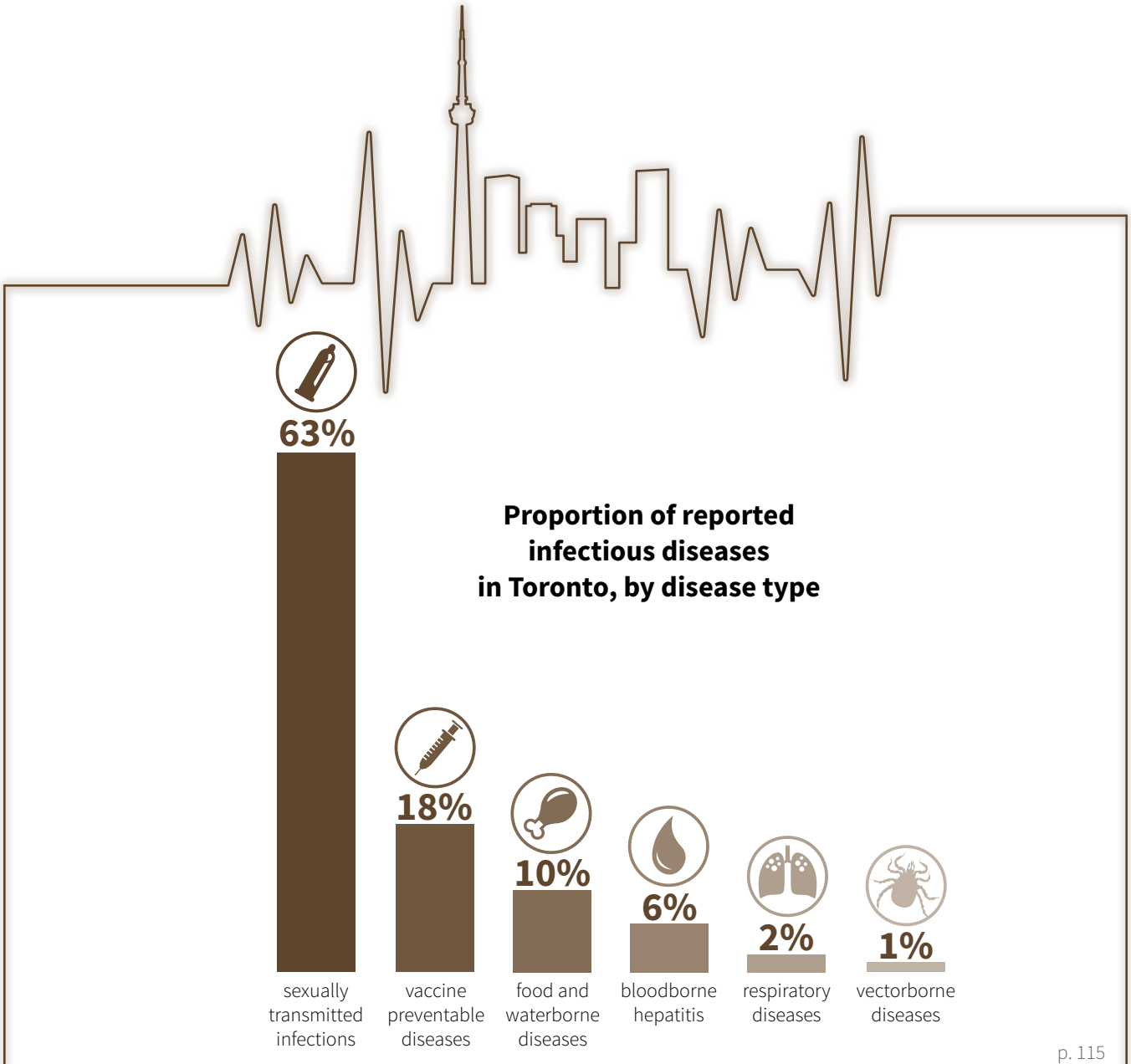
Introduction

Successful public health interventions such as vaccination, pasteurization, food safety programs, improved sanitation, and education have greatly reduced the burden of illness associated with infectious diseases. Despite this, infectious diseases still circulate and can have a significant impact on health. New and accessible prevention and treatment options for infections such as bloodborne hepatitis and HIV have led to longer lifespans and a longer chronic state of illness for those infected.

Complex contributing factors can include sexual practices, travel patterns, housing status, immigration status, vaccination status, food handling practices, and access to health care for prevention, early diagnosis and treatment. New challenges to the control of infectious disease have been introduced by the growing threat of antimicrobial resistance. As more drugs become ineffective, the risk of disease transmission and associated morbidity and mortality are increased.



Proportion of reported infectious diseases in Toronto, by disease type

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Overall **HIV** rates (cases per 100,00 people) in Toronto exceed the rest of Ontario

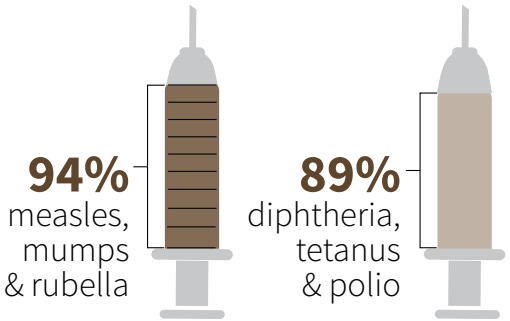
17.4 in **Toronto** **3.1** in **Ontario**

4 in **5** newly diagnosed HIV cases are male

16% of HIV cases in **Toronto** acquired their illness outside of Canada

p. 120

Immunization coverage rates for students age 7 to 17



94% measles, mumps & rubella

89% diphtheria, tetanus & polio

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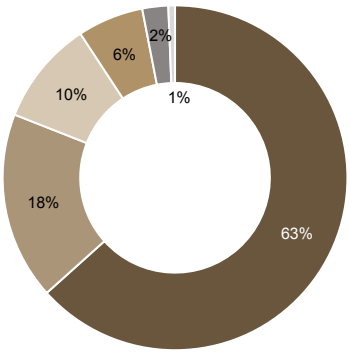
Overview of Infectious Diseases in Toronto

Under Ontario's Health Protection and Promotion Act [1], all confirmed and suspected cases of infectious diseases of public health significance must be reported to the Medical Officer of Health for follow-up. On average, Toronto Public Health receives 23,417 reported cases of infectious disease each year [2]. These diseases are frequently described by how they are acquired, which directly informs how they are controlled. In Toronto, sexually transmitted infections are the most frequently reported diseases and represented almost two-thirds (63%) of all infectious disease cases reported in 2017. Vaccine preventable diseases and food and waterborne diseases comprise the next largest groups of reported infectious diseases in Toronto, representing 18% and 10% of all cases respectively (Figure 9.1).

Figure 9.1: Number and Proportion of Infectious Disease Cases by Disease Type, Toronto, 2017



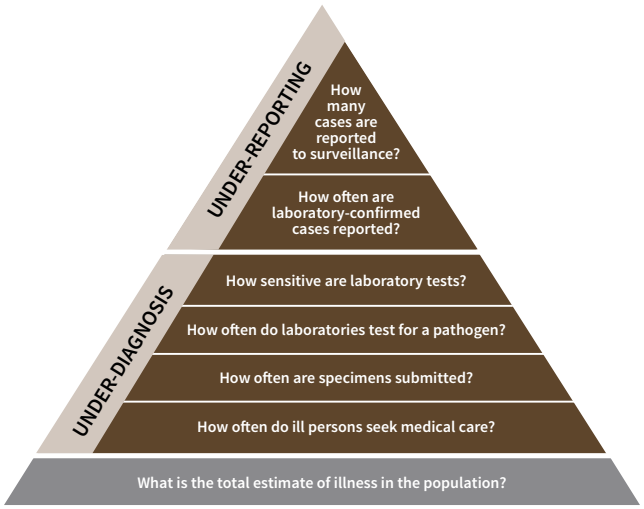
- Sexually Transmitted Infections: 63% (17,769 cases)
- Vaccine Preventable Diseases: 18% (4,938 cases)
- Food & Waterborne Diseases: 10% (2,743 cases)
- Bloodborne Hepatitis: 6% (1,737 cases)
- Respiratory Diseases*: 2% (682 cases)
- Vectorborne Diseases: 1% (175 cases)

* Excludes vaccine preventable respiratory diseases

Data Source: iPHIS (Data extracted: June 2018)

Cases of reportable infectious diseases may go unreported to public health for several reasons including: not all reportable diseases cause noticeable signs and symptoms, only a subset of individuals with symptoms seek medical care, and a diagnostic (laboratory) test may not always be ordered or completed. The burden of illness pyramid (Figure 9.2) is often used to illustrate the under-reporting of infectious diseases through traditional passive surveillance systems, which is in place in Toronto and across Ontario.

Figure 9.2: Burden of Illness, Infectious Diseases



Enteric Illnesses

Enteric illnesses are caused by infection with bacteria, viruses, and parasites transmitted primarily through ingestion of contaminated food or water, or contact with infected animals or people. Public health only learns of a small subset of these illnesses as symptoms can be mild and self-limiting and may not result in a visit to a physician. In a 2009 study [3] TPH estimates that one in six residents experience food borne enteric illness each year - which translates to an estimated 490,000 people affected. The large volume of estimated cases includes mild illnesses that can still contribute to significant lost time from work and notable healthcare costs. Additionally,

severe illness resulting in hospitalization, serious long-term health outcomes or even death are associated with illness from diseases such as verotoxin-producing *Escherichia coli,* listeriosis, hepatitis A, and shigellosis.

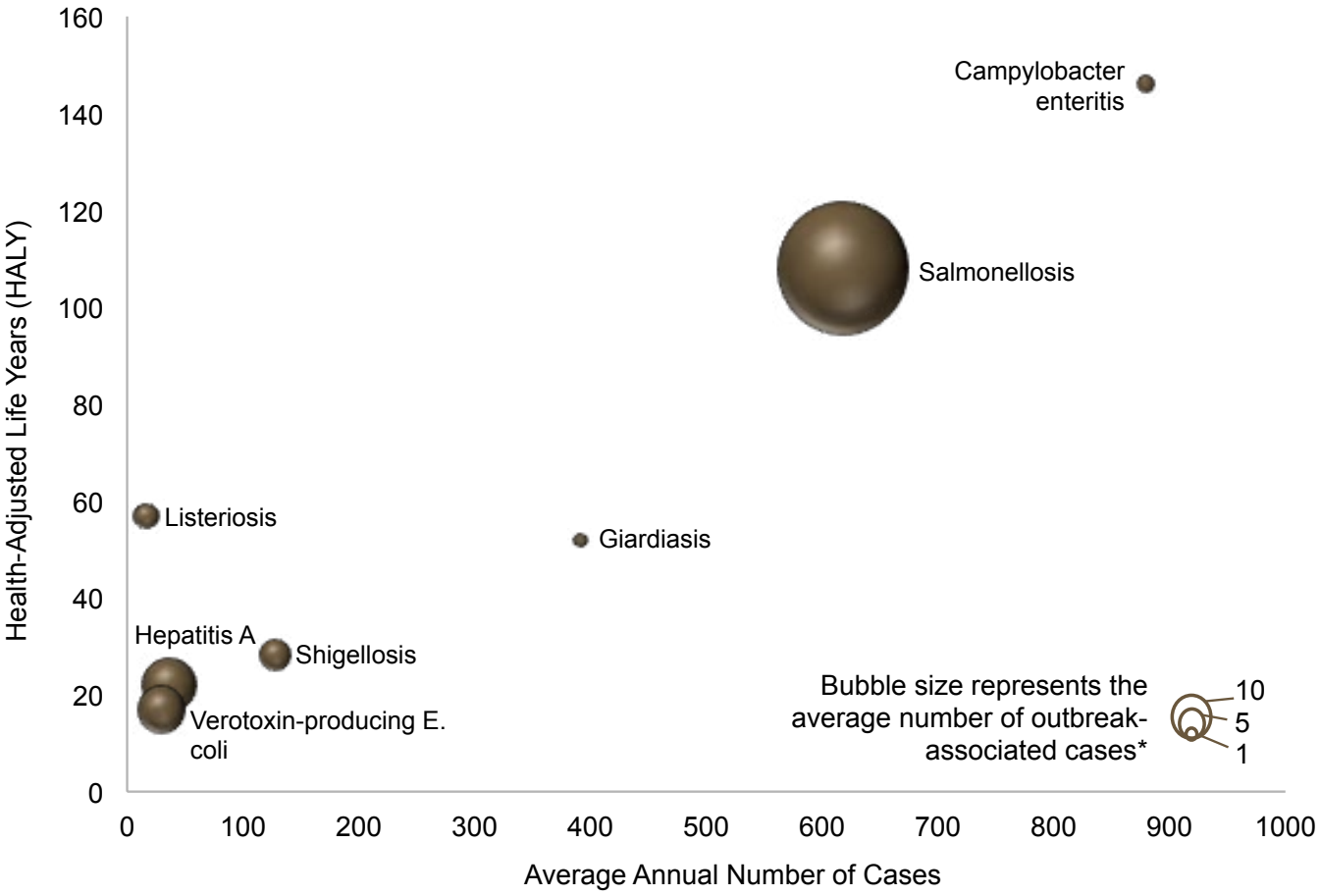
In Toronto, in 2017:

- 2,743 cases of enteric illness were reported [2]. This is however, a vast under-estimate of the associated burden of illness.

Figure 9.3 shows the relative incidence and health burden (using health-adjusted life years) of select reportable enteric diseases, as well as of the size of associated outbreaks investigated by public health. Outbreak investigations can lead to food recalls and other important public health interventions such as boil water advisories.

More information on vector-borne diseases and the effect of climate change is included in Chapter 3.

Figure 9.3: Reported Cases, Outbreaks and Burden of Disease for Select Enteric Illnesses, Toronto, 2013 to 2017



* Includes residents of Toronto connected to Toronto-specific, provincial, and national outbreaks.
Data Source: iPHIS (data downloaded: December 20, 2018)

Vaccine-Preventable Diseases

Vaccines provide protection from several infectious diseases, like measles, mumps, influenza, invasive pneumococcal disease, and hepatitis A. Despite achieving high coverage levels for some mandatory vaccines for school-aged children, Toronto continues to experience outbreaks of vaccine preventable diseases due to pockets of susceptible people (i.e., under-immunized individuals). There are several recent examples highlighting the importance of maintaining high levels of immunization coverage.

In Toronto:

- The largest mumps outbreak in over 20 years began in January 2017 and resulted in 140 detected cases during the 13-month outbreak period. The majority of cases were between 18 and 35 years of age, and were not fully vaccinated. A number of cases frequented the same bars in the downtown core prior to their illness.
- A large community outbreak of measles occurred in 2015. While this outbreak resulted in the detection of ten cases of measles, TPH also followed up over 1,500 people who were exposed to confirmed cases. This was the highest number of measles cases reported in a single year since a large outbreak in 2008. Most (90%) cases linked to the 2015 measles outbreak were not up-to-date for their measles, mumps and rubella (MMR) vaccines.

Respiratory Illnesses

Respiratory infections pose significant threats to the health of Toronto's population, especially during winter months. While rhinoviruses are the most commonly detected respiratory viruses, seasonal influenza places the highest health burden on residents of Ontario [4]. Illness from influenza can lead to work and school absenteeism, serious diseases such as pneumonia, and can result in hospitalization and death in the most vulnerable, including seniors. Hospitals, long-term care homes, and retirement homes in Toronto house people with underlying medical conditions, seniors, and others at increased risk of severe outcomes related to infection with the influenza virus. Influenza vaccine is publicly funded and continues to be a key strategy to significantly reduce the risk of illness caused by the influenza virus [5].

In the 2016/2017 respiratory season[1] in Toronto:

- 4,591 cases linked to 320 respiratory illness outbreaks in Toronto healthcare institutions were reported to TPH; 61% (196 of 320 outbreaks) were reported in long-term care homes [2].
- Seasonal influenza, was the identified source for half (50%) of all respiratory outbreaks with a known causative agent.
- 68 deaths were linked to respiratory illness outbreaks. This is a vast under-estimate of deaths related to respiratory viruses – especially seasonal influenza [6].

More information about respiratory diseases is included in Chapter 11.

Tuberculosis

Tuberculosis (TB) is a serious but curable bacterial disease that spreads from person to person through the air. The emergence and spread of drug-resistant TB has escalated this disease as a major global public health issue. In Toronto, TB disproportionately affects those born in an endemic country and those experiencing homelessness and those with suppressed immune systems.

[1] Respiratory season runs from September 1st to August 31st each year.

In Toronto, in 2017:

- The case-fatality rate for TB was low, at 6% [2]. The complexity of TB cases dramatically increase, while the number of newly diagnosed cases remained relatively stable since 2008.
- 93% of TB cases reported to Toronto Public Health were born outside of Canada, and most (92%) acquired TB while living or travelling outside of Canada [2].

COMPARING TO

The incidence of TB in Toronto in 2017 (10 cases per 100,000 people) is three times higher than that for in the rest of Ontario (3.4 cases per 100,000) [2] and more than double the rate in Canada (4.8 cases per 100,000) [7].

HEALTH INEQUITIES

Toronto's homeless and under-housed population are at increased risk of TB infection; large-scale outbreaks and deaths have occurred in the past.

Immunization

Immunization is widely recognized as one of the most successful public health interventions ever implemented. Establishment of routine immunization programs has significantly reduced illness, death, and the spread of vaccine preventable diseases in Canada and around the world. Achieving high immunization rates in these programs is important for preventing the spread of vaccine preventable diseases, and is essential for the protection of the most vulnerable groups in Toronto including young children, the elderly, and those with compromised immune systems who may not be able to be vaccinated themselves. One strategy to achieve high population level immunization rates is making some vaccines mandatory for school aged children.

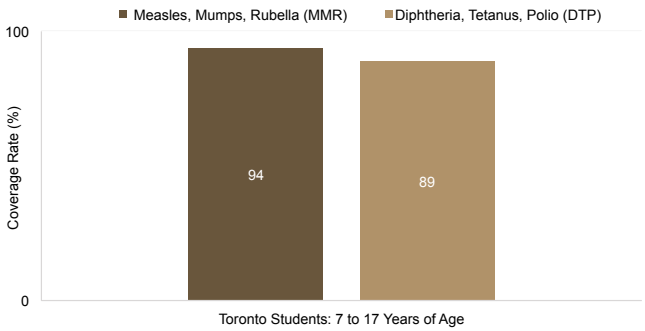
Student Immunization Coverage Rate

Immunization coverage refers to the proportion of a defined group of people (e.g., students of a specific age) who are appropriately immunized against a specific vaccine-preventable disease at a point in time. Measles is the most infectious vaccine preventable disease, and requires very high coverage rates to effectively prevent transmission from occurring in Toronto. Canada's national immunization coverage target for measles containing vaccine is 95%. [8] [9] Overall, immunization rates in Toronto schools are high, which helps keep students and other Toronto residents safe by preventing outbreaks in schools and transmission in the community.

In Toronto:

- For the 2018/19 school year, approximately 94% of Toronto students between the ages of 7 and 17 years old were compliant with the measles, mumps, and rubella (MMR) vaccine.
- For the 2018/19 school year, approximately 89% of Toronto students between the ages of 7 and 17 years old were compliant with the diphtheria, tetanus and polio (DTP) vaccines.

Figure 9.4: Immunization Coverage Rates for Vaccines Started in Infancy and Early Childhood, Toronto Students 7 to 17 Years of Age, Toronto, 2018/2019 School Year



Data Source: Ontario Ministry of Health, Panorama Enhanced Analytical Reporting (PEAR). Data extracted August 1, 2019.

Exemptions

Ontario's Immunization of School Pupils Act (ISPA) [10] requires that children and adolescents attending primary or secondary school be appropriately immunized against certain diseases. Exemptions to mandatory vaccination requirements can only be provided on medical grounds or for philosophical reasons (e.g., religious grounds or for reasons of conscience). Available data for Toronto have shown a small but continuous increase in philosophical exemptions over the past decade, which may be a marker of vaccine hesitancy.

- In the 2008/09 school year, the philosophical/religious exemption rate in Toronto for the measles, mumps and rubella (MMR) vaccine was approximately 0.9%. Ten years later, in the 2018/19 school year, this increased to approximately 1.7%.

7% of Indigenous children, six years of age and under, living in Toronto have never received any immunizations; this is markedly higher than the Canadian rate of 1.5% of children without any immunization (2015) [11].

The lack of a comprehensive provincial immunization registry capturing information on all immunizations administered in Ontario impacts the availability of accurate and timely data. Having a registry would yield a more complete understanding of the susceptibility of Toronto residents at any given time. Additionally, this information could be used to inform public health actions during exposures to a vaccine preventable disease (e.g. day nursery contacts of a measles case), while minimizing the possibility of suspension for school aged children with incomplete information related to their vaccine status.

Bloodborne Infections

While many infectious diseases can ultimately be cured and full health restored after the initial illness, some diseases can result in a long-lasting infection, sometimes lifelong. Reportable bloodborne infectious diseases that can result in chronic or lifelong infection include human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV). In general, these diseases disproportionately affect sub-populations in Toronto, including those who have emigrated from a country where these infections are more common, those exposed to unsafe injection practices or transfusion practices, intravenous/illicit drug users, and MSM.

People infected with these viruses may not have any symptoms or signs of their infection for many years, sometimes decades, resulting in an increased chance to unknowingly spread the infection to others. Without diagnosis and treatment, serious long-term health outcomes are more likely. In the case of chronic hepatitis, outcomes can include cirrhosis, liver failure, and hepatocellular carcinoma (liver cancer).

HIV/AIDS

Despite advances in prevention and treatment, HIV still presents a large health burden, ranking sixth in terms of infectious disease burden in Ontario [4]. Almost half of the cases reported in Ontario live in Toronto [12]. Groups that face a higher burden of HIV infection include injection drug users, men who have sex with men (MSM), and Indigenous persons.

There is no cure for HIV infection. People living with HIV must receive lifelong treatment to control the disease, and are more likely to be affected by other associated health conditions such as depression, neurological illnesses, some cancers, and cardiovascular illnesses [13]. People with HIV who are not diagnosed and treated early have up to a 50% reduction in their life expectancy compared to those who start treatment earlier [14].

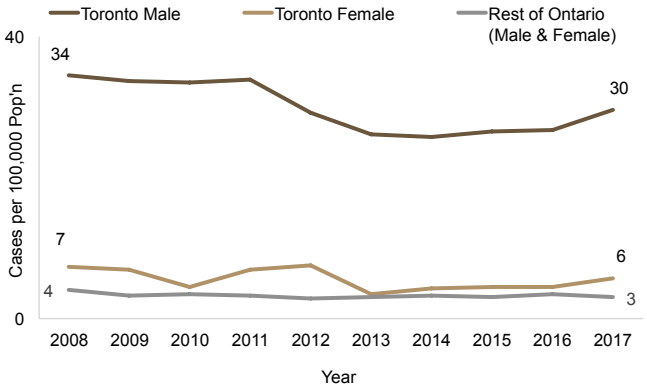
In Toronto, in 2017:

- 500 newly diagnosed HIV infections were reported to Toronto Public Health.
- 83% of HIV cases reported were male. The majority (79%) of males with available risk information reported sex with the same sex.
- 16% of all newly diagnosed HIV cases were born in countries where HIV is endemic, and most likely acquired their infection outside of Canada.

During the ten years from 2008 to 2017:

- Rates of HIV infection in the rest of Ontario remained relatively stable while in Toronto, rates had small increases in the most recent two years (Figure 9.5).

Figure 9.5: HIV Incidence, Toronto by Sex, and Rest of Ontario (Both Sexes), 2008 to 2017



Data Source: iPHIS (Data extracted: June 2018)

COMPARING TO In 2017, the rate of HIV infection in Toronto was 17.4 cases per 100,000 persons, compared with the rate for the rest of Ontario (3.1 cases per 100,000 population) and the overall Canadian [15] rate (6.4 cases per 100,000 population). This is most likely due to Toronto's large foreign-born [16] and MSM communities [17].

Diagnosis and Treatment of HIV

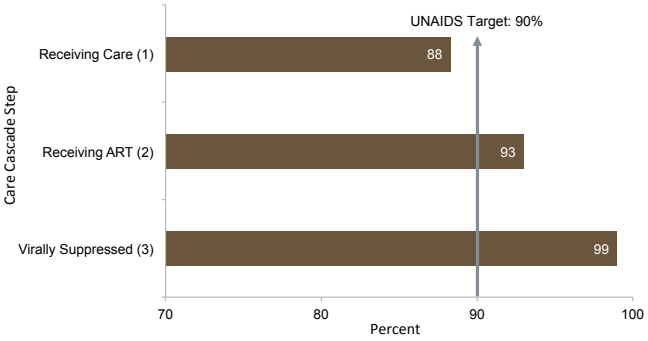
Early diagnosis and effective treatment of HIV infections are essential to an effective public health response to minimize further transmission. Ontario's provincial HIV/AIDS strategy mirrors the UNAIDS 90-90-90 target [18, 19] which states that, by the year 2020:

- 90% of people living with HIV will know their status.
- 90% of all people with diagnosed HIV will receive antiretroviral therapy.
- 90% of all people receiving antiretroviral therapy will achieve viral suppression.

In 2015, Toronto:

- Exceeded targets for the proportions of those with HIV receiving therapy (93%) and achieving viral suppression (99%). Additional work is still needed to ensure that all HIV infections are diagnosed and all those who are newly diagnosed receive timely and adequate care [18] (Figure 9.6).

Figure 9.6: People Living with Diagnosed HIV by Care Cascade Step, Toronto, 2015



[1] Proportion of individuals who have been diagnosed who are receiving care
[2] Proportion of individuals receiving care who are receiving antiretroviral therapy (ART)
[3] Proportion of individuals receiving ART who are virally suppressed
Data Source: Ontario HIV Epidemiology and Surveillance Initiative (OHESI), November 2018

Hepatitis B

Despite the decline in newly diagnosed hepatitis B virus (HBV) infections, this disease still presents a large health burden given its chronic nature and related health complications; it ranks fourth in terms of burden of illness associated with infectious diseases in Ontario [4]. The declining number of cases is due in large part to the vaccine against HBV which has been widely available since 1982 and was added to Ontario's school-based immunization program in the 1994/1995 school year.

The vaccine is 95% effective in preventing infection and the development of associated chronic disease and liver cancer. The vaccine is routinely administered to grade 7 students however, this means children under the age of 12 are not routinely offered immunization; this is the age group most likely to become chronically infected.

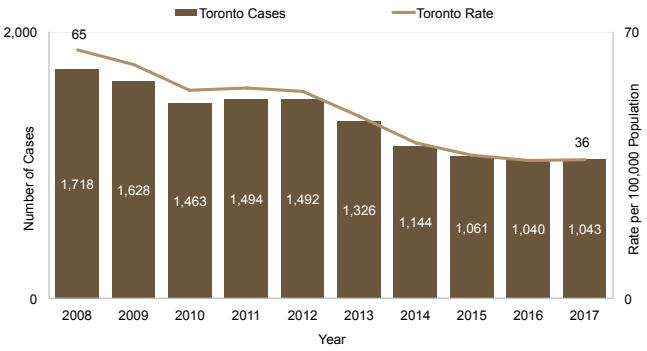
The risk of chronic infection differs with respect to age at time of infection. About 90% of infants infected at birth, 20 to 50% of children infected from ages 1 to 5 years, and 1 to 10% of those infected as older children will develop chronic illness [20]. Of these, 20 to 25% will develop cirrhosis and approximately 5 to 6% will develop liver cancer [21].

In Toronto:

- The rate of reported HBV infections in Toronto dropped by 44% during the ten year period from 2008 to 2017 (Figure 9.7).
- Approximately 69% of grade 7 students received HBV vaccine in the 2016/17 school year [10].
- 93% of residents diagnosed with HBV reported being born in, living in, or travelling to a country where HBV was endemic [2].

Compared to their Canadian-born counterparts, cases born outside of Canada are twice as likely to have a hospital stay related to their HBV infection [24].

Figure 9.7: Hepatitis B Virus Infection (Cases and Incidence Rates), Toronto, 2008 to 2017



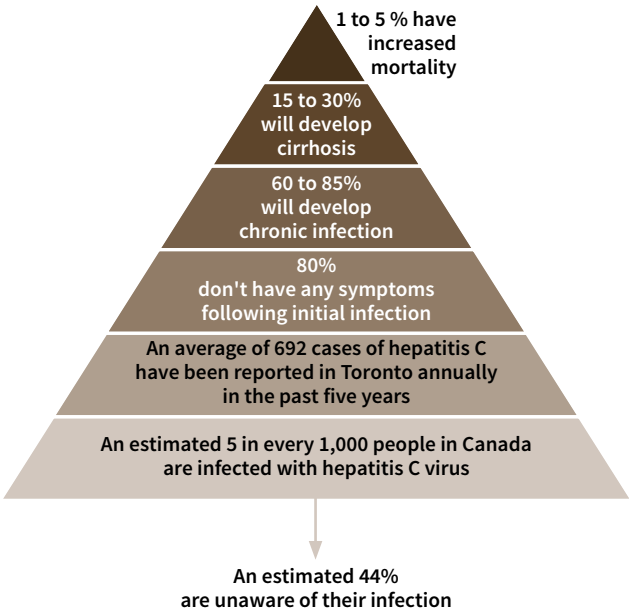
Data Source: iPHIS (Data extracted: June 2018)

Hepatitis C

Hepatitis C is a bloodborne infection caused by the hepatitis C virus, or HCV. Illness from HCV infection ranges in severity from a mild illness which lasts a few weeks, to a serious, lifelong illness. It can be acquired by sharing needles, syringes, or other equipment to inject drugs. Sexual transmission of HCV is less common but can occur; having a sexually transmitted disease or HIV, or engaging in sexual contact with multiple partners increases the risk of HCV infection [2].

Despite the decline in diagnosed HCV infections, this disease still presents a significant and substantial health burden, ranking first in terms of infectious disease burden of illness in Ontario [4]. Serious health risks associated with HCV infection, include chronic liver disease, cirrhosis, and even death (Figure 9.8) [22]. The virus can become chronic in up to 85% of HCV-infected people. Studies indicate that an estimated 44% are unaware of their infection [23]. In the coming years, it will be a priority to quantify the number of unidentified and untreated cases in Toronto.

Figure 9.8: Burden of Hepatitis C Infection

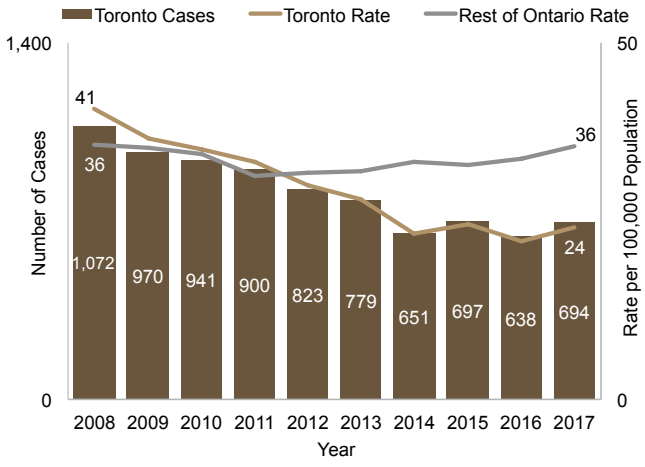


Treatment with antiviral medications can cure HCV in many cases, but in some parts of the world, access to necessary medical care is lacking. In Toronto, treatment for HCV infection is not universally available.

In Toronto:

- The number of reported HCV infections decreased by 35% between 2008 and 2017. During the same time period, the incidence rate dropped by 41% (Figure 9.9). As approximately 44% of those infected are unaware of their infection and the health outcomes of untreated HCV infection are substantial, this disease remains a significant contributor to the burden of infectious diseases despite the decline in reported cases.
- The most frequently reported risk factors for HCV infection cases in 2017 were [2]:
  - Being born, or having lived or travelled in an endemic country (40%).
  - A history of injection drug use (31%).

Figure 9.9: HCV Infection (Cases and Incidence Rates), Toronto and Rest of Ontario, 2008 to 2017



Data Source: iPHIS (Data extracted: June 2018)

Cancers Caused by Infection

Approximately 4% of all new cancer cases in Ontario come from preventable infectious causes [24]. The pathogens responsible for the majority of these cancers are human papillomavirus (HPV), hepatitis C virus (HCV), and hepatitis B virus (HBV). Untreated, chronic hepatitis B and C infections can lead to cirrhosis and liver cancer. Publicly funded vaccines to protect against HPV and HBV are available. Harm reduction approaches like needle exchange services can prevent acquisition of HCV, and treatment options are now available.

With the introduction of publicly funded HPV vaccine and implementation of Ontario's school-based HPV immunization program, a decreasing trend in new HPV infections has been observed in Ontario [25]. The HPV vaccine is expected to lead to decreases in cervical cancer in the province [26]. It is also possible that over time, decreases may occur for other HPV-associated cancers.

In Ontario[2]:

- HBV is responsible for approximately 350 deaths and 7,000 years-of-life-lost each year through liver cancer and cirrhosis.
- HCV is estimated to cause approximately 400 deaths annually [4].
- Cervical cancer is the most common HPV-associated cancer among women. Oropharyngeal cancers (cancers of the back of the throat, including the base of the tongue and tonsils) are the most common among men [27].
- Rates of liver cancer in men are highest in areas with large immigrant populations, including Toronto [28].
- Overall rates of liver cancer are increasing over time [27]; between 1986 and 2012 rates rose steadily at 3.8% annually.

More information on cancer and related risk factors is included in Chapter 11.

In Canada, 60% of HBV cases and 20% of HCV cases are reported among people who emigrated from countries where these diseases are endemic, and comprise a large proportion of cancer cases caused by infectious diseases [28] [29]. The highest rates of liver cancer in Ontario have been found in areas with high proportions of immigrants [30].

As HPV is not a reportable disease under the HPPA, incidence for this disease is not known.

As no universal screening program for HBV or HCV exists in Ontario, accurate estimates for the prevalence of these diseases are not available.

[2] Data available at the Ontario level only.

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