hospitals, long-term care homes, retirement homes or childcare facilities. Enteric outbreak investigations in institutions are initiated when three or more individuals with similar enteric symptoms occur within a 48-hour period in the facility.[3] The majority (59 per cent) of institutional enteric outbreaks did not have laboratory samples taken from ill individuals or a causative organism isolated. For outbreaks with an agent isolated, almost all were viruses (Table 7.1.1).

Enteric outbreak investigations in the York Region community are initiated when two or more epidemiologically linked people develop acute illness with similar signs and symptoms typically characterized by nausea, vomiting, diarrhea and other gastrointestinal symptoms.

Figure 7.1.1 Enteric outbreaks, York Region , 2008–2015:

Outbreaks by etiologic agent

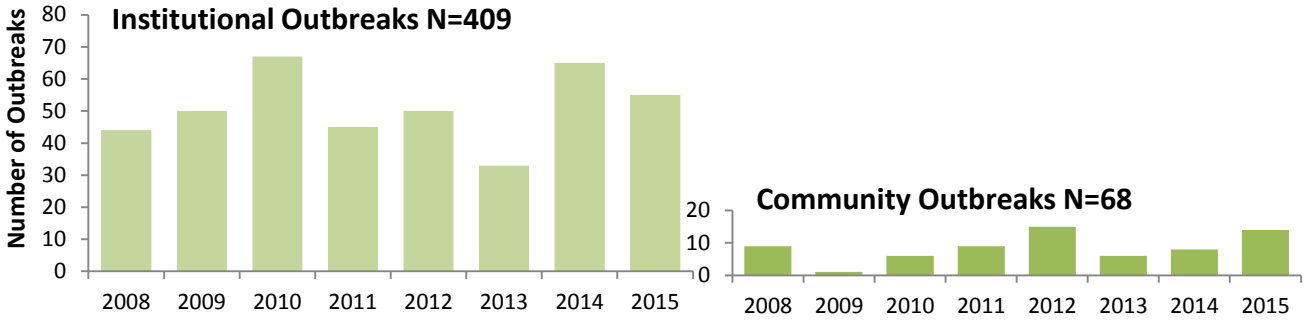


Table 7.1.1 Enteric outbreaks, York Region, 2008–2015:

Agents isolated

Agent	% of outbreaks
Institutional Outbreaks *(169 outbreaks)*	
Norovirus	88%
Rotavirus	5%
Other viral agent	3%
Other agent (*Clostridium difficile*, *Clostridium perfringens*, *Giardia*, *Salmonella*, *Shigella*, VRE)	4%
Community Outbreaks *(34 outbreaks)*	
Norovirus	65%
Salmonella	12%
Campylobacter	9%
Verotoxin-producing *E. coli*	6%
Other agent (*Clostridium perfringens*, *Cryptosporidia*, *Shigella*)	9%

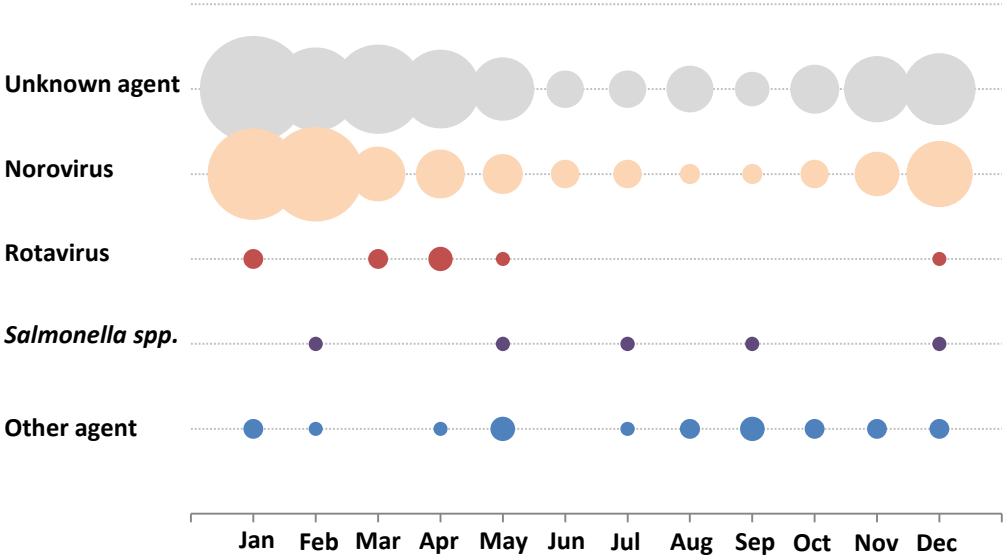
Percentage is among outbreaks with an isolated agent. Some outbreaks had multiple agents isolated. Each outbreak was counted once, classified under the primary agent.

Reported proportions do not sum to 100% due to rounding.

Norovirus is the most common cause of sporadic enteric illness as well as causing outbreaks,[1] and was the most common organism isolated in York Region outbreaks with enteric symptoms. As few as 18 particles can result in norovirus infection, yet an infected person can shed billions of particles. This makes norovirus highly contagious.[4] Norovirus outbreaks occurred throughout the year in York Region (Figure 7.1.2); however, outbreaks were more frequently reported from December to February. Norovirus outbreaks lasted a median of 10 days.

Outbreaks caused by bacterial agents occurred throughout the year (Figure 7.1.2).

Figure 7.1.2 Enteric outbreaks, York Region , 2008–2015:
Seasonality by etiologic agent



Some outbreaks had multiple agents isolated. Each outbreak was counted once, classified under the primary agent.

7.2 Respiratory outbreaks

Respiratory infections affect the upper or lower respiratory tract and may be caused by viruses or bacteria. Symptoms of respiratory infection may include coughing, sneezing, runny nose, sore throat and fever.

York Region Public Health investigated approximately 40 outbreaks with respiratory symptoms per year from 2008 to 2015. The annual number of respiratory outbreaks varied (Figure 7.2.1), with the highest number in 2014. This increase was driven in part by the 2014–15 influenza season, which had a high number of cases and had an unusually high number of influenza outbreaks (Table 5.1.1).

The vast majority of respiratory outbreaks occurred in institutional settings. The criteria for defining an outbreak have changed slightly over the time period. The current criteria include: two cases of acute respiratory illness within 48 hours if one of these cases has a laboratory diagnosed infectious agent or the cases are from separate units, or three cases of acute respiratory illness within 48 hours on a unit/floor.[5]

Seventy-seven per cent of institutional respiratory outbreaks had a causative organism isolated from at least one ill individual (Table 7.2.1). All identified agents were viral and influenza was most often isolated. Almost half of the institutional outbreaks were attributed to influenza and these outbreaks lasted a median of seven days.

There were very few outbreaks with respiratory symptoms identified in non-institutional settings; and most were influenza. Two community outbreaks of pertussis were also investigated.

Figure 7.2.1 Repiratory outbreaks, York Region , 2008–2015:

Outbreaks by etiologic agent

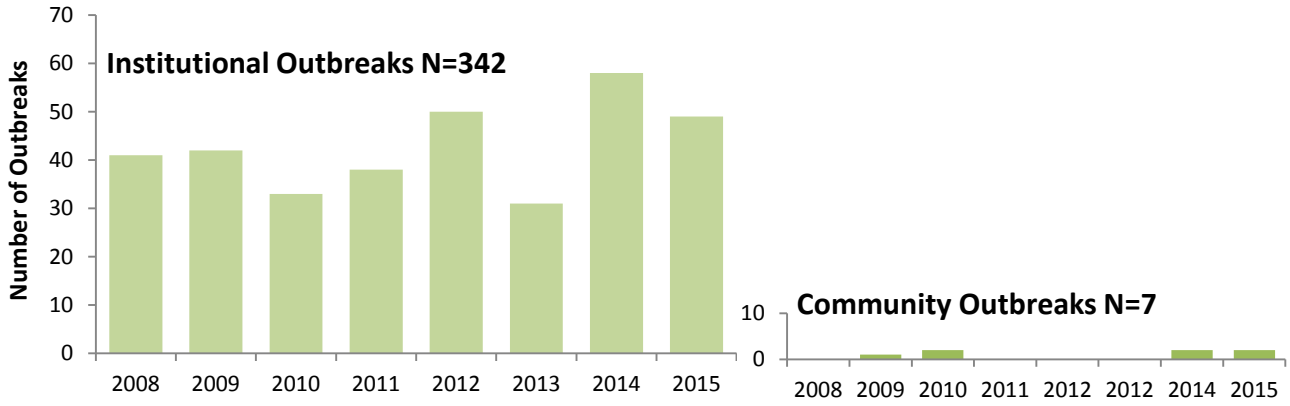


Table 7.2.1 Respiratory outbreaks, York Region, 2008–2015:

Agents isolated

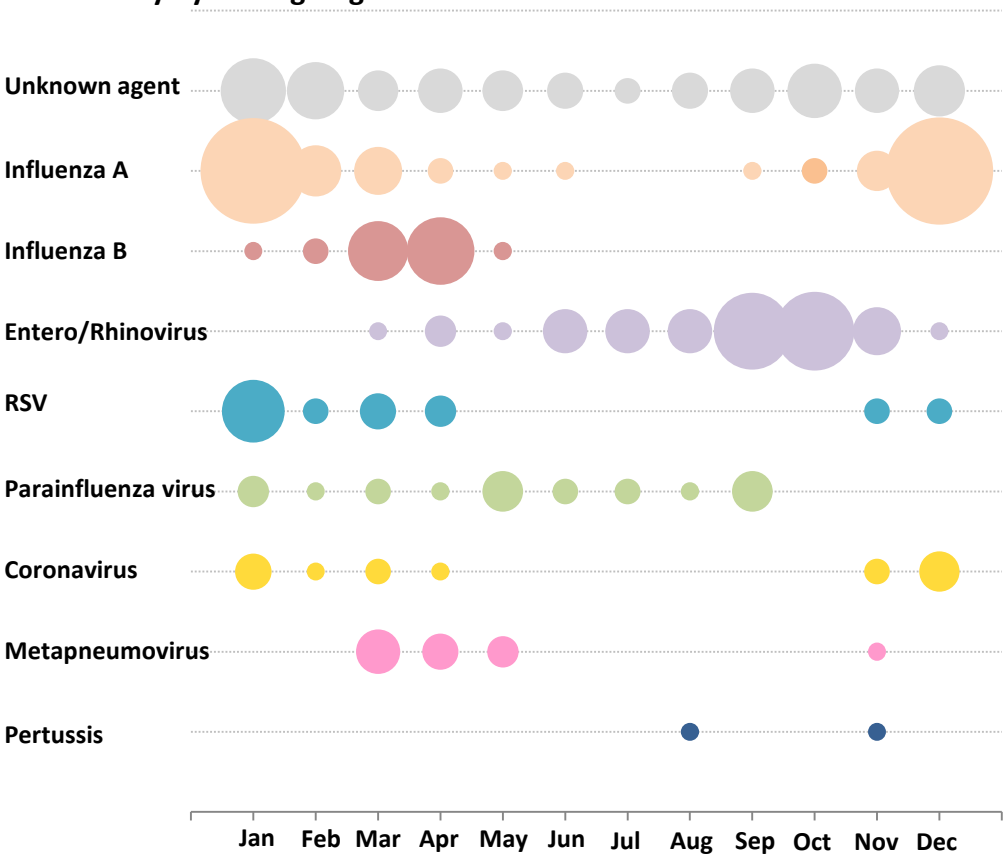
Agent	% of outbreaks
Institutional Outbreaks *(264 outbreaks)*	
Influenza	45%
Entero/Rhinovirus	26%
Respiratory Syncytial virus	10%
Parainfluenza virus	8%
Coronavirus	6%
Metapneumovirus	5%
Community Outbreaks *(7 outbreaks)*	
Influenza	71%
Pertussis	29%

Percentage is among outbreak with an isolated agent. Some outbreaks had multiple agents isolated. Each outbreak was counted once, classified under the primary agent.

Respiratory outbreaks without an agent identified were seasonal with a peak occurence in January (Figure 7.2.2). Influenza A outbreaks occurred almost exclusively in the winter months, peaking in December and January, whereas influenza B outbreaks were more frequent in March and April. This is consistent with the seasonality of community cases.

Respiratory syncytial virus (RSV) outbreaks were also seasonal, with the greatest number reported in January. Coronavirus outbreaks were also more commonly reported in the winter. Outbreaks attributed to enterovirus or rhinovirus occurred in most months, but were more frequently reported in September and October. Parainfluenza outbreaks occurred from January to September with no clear pattern. Almost all metapneumovirus outbreaks occurred in the spring.

Figure 7.2.2 Respiratory outbreaks, York Region , 2008–2015:
Seasonality by etiologic agent



Some outbreaks had multiple agents isolated. Each outbreak was counted once, classified under the primary agent.

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8

The impact of global disease events on York Region

This chapter highlights select global events that have occurred between 2000 and 2015 and have involved reportable diseases mentioned or discussed in this report. In addition to responses at the international, national and provincial level, these have also required coordination and response by Ontario public health units. This report provides general information about these epidemics and pandemics and describes York Region's involvement in these global events.

8.1 SARS

Severe acute respiratory syndrome (SARS) is a respiratory viral illness that is characterized by fever, cough, shortness of breath and difficulty breathing.[1] It is a novel virus that initially originated in China, where unusual acute respiratory illness activity was reported in November 2002. Little was known about the respiratory illness at that time but it quickly spread throughout the world and resulted in a large epidemic in early 2003.[2] During this epidemic, 8,096 probable cases were reported globally, with 774 deaths.[3] The countries most affected by SARS were China (including Hong Kong), Taiwan, Singapore and Canada.

SARS was first identified in York Region in March 2003.[4] This was following the transfer of a patient from The Scarborough Hospital–Grace site to Mackenzie Richmond Hill Hospital (formerly known as York Central Hospital). This patient had been in close contact with a SARS case in the emergency department prior to being transferred.[2] This resulted in the spread of the virus within the hospital and closure of the hospital to new patients for approximately three weeks beginning at the end of March. During the period of March to July 2003, two SARS outbreak were identified. The first outbreak occurred between March 15 and May 14 and the second outbreak occurred between May 23 and July 5. Across both outbreaks there were 17 different exposure sites identified. In addition to the hospital closure, one retirement home, one school, two workplaces and one retail outlet were closed or had full screening activities conducted on site. York Region was the second largest epicentre in North America during this outbreak.[4] A total of 251 probable cases were reported in Canada.[3] There were 88 SARS cases in York Region, with 16 hospitalizations and eight deaths.[4] All cases acquired the disease in Ontario and 46 per cent of cases were exposed to SARS while working in healthcare settings. During the outbreak, York Region Public Health investigated and followed-up with over 21,000 contacts, quarantined more than 5,000 individuals and screened and assessed 1,153 patients in a 44-day period at the SARS Assessment Clinic. This outbreak required collaboration between public health and other regional departments, hospitals, police, fire, long-term care facilities and other community and government agencies in order to develop a comprehensive response to the outbreak.

This epidemic truly imposed a challenge on healthcare systems across the world due to the novelty of the disease, which meant that there were no tests to confirm diagnosis of the disease and no vaccine. Discussions of the case definition, treatment recommendations and case and contact management continued throughout the response. The SARS outbreak resulted in governmental changes within York Region, as well as provincially and nationally, including: changes in outbreak response and management; changes and clarity in infection control procedures; improvements to surveillance practices; and improvements in communication processes between levels of government and institutions.

8.2 H1N1

In 2009, a novel influenza A (H1N1) virus emerged and resulted in an influenza pandemic. This virus had not previously been identified in humans or other animals.[5] The first few cases in Canada occurred in April 2009. The pandemic had two distinct waves. The first wave occurred between April and August 2009 and the second wave was between September 2009 and January 2010 in Canada. The World Health Organization declared that the world was in the post-pandemic phase in 2010. The second wave had four to five times more hospitalizations and deaths compared to the first wave. At least 18,500 deaths were recorded globally during the pandemic. However, this is believed to be an underestimate since many deaths are not tested or associated to influenza.[6]

During the first wave of the pandemic, there were 532 confirmed influenza A H1N1 cases in York Region. [7] During the second wave, there were 361 confirmed cases of H1N1. Since testing for H1N1 was limited to severe cases, the number of cases associated with the pandemic is underestimated.

During this pandemic, York Region Public Health operated five mass immunization clinics in the community to vaccinate as many residents as possible.[7] More than 106,000 doses of the H1N1 influenza vaccine were administered by York Region Public Health during the immunization clinics. York Region also worked with healthcare providers to distribute the H1N1 vaccine. By the end of February 2010, more than 549,000 H1N1 vaccine doses were distributed to healthcare providers in York Region. York Region also operated two community flu assessment centres to assess residents with mild to moderate influenza-like symptoms and provide access to antiviral treatment. A total of 585 individuals with influenza-like symptoms were seen at the York Region assessment centres. This was in addition to flu assessment centres operated by the three York Region hospitals.

8.3 Ebola

Ebola virus disease (EVD) is a severe acute illness caused by a virus in the family *Filoviridae* and has been fatal in many cases.[8] The natural reservoir host of the virus is believed to be forest-dwelling fruit bats. Transmission of the virus can occur by contact with infected mammals and by person-to-person transmission through contact with infected bodily fluids (e.g., blood, urine, semen, vomit) and organs.

EVD was first recognized in two outbreaks that had occurred in 1976 in Democratic Republic of Congo and Sudan.[8] Outbreaks have occurred since 1976 to present in Africa. However, the largest outbreak of EVD to date was reported in 2014 in West Africa and continued into 2016. The countries primarily affected by this outbreak were Guinea, Sierra Leone and Liberia.[9] Other countries that had cases or had cases imported were Senegal, Nigeria, Mali, Italy, Spain, United Kingdom and United States. There were more than 28,600 cases and 11,300 deaths associated with this outbreak.

During this time period, Public Health Agency of Canada quarantine officers screened travelers from Sierra Leone, Guinea and Liberia and orders were issued to these individuals to report to public health should they develop any symptoms.[10] Local public health units were notified of travelers from an EVD affected country and were responsible for monitoring and providing education to these travelers for a 21-day monitoring period. This involved providing information on EVD compatible symptoms, providing recommendations to limit certain activities, following-up throughout the 21-day monitoring period to assess whether any EVD compatible symptoms had occurred and providing advice and support to the traveler regarding any EVD concerns. York Region followed up with 30 individuals who had travelled to EVD affected countries during the course of the outbreak. No cases of EVD were reported in Canada.

8.4 MERS CoV

Middle East respiratory syndrome is a respiratory disease caused by a novel coronavirus, referred to as the Middle East respiratory syndrome coronavirus (MERS-CoV).[11] MERS-CoV is a zoonotic virus as it can be transmitted from animals to humans.[12] Camels are considered to be the primary host for MERS-CoV and are the main cause of infection in humans. There is also evidence of human-to-human transmission among individuals who have been in close contact with a case; however, this has mostly been observed in healthcare settings and has not been observed as a sustained transmission mode in the community.[12] MERS-CoV infection is characteristic of fever, cough and shortness of breath. There is no vaccine or effective antiviral treatment available for MERS-CoV.[13]

MERS-CoV was first identified in Saudi Arabia in 2012,[12] and has since been identified in other countries in the Middle East.[13] There have been many hospital-associated MERS-CoV outbreaks in Saudi Arabia since 2012. There have also been reports of cases in countries outside of the Middle East, mostly in individuals who have travelled to the Middle East. Outside of the Middle East, South Korea experienced the largest MERS-CoV hospital outbreak starting in May 2015. Globally since September 2012, there have been more than 1,800 laboratory-confirmed cases and more than 600 related deaths.[14] No cases were reported in Canada.[13] In York Region, between 2013 and 2015, 40 cases were followed up for potential MERS-CoV infection. All tested negative for the disease.

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9

Technical notes

This section details the data processes conducted to create the *Reportable Diseases in York Region 2000 to 2015* report.

The data presented in this report represent the most current disease counts and rates in York Region and they supersede all previously reported statistics. Please note that the data presented in this report will not account for cases reported after the time of report production with episode dates that occurred during the report period, or cases for which the diagnosing health unit has changed.

9.1 Data sources

The most common source of case identification is through laboratory notification of confirmed test results (e.g., serology, microbiology cultures, etc.). Physicians are required to report cases that fulfill laboratory or clinical case definitions.

Reportable Disease Information System (RDIS): Before 2005, RDIS, a Ministry of Health and Long-Term Care (MOHLTC) supported database, was a stand-alone database used by Ontario public health units to capture reportable disease information for case management and surveillance from which information was exported to the MOHLTC. Very limited case episode data for all Ontario health units for all reported diseases that occurred from 1990 to 2005 were transferred from the RDIS system into iPHIS in 2005. Therefore, limited data is available for cases reported before 2006.

Integrated Public Health Information System (iPHIS): iPHIS is an Ontario Ministry of Health and Long-Term Care-supported centralized database used for the collection of information related to reportable disease cases and contacts as well as outbreak events occurring in public health units across Ontario. iPHIS replaced RDIS in 2005.

- York Region case and outbreak data were obtained from the Ontario Ministry of Health and Long-Term Care, integrated Public Health Information System (iPHIS) database, extracted by York Region Public Health on November 9, 2016 (OM travel risk/exposure), November 16, 2016 (STD travel risk), November 17, 2016 (STD risk factors), December 21, 2016 (outbreaks), January 27, 2017 (chickenpox, influenza outbreaks) and February 9, 2017 (all other data).

Statistics Canada CANSIM Tables (Canadian socioeconomic information management system): Population estimates for York Region and Ontario were provided through (CANSIM) tables, Statistics Canada's key socioeconomic database. This database is populated by various data sources including census data from Statistics Canada. The population estimates from the CANSIM tables were used in the denominators for rate calculations.

- Population data were obtained from Statistics Canada. Table 051-0062 - Estimates of population by census division, sex and age group for July 1, based on the Standard Geographical Classification (SGC) 2011, annual (persons) (table), CANSIM (database), accessed: February 10, 2016.

IntelliHEALTH Ontario: Population estimates for each of the municipalities in York Region were obtained from Statistics Canada through IntelliHEALTH Ontario, a data repository for the Ontario Ministry of Health and Long-Term Care, for 2011 to 2013.

York Region Long Range Planning Branch: Data for municipality estimates for 2014 and 2015 were obtained from York Region's Long Range Planning Branch, which is based on Statistics Canada data and Canada Mortgage and Housing Corporation Housing Completion data. These estimates were used as the denominator for geography-specific incidence rate calculations.

Public Health Ontario Portal: Historical data from RDIS archived in the Public Health Commons and extracted using the ehealth portal .

- Ontario case data for 2000 to 2004 were extracted from the Public Health Ontario portal by York Region Public Health in March, 2016. York Region aggregate chicken pox counts 2000-2004 were extracted on February 9, 2017.

PHO Query: Provincial aggregated reportable disease case counts were accessed from the PHO Query Tool (Ontario Ministry of Health and Long-Term Care, integrated Public Health Information System (iPHIS) database).

- Ontario case and rate data for 2005 to 2015 were obtained from Public Health Ontario Query Tool, extracted by York Region Public Health for iGAS, chlamydia and tuberculosis on February 10, 2017; all other diseases on October 19, 2016.

9.2 Case definitions

Specifications of reportable diseases are listed in Ontario Regulation 559/91 under the *Health Protection and Promotion Act*. West Nile virus was added as reportable in 2003, cyclosporiasis was added in 2001 and invasive pneumococcal disease was added in 2001. The Regulation was last amended in late 2013 to add Acute Flaccid Paralysis and Paralytic Shellfish Poisoning to the list of reportable diseases. Local public health units in Ontario are required to conduct surveillance on both confirmed and probable cases of many reportable diseases, including Lyme disease. Details of case definitions used in this report were found in Appendix B–Provincial Case Definitions of the Ontario Public Health Standards, *Infectious Diseases Protocol*, 2016 and are summarized in Table 9.1.

Over the time period covered by this report, there may have been changes to case definitions, laboratory testing methods, or physician/public health practice that may inform the interpretation of the trends displayed. In particular, the Ontario Public Health Standards (OPHS) were released in 2008 along with program-specific protocols, to replace the Mandatory Health Programs and Services Guidelines. As part of the Infectious Diseases Protocol (2008), updated case definitions for reportable disease cases were made available to public health units on April 28, 2009. In York Region, the revised case definitions were implemented in January 2010.

The year of incidence for a case is assigned based on case-related dates that are available for that particular case. The following hierarchy of dates is used: symptom onset, specimen collection, lab test result and the report of illness to the public health unit. Tuberculosis cases are attributed to the year of diagnosis.

The data includes cases for which a York Region residential address was recorded for a case at the time of illness. Therefore, it is not reflective of the location of exposure.

Select diseases are categorized by illness progression. In this report:

- Syphilis data are reported as infectious (primary, secondary, early latent, infectious neurosyphilis and early congenital) and non-infectious (late latent, tertiary, non-infectious neurosyphilis and unstaged syphilis).
- HIV infection incidence includes cases of AIDS. HIV and AIDS co-diagnosis is defined as diagnosis of AIDS-related illness within three months of HIV isolation.
- Hepatitis B is reported as acute (new infection) or chronic (persistent infection for more than six months).

Only cases of active tuberculosis are included in this report.

Infants testing positive for hepatitis C and HIV will not be reflected in the data until their confirmatory testing is completed 18 months after birth.

For Lyme disease, confirmed and probable cases are reported separately for comparability with other York Region data products.

Hepatitis B estimates for the period of 2000 to 2005 (prior to iPHIS implementation in York Region) may be overestimated because of duplicate records. Due to the high volume of hepatitis B case investigations along with the time associated with investigating cases, hepatitis B case records (for the same client) created in multiple health unit jurisdictions may not have been identified and resolved after the standalone systems (RDIS) were amalgamated into the centralized iPHIS database.

Table 9.1

Classifications included in this report

Disease Category	Disease	Classifications
Enteric Diseases	Amebiasis	Confirmed and probable
	Botulism	Confirmed, probable and suspect
	Campylobacter enteritis	Confirmed and probable
	Cholera	Confirmed and probable
	Cryptosporidiosis	Confirmed and probable
	Cyclosporiasis	Confirmed and probable
	Giardiasis	Confirmed and probable
	Hepatitis A	Confirmed and probable
	Listeriosis	Confirmed and probable
	Paralytic shellfish poisoning	Confirmed and probable
	Paratyphoid fever	Confirmed and probable
	Salmonellosis	Confirmed and probable
	Shigellosis	Confirmed and probable
	Trichinosis	Confirmed and probable
	Typhoid fever	Confirmed and probable
	Verotoxin-producing *E. coli* infection (VTEC)	Confirmed and probable
	Yersiniosis	Confirmed and probable

Table 9.1 continued

Disease Category	Disease	Classifications
Diseases Transmitted by Direct Contact and Respiratory Routes	Encephalitis/meningitis syndrome	Confirmed and probable
	Group A streptococcal disease, invasive (iGAS)	Confirmed
	Group B streptococcal disease, neonatal	Confirmed and probable
	Legionellosis	Confirmed and probable
	Leprosy	Confirmed and probable
	Severe Acute Respiratory Syndrome (SARS)	Confirmed and probable
	Tuberculosis, active	Confirmed and suspect
Sexually Transmitted and Blood-borne Infections	Chancroid	Confirmed and probable
	Chlamydia trachomatis infection	Confirmed and probable
	Gonorrhea	Confirmed and probable
	Hepatitis B, acute	Confirmed and Probable
	Hepatitis B, chronic	Confirmed (Carrier)
	Hepatitis C	Confirmed
	Human immunodeficiency virus (HIV infection), including AIDS	Confirmed
	Ophthalmia neonatorum	Confirmed and probable
	Syphilis, infectious	Confirmed
	Syphilis, non-infectious	Confirmed
Vaccine Preventable Diseases	Acute flaccid paralysis syndrome	Confirmed
	Chickenpox (Varicella)	Confirmed
	Diphtheria	Confirmed and probable
	Haemophilus influenzae b disease, invasive	Confirmed and probable
	Influenza	Confirmed
	Measles	Confirmed and probable
	Meningococcal disease, invasive	Confirmed and probable
	Mumps	Confirmed and probable
	Pertussis	Confirmed and probable
	Poliomyelitis	Confirmed and probable
	Pneumococcal disease, invasive	Confirmed
	Rubella and congenital rubella syndrome	Confirmed and probable
	Smallpox	Confirmed and probable and suspect
	Tetanus	Confirmed
Vector-borne and Zoonotic Diseases	Anthrax	Confirmed, probable and suspect
	Brucellosis	Confirmed and probable
	Creutzfeldt-Jakob disease	Confirmed, probable and suspect
	Hantavirus pulmonary syndrome	Confirmed
	Hemorrhagic fevers	Confirmed and probable
	Lyme disease	Confirmed and probable
	Malaria	Confirmed and probable
	Plague	Confirmed and probable
	Psittacosis/ornithosis	Confirmed and probable
	Q fever	Confirmed and probable
	Rabies, human	Confirmed and probable
	Tularemia	Confirmed and probable
	West Nile virus illness	Confirmed and probable
	Yellow Fever	Confirmed and probable

9.3 Outbreak definitions

Outbreaks are attributed to the year and month in which they were reported to public health.

Outbreaks were grouped by:

- Outbreaks with predominately gastrointestinal symptoms (enteric).
- Outbreaks with predominately respiratory symptoms.

Enteric and respiratory outbreaks were further classified by the exposure setting as follows:

- Institutional outbreaks include outbreaks where the primary setting is a long-term care facility, retirement home or childcare facility. Outbreaks in hospitals were excluded from this report.
- Community outbreaks include outbreaks where the primary setting is a food premise or other community setting such as a private home, private gathering location, recreational camp, medical office, funeral home, school, etc.

9.4 Data verification

To ensure accuracy and facilitate comparison of reportable disease trends over time in this report, an audit of the case classifications for all reportable disease cases investigated in York Region between 2000 and 2012 was conducted in 2013 and 2014. The audit focused on the verification of all reportable disease case classifications according to the case definition provided by the Ministry of Health and Long-Term Care at the time of the case episode. Case classifications were compared against the Ontario Public Health Standards Appendix B case definitions (2010 to 2012), the iPHIS manual case definitions (2005 to 2009). All other relevant case definitions for the period of interest were obtained from Public Health Ontario (e.g., 2000 to 2004). The audit encompassed a combination of iPHIS record reviews, RDIS record reviews and manual chart reviews where required. In 2016, audits to review the case classifications were completed for a sample of reportable disease cases investigated by York Region between 2013 and 2015.

Additional data quality audits were completed, which included:

- The identification and resolution of duplicate client and cases
- Verification of geographic classification
- Verification of episode/diagnosis year
- Validation/revision of out of range values for client age and sex.

Where required, some additional case details (e.g., co-infections) were also verified in client records. Exposure and risk information were not reviewed in detail. Risk factor estimates may be slightly under-reported as risk factors included in the 'other' category (free text field) may be recorded elsewhere in the case record.

9.5 Calculations and comparisons

Calculations were computed and graphed using MS Access 2010 and MS Excel 2010.

Annual case counts represent the number of cases whose earliest known case related date (or date of diagnosis for active tuberculosis) occurred in the year.

Seasonality or monthly case counts represent the number of cases whose earliest known case related date (or date of diagnosis for active tuberculosis) occurred in the month.

Rates are based on the number of reportable disease cases that occur in the York Region population in a designated period of time. Annual rates are the annual count divided by the number of person-years at risk (estimated by annual population) displayed per 100,000 population. The use of a standardized incidence ratio (SIR) adjusts for population age structure differences so comparisons can be made in disease occurrence between York Region and Ontario while controlling for these differences. However, the age distributions in York Region and Ontario are very similar and testing demonstrated that the SIRs did not differ from the crude ratios for a number of diseases. This report compares the crude rates for York Region to the rate for Ontario as a whole. York Region cases were not removed from the Ontario cases when calculating Ontario rates, and differences between York Region and Ontario were not statistically tested.

Sex-specific annual rates were presented for sexually transmitted infections. Cases with unknown sex or transgender sex were excluded. Age-group specific and sex-specific rates were calculated to describe the relative burden of illness by age and sex. Cases with an unknown age were excluded from age-specific analyses and cases that were not classified as male or female were excluded from sex-specific analyses.

Subtypes/species/serovars proportions were calculated using a denominator of cases with a recorded subtype/species/serovar or recorded as 'other'.

For select diseases, municipality-specific rates were calculated.

Reporting of travel risk factor was a percentage of all cases. Cases that reported a travel exposure or travel risk factor or living in an endemic area risk factor were categorized as having reported travel. All other cases were categorized as 'no or unknown travel'. Exposure to recreational water was assigned to a case if the case reported the risk factor 'recreational water'. All other cases were categorized as 'no or unknown recreational water exposure'.

For STI risk factor reporting that is grouped by sexual practice, cases that did not report a sexual practice were excluded from the charts. For other risk factor reporting, cases with reported known risk factors (or pregnancy for STI reporting) were included in the analysis and expressed as a percentage of all cases with at least one reported known risk factor.

Reinfection rates for STIs are based on recurrence of the same infection that occurred within the previous five-year period in the same client. Chlamydia and gonorrhea were considered co-infections if they were both included in the same encounter.

Tuberculosis cases among HIV infected individuals was determined if HIV was listed as a risk factor, or there was an HIV infection in the database that predated or was concurrent with the tuberculosis diagnosis.

The outbreak duration is defined as the period between the symptom onset of the first case and the symptom onset of the last case (onset last case – onset first case + 1 day). The attack rate for an institutional outbreak was the number of cases in the outbreak divided by the number at risk in the unit or facility.