

3.2

Public Health Strategies to Prevent Disease

Here is a summary of what you will learn in this section:

- Public health strategies improve the health of residents of Ontario.
- Current strategies include immunization programs, smoke-free environments, healthy lifestyles, screening programs, and health education programs.
- Individuals can make healthy lifestyle choices to improve quality of life.



Figure 3.16 In 1796, Edward Jenner developed the process of vaccination.

The Father of Vaccination

In the 18th century, smallpox killed 30 percent of the people it infected and left survivors marked with deep-pitted scars called pock marks. In 1796, Edward Jenner, a British country doctor, noticed that young people who milked the cows and contracted a mild case of a related disease called cowpox never got sick from smallpox. He designed an experiment in which he put some pus from cowpox sores into an open wound on a young boy's arm (Figure 3.16). Subsequently, the boy became resistant or immune to the smallpox disease. Jenner used the word “vaccination” to describe the injection of the smallpox vaccine.

Today in Ontario, vaccinations are given for many diseases, including influenza, tetanus, and polio. Vaccinations are also called immunizations, needles, or shots. A vaccine is a substance that is given to boost your body's defense system, which is called your immune system. Most vaccines contain a small amount of dead or inactivated virus or bacteria. The most common vaccine given each year is the influenza vaccine. The influenza vaccine not only protects individuals from becoming ill but also lessens the impact that influenza has on the health-care system. Ontario was one of the first locations in North



Figure 3.17 Rahima Banu was one of the last known cases of smallpox. She survived.

America to offer the influenza vaccine as part of the Universal Influenza Immunization Program. In 2008, 42 percent of all Ontarians received the influenza vaccine.

Since Jenner's discovery, vaccinations are used around the world. Smallpox, once feared as a deadly disease, was eliminated in 1979 because of Jenner's vaccine (Figure 3.17).

A26 Quick Lab

Catch Me If You Can



Figure 3.18 Virus particles from a sneeze spread quickly and contaminate surfaces they touch.

The cold virus is a common virus that can live on household surfaces for up to two days. When a person coughs or sneezes, cold viruses in the droplets are expelled and can contaminate surfaces (Figure 3.18). In one study, a cold virus was found on 25 percent of individuals one hour after they had touched a surface contaminated with the virus.

Purpose

To simulate the spread of a virus



Materials & Equipment

- paper cups
- a dropper or pipette
- 1 M NaOH
- distilled water
- phenolphthalein solution



CAUTION: NaOH and phenolphthalein may irritate the skin and eyes. Use caution when using these liquids.

Procedure

1. Each student should obtain a paper cup that is half-filled with liquid from your teacher. Assume that one of the students will have a paper cup that contains the "virus."
2. Walk around the classroom until your teacher tells you to stop. Trade liquids with the closest student to you. Use your dropper to take some of your liquid and add it to the paper cup of the other student. The other student should take some liquid from his or her cup, and add it to your cup. This is the first "exchange."
3. Repeat step 2 until at least four exchanges have been made.
4. Your teacher will add a drop of "virus indicator" (phenolphthalein) to each paper cup. If the cup turns pink, it has been infected with virus.
5. Record the number of infections in the class.

Questions

6. What process could you use to identify the original source of infection in your simulation? Try to identify the original source using your process.
7. How would the identification process be different if the disease were present in a food source?
8. In this simulation, the individual becomes immediately infected every time that there is a contact (an exchange of liquids). Describe a disease in which the infection does not immediately appear after contact.

A Look at Some Public Health Strategies

Technology has helped scientists learn about the cell, tissues, organs, and organ systems. This understanding has helped doctors develop strategies to prevent the occurrence of disease. Knowledge has also led to the development of drugs or therapies that are uniquely tailored to act on the whole organism. Public health agencies have also developed strategies to affect the health of an organism.

Keeping Canadians healthy is a priority for the various health agencies at each of the three levels of government: federal, provincial, and municipal. Each level of government contributes to developing public health strategies. For example, the Public Health Agency of Canada is a branch of the federal government that works with each province and territory to support a sustainable health-care system. The Ontario Ministry of Health and Long Term Care provides information on health strategies that are of concern to Ontarians. At the municipal level, public health units in Ontario implement federal initiatives and provincial policies to support the health of citizens.

Prevention Programs

There are 36 public health units across Ontario. Each health unit administers **public health strategies** for health promotion and disease prevention programs including immunization, healthy lifestyles, education, and screening services. Rates of cancer and chronic disease, level of nutrition, instances of infectious disease transmission, quality and safety of water, Sun protection behaviours, degree of physical activity, and safe sexual practices all have an impact on the health of Ontarians. These programs teach people how to lead healthier lifestyles.

While public health programs are geared to support and encourage healthy living practices, they are also designed to reduce the cost of health care. The old saying “An ounce of prevention is worth a pound of cure” drives many of the initiatives of public health strategies. Many preventive measures are therefore directed at children and youth to reduce overall health costs and to prevent the development of disease.

Suggested STSE Activity •••••

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Learning Checkpoint

1. Describe and explain the importance of Edward Jenner's experiment with cowpox.
2. Name several vaccines that are routinely administered in Ontario.
3. State two reasons why public health units think it is important to administer the influenza vaccine each year.
4. What is the job of a public health unit?
5. Describe the role played by public health units in keeping Ontarians healthy.

Immunization Programs

Immunization involves making a person immune to infection through vaccination. Around the world, immunization saves millions of lives each year. However, thousands of children die every day from diseases that are preventable with vaccines. Most children today in Ontario have never had polio, tetanus, whooping cough, rubella, measles, and bacterial meningitis because of vaccines. Immunization of children for these diseases occurs at several points in their development (Figure 3.19). Even adults require booster shots.

Measles, mumps, and rubella (MMR) are infectious diseases that can have serious complications including mental retardation, sterility, and deafness. Vaccination against these diseases lowers the incidence of these diseases and also of the complications. The MMR vaccine is administered soon after a child's first birthday and again at about 18 months. This vaccine provides protection against measles, mumps, and rubella and is required by law for all school-aged children in Ontario unless an exemption is granted.

However, vaccination is not without controversy. Over the past several years, some parents have chosen not to vaccinate their children because of the suspicion that the vaccine causes autism. There is no scientific evidence that vaccines cause autism. While the decision to vaccinate may appear to be an issue for each individual, in reality the decision affects society as a whole. By becoming vaccinated, you are protecting yourself from disease and preventing the possibility of spreading disease to others in the community.

Developing an HIV Vaccine

Scientists around the world are currently working to develop an HIV vaccine to address the global problem of HIV/AIDS. Human immunodeficiency virus (HIV) is a virus that attacks a person's immune system (Figure 3.20). Over time, the immune system becomes weak, which leaves the individual susceptible to all types of infections. The most advanced stage of HIV infection is referred to as acquired immune deficiency syndrome (AIDS). The time between HIV infection and an AIDS diagnosis is between 10 and 15 years. Some drugs can slow the disease progression, but there is no cure.

A vaccine would prevent people from becoming infected with HIV. In 2007, there were over 33 million people in the world living with HIV; over 7000 people become infected each day.

HPV Vaccine

In 2008, Dr. Harald zur Hausen was awarded the Nobel Prize in medicine for his work in discovering the connection between human papilloma virus (HPV) infections and cervical cancer. An HPV vaccine was developed based on his research. HPV is a common family of viruses that is found in both males and females.



Figure 3.19 Immunization can protect you from diseases, including influenza.



Figure 3.20 AIDS is caused by the human immunodeficiency virus (HIV).

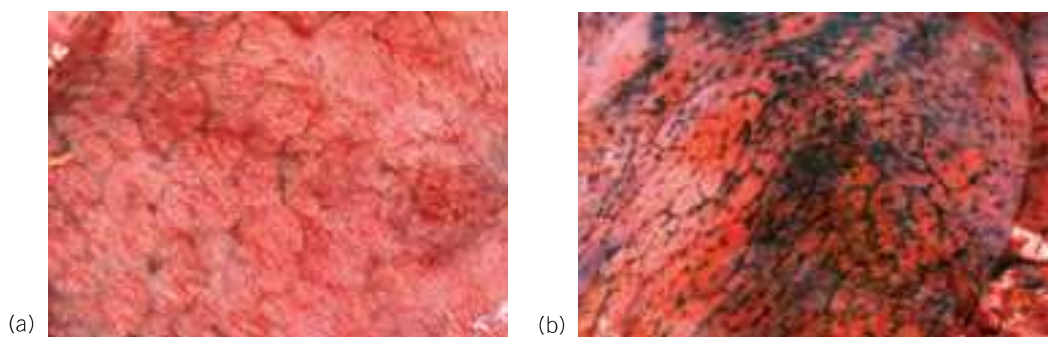
Today, in Ontario, the HPV vaccine has been approved for females aged 9 to 26 years old. The Ontario provincial government has made the HPV vaccine available at no cost for all girls in Grade 8. Zur Hausen believes that it is also important for males to be vaccinated to prevent cervical cancer in their partners. However, the vaccine is currently approved only for females.

Smoke-Free Environments

Smoking tobacco kills about 13 000 people in Ontario each year. Tobacco smoke contains more than 1000 chemicals — one-fifth of those are toxins. Many of the chemicals have been proven to cause cancer and are called carcinogens. Inhaled smoke deposits carcinogens in the body. These carcinogens affect cells, tissues, and organs, particularly the lungs (Figure 3.21). Second-hand smoke is smoke from a burning cigarette or cigar or the smoke exhaled by a smoker. Second-hand smoke can affect the heart rate and blood pressure and can increase the cellular levels of poisonous gas. In addition to causing cancer, smoking aggravates other conditions such as heart disease, liver disease, and emphysema. Unborn babies of mothers who smoke have a higher incidence of neurological damage and lower birth weights.

As of May 2006, smoking has been prohibited in all workplaces and enclosed public places. As part of the Smoke-Free Ontario Strategy, the government is committed to reducing tobacco consumption and increasing the proportion of smoke-free homes. The strategy also encourages young people not to smoke, provides programs to quit smoking, and protects people from second-hand exposure to smoke. In January 2009, the Ontario government enacted further legislation that banned smoking in cars when children under 16 years are present.

Figure 3.21 (a) A lung from a non-smoker. (b) A lung from a smoker. The black areas are tar deposits from cigarette smoke, which damage the lungs and can cause lung cancer, bronchitis, and emphysema.



Promoting Public Awareness: Healthy Lifestyles Outdoors

Most of us enjoy being outside on a nice sunny day. Some public health strategies involve campaigns to make the public aware of ways to practise healthy lifestyles when outside. These campaigns include protecting yourself from the Sun and from the West Nile virus.

The Sun produces vast quantities of energy; much of this energy is ultraviolet (UV) radiation, which is classified as a carcinogen because it can cause skin cancer. UV radiation can cause a mutation in a cell's DNA. Over 62 000 Canadians develop skin cancer each year.

Various health strategies are aimed at reducing the number of people developing skin cancer. Programs have been developed to provide information about the links between exposure to UV radiation and skin cancer, to promote Sun protection behaviours, which include limiting sun exposure, wearing protective clothing and sunglasses, and using sunscreen (Figure 3.22).

West Nile Virus

The West Nile virus is spread by mosquitoes and can affect birds, humans, horses, and other animals. A mosquito becomes infected when it feeds on the blood of a bird carrying the virus. Within two weeks, the mosquito can transmit the virus to people and animals (Figure 3.23). The virus causes a range of symptoms in humans from mild influenza-like symptoms to serious paralysis, seizure, or even death. About 80 percent of people who contract the virus have no symptoms at all.

Currently, there is no vaccine for the West Nile virus. However, public awareness campaigns suggest measures that we can take to protect ourselves from the virus, including:

- Minimize exposure to mosquitoes from dusk to dawn when mosquitoes are most active.
- Remove all sources of standing water and dense brush to limit the breeding ground for mosquitoes.
- Apply insect repellent that contains no more than 30 percent DEET (N,N-diethyl-meta-toluamide) to clothes and exposed skin.
- Wear light-coloured clothing that covers arms and legs.

Local health authorities monitor the spread of the West Nile virus in particular areas. Workers determine if pesticides need to be used to control mosquito larvae or adults in storm drains, ditches, or wetland areas.



Figure 3.22 Wearing a hat and sunscreen and limiting your time in the Sun are some behaviours that reduce your risk of developing skin cancer.



Figure 3.23 Mosquitoes can carry the West Nile virus (magnification 10×).

Learning Checkpoint

1. How do vaccination programs reduce the incidence of certain diseases?
2. What is the Smoke-Free Ontario Strategy?
3. Describe three Sun protection behaviours.
4. What is the West Nile virus?
5. Describe three ways to limit your risk of contracting the West Nile virus.

During Writing



Reliable Sources

A report makes references to authority — organizations or individuals — whose information is usually reliable and based on research. Advertising may also refer to authority, but often in vague terms, using phrases such as “More doctors recommend ...” or “Tests confirm ...” You never find out which tests! Note the reliable sources referenced in this chapter. When writing a report, ensure that your facts and information come from reliable sources.

Screening Programs

Screening programs apply a relatively simple, inexpensive test to a large number of people to identify those people who have risk factors for cancer. The goal of screening is to reduce the incidence of disease through early detection. There are two types of screening programs: cancer screening programs and DNA screening programs.

Cancer Screening

Cancer affects almost every organ in the body, from the skin to the colon. There are several cancer screening initiatives that are currently available in Ontario.

- The Ontario Cervical Cancer Screening Program recommends that women have a Pap test annually once they become sexually active. The Pap test can detect abnormalities or changes in the cervix before cancer develops. If the test is normal for three years in a row, the woman should have a Pap test every two to three years.
- The Ontario Breast Screening Program provides mammograms and breast examinations to women between the ages of 50 and 74 years. The goal is to reduce the mortality from breast cancer.
- The ColonCancerCheck Program provides funding to screen for colorectal cancer, which is a leading cause of cancer death in Ontario. All adults over 50 years of age are screened using the fecal occult blood test (FOBT) every two years. This simple screening tests the feces for blood.

DNA Screening

Today, we have technology that allows biologists to investigate diseases by looking at the genetic information contained within our DNA. The information coded in DNA is used to make proteins. Each section of DNA that codes for a particular protein is called a **gene**. Tests have been developed that can indicate if an individual may have a series of genes that are related to diseases such as heart disease and types of cancers. This is known as **DNA screening** (Figure 3.24).

There are sections of DNA that scientists can follow throughout the process of cell division. These sections are called DNA markers. Since scientists noticed that some of the markers changed during the cell's life, they believed that the cell's DNA was changing. They concluded that this change was related to changes in the cell's environment. This finding had implications for the study of disease. For example, if an individual has a gene that increases the likelihood of developing a disease, it might be possible to change that gene by altering the cell's environment by making alterations in lifestyle.



Figure 3.24 A scanning electron micrograph of a cancer cell (white) and an autoradiogram showing the genetic code of a section of DNA. The presence or absence of particular sections of DNA, called genes, has been linked to the development of certain forms of cancer.

DNA screening may become part of the diagnosis and treatment of diseases within the decade. Even the treatment of cancer may involve DNA screening. For example, if a woman carries a specific version of the gene for breast cancer, she may also have an increased risk for ovarian cancer. Treatment may include removing the ovaries, as well as treating the breast cancer. However, DNA screening is not without controversy. For example, although DNA screening will detect if a person is at risk of getting cancer, some individuals may not want to know if they are at risk. Other individuals may want to know as much information as possible so that they can take steps to reduce their risk.

Health Education Programs

Many public health strategies implement education programs to promote health. These programs involve communicating information using numerous brochures, websites, posters, and television commercials (Figure 3.25). Examples of health education programs include HIV/AIDS education and nutrition education.

HIV/AIDS is considered to be one of the most serious public health problems in the world. Experts believe that education and awareness of HIV/AIDS is vital to reducing the spread of HIV. Ontario has over 80 organizations and initiatives that deliver HIV/AIDS education and support to groups across the province. In addition, HIV/AIDS education is part of the Ontario curriculum.

Another area of health education is in nutrition. Research has shown that there is a link between good nutrition, school performance, and development of a healthy body. Programs have been created to provide opportunities for families to develop awareness of healthy eating habits. Some of the programs are associated with schools. For example, The NutriSTEP™ Program is a screening program to identify nutritional problems in children aged three to five years.

Public Programs and Personal Choices

Public health agencies use immunization programs, advertising campaigns, partnerships with medical and educational groups, and other strategies to promote healthy living. The reality is that healthy living is still a personal choice. Some of the choices appear to be easier than others. For example, vaccination is considered by the World Health Organization to be one of the most cost-effective health investments. In Ontario, most vaccinations are provided without cost. Vaccinations have greatly reduced the incidence of diseases such as mumps, measles, and rubella. Other choices, such as committing to Sun protection behaviours or healthy eating patterns, may be more difficult for some individuals. Despite the presence of programs that raise awareness about these issues, the incidence of skin cancer is still on the rise.



Figure 3.25 Your local public health unit provides information about many different programs.

Take It Further

Many diseases can be prevented through the use of vaccination. The World Health Organization has identified six diseases that they believe should be targeted through universal immunization programs. These diseases include whooping cough, tetanus, diphtheria, polio, tuberculosis, and measles. Find out more about the use of vaccines to fight these diseases and the impact the use of vaccines has on global health. Begin your research at [ScienceSource](https://www.science.org).