Old Foes and New Threats

Ontario's Readiness for Infectious Diseases

Ontario

2012 Annual Report of the Chief Medical Officer of Health of Ontario
to the Legislative Assembly of Ontario

Letter of Transmission

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Ontario

The Honourable Speaker
Legislative Assembly of Ontario
Room 180, Main Legislative Building
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Dear Speaker:

In April 2013, on behalf of Ontario's Public Health Leadership Council, I released *Make No Little Plans* – Ontario's Public Health Sector Strategic Plan. It is the roadmap we are using to help Ontarians be the healthiest people in the world, supported by the best public health system in the world.

This report identifies ways to advance one of the five strategic goals of *Make No Little Plans* – improving infectious disease prevention and control.

In public health, we look at the interplay of the three factors that contribute to an infectious disease problem – the *host*, the population of Ontario; the infectious *agents* themselves; and our *environments* – to determine where we might be vulnerable and where we might intervene to reduce risk.

To prepare this report, we used *hindsight* – to review the lessons from past events and challenges; *oversight* – to review what we're doing right now to ensure that the public health system is strong and vigilant; and *foresight* – to anticipate what might be coming our way.

In Ontario, we continue to make progress in reducing the burden of many infectious diseases, and we have strengthened our capacity to anticipate, prepare for and respond to emerging infectious diseases.

However, we cannot become complacent. There is still more work to do.

We must continue to educate the public and health care providers about infectious diseases and what they can do to reduce the risks. We must continue to reinforce the vital importance of immunization, safe food, safe water and good infection and prevention control practices, everywhere, all the time.

We must continue to improve scientific literacy – beginning with school-aged children – so more Ontarians are knowledgeable about viruses, bacteria, parasites and fungi and more are able to distinguish between credible scientific evidence and myths.

We must reinvigorate Ontario's Immunization System. Vaccines prevent infectious diseases, save lives and reduce health care costs.

We must reduce sexually transmitted and blood-borne infections and encourage the development of new vaccines, particularly for antibiotic resistant sexually transmitted infections. All students should be provided with up-to-date information and decision-making skills to optimize their sexual health and help them protect themselves from sexually transmitted infections.

We must reduce health care-acquired infections by continuing to reinforce good infection prevention and control practices in hospitals, long-term care homes and other community settings.

We must discourage the inappropriate use of antibiotics in people and animals.

And we must continue to make progress on the other strategic goals in *Make No Little Plans* – strengthening the public health sector's capacity by improving information and knowledge systems; reducing preventable diseases by continuing to address the modifiable risk factors that put people at risk of bad outcomes from infectious diseases, such as tobacco use and harmful alcohol use; and by promoting healthy environments, both natural and built.

This is our roadmap for improving the prevention and control of infectious diseases in Ontario.

Original signed by

Arlene King MD, MHSc, FRCPC
Chief Medical Officer of Health

Attachment

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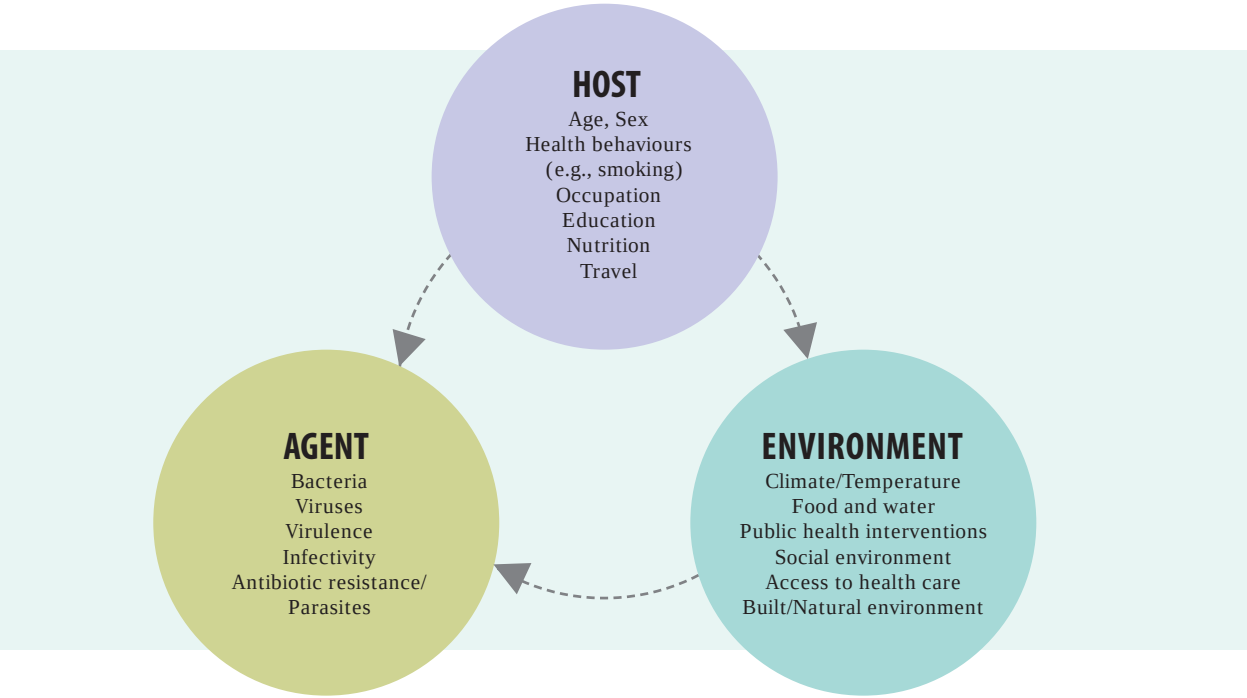
Infectious Diseases Never Sleep

Infectious diseases are caused by a range of bacteria, viruses, parasites and fungi. These diseases are transmitted to humans in different ways: through insect bites and contact with animals; through food and water; from one person to another by touch, during sexual intercourse or through the air when people cough or sneeze; through contact with blood or other body fluids; by touching surfaces that have been contaminated because people who are ill have touched them; and from medical equipment that has not been properly cleaned.

Many of these organisms are continually evolving as are the human populations they infect and our environments. Any changes to the equilibrium of what is known as the epidemiologic triad – the host, the agent and the environment – can result in infections, outbreaks or epidemics.

Infectious diseases spread in two ways:

- **Indirectly** – from insects, animals, water or food products to humans. Examples of indirect infections are Lyme disease, West Nile virus, *E. coli* and some forms of influenza (zoonotic diseases).
- **Directly** – from one person to another. Examples of direct infections are measles, whooping cough (pertussis), influenza and other respiratory diseases, tuberculosis, HIV and other sexually transmitted infections, and hepatitis B and C.

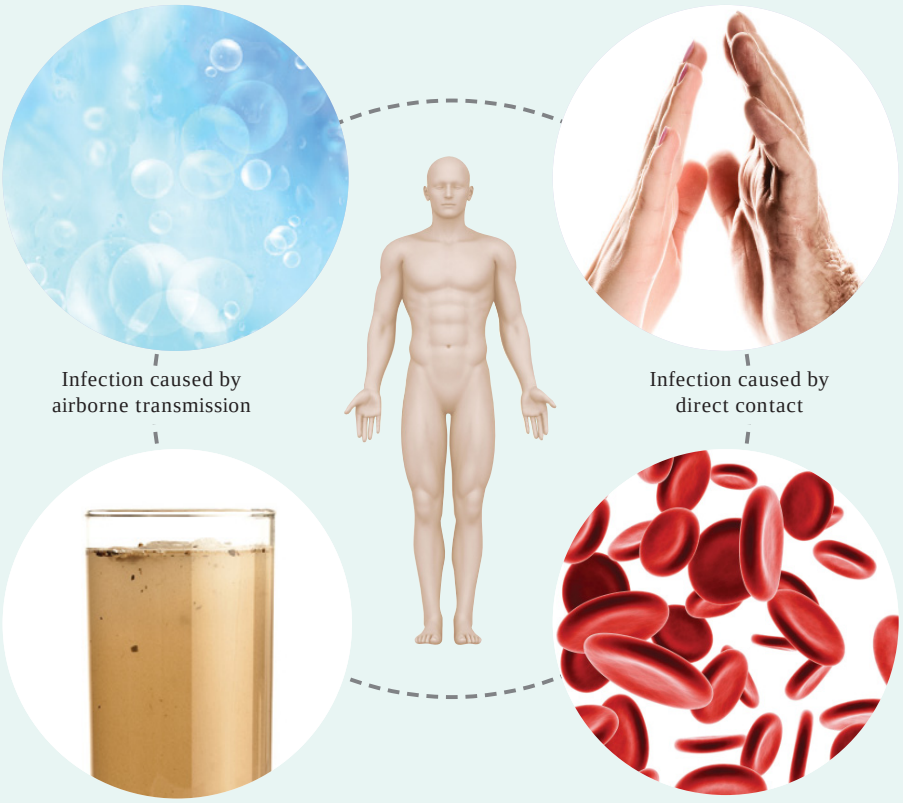


Ontarians are healthier than we have ever been but, as a population we are experiencing changes that can increase our risk of infectious diseases. For example, our population is aging and many of us have chronic diseases, conditions or risk factors (e.g., lung disease, obesity, tobacco use) that make us more vulnerable to infectious diseases or to complications from those diseases (e.g., pneumonia). We are also traveling more, making it more likely that we will be exposed to infectious diseases against which we have no or little immunity.

Some infectious agents – such as those that cause tuberculosis (TB), gonorrhoea and methicillin-resistant *Staphylococcus aureus* – are continually adapting and changing, becoming more resistant to treatment.

Changes in the environment – including lack of immunization, breaks in infection control practice, breakdowns in aging infrastructure, failure to detect the early signs of disease, climate change and lack of vigilance or complacency – create opportunities for infectious diseases to emerge and spread.

Human pathogen transmission



Infectious Diseases Threaten Health, Take Lives Prematurely and Increase Health Costs

Many Ontarians will become ill with at least one infectious disease every year. Most of these infections are minor, often need no treatment and go unreported. Some can be treated and some can be serious.[1]

The numbers tell the story:

70+	The number of reportable infectious diseases in Ontario (see Appendix A).
1	The number of infectious diseases that have been eradicated from the globe: only smallpox has been completely eradicated; however, polio has been eliminated from most parts of the world.
2,000	The average number of infectious disease outbreaks in Ontario each year – mainly respiratory diseases like influenza.[2]
7,000,000	The number of episodes of infectious diseases in Ontarians each year.[2]
5,000	The number of Ontarians who die from infectious diseases each year[2] – almost 10 times the 579 who die in traffic accidents,[3] and about twice the number that die from Alzheimer's disease.[4]
$2 billion	The cost of the SARS outbreaks to Canada.[5, p.211]

Infectious diseases can have a devastating impact on the health of individuals, families, communities and our health care system. As part of the first pillar of Ontario's health system plan[6] – *Keeping Ontario Healthy* – we must continue to prevent, contain and, whenever possible, reduce, eliminate or eradicate infectious diseases.

Effective Strategies and Tools to Prevent and Manage Infectious Diseases

All parts of the health system and other sectors, as well as the general public, play critically important roles in preventing and managing infectious diseases.

The following illustrates the main tools used now to prevent and manage infectious diseases:

- Vaccine programs for vaccine-preventable diseases
- Infection control programs that prevent the spread of infectious diseases in health care settings, such as hospitals, long-term care homes and community care settings, and in public places
- Public education programs that promote sanitation, immunization, hand hygiene and cough hygiene
- Standards and inspections for drinking water and food handling
- Standards for preventing and managing infectious diseases and the Infectious Diseases Protocol[7]
- Professional education about safe food production, distribution and handling practices
- Safe veterinary practices
- Procedures to protect private water systems
- Surveillance programs that systematically collect, connect and analyze data on cases of infectious diseases and then share the findings with those who need to know and who will take action[8, p.713]
- Procedures for managing outbreaks when they occur

Stronger Public Health Standards for Preventing and Managing Infectious Diseases

Ontario Public Health Standards (2008) set out the steps in the Infectious Diseases Protocol that the province's 36 public health units are expected to follow to prevent and manage infectious diseases.[7] The Protocol, which is reviewed and updated regularly, provides direction on how to:

- establish baseline rates of infectious diseases of public health importance and factors that influence their occurrence
- identify emerging trends and changes in baseline infectious disease rates
- communicate in a timely way any infectious disease incidence in excess of expected levels
- assess population health status with respect to infectious diseases
- plan evidence-based public health policies, programs, interventions and services to prevent and control infectious diseases in the community and in high-risk settings
- evaluate public health policies, programs, interventions and services to control and prevent infectious diseases.

Old Foes and New Threats

Over the past 30 years, Ontario has experienced a number of infectious disease outbreaks. Some were caused by old foes – infectious diseases that have been with us for some time, including:

- water borne illnesses, such as those due to *E. coli* (Walkerton, 2000)[9]
- vector-borne illnesses like West Nile Virus (introduced to Ontario in 2001)[10,11]
- vaccine-preventable illnesses like rubella – the virus that causes German measles (Oxford County, 2005)[12]
- respiratory illnesses such as Legionnaire's disease (Toronto, 2005)[13]
- food-borne illnesses, such as listeriosis (Toronto, 2008)[14,15]

Some were caused by new emerging threats, such as:

- the human immunodeficiency virus (HIV) that causes AIDS
- the Severe Acute Respiratory Syndrome (SARS)-associated coronavirus that causes a severe respiratory infection
- antibiotic resistant bacteria that are the cause of infections acquired in health care settings, such as methicillin-resistant *Staphylococcus aureus* and *Clostridium difficile* associated disease
- influenza A (H1N1) 2009, that caused the H1N1 pandemic
- antibiotic resistant bacteria that are making it more difficult to treat diseases that have been with us for some time, such as multidrug-resistant tuberculosis and antibiotic resistant gonorrhoea
- antibiotic resistant viruses that are making it difficult to treat some strains of influenza and HIV.

Globally, new organisms that can cause infections in humans emerge every year. For example, in the last year alone, we saw new variants of influenza emerge from China (H7N9, H10N8), Chikungunga Fever arise in the Caribbean, and Middle East Respiratory Syndrome Coronavirus appear in the Middle East (MERS-CoV)(2012). To date, no cases of these diseases have been identified in Ontario.

Our Three-Pronged Approach to Developing this Report

To develop this report and identify priorities in infectious disease prevention and control, we used a three-pronged approach:

I. Hindsight

Learning from past events and challenges. Learning these lessons helps us strengthen our response and systems, and plan for the future.

II. Oversight

Keeping the system strong and vigilant. Reviewing what we're doing right now to prevent and control infectious diseases.

III. Foresight

Anticipating new threats. Continuing to develop the skills and systems to anticipate emerging threats and act to prevent them.

This report uses this three-pronged approach to describe how Ontario's public health sector is working to prevent and control infectious diseases. It also makes a small number of key, critical recommendations to improve the prevention and control of infectious diseases, and to strengthen our capacity to respond to old foes and new threats.

I. Hindsight: Learning from Past Threats and Outbreaks

Since the beginning of the 21st century, Ontario has experienced a series of different infectious disease outbreaks that made people ill and cost some their lives. Each one triggered an investigation and sometimes, an inquiry.

In addition to these highly publicized outbreaks, there were thousands of smaller, more contained – but not necessarily less serious – outbreaks, due to influenza, noroviruses, other respiratory viruses and health care-acquired infections.

Investigations into an infectious disease outbreak ask similar questions: Why did this happen? What could we have done to prevent it or respond more quickly?

From these investigations, we can take away some key lessons:

1. Expect the Unexpected

At least three times in the last 30 years, Ontarians have felt first-hand the illness, fear and uncertainty of a new emerging disease. In the early 1980s, the human immunodeficiency virus that causes AIDS killed many Ontarians and many others across the globe before there was even a test to detect it. In 2001, West Nile virus (WNV) was introduced into Ontario.[10] There were no human cases until 2002 and deaths followed after that.[10] In 2003, SARS hit. Although that virus was not easily spread, it caused widespread fear and threatened to shut down Toronto.

Ontario was not alone in its lack of preparedness for HIV or SARS. As the SARS Commission report noted: "No one foresaw the sudden emergence of an invisible unknown disease with no diagnostic test, no diagnostic criteria, uncertain symptoms, an unknown clinical course, an unknown incubation period, an unknown duration of infectivity, an unknown virulence of infectivity, an unknown method of transmission, an unknown attack rate, an unknown death rate, an unknown infectious agent and origin, no known treatment and no known vaccine."[17, p.14]

Between 1985 and 2000, Ontario made significant investments in its testing, surveillance and lab programs for HIV; however, it did not make comparable investments in the broader public health infrastructure to detect and monitor other diseases. Because we did not learn the real lesson of HIV – that new and unexpected diseases do happen – we were unable to react as quickly, comprehensively

or effectively when faced with SARS. The only thing that prevented much worse outcomes from SARS were the nurses, doctors, paramedics and others who stepped up, sometimes at great personal risk.

New threats like HIV and SARS can happen again[16,17] and we must be prepared.

2. Complacency Increases Risk

The complacency which caught the province off guard in 2003 must never again be repeated because the question is not if there will be another serious global public health threat – but rather 'when'.[18, p.6]

Many inquiry reports observed that Ontario was more vulnerable to infectious diseases because the infectious disease control system had worked so well for many years. We were, in fact, a victim of our own success. Many people had come to believe that infectious diseases had either been eradicated or that modern medicine would be able to treat them. We became complacent and stopped investing in public health, which meant that the infrastructure was crumbling and vulnerable and policies had not kept pace with new threats or new science.

When the Walkerton tragedy occurred, the people in charge of the water system had no formal training, water quality was not being regulated and the provincial guidelines for water safety were not being enforced.[9] When SARS hit, health care settings were woefully unprepared in terms of protective equipment for health care staff, and the public health laboratory system was understaffed and working with old equipment.[17] At the time of the listeriosis outbreak, the food safety system was weak. Many different federal and provincial agencies had responsibilities for meat inspections but roles and responsibilities were not clear, so there were serious gaps and duplications in the inspection process.[14,19]

3. Information is Power

During an outbreak, it is hard to obtain early data and share it appropriately. In most of the recent outbreaks in Ontario, there were examples of the right information not getting to the right people at the right time. For example, the Walkerton Public Utilities Commission had laboratory tests showing that the water was contaminated for days before sharing that information with public health staff investigating the outbreak. During the SARS outbreak, critically important information did not reach the right people quickly enough – in part because of the lack of good data (i.e., information recording and tracking) systems.

Toronto Public Health, SARS 2003

In many cases, players in the health system delayed or hindered the flow of information because of concerns about privacy[17] – even though the Information and Privacy Commissioner has clearly said that information can be shared during an outbreak.[20] In other cases, different levels of government and different government departments didn't have effective protocols for sharing information.

To stop infectious diseases, the public health system needs immediate access to accurate and timely information. It needs data to help detect both old foes and new threats early, and to identify and monitor outbreaks when they occur. It needs valid information on the immunization status of individuals and at-risk populations. It also needs electronic information systems that can help collect, analyze and share data among those who need it. Because infectious diseases know no borders, the system needs transparent interfaces across the province and effective relationships with other jurisdictions so Ontario can share timely, accurate information to stay ahead of global trends.

4. Infection Prevention and Control is an Attitude as well as a Skill

Precautions up, disease down; precautions down, disease up.[17]

Preventing the spread of infectious diseases requires the constant and consistent use of infection control practices – such as hand-washing, covering a cough, cleaning surfaces and using clean equipment – by health care providers, people who process or handle food and members of the public. Maintaining these skills and practices takes ongoing education, reinforcement and accountability measures even – or perhaps especially – with health care providers, who work in settings where they are surrounded by bacteria and viruses as well as highly vulnerable patients. Improving infection prevention and control also means changing attitudes: we must create a culture that truly recognizes and values preventive measures, and makes them part of how everyone works, every day.

When faced with infectious diseases that can be passed from one person to another, the people most at risk are those who are highly vulnerable – often the very old or the very young and people with pre-existing health conditions. Health care providers caring for people who are ill are also at risk – both of being exposed themselves and of exposing other patients in their care. Infection prevention and control practices are designed to protect both patients and health care providers. Immunization is an important strategy to protect both workers and patients.

For example, much of the spread of SARS was due to poor infection prevention and control practices. The listeriosis outbreak was caused by a failure to properly clean food processing equipment. Outbreaks of hepatitis B and C have been caused by equipment in clinics that was not properly sanitized.[21–23]

Breaks in infection prevention and control are more likely to occur in environments that do not have a strong focus on safety or where workers do not see the link between their infection prevention and control practices, their own safety and well-being, and the safety of the patients in their care. Workplace safety can play a key role in helping to prevent the spread of infectious diseases in health care settings, in the management and care of farm animals, and in the food production, distribution and handling system.

5. The Case for Collaboration

Many different levels of government and agencies have roles to play in preventing, detecting and managing infectious diseases. For example, the Ministry of Labour works to ensure safe work environments for our health care workers. With water-borne illnesses, the Ministry of the Environment is involved. With zoonotic and food-borne illnesses, the Public Health Agency of Canada, Health Canada, Canadian Food Inspection Agency and the Ontario Ministry of Agriculture and Food all play key roles – as does the private sector (e.g., producers, retailers, restaurants). With a communicable disease, international, federal, provincial and local public health authorities are often all part of the response.

Collaboration is key to effective disease control. However, different agencies have different protocols and systems, so working together may be challenging. When many organizations are involved, conflicting messages may come from different sources, causing confusion or a loss of public trust. To improve collaboration, it is important for the players to clarify everyone's roles and responsibilities before an outbreak or health emergency happens. When an outbreak or health emergency does occur, all relevant sectors from all jurisdictions should meet regularly, problem solve together and communicate clearly with the public.

6. Communication Saves Lives

During an infectious disease outbreak, both the health system and the public look to public health for leadership and guidance. Public health's ability to communicate clearly and to speak with one voice is critical. Communication during an outbreak can be a challenge for Ontario's health sector, because there are so many independent players including: the World Health Organization, the Public Health Agency of Canada, elected officials, the federal and provincial Chief Medical Officers of Health, Public Health Ontario, local medical officers of health and local boards of health, hospital leaders, private practitioners, professional colleges, professional associations and unions, media pundits and members of the public.

7. Prevention is Cost Effective

Beyond the tremendous cost to individuals and families, infectious diseases are expensive for the health care system and for society at large.

The outbreaks and tragedies that occurred at the beginning of this century reinforced that it is more cost effective to prevent and control infectious diseases than it is to treat them or to manage an outbreak. For example, the total cost of SARS in Canada was over $2 billion, including a $350 million loss in tourism revenue, a $220 million loss in airport activity, and a $380 million drop in retail sales.[5] Much less dramatic outbreaks are also expensive. For example, it costs significantly more to hospitalize someone with *Haemophilus influenzae* type B than to immunize them. In fact, for many infectious diseases, there are few effective treatment options and fewer still that are inexpensive.[24] For those infectious diseases where there is no effective treatment, prevention is the only option.

II. Oversight: Keeping the System Strong and Vigilant

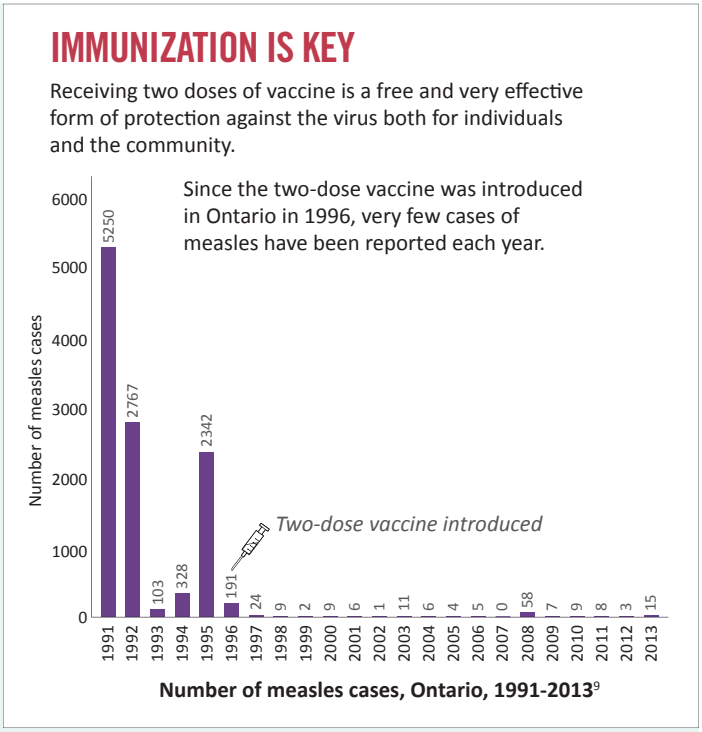
Over the past 10 years, Ontario has increased its investment in public health infrastructure and enhanced our capacity to oversee programs that prevent and detect infectious diseases. As a result, our public health system is much stronger; however, there still are gaps and weaknesses to address.

1. Investing in Prevention

Immunization

Immunization is still the first and best line of defence against infectious disease. Because of vaccines – which protect the public at relatively low cost – several generations of Ontarians have grown up not knowing the devastation that illnesses like polio, diphtheria, tetanus, measles and rubella can cause.

In the last 10 years, Ontario has almost doubled the number of publicly funded vaccines. The province now provides 21 vaccines to protect people against 16 diseases – including the annual influenza vaccine for the whole population and the human papilloma virus (HPV) vaccine for adolescent girls. The pneumococcal vaccine, which is normally administered to children, is now recommended for adults age 50 and older to prevent invasive pneumococcal disease – a deadly health problem for Ontarians as they age that causes a significant burden of disease.[25] To make immunization more accessible, Ontario has trained pharmacists to give influenza shots to those aged five and older.



Source: Modified from: Ontario Agency for Health Protection and Promotion (Public Health Ontario). Defending Ontario Against Measles. Toronto, ON: Queen's Printer for Ontario; 2014

We have achieved a lot with our immunization programs and more is possible. There are a number of new vaccines, new uses for existing vaccines and alternative vaccine "presentations" that are not currently publicly funded, which could be added to our arsenal to protect more Ontarians against infectious diseases and their complications. They include a new herpes zoster ("shingles") vaccine; a combined infant vaccine that provides protection against diphtheria, tetanus, pertussis, hepatitis B, poliomyelitis, and *Haemophilus influenzae* type B; HPV vaccine for males; and influenza vaccine in an intranasal spray form. In addition to vaccines that are already available, there are more vaccines in the pipeline.

In 2012, the Immunization System Review, an expert committee, was established to provide advice on how to improve the overall effectiveness and efficiency of Ontario's immunization system. When *Make No Little Plans*, Ontario's Public Health Sector Strategic Plan[26] was released, that review was still underway. *Make No Little Plans* stressed the importance of implementing the findings of the Immunization System Review, evaluating and renewing the province's Universal Influenza Immunization Program and prioritizing new vaccines for public funding. Since that time, the report of the Immunization System Review has been completed. The report reinforces the urgent need to promote immunization and build public confidence, to develop a way to record and track all immunizations administered in the province and to use evidence to continue to improve our immunization system.

Publicly Funded Vaccines in Ontario March 2014

Ontario's publicly funded immunization program provides 21 different vaccines which protect us against 16 diseases
Diphtheria, tetanus, pertussis, polio (DTaP-IPV)
Diphtheria, tetanus, pertussis, polio, *haemophilus influenzae* type b (DTaP-IPV-Hib)
Haemophilus influenzae type b (Hib)
Hepatitis A (HA)
Hepatitis B (HB)
Human papillomavirus (HPV)
Influenza (Inf)
Measles, mumps, rubella (MMR)
Measles, mumps, rubella, varicella (MMRV)
Meningococcal conjugate ACYW (Men-C-ACYW)
Meningococcal conjugate C (Men-C-C)
Meningococcal polysaccharide ACYW (Men-P-ACYW)
Pneumococcal conjugate 13 (Pneu-C-13)
Pneumococcal polysaccharide 23 (Pneu-P-23)
Polio (IPV)
Rotavirus (Rot-1)
Tetanus, diphtheria (Td)
Tetanus, diphtheria, pertussis (Tdap)
Tetanus, diphtheria, pertussis, polio (Tdap-IPV)
Tetanus, diphtheria, polio (Td-IPV)
Varicella (Var)

Notes: * Excludes BCG and rabies vaccine: BCG vaccine is only administered to specific populations in northern health units. Rabies vaccine is only provided to prevent rabies in those exposed to the rabies virus.

Prevention Programs for Diseases with No Vaccines

For infectious diseases where there are currently no vaccines, such as HIV, hepatitis C and sexually transmitted infections, Ontario has implemented prevention programs designed to reach those who are infected as well as those most at risk. These programs provide information, support, harm reduction materials and other services that can help reduce disease transmission. They focus on reducing unsafe sex and drug use. They also try to address the underlying drivers of risk, including marginalization, discrimination, mental health and addiction issues, and poverty.

Because there is no vaccine to prevent hepatitis C, Ontario has established an enhanced surveillance program that investigates the source of each infection and follows up to prevent other cases. HIV prevention programs – combined with effective treatments that reduce viral load and make people less infectious – have resulted in a recent drop in new diagnoses. In terms of cost effectiveness, the public health investment in community-based HIV prevention programs helped avert 7,556 new HIV infections between 2006 and 2009, avoiding $3 billion in health care costs.[27] But we can't afford to be complacent. Even with the progress Ontario has made, HIV is still a significant disease burden in the province.

Enhanced Infection Prevention and Control

Since 2003 (post-SARS), the government has invested in a number of initiatives to enhance infection prevention and control practices in health care settings. The government has funded 246 infection prevention and control positions in hospitals and local public health units. Their role is to enhance capacity and coordinate activities related to outbreak preparedness and management. The province's 14 Regional Infection Control Networks (RICNs), which are now part of Public Health Ontario, provide expert advice and promote standard approaches to infection prevention and control across the province.

Hand hygiene can decrease infections in health care settings and is the single most important method of preventing infections.

The Ministry of Labour is working with employers to champion standards and education to improve workplace safety. The Ministry of Health and Long-Term Care has also introduced new education programs, standards and requirements. Just Clean Your Hands,[28] a program developed by the Public Health Division at the Ministry of Health and Long-Term Care provides education and resources on proper hand hygiene for staff in hospitals, long-term care homes and other health care settings. The Just Clean Your Hands program, which was recognized by the World Health Organization, is now managed and coordinated by Public Health Ontario. As part of an initiative now led by Health Quality Ontario, Patient Safety Indicators – including hand hygiene practices – have been identified for health care settings, and hospitals are expected to monitor and report on compliance with these indicators.[29]

Infection prevention and control activities also target the public and the private sector. In terms of public education, Ontarians are being encouraged to wash their hands, cover their cough and stay home when they are ill to reduce the spread of respiratory infections. Patients in hospitals and other health care settings are being encouraged to ask their care providers whether they have washed their hands. In addition, workplaces have been encouraged to install hand sanitizer dispensers in public areas and promote their use as a way to reduce illness and improve productivity.[30, 31]

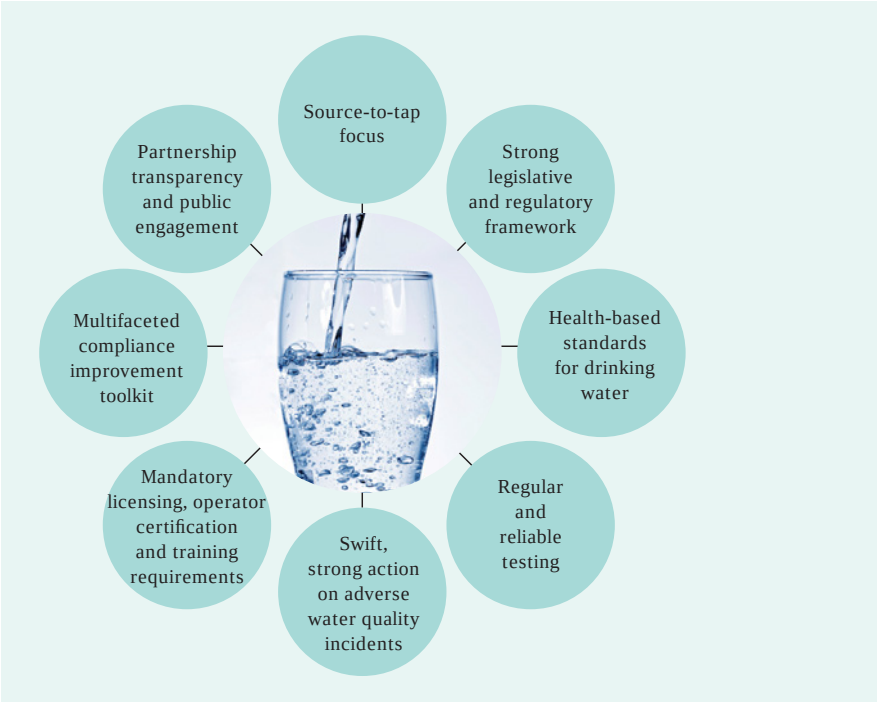
Stronger Standards, Better Regulation and More Effective Inspections

Drinking water protection starts at the source and continues until you turn on your tap. The same is true of food safety. It starts where food is produced and continues at each stage of its journey from farm to fork. Over the past few years, Ontario has made great strides in its oversight of both water and food safety.

Safer Water

In terms of **water safety**, the recommendations of the Walkerton Commission, led by Justice Dennis O'Connor,[9] have been implemented.

Ontario appointed a Chief Drinking Water Inspector to oversee efforts to protect drinking water sources and ensure regulated drinking water systems meet Ontario's rigorous framework for water protection. New initiatives include strong, health-based standards and a swift response to adverse water quality incidents. New legislation since the Walkerton outbreak has set stringent requirements for managing both large and small drinking water systems and the legislation is being enforced. For example, drinking water system operators must meet certain training requirements and be certified. Municipal water suppliers must have a quality management system in place. Ontario is also implementing plans to protect sources of municipal drinking water. Two source protection plans have already been approved. Each year the Minister of the Environment and the Chief Drinking Water Inspector prepare annual reports that provide an overview of Ontario's drinking water programs, including water quality and inspection results.[32]



The Walkerton Clean Water Centre, a state of the art facility, offers hands-on expert training, conducts applied research, and serves as a practical resource for operators and water professionals.

Many of the activities to protect Ontario's drinking water are led by our partners at the Ministry of the Environment. However, the responsibility for overseeing small drinking water systems has been transferred to public health. Local public health units work closely with their colleagues in the Ministry of the Environment to monitor drinking water quality, detect problems early and prevent or reduce water-borne illnesses. Public health also works with the 10% of Ontario households that have private water systems, providing education, free drinking water testing and advice from inspectors.

Safer Food

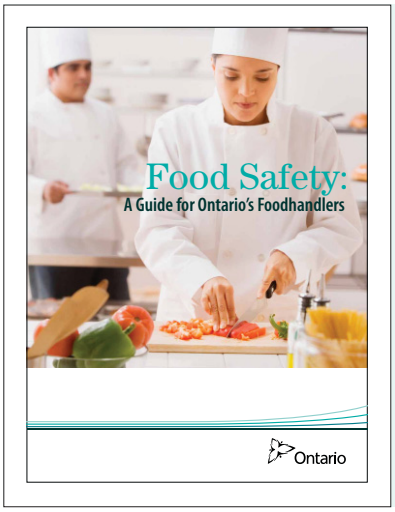
When it comes to food safety, the regulatory process is more complicated. The journey from farm to fork has changed significantly. As our food comes from farther and farther away, it becomes more challenging to ensure the safety of the food chain. To keep food safe, we need systems and safeguards on the farm, in transportation systems, in manufacturing plants, in restaurants and food premises, and at home.

For those parts of the food industry that are federally regulated, the Canadian Food Inspection Agency is responsible for ensuring food safety. The federal government has responded to recent food safety issues by revamping oversight of the Canadian Food Inspection Agency and transferring responsibility for food inspection at the federal level from the Minister of Agriculture to the Minister of Health. In its recent budget, the federal government also announced $390 million over five years to strengthen Canada's food safety system.[33]

In Ontario, three provincial ministries collaborate to enhance food safety:

- The Ministry of Agriculture and Food monitors compliance with legislated standards for food products produced and processed in Ontario. Its comprehensive science-based food safety programs include licensing, inspection, laboratory testing, monitoring, compliance and advisory services.

- The Ministry of Natural Resources sets standards for the handling and processing of fish and inspects fish plants. It also enforces the legislated standards for food production and processing on OMAF's behalf.
- The Ministry of Health and Long-Term Care is responsible for legislation, policies and guidelines to reduce food-borne illness, including setting safe food standards for food premises. With the support of Public Health Ontario, it is also responsible for responding to food-borne outbreaks and other food hazards, and for overseeing and coordinating the response to multi-jurisdictional food-borne illness outbreaks and investigations.



To improve food safety, the Ministry of Health and Long-Term Care collaborates with the private sector. For example, as part of the Open for Business strategy, the ministry works with the hospitality industry to address issues related to food safety.[34] In consultation with industry and local public health units, the ministry has revised its Food Safety Protocol[35] and developed a comprehensive Food Handler Training Plan,[36] which will give those working in the food industry access to consistent training.

In the event of a food-borne hazard or illness in Ontario, many different parties are part of the response, including the Ministry of Health and Long-Term Care, Public Health Ontario, the 36 local boards of health, the Ontario Ministry of Agriculture and Food, the Ministry of the Environment, the Ministry of Natural Resources, the Canadian Food Inspection Agency, Health Canada, and the Public Health Agency of Canada. To enhance collaboration during a multi-jurisdictional food-borne illness outbreak, the federal government worked with the provinces and territories to develop the Foodborne Illness Outbreak Response Protocol (FIORP).[37] Ontario also worked with its partners to update its guide to a multi-party response to investigating a foodborne illness outbreak: Ontario's Foodborne Illness Outbreak Response Protocol (ON-FIORP).[38] The ON-FIORP, which is a voluntary agreement, sets out the roles and responsibilities of each party in the event of an outbreak.

The most recent challenge to food safety in the province are growing efforts to market unpasteurized or raw milk, which carry a high risk of *Salmonella*, *E. coli*, and *Listeria*. According to ministry commissioned research, most Ontarians are aware that unpasteurized milk poses a health risk and almost as many know its sale is banned in the province, but 70% believe that Ontarians should have the right to purchase raw milk. As with vaccine hesitancy, this view is driven by a lack of awareness of the seriousness of the risks or of the importance of measures such as pasteurization. To counter these misperceptions, public health is working to educate people and is enforcing the statutes and regulations banning the sale of raw milk.

2. Creating a Modern, Robust Surveillance System

Smarter Information Systems

During SARS, Ontario's public health sector had relatively little surveillance capacity and was using a reportable disease information system with no interconnectedness between local public health units. As the Chief Medical Officer of Health at that time noted, Toronto was using 19th century tools to fight a 21st century disease.[5, p.29]

In the years since, we have worked hard to build better information systems as well as the skills to detect infectious diseases early. In 2005, the public health sector implemented the Integrated Public Health Information System (iPHIS), a province-wide, secure, integrated web-based public health information system for reporting infectious diseases. iPHIS is used by all local public health units to collect and transmit surveillance information on reportable infectious diseases electronically. It allows local public health units to identify and track unusual and unexpected instances of infectious diseases – and to share case, contact and exposure data that can help identify cross-jurisdictional outbreaks. All data on infectious disease are analyzed daily to identify any anomalies or spikes that may require investigation.

iPHIS is an effective way to communicate enhanced surveillance directives, and it helped improve case management and contact tracing across Ontario. Most importantly, information gathered through iPHIS has helped the public health system prevent a significant number of illnesses. In 2008, iPHIS helped ministry staff detect a higher number of cases of listeriosis than usual, which triggered a move to enhance surveillance, including conducting additional laboratory analyses and asking local public health units to enter reports of any new cases within one business day. We were able to link cases of listeriosis from across the province, detect the outbreak earlier, take action and save lives.

iPHIS also played a key role in the management of the 2008 outbreak of legionellosis; a 2008 E.coli outbreak in Niagara, Halton and North Bay related to unwashed lettuce; a 2008 *Salmonella* outbreak; and, a mumps outbreak in 2007 in Southwestern Ontario. The ability to quickly connect cases is particularly important for food-borne illnesses, where the cause of the problem may be in one plant or on one farm, but the product is then shipped across the province, country, or even farther afield.

Despite the benefits of iPHIS, our public health information system still has serious limitations. For example, there is no systematic way of knowing who has and has not been immunized (i.e., a provincial immunization record repository) because immunization status is not part of iPHIS. This deficiency was a challenge for the health system during the H1N1 pandemic.[30] At that time, the ministry developed spreadsheets and a basic database to help health units track vaccine uptake. This type of data management system is not sufficient to manage information on the large number of publicly funded vaccines, to assess vaccine coverage or to support efforts to promote immunization. And it certainly was not adequate to support the province during a potential emergency.

To be able to detect outbreaks early, the system must have the capacity to integrate laboratory reports. iPHIS is not directly linked to our public health Laboratory Information System nor does it connect to the Ontario Laboratory Information System. Having a system that could make those linkages electronically would reduce the manual efforts required today and result in substantial savings.

Ontario is now implementing Panorama, a pan-Canadian information management system developed as a result of SARS to support communicable disease surveillance and immunization and vaccine inventory tracking. The Immunization and Inventory modules of Panorama have been adopted and are in early implementation in Ontario and other jurisdictions across Canada. At the time this report was written, Panorama's Immunization module was up and running in six Ontario public health units. This module, along with the Inventory module which will be used by the Ontario Government Pharmacy, will soon be fully operational across the province. With these modules, public health units and the Ontario Government Pharmacy will be able to manage immunization records and vaccine inventories more efficiently.

Panorama's seven main components

Panorama's Immunization module will provide the foundation of a provincial immunization record repository, focusing first on Ontario's schoolchildren. Over time, with the recently established clinical immunization data standards and the development of computer system interfaces, Panorama will be able to import immunization information from other sources including community immunization clinics and immunizations delivered in hospitals, emergency departments, pharmacies, long-term care homes or other health care settings – including physicians' offices.

In the future, the Panorama modules for infectious disease Investigations and Outbreak Management should be implemented to improve the tracking and reporting of communicable diseases. By linking these modules with the Immunization module, the public health system will be able to identify at-risk populations during an outbreak.

New Surveillance Strategies

The public health system is also exploring new strategies and approaches to detect outbreaks and diseases early, such as syndromic and enhanced surveillance.

Syndromic surveillance involves analyzing existing health information – such as data from emergency departments, Telehealth Ontario calls and local pharmacy prescriptions – in real time to detect possible disease outbreaks earlier than is possible with traditional public health methods, such as passive reporting (i.e., waiting for hospitals or physicians to contact public health to report they are seeing more cases than usual of, for example, respiratory or diarrheal illnesses).

Enhanced surveillance involves using a number of techniques, such a sending a health alert, asking organizations to submit surveillance data more frequently or requiring more laboratory testing, to identify a disease or cases more quickly. For example, to enhance surveillance of health care-acquired infections, hospitals are now required to report on a range of Patient Safety Indicators including cases of *Clostridium difficile* associated disease and other antibiotic resistant infections acquired by patients in their care.

Better Structures, Clearer Roles

In 2007, the Government established the Ontario Agency for Health Protection and Promotion, now known as Public Health Ontario (PHO), a Crown corporation dedicated to protecting and promoting the health of all Ontarians.[39] PHO provides expert scientific and technical advice on infectious diseases and infection prevention and control. It also conducts surveillance and epidemiology, research, and professional development.

Certain key functions formerly managed by the Ministry of Health and Long-Term Care were transferred to PHO, including the public health laboratories, infectious and communicable disease surveillance activities, and the Provincial Infectious Disease Advisory Committee (PIDAC). In its first few years of operation, PHO has taken a number of steps to strengthen Ontario's disease surveillance

Public Health Ontario laboratory, Toronto

system and make it more vigilant, including modernizing the public health laboratories, instituting regular surveillance reports and supporting partners in responding to infectious disease outbreaks.

Ontario's public health laboratories conduct more than four million tests per year, including testing for tuberculosis, HIV, influenza and sexually transmitted infections. PHO has implemented an ambitious multi-year plan to modernize the laboratory system and make it more efficient. Since 2010, the implementation of high volume testing and other initiatives have significantly reduced test turnaround times. With shorter waits for lab results, the public health sector can now detect and respond to outbreaks more quickly. Better testing also leads to better management of individual cases, better outcomes and less risk of disease spread.

Better Communication and Co-ordination

Communication and co-ordination within the public health sector and beyond is now much stronger. In response to the recommendations of a previous Chief Medical Officer of Health report, the parts of the ministry responsible for public health and PHO are now located closer together. Formal communication and co-ordination protocols are in place and information is shared effectively. Morning rounds provides a daily opportunity for the ministry and PHO to discuss public health issues and to share information. Communication with health units also has improved significantly.

A number of other mechanisms have been established to improve intergovernmental co-ordination. For example, the Pan-Canadian Public Health Network, established in 2005 by Canada's Federal, Provincial and Territorial Health Ministers, provides a forum to discuss infectious disease prevention and control, as well as emergency preparedness, while respecting each government's jurisdiction. The Council of Chief Medical Officers of Health also provides a pan-Canadian forum for Chief Medical Officers of Health to advance public health science and practice across Canada.

Morning rounds at 8:30 A.M. provides a daily forum for discussion between Public Health Ontario and the Ministry of Health and Long-Term Care on current and emerging issues.

3. Responding Faster to Outbreaks

While the public health system is largely focused on preventing infectious disease outbreaks, outbreaks will happen and the system must be ready. Investments over the past few years have enhanced our capacity to react quickly.

Preparedness

Post SARS, the public health sector and its partners across the entire health care system invested in preparing for a possible influenza pandemic. The Ontario Health Plan for an Influenza Pandemic (OHPIP) includes: surveillance systems, stockpiles of antiviral medications and immunization supplies, arrangements to purchase and distribute vaccine, planning in all health care settings, stockpiles of equipment for health care workers, training of health care workers and emergency personnel, an expert scientific committee to guide the response, communication protocols, and public and provider communication and education.

Ontario's pandemic influenza plan was tested in 2009 with the emergence of the H1N1 pandemic and was effective. The networks created through that planning stood the province in good stead when faced with a real threat. As soon as a vaccine for H1N1 became available, the health care system immunized 2.75 million Ontarians within 14 weeks, from October 2009 to January 2010.[40] By the end of April 2010, a total of 3.86 million doses of vaccine had been administered.

An Emergency Operations Centre and Surge Capacity

Ontario's Ministry Emergency Operations Centre (MEOC), established in 2004, now co-ordinates the provincial response to health emergencies and manages communication among all health system players. With a small core staff, it can operate 365 days a year, always ready to help manage a disease outbreak or other health incident. When a full-blown health emergency occurs, it can staff up and

Ministry Emergency Operations Centre, Ministry of Health and Long-Term Care

The Emergency Medical Assistance Team is a mobile medical field unit that can be on site within 24 hours in a community with road-access

be fully operational in 30 minutes. Elaborate plans are in place to staff the MEOC with people with expertise in all aspects of emergency management as well as the needs of different care settings. Team members participate in regular mock emergency exercises to stay sharp and refine their responses.

Over the past five years, the MEOC has been fully activated to respond to 13 emergencies, including: the H1N1 pandemic in 2009; variant influenza H1N1 infection in 2012; the severe influenza season and national Tamiflu shortage in 2012–2013; and the emergence of the MERS-CoV in the Middle East and avian influenza H7N9 in China in 2013.

To ensure surge capacity in the event of a health emergency, including large disease outbreaks or incidents, public health has developed plans for different scenarios, which include the Emergency Medical Assistance Team, a mobile medical field unit that can be deployed within 24 hours anywhere in Ontario with road access.

Globally, Ontario is part of a world-wide effort to implement the International Health Regulations,[64] a framework for managing events that may constitute a public health emergency of international concern.

More Scientific and Technical Support

PHO has established Infection Control Resource Teams that provide rapid, on-site assistance with outbreak investigation and management for hospitals as well as support to local public health units. PHO also provides scientific consultation, supports professional development, conducts research and shares evidence to help the sector manage infectious diseases more effectively.

Better Protocols and More Cross Jurisdictional Collaboration

As discussed earlier, investigating and responding to a food-borne illness outbreak in Canada may involve several organizations at all levels of government across a number of jurisdictions. Mechanisms like FIORP[37] and ON-FIORP[38] help ensure effective collaboration. With ON-FIORP, Ontario is now in a stronger position to get ahead of food-borne illness outbreaks because it can establish an outbreak investigation co-ordinating committee as soon as a food-related hazard is identified – often before any illnesses have been reported.

Although both FIORP and ON-FIORP were developed specifically to address food-borne illnesses, these protocols have proven to be effective tools when jurisdictions are faced with other risks, such as vaccine preventable and respiratory infectious diseases.

III. Foresight: Anticipating New Threats

The future belongs to those who prepare for it today.

Ontario's public health system is now significantly more robust than it was 10 years ago. We have invested in people and technology, and our surveillance systems and diagnostic capacities are substantially stronger. We are anticipating, preventing, mitigating and managing infectious disease threats and outbreaks much better than in the past.

But are we ready for the future?

What will we face over the next 10 years? Will it be the same old foes – the diseases that have created the greatest burden in the past? Or new threats?

What changes in the host, infectious agents or environments will make us most vulnerable? Where should we focus our attention?

The box on the right lists the 10 most "burdensome" infectious disease agents in Ontario. And many other infections are reported annually, such as sexually transmitted infections (STIs), salmonellosis and pertussis (see Appendix 1).

The 10 most burdensome infectious agents in Ontario in 2010 were:

1. hepatitis C virus (HCV)
2. *Streptococcus pneumoniae*
3. human papillomavirus (HPV)
4. hepatitis B virus (HBV)
5. *E. coli*
6. human immunodeficiency virus (HIV/AIDS)
7. *Staphylococcus aureus*
8. influenza
9. *Clostridium difficile*
10. rhinovirus

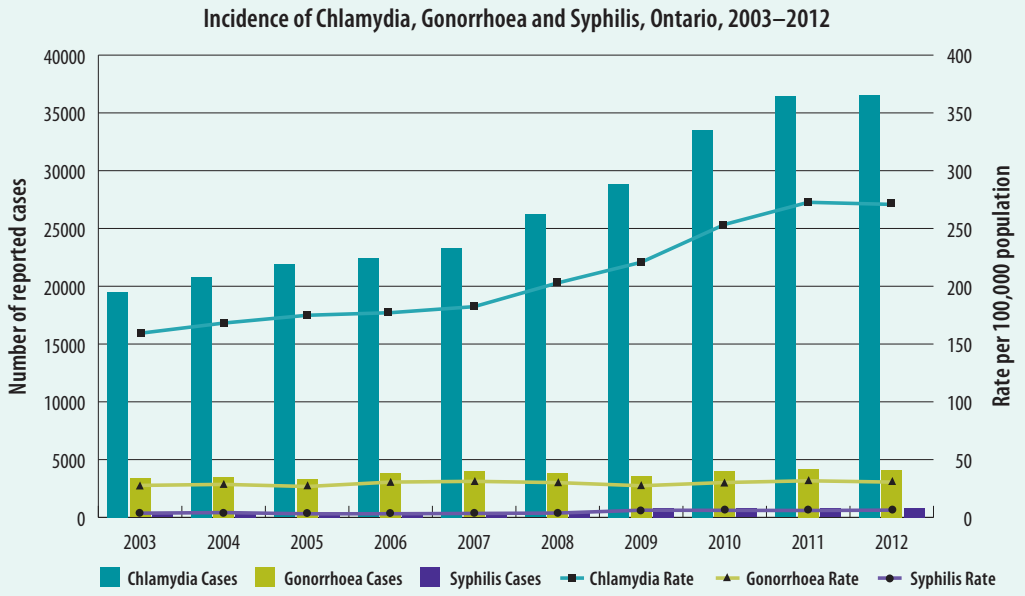
Nearly 50% of the total burden of infectious diseases could be attributed to the top five pathogens.[2]

1. Old Foes

Sexually Transmitted and Blood-Borne Infections on the Rise

We have been able to slow the spread of HIV, but we have been less effective in preventing other Sexually Transmitted and Blood-Borne Infections (STBBI), such as hepatitis C, a blood-borne infection that affects almost 110,000 Ontarians.[41]

Recently, Ontario has seen dramatic increases in chlamydia in both young men and young women. In just ten years, between 2003 and 2012, the number of annual chlamydia cases in Ontario jumped 88%. We've also seen worrisome increases in syphilis (from 239 cases in 2002 to 818 in 2012) and gonorrhoea (from 3,085 cases in 2002 to 4,097 in 2012) – particularly in young men and women (i.e., under age 25), men who have sex with men, and sex workers and their partners.



Source: Public Health Ontario

If these rising trends are not reversed, we will see more illness and more complications, such as infertility and, in the case of hepatitis B and C, liver disease and liver cancer. Beyond their effect on the people infected, STBBI are costly for the health system – both in treatments and in time needed to trace contacts. Even the gains we have made with HIV could be lost if we lose our focus on the threat from STBBI.

Of great concern is our ability to control multidrug-resistant gonorrhoea. Without action, we may soon run out of antibiotics to treat this disease.[42] To encourage practitioners to prescribe the most appropriate antibiotics to treat gonorrhoea, Ontario has developed and actively promotes gonorrhoea testing, surveillance and implementation guidelines. In addition, we need innovations such as gonococcal vaccines. We must also continue to promote sexual health, focusing particularly on groups disproportionately affected by STBBI, such as young men and women, men who have sex with men, people who inject drugs and other priority populations.

This is the approach that Ontario is taking in its new HIV strategy. With that strategy, we will focus attention on: improving the health and well-being of populations most affected by HIV; promoting sexual health and preventing new HIV infections and STBBI; diagnosing HIV infections early and engaging people in timely care; improving health, longevity and quality of life for people with HIV; and ensuring the quality, consistency and effectiveness of all provincially funded HIV programs and services. The proposed HIV strategy also highlights the role of immunization in protecting people's health – particularly HPV vaccine for males – and on the potential to use a range of prevention

technologies, including condoms and treatment. Recent studies have demonstrated that when HIV is well managed and people have a viral load below 200, they are significantly less infectious.[43] One of our prevention strategies must then become ensuring that all people with HIV are diagnosed as early as possible and have access to antiretroviral therapy.

Treatment Resistant Strains Make Old Foes Stronger

Old foes often emerge in new guise. That is what has happened with multidrug-resistant gonorrhoea and multidrug-resistant TB. According to the U.S. Centers for Disease Control and Prevention,[17] bacterial organisms have now evolved to be antibiotic resistant.[44] And the impact could be devastating. Worldwide, cases of multidrug-resistant TB have ballooned, killing an estimated 170,000 people in 2012. These less treatable strains are only a plane ride away.

With the rise in antibiotic resistant strains, there is growing pressure to reduce antibiotic use – both in humans and in the raising of animals. Physicians may find their prescribing practices scrutinized and the public is being discouraged from requesting antibiotics for mild respiratory illnesses. In place of antibiotics, we will need to develop other effective prevention strategies, such as vaccines and environmental engineering that inhibits disease spread.

Vaccine Hesitancy Threatens Health Gains

One of the most effective responses to an infectious disease is an effective vaccine; however, we are seeing growing hesitancy about the use of vaccines. Over the last few years, Ontario, British Columbia, Quebec and Alberta – as well as other jurisdictions in Europe and the U.S. – have seen outbreaks of vaccine-preventable diseases that we thought were under control, such as measles and whooping cough.

Most Ontarians recognize the importance of immunization and comply with vaccine recommendations. However, a vocal minority mistakenly perceive vaccines as unsafe or no longer necessary. Mixed messages about the value of immunization – often spread through social media – are leading to a loss of confidence. Because of vaccine hesitancy, some parents are refusing or delaying immunization for their children.[45] If these trends continue, they will threaten the health gains we have made through immunization.

When there are high rates of vaccine coverage among young people, there are fewer cases of vaccine-preventable diseases in older people.[2]

To maintain the immunization coverage rates we need to create "herd immunity", which protects those in the population who are not immunized or not fully protected by vaccines (e.g., the very young, the elderly, people who are immune compromised), we must find more effective ways to communicate with Ontarians about the importance of immunization and to dispel myths and misperceptions about vaccine safety.[2]

2. Emerging Threats

More Health Care-Acquired Infections in More Health Settings

Effective prevention of infectious diseases in health care settings requires a consistent multi-faceted approach: the right engineering and equipment, attention to hygiene, training for health care providers, and the co-operation of patients and their families and friends. It can be difficult to maintain good infection control practices in complex care environments – but we know it can be done. During infectious disease outbreaks such as SARS and during the H1N1 pandemic, health care facilities were much more diligent in enforcing infection prevention and control practices. In fact, patients in intensive care were more than twice as likely to develop a health care-acquired infection in the pre-SARS period than during the SARS period.[46]

Despite the advances we have made in infection prevention and control in Ontario, health care-acquired infections are on the rise and becoming more deadly. Many of these health care-acquired infections – including *Clostridium difficile* associated disease, methicillin-resistant *Staphylococcus aureus*, carbapenemase-producing *Enterobacteriaceae* (CPE) and extended spectrum betalactamase (ESBL) producing bacteria – are either antibiotic resistant or extremely difficult to treat. Of greatest concern are the bacteria that are resistant to multiple types of antibiotics[47] and those, like ESBL, that produce an enzyme that breaks down antibiotics.

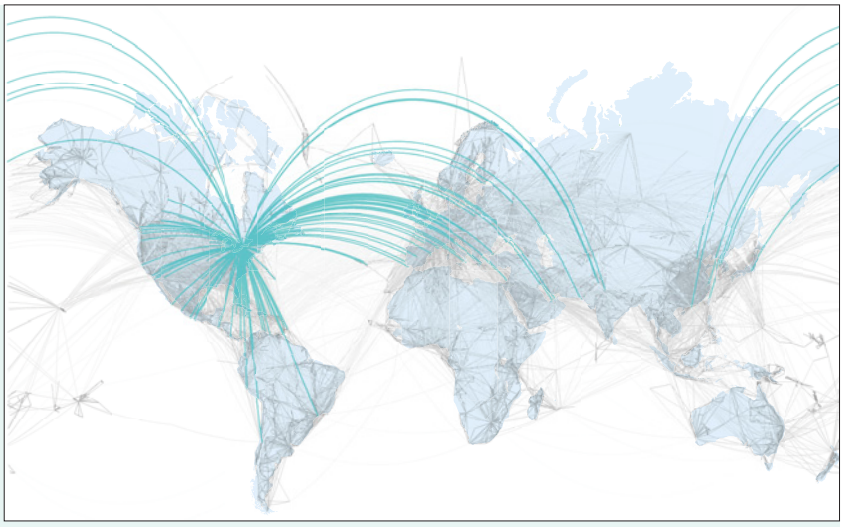
Right now, the concern is mainly in hospitals and long-term care homes. However, as more procedures shift from hospitals to community-based clinics, the risks may increase in settings that have significantly less infection prevention and control experience or expertise. In 2011, three of the province's 36 local public health units (Toronto, Ottawa and Peel) were called in to help respond to major infection prevention and control (IPC) lapses in community health care providers' practices. To protect the public's health, we must ensure these community clinics have the skills and supports to identify possible risks and maintain good infection prevention and control practices.

In July 2012, in response to these lapses, a community IPC lapses task group was struck to provide advice on how to improve IPC practices in community-based health care facilities and develop a consistent approach to assessing and managing community-based IPC lapses. Its recommendations include: building infection prevention and control capacity in these community clinics, improving collaboration and risk assessment, ensuring professional accountability and clarifying roles and responsibilities. In response to these recommendations, the ministry is developing an action plan, which will include guidance documents and risk assessment processes to enhance existing infection control practices as well as more infection prevention and control education in these settings.

Social Trends are Creating New Challenges

Larger trends – such as aging, globalization and urbanization – can increase the risk of infectious diseases.

Our **aging population** is more susceptible to infectious diseases than younger adults. Older Ontarians may have weaker immune systems and are more likely to suffer from two or more chronic conditions, which affect their ability to resist infections.[48] Their risk of exposure to infectious diseases increases when they are in institutional settings, such as hospitals or long-term care homes.



Source: Bio.Diaspora Project

With **globalization**, more people are travelling and migrating. With air travel, it can take only a matter of hours for a disease to cross the world.[49] Globalization also has implications for our food supply. A significant amount of the food that Ontarians eat now travels thousands of miles to our tables. Mass food production and distribution methods make it more difficult to ensure food safety, thereby increasing the risk of food-borne illnesses.

Over the past two decades, a large proportion of the world's population has moved from rural to urban areas. In other countries, particularly in the developing world, **urbanization** can lead to changing ecosystems, increasing the risk that animal viruses will infect humans, and then spread around the world. Cities also are becoming important hubs for the transmission of infectious diseases, as shown by recent pandemics. Public health in both developing and developed countries need to be aware of the changes in infectious diseases associated with urbanization.[50]

Changing Physical Environments are Increasing Risks

Climate change is altering ecosystems, allowing insects that carry disease, such as mosquitoes, to live longer and reproduce more.[51] Habitat change has also been linked to the emergence of novel human and veterinary disease agents.[52] In Ontario, the main risk from climate change will be a wider range of species that carry diseases, like the ticks that transmit Lyme disease and mosquitos that carry West Nile virus.

Heavy rains and flooding related to climate change also have the potential to contaminate our water supply. Rainwater can carry unwanted substances and harmful pollutants into Ontario's ground and surface water, potentially overwhelming the water treatment facilities that protect our drinking water.[32] The risk of waterborne disease is greater because our aging drinking water infrastructure – treatment plants, pipes, pumps, valves, storage tanks, reservoirs, meters and fittings – are near the end of their expected lifespan.[53]

Black fly | Flea | Mosquito | Sand fly | Tick

The lack of infrastructure in Ontario's First Nations communities is of particular concern, as it increases both the risk of infectious diseases and health inequities.[54,55]

Staying Ahead of New Pathogens

Some of the most serious threats to our health have yet to be discovered. Most will likely be the result of the interconnectedness among humans, animals and the environment. In an effort to identify new pathogens as early as possible, the U.S. Centers for Disease Control and Prevention is now working closely with pathologists, forensic pathologists and medical examiners to ensure that unexplained deaths were not caused by an as-yet-unseen or unknown bacteria or viruses.[56]

Ontario may need to enhance its capacity to work across disciplines to contribute to world-wide efforts to stay ahead of new pathogens.

Zoonotic diseases – diseases that spread from animals to humans – account for over 60% of all infectious diseases in humans and 75% of recently emerging infectious diseases, such as SARS and the H1N1 pandemic. They began by infecting animals but their genetic code changed over time, allowing them to infect people.[65] To reduce the risk of zoonotic diseases, we must recognize that animal health, human health and the eco-system are inextricably linked – and foster environments that support both healthy animals and healthy people.

3. New Opportunities

Harness 21st Century Information Technologies

As infectious disease threats emerge and evolve, so does our ability to identify and track these illnesses. New technologies can continually enhance our efforts to detect, prevent and control infectious diseases. Information about cases of infectious diseases can now be shared more quickly – even when the cases occur in remote places. Geographic Information Systems (GIS) can be used to map and help control outbreaks. As part of syndromic surveillance, we can use web analytics to track patterns in Internet search queries and identify possible outbreaks early. For example:

- Google has found certain search terms that may be good indicators of influenza activity.
- PulseNet, a surveillance system used to identify foodborne disease outbreaks, has created a standardized laboratory method for health and food agency laboratories that allows them to share and compare information on food-borne organisms. It also posts this information on-line, making it easier to identify an outbreak or common source of food-borne illnesses more quickly.
- BioDiaspora.com, an initiative developed here in Ontario, uses global air traffic patterns, GIS, simulation modelling and other data systems to predict how emerging infectious diseases will spread around the world.

In terms of our immunization system, we could be using bar codes on vaccine vials linked to the national drug information database to rapidly and accurately record immunizations in a provincial immunization record repository. Ideally, the immunization information system would also be

Vials of vaccines with barcodes

able to send notices to Ontarians and their physicians to remind them of when they are due for an immunization, and people would be able to check their own immunization status.

Social media is another possible infection control tool. Many people get the majority of their information about illness and prevention through various social media sites.[57] Social media and other data sources can also be tapped for insights into how people will react when faced with a new disease control measure or the threat of infectious disease.[58] A creative 21st century public health system may be able to use social media to prevent disease, manage outbreaks, and promote immunization. For example, modelling studies show that when clusters of negative vaccine sentiments lead to clusters of unprotected individuals, the risk of disease outbreaks increases. Through on-line social media, public health practitioners may be able to target interventions to those at-risk clusters.[59]

Be Smarter About Assessing and Responding to Risks

When tracking new and emerging pathogens, how will we determine which ones pose real risks? Are recent emerging agents – such as the MERS-CoV, H7N9 avian influenza viruses or CPE – serious threats to Ontario residents?

Ontario must be prepared for the unexpected – the threat of emerging infectious diseases is real. Investing in infectious disease prevention and control is cost-effective, and the failure to maintain and enhance this investment could result in new outbreaks of old foes, like *E. coli*, listeriosis, Legionnaire's disease or something completely new.

At the same time, we must be smart about how and where we invest our resources. We must be able to assess the potential impact of any emerging infectious disease and respond appropriately.

As part of our commitment to vigilance, Ontario implemented the daily hazard identification and risk assessment process, which scans a set of information sources to identify emerging issues or incidents and then analyzes and reports on them, as appropriate. We are also using modeling to help identify priority populations for influenza vaccination (i.e., the people most likely to experience a bad outcome from influenza).[60]

With so many different infectious threats competing for attention and resources, we need to develop a framework to help prioritize diseases and use our resources effectively to protect population health. Ontario researchers have been pioneers in developing methods that can be used to guide evidence-based decision making for the best use of public health resources. Studying diseases that spread from animals to people (i.e., zoonoses), they used a method called "conjoint analysis" (widely used in market research) to determine the kinds of diseases that disease experts (e.g., veterinarians and doctors) and the general public would like to see as priorities for prevention and control efforts. They found that members of the general public had clear preferences about how disease threats should be prioritized, based on factors such as how common the disease is, how dangerous the disease is if it starts to spread, and the relative impact of disease on humans and animals.[61] These methods hold great promise as a way for Ontario to make rational, evidence based decisions about how best to use limited resources.

Ontario's Readiness for Infectious Diseases: Conclusions and Recommendations

Ontario is much more ready for infectious diseases today than it was 10 years ago. We have implemented the recommendations from the SARS, Walkerton and Haines reports. But infectious diseases never sleep, and neither can we. We must remain vigilant.

Within the epidemiologic triad of host, infectious agent and environment, we must do everything we can to make sure Ontarians are as healthy and resilient as possible so we can fight off infectious diseases. We must create healthy environments – in our homes, daycares, schools and workplaces; on our farms; in our health care settings; and in our communities – to help prevent the emergence and spread of infectious diseases. When it comes to the infectious agents themselves, we must continue to develop effective vaccines and treatments while, at the same time, avoiding practices, such as the inappropriate use of antibiotics, that lead to less treatable strains. We must also continue to develop a resilient public health system that can anticipate and respond to health threats.

Here is our strategy to advance Ontario's readiness for infectious diseases:

1. **End the complacency.** Continue to educate the public and health care providers about the risks of infectious diseases and what they can do to reduce the risks. Continue to reinforce the vital importance of immunization, food safety, safe water and infection and prevention control practices, everywhere, all the time.

2. **Improve scientific literacy** – beginning in school – so more Ontarians are knowledgeable about viruses, bacteria, parasites and fungi and more are able to distinguish between credible scientific evidence and myths.

   The **Ministry of Education** should address the need for greater health literacy for all students.

3. **Reinvigorate Ontario's Immunization System.** Vaccines prevent infectious diseases, save lives and reduce health care costs.

   The **Ministry of Health and Long-Term Care** and its partners should address the findings of the Immunization System Review, focusing first on building public confidence in immunization and continuing to create a provincial immunization record repository (Panorama).

4. **Reduce sexually transmitted and blood-borne infections.** Implement strategies to reduce all STBBI and encourage the development of new vaccines, particularly for antibiotic resistant sexually transmitted diseases.

   The **Ministry of Education** should ensure that all students have up-to-date information and decision-making skills to optimize their sexual health and help them protect themselves from STBBI.

The **Ministry of Health and Long-Term Care** and its partners should implement Ontario's proposed HIV/AIDS strategy to 2020 – Changing the Course of the HIV Prevention, Engagement and Care Cascade in Ontario[62] – and the province's Strategy to Address Hepatitis C in Ontario 2009–2014.[63]

5. **Reduce health care-acquired infections.** Continue to reinforce infection prevention and control practices in hospitals, long-term care homes and other community settings.

   The **Ministry of Health and Long-Term Care** and its partners should implement the recommendations from the community infection prevention and control lapses task group and the ministry's action plan.

6. **Slow the emergence of antibiotic resistance.** The **Ministry of Health and Long-Term Care** and Public Health Ontario should work with our health sector partners, with the Ontario Ministry of Agriculture and Food and its partners, as well as with our federal and provincial/territorial partners in health and agriculture to develop a strategy to discourage inappropriate use of antibiotics in people and animals.

7. **Improve public health information and knowledge systems.** The **Ministry of Health and Long-Term Care** should continue to implement cutting edge information and knowledge systems in public health, including the infectious disease Investigations and Outbreak Management modules of Panorama.

8. **Keep Ontarians healthy.** Continue to address the modifiable health, social and environmental risk factors that put people at risk of bad outcomes from infectious diseases, such as tobacco use, harmful alcohol use and air pollution.

In *Make No Little Plans*, Ontario's Public Health Sector Strategic Plan,[26] the vision is that Ontarians will be the healthiest people in the world. Improving the prevention and control of infectious diseases is one of five goals in that plan. We must continue to enhance our ability to manage both old foes and new threats. We must also capitalize on new opportunities and technologies to keep Ontarians healthy, anticipate and detect infectious diseases earlier, respond more quickly and educate the public.

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APPENDIX 1: Reportable Infectious Diseases in Ontario 2012

Table 2: Reportable Disease Case Counts and Crude Rates, Ontario, 2012

Disease	2012 Confirmed Cases	Crude Rate/100,000
AIDS	68	0.50
Amebiasis	195	1.44
Botulism	5	0.04
Brucellosis	9	0.07
Campylobacter Enteritis	3898	28.86
Chlamydial Infections	36549	270.62
Creutzfeldt-Jakob Disease, All Type	3	0.02
Cryptosporidiosis	297	2.20
Cyclosporiasis	79	0.58
Cytomegalovirus Infection, Congenital	3	0.02
Encephalitis	19	0.14
Encephalitis/Meningitis	157	1.16
Food Poisoning, All Causes	59	0.44
Giardiasis	1341	9.93
Gonorrhoea (All Types)	4097	30.33
Group A Streptococcal Disease, Invasive	606	4.49
Group B Streptococcal Disease, Neonatal	56	0.41
HIV	781	5.78
Haemophilus Influenzae B Disease, Invasive	5	0.04
Hepatitis A	124	0.92
Hepatitis B – Acute	104	0.77
Hepatitis B – Chronic	2240	16.59
Hepatitis C	4172	30.89
Hepatitis D	4	0.03
Herpes, Neonatal	5	0.04
Influenza	8481	62.79
Legionellosis	190	1.41
Leprosy	2	0.01
Listeriosis	43	0.32
Lyme Disease (includes probable cases)	185	1.37
Malaria	220	1.63
Measles	3	0.02
Meningitis	137	1.01
Meningococcal Disease, Invasive	32	0.24
Mumps	16	0.12

Table 2: Reportable Disease Case Counts and Crude Rates, Ontario, 2012 (continued)

Disease	2012 Confirmed Cases	Crude Rate/100,000
Ophthalmia Neonatorum	4	0.03
Paratyphoid fever	36	0.27
Pertussis (Whooping Cough)	822	6.09
Q fever	19	0.14
Rabies	1	0.01
Rubella	1	0.01
Salmonellosis	3038	22.49
Shigellosis	271	2.01
Streptococcus Pneumoniae, Invasive	1273	9.43
Syphilis, Early Congenital	2	0.01
Syphilis, Infectious	818	6.06
Syphilis, Other	727	5.38
Tetanus	1	0.01
Trichinosis	2	0.01
Tuberculosis	615	4.55
Tularemia	1	0.01
Typhoid fever	82	0.61
Verotoxin Producing *E. coli*	210	1.55
West Nile virus illness	239	1.77
Yellow fever	2	0.01
Yersiniosis	162	1.20

Source: **Cases:** Ontario Ministry of Health and Long-Term Care, integrated Public Health Information System (iPHIS) database, extracted by Public Health Ontario [2013/11/13]. **Population:** Population Estimates, Ontario Ministry of Health and Long-Term Care, intelliHEALTH Ontario, extracted [2014/03/07].

Notes: **1)** iPHIS is a dynamic disease reporting system which allows ongoing updates to data previously entered. As a result, data extracted from iPHIS represent a snap shot at the time of extraction and may differ from previous or subsequent reports. **2)** Cases are reported based on 'episode date', with the exception of HIV, AIDS and TB. The episode date is an estimate of the onset date of disease for a case. In order to determine this date, the following hierarchy is in place in iPHIS: Onset Date > Specimen Collection Date > Lab Test Date > Reported Date. If an onset date exists it will be used as the episode date. If not available, then the next available date in the hierarchy will be used. Cases of AIDS and TB are based on diagnosis date. HIV cases are based on encounter date. **3)** The data only represent cases reported to public health and recorded in iPHIS. As a result, all counts will be subject to varying degrees of underreporting. **4)** Includes only confirmed cases. **5)** Includes both confirmed and probable cases. **6)** Although probable cases for these diseases are reportable, no probable cases were observed in 2012. **7)** Includes confirmed, probable and suspect cases. **8)** Measles, rubella and congenital rubella syndrome have been eliminated from Canada. However as these diseases remain endemic in other countries, imported cases continue to occur in Ontario. **9)** Due to underreporting in iPHIS, the data for invasive Haemophilus influenzae b and Meningococcal disease, comprised of linking and validating cases that were reported in iPHIS as well as laboratory data from the Public Health Ontario Laboratory. **10)** Varicella is reportable at the provincial level in the form of individual cases as well as aggregate case counts by health unit, age group and month. Although aggregate case counts are subject to underreporting, individual case counts have been excluded from this table as they represent the more severe spectrum of disease (e.g., hospitalized cases, cases with complications including death).

APPENDIX 2: Medical Officer of Health Vacancies in Ontario

Ontario Public Health Units with Vacant Medical Officer Positions Filled by Acting MOHs as of February 20, 2014

Elgin-St. Thomas Health Unit
Haldimand-Norfolk Health Unit
Huron County Health Unit
County of Oxford Department of Public Health and Emergency Services
Total = 4 Health Units with MOH Vacancies

* Under 62. (1)(a) of the Health Protection and Promotion Act, every board of health shall appoint a full-time medical officer of health.

** Vacancies may include positions filled by qualified physicians awaiting appointment by boards of health and ministerial approval.

Ontario Public Health Units with Vacant Associate Medical Officer of Health (AMOH) Positions as of February 20, 2014

Durham Regional Health Unit
Grey Bruce Health Unit
Sudbury and District Health Unit
Toronto Public Health
Total = 4 Health Units with AMOH Vacancies

* Under 62. (1)(b) of the Health Protection and Promotion Act, every board of health may appoint one or more associate medical officers of health.

** Vacancies may include less than or more than one FTE position per health unit and include positions filled by qualified physicians awaiting appointment by boards of health and ministerial approval.

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