Cancer Care Ontario

2016

Prevention System Quality Index

Monitoring Ontario's Efforts in Cancer Prevention

Ontario

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2016

Prevention System Quality Index

Monitoring Ontario's Efforts in Cancer Prevention

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Foreword

The *2016 Prevention System Quality Index (PSQI): Monitoring Ontario's Efforts in Cancer Prevention* is Cancer Care Ontario's second report on system-level policies and programs that can reduce the prevalence of cancer risk factors and exposures in the population.

Reducing the prevalence of cancer risk factors and exposures is key to improving the health of Ontarians because approximately half of all cancer cases are preventable. Targeting these risk factors may also reduce the burden of other major chronic diseases, such as diabetes, cardiovascular disease and chronic respiratory disease, because they share many of the same risk factors.

The 2016 PSQI reports on 21 indicators related to tobacco, alcohol, healthy eating, physical activity, ultraviolet radiation, environmental carcinogens, occupational carcinogens and infectious agents. The report is intended to inform the development and implementation of policies and programs that can reduce the risk of cancer.

The PSQI supports the work of Cancer Care Ontario's partners in governments, non-governmental organizations and public health units in Ontario. It brings together data and describes policies and programs from a variety of sectors, including health, education, labour, municipal affairs, transportation, environment and finance. It identifies achievements and gaps in the system and highlights opportunities to advance cancer prevention efforts in Ontario based on the evidence for effective policies and programs. Efforts to prevent cancer require a "Health in All Policies" approach to substantially reduce the prevalence of risk factors and exposures, and create healthier environments and structural supports that would make healthier choices easier for Ontarians. Improving the health of Ontarians so that fewer develop cancer is central to ensuring a sustainable cancer system for future generations, which is a strategic goal of the *Ontario Cancer Plan IV* for 2015 to 2019.

As you read the 2016 PSQI report, I encourage you to consider how your organization can support the implementation of policies and programs that can prevent cancer and other chronic diseases in Ontario.

Linda Rabeneck, MD MPH FRCPC
Vice President, Prevention and Cancer Control
Cancer Care Ontario

Reducing the prevalence of cancer risk factors and exposures is key to improving the health of Ontarians because approximately half of all cancer cases are preventable.

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The 2016 Prevention System Quality Index Supplementary Tables and Technical Appendix are posted online at cancercare.on.ca/PSQI

Highlights

Tobacco

In 2014, 18.7 per cent of Ontarians age 20 and older reported smoking daily or occasionally.

Tax as a percentage of tobacco retail price

- Increasing tobacco taxes reduces the prevalence of tobacco use more than any other policy intervention.
- As of April 2016, taxes were 65 per cent of the average total tobacco retail price in Ontario, well below the World Health Organization's recommendation of at least 75 per cent.

Exposure to second-hand smoke

- The Smoke-Free Ontario Act prohibits smoking in enclosed public places, enclosed workplaces and some outdoor spaces.
- The percentage of non-smokers age 20 and older exposed to second-hand smoke in public places declined from 2003 to 2007, but increased significantly from 10.1 per cent in 2007 to 14.2 per cent in 2014.
- Exposure to second-hand smoke was substantially higher in adolescents ages 12 to 19.

Long-term smoking cessation

- A sustained focus on smoking cessation can substantially reduce smoking prevalence.
- In 2014, 3.9 per cent of recent daily smokers age 20 and older had quit smoking for at least one year.

Alcohol

In 2014, 8.2 per cent of Ontarians age 19 and older reported drinking, on average, alcohol in excess of the recommended daily limits for cancer prevention.

Minimum retail price of alcohol sold in off-premises alcohol outlets

- Setting minimum prices for alcohol has been shown to reduce alcohol consumption.
- As of March 2016, none of the minimum retail prices for beer, table wine and spirits in Ontario met the minimum price per standard drink estimated to achieve appreciable reductions in alcohol consumption at the population level ($1.63 in 2015 dollars).

Private off-premises alcohol outlets

- Privatization of off-premises alcohol outlets may result in increased alcohol consumption in a population.
- In 2015, 75.9 per cent of the off-premises alcohol outlets in Ontario were privately owned, similar to 2014.

Alcohol outlet density (on- and off-premises)

- Increasing the density of alcohol outlets in a geographic area may result in higher alcohol consumption in that area.
- In 2015, the density of on- and off-premises alcohol outlets in Ontario was 17.2 for every 10,000 people age 15 and older, similar to 2014.

Healthy eating

In 2014, 67.8 per cent of Ontarians ate vegetables and fruit fewer than five times per day. Vegetable and fruit consumption is considered to be a good marker of overall diet quality.

Household food insecurity

- Food insecurity is a strong determinant of health because it directly influences the quality and quantity of food eaten. Adults and some children experiencing food insecurity tend to eat significantly fewer servings of vegetables and fruit than those who are food secure.
- In 2014, 11.9 per cent of Ontario households experienced food insecurity. The prevalence of severe household food insecurity remained stable from 2005 to 2014; however, the prevalence of moderate food insecurity increased slightly, but significantly, and the prevalence of marginal food insecurity decreased slightly, but significantly.

Food literacy development in secondary schools

- Enhancing food literacy can increase the consumption of healthy foods. Food literacy includes knowledge about nutritional needs, the ability to meal plan and budget, the ability to prepare food and knowledge about food safety.
- Approximately one-third of students who entered Grade 9 from the 2005/06 to 2009/10 school years earned one or more credits in a course that included a food literacy component during their secondary school education. This estimate has changed very little over time.

Physical activity

In 2014, 48.5 per cent of Ontario adults and 30.6 per cent of adolescents were inactive during leisure time.

Use of active transportation to or from work and school

- Adults and children who use active transportation (walking and bicycling) have higher overall physical activity levels.
- In 2011, active transportation was used in 21.6 per cent of trips taken to or from work by adults age 19 and older in Greater Golden Horseshoe regions. Most of these trips were to or from public transit. In youth ages 11 to 18, 51.4 per cent of trips taken to or from school used active transportation.

Health and physical education specialist teachers in schools

- Professional development for teachers in physical education can increase the time students spend being physically active during physical education classes.
- In the 2013/14 school year, 19.7 per cent of elementary and 21.7 per cent of secondary schools reported having specialist teachers assigned to teach health and physical education.

Enrolment in health and physical education

- Health and physical education classes can increase overall physical activity in children and adolescents.
- In the 2013/14 school year, 88.6 per cent of Grade 9 students earned one or more health and physical education credits, compared to 26.0 per cent of Grade 12 students.

Ultraviolet radiation (UVR)

In 2006, Ontario residents spent more time in the sun without improving sun protection behaviours than in 1996. In addition, the proportion of Ontarians who used UVR-emitting tanning devices increased during this period.

Shade policies in local municipalities

- Shade provided by built structures and tree canopies can protect people from UVR exposure more effectively than sunscreen.
- As of March 2016, three local municipalities with a population of 100,000 or more have strong shade policies. The guidelines that these municipalities follow when evaluating plans for developing or redeveloping sites state that shade should be provided for a broad range of municipally and privately owned sites.

Adults and children who use active transportation have higher overall levels of measured and self-reported physical activity.

Environmental carcinogens

A large number of Ontarians are exposed to two environmental carcinogens: radon and fine particulate matter ($PM_{2.5}$).

Radon levels in residences

- Radon is a naturally occurring radioactive gas released into the air during the decay of uranium in soil and rock.
- High radon concentrations in Ontario homes can be reduced by including radon prevention measures in the building code and by testing and remediating existing homes.
- From 2009 to 2013, 25.2 per cent of homes surveyed in Ontario had radon concentrations greater than or equal to 100 Bq/m^3, the average annual radon concentration at which the World Health Organization recommends remedial action.

Fine particulate matter ($PM_{2.5}$) concentrations in outdoor air

- $PM_{2.5}$ is one of the major components of outdoor air pollution.
- Motor vehicle traffic, industrial sources, and residential fireplaces and woodstoves are key contributors to $PM_{2.5}$ in Ontario.
- In 2014, $PM_{2.5}$ concentrations were higher than the reference level of 10 $\mu g/m^3$ (set by the Canadian Ambient Air Quality Standards and World Health Organization's Air Quality Guidelines) at three monitoring stations in Ontario: Hamilton Downtown (10.8 $\mu g/m^3$), Windsor West (10.7 $\mu g/m^3$) and Windsor Downtown (10.1 $\mu g/m^3$).

Occupational carcinogens

Many workers in Ontario are exposed to formaldehyde and nickel, which are known carcinogens. The Toxics Reduction Act requires facilities in the manufacturing and mineral processing industries in Ontario to report the amount of toxic substances they use and the number of employees working at their facilities, as well as to develop plans for reducing the use of these substances.

Industrial formaldehyde use and employment in industries using formaldehyde

- Reducing formaldehyde use and workers' exposure would be most comprehensively achieved by eliminating or substituting it with a substance that is not known to cause cancer. It is also possible to lower exposure through engineering controls, such as increasing ventilation.
- In 2013, 20 industrial facilities with 7,467 employees used an estimated total of 8,220 tonnes of formaldehyde. The paper, chemical and wood product manufacturing industries accounted for nearly 99 per cent of the total formaldehyde used by reporting facilities in Ontario.

Industrial nickel use and employment in industries using nickel

- Large-scale reductions in nickel use may not be as feasible as for other substances. Workers' exposure to nickel can be reduced through engineering and administrative controls and use of personal protective equipment.
- In 2013, 122 industrial facilities with 40,199 employees used an estimated total of 874,580 tonnes of nickel. Primary metal manufacturing, and mining and quarrying accounted for nearly 98 per cent of the total nickel used by reporting facilities in Ontario.

Infectious agents

Chronic infections with viral, bacterial and parasitic infectious agents are estimated to cause 7.4 per cent of cancers in developed countries. Human papillomavirus (HPV) is sexually transmitted and causes virtually all cervical cancers. Hepatitis B virus is transmitted through blood and other body fluids and is a cause of liver cancer. Infection with HPV and hepatitis B virus can be prevented through vaccination.

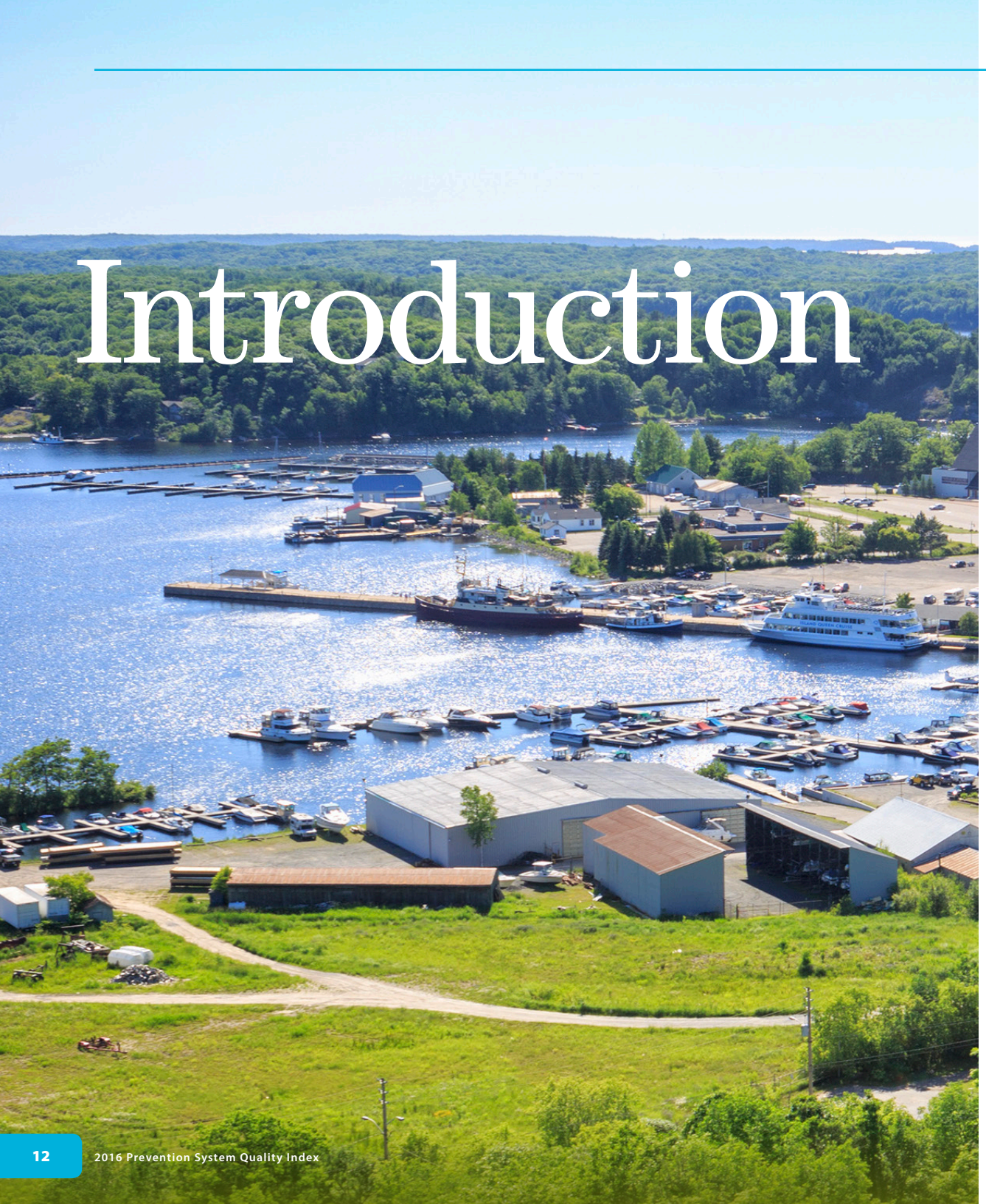
School-based HPV vaccination coverage

- In 2007, Ontario introduced a publicly funded school-based HPV vaccination program for girls in Grade 8. As of September 2016, boys also receive the HPV vaccine as part of the school-based vaccination program.
- At the end of the 2012/13 school year, the vaccination coverage rate for the school-based HPV vaccination program in Grade 8 girls in Ontario was 80.2 per cent.

School-based hepatitis B vaccination coverage

- Ontario publicly funds the hepatitis B vaccine for the school-based program and for certain high risk groups.
- The province's school-based hepatitis B vaccination program for all students in Grade 7 started in 1994.
- At the end of the 2012/13 school year, the vaccination coverage rate for the school-based hepatitis B vaccination program in Grade 7 students in Ontario was 86.9 per cent.

Introduction



The 2016 Prevention System Quality Index (PSQI) is Cancer Care Ontario's second report on system-level policies and programs that can reduce the prevalence of cancer risk factors and exposures in the population.

The PSQI reports on indicators of effective policies and programs, identifies achievements and gaps in the prevention system, and highlights opportunities for improvement. It aims to provide evidence and data that can help policy-makers, policy-influencers and program planners in governments, non-governmental organizations and public health units implement policies and programs that prevent cancer in Ontario.

The policies and programs described in this report fall under the jurisdiction of various levels of government in several sectors, including health, education, labour, municipal affairs, transportation, environment and finance. Many policies and programs that directly or indirectly affect the health of the population and the distribution of health inequities are beyond the role of

public health or the healthcare system. While public health will play a larger role in healthcare system planning with the enactment of the Patients First Act[1] in Ontario, it is also important for governments to make health a whole-of-government priority by collaborating across departments and ministries and adopting a "Health in All Policies" approach, which takes into account the health of the population in the development of policy in all sectors.

The PSQI complements the 2012 report entitled *Taking Action to Prevent Chronic Disease: Recommendations for a Healthier Ontario (Taking Action)* that Cancer Care Ontario co-authored with Public Health Ontario.[2] Many of the policies and programs that were recommended in *Taking Action* are monitored and discussed in the PSQI. In addition, the PSQI was developed to address the recommendation in *Taking Action* to improve measurement and monitoring of the prevention system in Ontario.[3]

Cancer risk factors and exposures in Ontario

In countries similar to Canada, an estimated 40 to 50 per cent of cancers could be prevented by changes in behavioural, occupational and environmental risk factors.[4-6] Targeting cancer risk factors and exposures may also reduce the burden of other major chronic diseases, such as diabetes, cardiovascular disease and chronic respiratory disease, because they share many of the same risk factors.

In Ontario, the prevalence of four modifiable risk factors is regularly tracked: smoking, alcohol consumption, physical inactivity, and inadequate vegetable and fruit consumption (Figure 1). From 2003 to 2014, improvement was seen in the prevalence of some risk factors, such as smoking.

- **The percentage of adults age 20 and older who smoked daily or occasionally decreased significantly from 22.7 per cent in 2003 to 18.7 per cent in 2014.**
- **The percentage of adults age 18 and older who were physically inactive during leisure time decreased slightly, but significantly, from 51.1 per cent in 2003 to 48.5 per cent in 2014.**
- **The percentage of adults age 19 and older who on average drank alcohol in excess of the recommended daily limits for cancer prevention (i.e., more than one drink a day for women and two drinks a day for men) was 8.2 per cent in 2014, a number that has remained stable since 2003.**
- **The percentage of adults age 18 and older with inadequate vegetable and fruit consumption (i.e., ate vegetables and fruit fewer than five times per day) was 67.8 per cent in 2014, a number that has remained stable since 2003.**

From 2004 to 2013, healthcare costs associated with smoking, physical inactivity, unhealthy eating and excessive alcohol consumption decreased by 1.9 per cent, or $4.9 billion. The majority of these savings may be linked to the reduction in smoking prevalence related to the province's comprehensive tobacco control strategy.[7] Despite these cost reductions, an estimated 22 per cent of the total healthcare costs from 2004 to 2013 in Ontario resulted from these four modifiable risk factors.[7]

Risk factors and exposures are not equally distributed across the population and vary by socio-demographic factor, such as education, income, geographic location and immigration status. These socio-demographic factors are well-established determinants of health that can work independently and together to influence health behaviours and outcomes. For example, low socio-economic status contributed to 15 per cent of Ontario's healthcare costs from 2004 to 2013,[7] underscoring the need to consider health equity when developing policies and programs, including targeted interventions that reduce socio-economic disparities and the resulting health inequities in sub-populations.

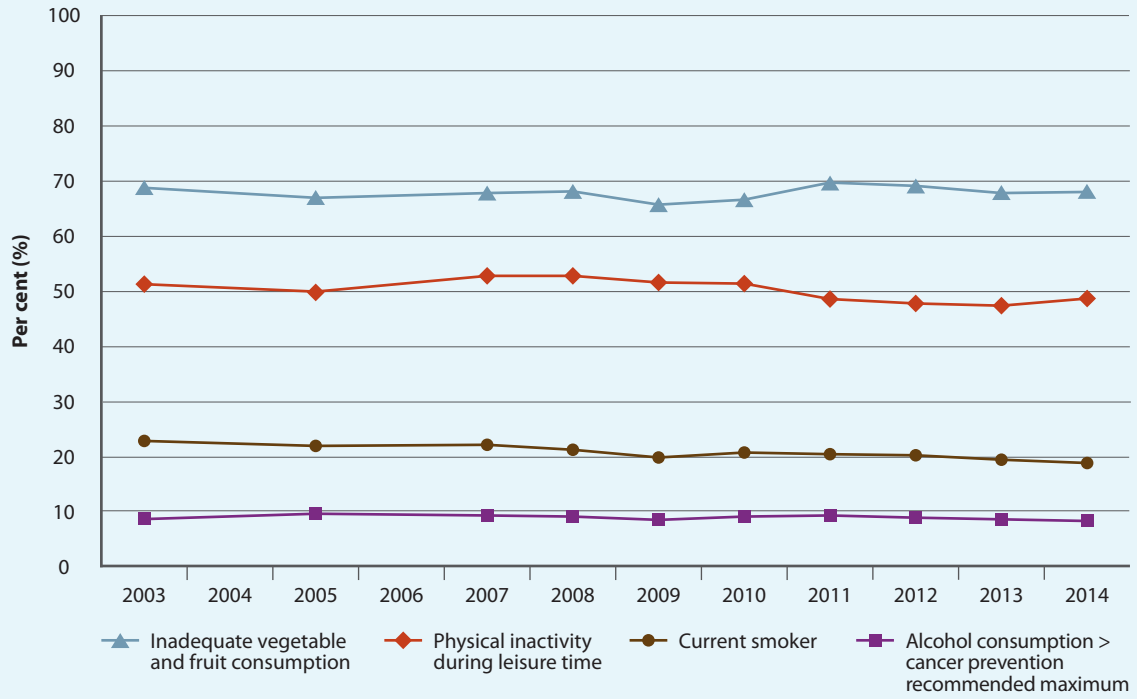
Reducing the prevalence of cancer risk factors and exposures at the system level

In Ontario, there are several system-level policies that can help reduce cancer risk factors and exposures, including alcohol control policies and environmental regulations. A comprehensive provincial tobacco control strategy contributed to a reduction in smoking prevalence and a substantial cost savings to the healthcare system from 2004 to 2013.[7] Comprehensive tobacco control strategies include dedicated, sustained funding and provincial coordination, and

Indicators

Several types of indicators have been chosen to assess system-level policies and programs or lack thereof, depending on the availability of data sources. Indicators can measure the resources dedicated to policies or programs, the process by which the policies or programs are implemented, products that result from the policies or programs, or outcomes of policies or programs.

FIGURE 1
Percentage of adults in Ontario with selected modifiable risk factors, 2003–2014



Source: Canadian Community Health Survey, 2003, 2005, 2007–2014 (Statistics Canada)
Notes: Estimates are adjusted to the age distribution of the 2011 Canadian population. Data are presented in Supplementary Table S1.

incorporate economic, regulatory, social, educational and clinical strategies.[8] Similar comprehensive strategies could be implemented for other risk factors in Ontario.

There have been minimal reductions in the prevalence of most other risk factors over the past decade in Ontario, highlighting the need for stronger prevention policies and programs. Accordingly, the focus of the PSQI is on system-level interventions, including policies and broad-scale programs that reduce cancer risk factors and exposures at the population level. System-level policies and programs facilitate healthier individual choices and are more effective at reducing the prevalence of risk factors and exposures than small-scale programs that focus on changing each person's behaviours.[9-11] Population health monitoring in the province has focused mainly on the behaviours of individuals, whereas the PSQI aims to monitor system-level performance, which can help demonstrate the need for stronger policies and programs that improve the health of the population.

2016 Prevention System Quality Index

The 2016 PSQI reports on indicators of system-level policies and programs that can reduce the prevalence of the following cancer risk factors and exposures: tobacco, alcohol, unhealthy eating, physical inactivity, ultraviolet radiation, environmental carcinogens, occupational carcinogens and infectious agents. Occupational carcinogens and infectious agents are new domains for 2016. Cancer screening, which was included in the 2015 PSQI, is reported on annually in the Cancer System Quality Index and will receive an in-depth evaluation in an integrated cancer screening report that will be published by Cancer Care Ontario.

The 2016 PSQI report was developed by integrating feedback on the 2015 PSQI report, strategic advice from the PSQI Advisory Committee and technical advice from domain-specific expert panels. The advisory committee and expert panels included representatives from public health units, government agencies, non-governmental organizations and academic institutions.

Structure of the PSQI report

Each section of the report begins with an overview of the burden of cancer related to each risk factor or exposure domain. Only risk factors and exposures that have a strong level of evidence supporting their association with cancer, based on reviews by the International Agency for Research on Cancer and the World Cancer Research Fund/American Institute for Cancer Research, are included in the PSQI. A brief summary of effective system-level policies and

programs that can reduce the risk factors or exposures is provided for each domain. Evidence supporting the inclusion of the selected indicators is discussed, along with the indicator findings and relevant policies and programs in Ontario. Also described are the evidence and current status of important system-level policies and programs that are lacking adequate data to develop indicators. Finally, each section identifies opportunities for reducing the prevalence of the risk factors or exposures and for improving monitoring.

The inequitable distribution of risk factors across sub-populations is briefly discussed in some sections of the report, as is the impact of certain policies and programs on these sub-populations. A discussion of risk factors in Ontario's First Nations, Inuit and Métis populations is not included in this report, but is addressed in *Path to Prevention—Recommendations for Reducing Chronic Disease in First Nations, Inuit and Métis,*[12] the *Aboriginal Cancer Strategy III: 2015–2019,*[13] *Cancer in First Nations in Ontario: Risk Factors and Screening*[14] and *Cancer in the Métis People of Ontario: Risk Factors and Screening Behaviours.*[15]

PSQI indicators

Several indicators from the 2015 PSQI were refined and 13 new indicators were added to the 2016 report. Table 1 lists the risk factor and exposure domains and indicators for the 2016 PSQI report. Indicator criteria adapted from the United Kingdom's National Health Service *Good Indicators Guide*[16] and outlined in Table 2 were used as a guideline when selecting indicators for the 2016 PSQI.

The PSQI makes use of the best data available, but there are many gaps, particularly in province-level data. The data sources generally used in the PSQI include administrative data, such as those from the Ministry of Education, and survey data, such as the Canadian Community Health Survey. These data sources have limitations. Administrative data used in the PSQI are collected for other purposes. Therefore, they may not represent exactly what the PSQI is trying to measure. Surveys are prone to biases and may not be representative of the whole population; they may also not reflect typical behaviours or exposures. Some survey data sources used in the PSQI are collected only once every few years, such as the Transportation Tomorrow Survey, or are collected during one time period only, such as the Cross-Canada Survey of Radon Concentrations in Homes.

PSQI methods, indicator definitions and limitations are included in the PSQI Technical Appendix posted online at cancercare.on.ca/PSQI. Data tables for each indicator are included in the PSQI Supplementary Tables, also posted online. In the text, whenever the term "significant" is used, it refers to statistical significance.

TABLE 1

2016 Prevention System Quality Index risk factor and exposure domains and indicators

Domain	Indicator
Tobacco	• Tax as a percentage of tobacco retail price • Exposure to second-hand smoke • Long-term smoking cessation
Alcohol	• Minimum retail price of alcohol sold in off-premises alcohol outlets • Private off-premises alcohol outlets • Alcohol outlet density (on- and off-premises)
Healthy eating	• Household food insecurity • Food literacy development in secondary schools
Physical activity	• Use of active transportation to or from work • Use of active transportation to or from school • Health and physical education specialist teachers in schools • Enrolment in health and physical education
Ultraviolet radiation	• Shade policies in local municipalities
Environmental carcinogens	• Radon levels in residences • Fine particulate matter ($PM_{2.5}$) concentrations in outdoor air
Occupational carcinogens	• Industrial formaldehyde use and employment in industries using formaldehyde • Industrial nickel use and employment in industries using nickel
Infectious agents	• School-based human papillomavirus (HPV) vaccination coverage • School-based hepatitis B vaccination coverage

TABLE 2

2016 Prevention System Quality Index indicator criteria

Criteria	Description
Importance	Does the indicator answer a meaningful question about the policy or program?
Validity	Is the indicator valid, measuring what it is intended to measure?
Feasibility	Is there an existing source of data, or is it feasible to collect those data?
Evidence-based	Is the indicator supported by systematic reviews and/or by expert consensus?
Actionable	Is the indicator able to lead to policy recommendations?
Scope	Is the potential scope and impact of the outcome applicable across the province?
Sensitivity	Is the indicator expected to be sensitive to policy and program changes (trend or cross-sectional data)?

The PSQI reports on indicators of effective policies and programs, identifies achievements and gaps in the prevention system, and highlights opportunities for improvement.

Tobacco

INDICATORS:

Tax as a percentage of tobacco retail price

Exposure to second-hand smoke

Long-term smoking cessation

Tobacco use increases the risk of nearly 20 different types of cancer.[17]

In high-income countries, approximately 30 per cent of cancer deaths can be attributed to smoking.[4] Exposure to second-hand tobacco smoke also increases the risk of lung cancer.[18] The smoking rate has been declining for at least two decades and has continued to decline since 2003;[19] however, in 2014, 18.7 per cent of Ontarians age 20 and older (more than two million adults) reported smoking daily or occasionally. A higher proportion of Ontarians with lower income and education are current smokers than Ontarians with higher income and education.

Tobacco use can be reduced through policies and programs that are implemented within the context of a comprehensive tobacco control strategy. Effective tobacco control interventions include taxation or pricing policies to increase the cost of tobacco products; legislation and policies that reduce exposure to second-hand smoke; policies and programs that prevent youth from starting to smoke; tobacco industry denormalization, such as requiring plain and standardized cigarette packaging; sustained mass media campaigns; smoking cessation counselling in all healthcare settings accompanied by healthcare provider reminder systems; information and communication technology-supported interventions, such as quitlines and mobile phone-based interventions; and subsidized cessation medications, such as nicotine replacement therapy.[20-22] Jurisdictions that invest more in

comprehensive tobacco control programs see greater reductions in population-level smoking prevalence.[8, 23]

The indicators in this section focus on tobacco taxation, exposure to second-hand smoke and smoking cessation. These indicators measure the impact of a broad range of evidence-based policies and programs that are essential components of a comprehensive tobacco control strategy. For a detailed evaluation of Ontario's tobacco control strategy, see the *Smoke-Free Ontario Strategy Monitoring Report*, which is released annually by the Ontario Tobacco Research Unit.[24]

Tobacco taxation

Increasing tobacco taxes has the greatest impact of any policy intervention on reducing tobacco use in the population. It increases the number of smokers who try to quit, reduces the number of former smokers who relapse and decreases the average cigarette consumption in continuing smokers.[25] Increasing tobacco taxes also prevents youth, who are more sensitive to price changes, from starting to smoke or becoming regular smokers.[25, 26] In high-income countries, a 10 per cent increase in tobacco prices reduces tobacco consumption by about four per cent in adults.[27] When prices increase in high income countries, tobacco use most consistently declines in adults and youth with low socio-economic status.[28, 29]

The World Health Organization recommends that tobacco taxes should be at least 75 per cent of the total retail price of tobacco, with at least 70 per cent making up an excise tax, which is added as a fixed amount to tobacco products and indexed to inflation. The remaining taxes on tobacco would be sales taxes. Because excise taxes are not linked to the manufacturer's price, increasing excise taxes can lead to the greatest increase in the price of tobacco products and can reduce the market share of discount brands.[30]

In Canada, tobacco taxes are a composite of federal and provincial/territorial excise and sales taxes. In February 2016, the Ontario government increased the excise tax by $3 on a carton of 200 cigarettes. Prior excise tax increases in Ontario were in 2014 ($3.25), 2006 ($1.25) and 2005 ($1.25).[31] Beginning in 2016, $5 million dollars of revenue from the tobacco tax will be used to improve access to smoking cessation services for priority populations in Ontario.[32] The Ontario government also plans to increase excise taxes annually at the rate of inflation for five years starting in 2017. From 2017 to 2021, the total provincial tobacco taxes are scheduled to increase by $3.22 per carton of 200 cigarettes, based on the target inflation rate of 2.0 per cent as of February 2016.[33]

In 2015, four provinces increased their excise tobacco taxes by amounts ranging from $1 to $10: Manitoba ($1), Nova Scotia ($4), Prince Edward Island ($5) and Alberta ($5 in March and $5 in October).[34-38] In 2016, New Brunswick ($6.52) and Nova Scotia ($4) increased their tobacco taxes along with Ontario.[39, 40]

Indicator: Tax as a percentage of tobacco retail price

This indicator presents information on tax as a percentage of the total retail price, including all taxes levied on tobacco, and compares Ontario to the other provinces and territories. As of April 2016, taxes made up 65.0 per cent of the average total tobacco retail price in Ontario, which is the second lowest tax rate in Canada (Table 3) and well below the World Health Organization's recommendation of at least 75 per cent. The province with the highest tax as a percentage of total retail price was Alberta at 75.0 per cent, followed by British Columbia at 73.5 per cent, while the lowest was Quebec at 62.4 per cent.

The average pre-tax price of a carton of 200 cigarettes, determined using the Consumer Price Index and inter-city indexes of consumer price levels, varies across the country and over time (see the 2016 Prevention System Quality Index Technical Appendix for detailed methodology). The Prevention System Quality Index previously reported that taxes made up 66.8 per cent of the Ontario average total retail price of $88.64 per carton in June 2014.[41] By April 2016, the cost of a carton of cigarettes in Ontario had increased to $97.12 due to the February 2016 increase of $3 in Ontario's tobacco excise taxes[42] and an increase in the average pre-tax price of cigarettes. Because the increase in the average pre-tax price of a carton of cigarettes exceeded the increase in taxes, the percentage of the total retail price made up by tobacco taxes decreased from 2014 to 2016, even though the average total retail price of cigarettes in Ontario increased. Ontario's average total retail price of cigarettes is still the second lowest in the country.

Based on the current average pre-tax price of cigarettes, a substantial increase in tobacco excise taxes would have to take place for Ontario to reach or exceed the level recommended by the World Health Organization to reduce cigarette consumption.[25] Using the current average pre-tax price of a carton of 200 cigarettes in Ontario, excise taxes would have to rise by $38.76 to reach the target of 75 per cent tobacco taxes as a percentage of retail price.

Research has demonstrated that increasing tobacco taxes does not cause a significant shift to contraband tobacco and the benefits outweigh any minor

TABLE 3

Tobacco taxes as a percentage of total retail price per carton of 200 cigarettes, by province/territory, April 2016

Province/territory	Average pre-tax price of a carton of 200 cigarettes ($)	Total tobacco taxes on a carton of 200 cigarettes ($)	Average total retail price of a carton of 200 cigarettes ($)	Tobacco taxes as a percentage of total retail price (%)
Alberta	25.25	75.84	101.09	75.0
British Columbia	26.49	73.60	100.09	73.5
Prince Edward Island	31.56	85.39	116.95	73.0
Nova Scotia	35.66	92.83	128.49	72.2
Newfoundland and Labrador	33.67	85.59	119.26	71.8
Manitoba	39.26	95.53	134.79	70.9
New Brunswick	34.44	78.55	112.99	69.5
Saskatchewan	37.09	81.85	118.94	68.8
Northwest Territories	39.76	84.13	123.89	67.9
Yukon	32.30	67.80	100.10	67.7
Nunavut	36.58	76.41	113.00	67.6
Ontario	**33.97**	**63.15**	**97.12**	**65.0**
Quebec	33.09	55.03	88.12	62.4

Source: Federal and Provincial/Territorial Tobacco Tax Rates, April 2016 (Non-Smokers' Rights Association/Smoking and Health Action Foundation)

increase in contraband use that may occur.[43] Enhancing enforcement and control systems can restrict any increase in contraband tobacco.[43] In Ontario, the Tobacco Tax Act makes it illegal to buy, possess or distribute untaxed or unregulated tobacco products.[44] The Ontario Ministry of Finance provides tobacco enforcement and other measures to counteract illegal tobacco. Furthermore, Ontario is creating a new Contraband Tobacco Enforcement Team within the Ontario Provincial Police, which will be responsible for investigating the smuggling and trafficking of contraband tobacco.[45]

Taxes made up 65 per cent of the average total tobacco retail price in Ontario, which is the second lowest tax rate in Canada and well below the World Health Organization's recommendation of at least 75 per cent.

Second-hand smoke

There is no safe level of exposure to second-hand smoke.[18] Smoke-free laws and policies primarily protect people from second-hand smoke and have the secondary benefit of reducing overall smoking prevalence in the population by increasing quit attempts and cessation, preventing youth from starting to smoke and reducing cigarette consumption in continuing smokers.[26] The Smoke-Free Ontario Act, enacted in 2006, began by prohibiting smoking in enclosed public places and enclosed workplaces.[46] The regulations under the act have been amended several times to include further protection from second-hand smoke: a prohibition on smoking in motor vehicles when children under age 16 are present (2009); a ban on smoking in outdoor bar and restaurant patios, playgrounds, and public sports fields and surfaces (2015); and smoking bans on the outdoor grounds of hospitals and psychiatric facilities (2016).[46]

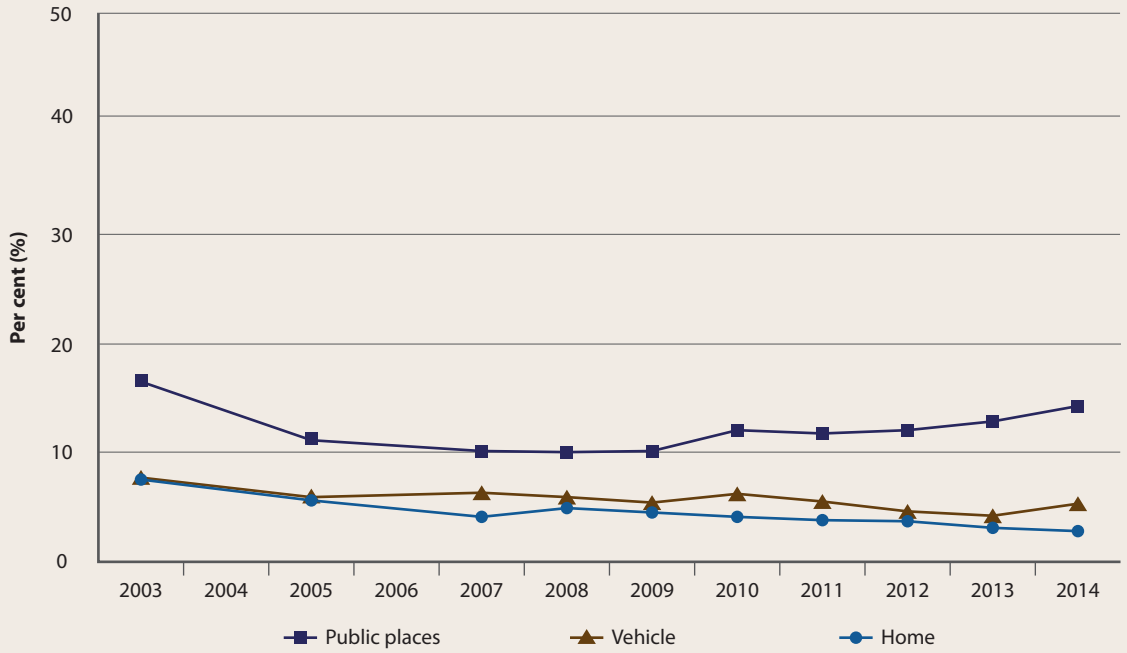
Some municipalities' bylaws go beyond the provincial legislation to provide additional protection from second-hand smoke. For example, Huron County prohibits smoking in all hotel rooms and other temporary accommodations, the Town of Cobourg prohibits the use of tobacco products on municipal property and beaches, and Toronto bans waterpipe use in establishments, such as hookah bars.[47]

Indicator: Exposure to second-hand smoke

The second-hand smoke indicator looks at trends in second-hand smoke exposure in public places, at home and in private vehicles among non-smoking adults and adolescents in Ontario. Non-smoking Ontario adults age 20 and older most commonly reported being regularly exposed to second-hand smoke in public places (Figure 2). Despite a significant decline in the percentage of non-smoking adults exposed to second-hand smoke in public places from 2003 to 2007, a significant increase occurred thereafter with exposure rising from 10.1 per cent in 2007 to 14.2 per cent in 2014. The significant rise in self-reported exposure to second-hand smoke in public places over the past few years may be due to more people smoking in outdoor spaces after the implementation of the Smoke-Free Ontario Act. It is also possible that non-smokers became more aware of their exposure to second-hand smoke once smoking was restricted in the majority of public places. Recent provincial regulatory amendments and municipal bylaws that ban smoking in additional outdoor settings may lead to a reduction in second-hand smoke exposure in public places in the future. The effects of the provincial ban on smoking on outdoor bar and restaurant patios, playgrounds and public sports fields and surfaces were evaluated in four municipalities. Self-reported exposure to second-hand smoke in these locations was lower after the ban, compared to the year before the ban.[48] Exposure to second-hand smoke in outdoor public places could be further reduced by continuing to strengthen provincial smoke-free regulations and municipal smoke-free bylaws, especially in areas where there may be high levels of exposure, such as entrances to buildings.[49]

FIGURE 2

Percentage of non-smoking adults (age 20+) in Ontario who were exposed to second-hand smoke in the past month, by location of exposure, 2003–2014



Source: Canadian Community Health Survey, 2003, 2005, 2007–2014 (Statistics Canada)
Notes: Estimates are adjusted to the age distribution of the 2011 Canadian population. Data are presented in Supplementary Table S2.

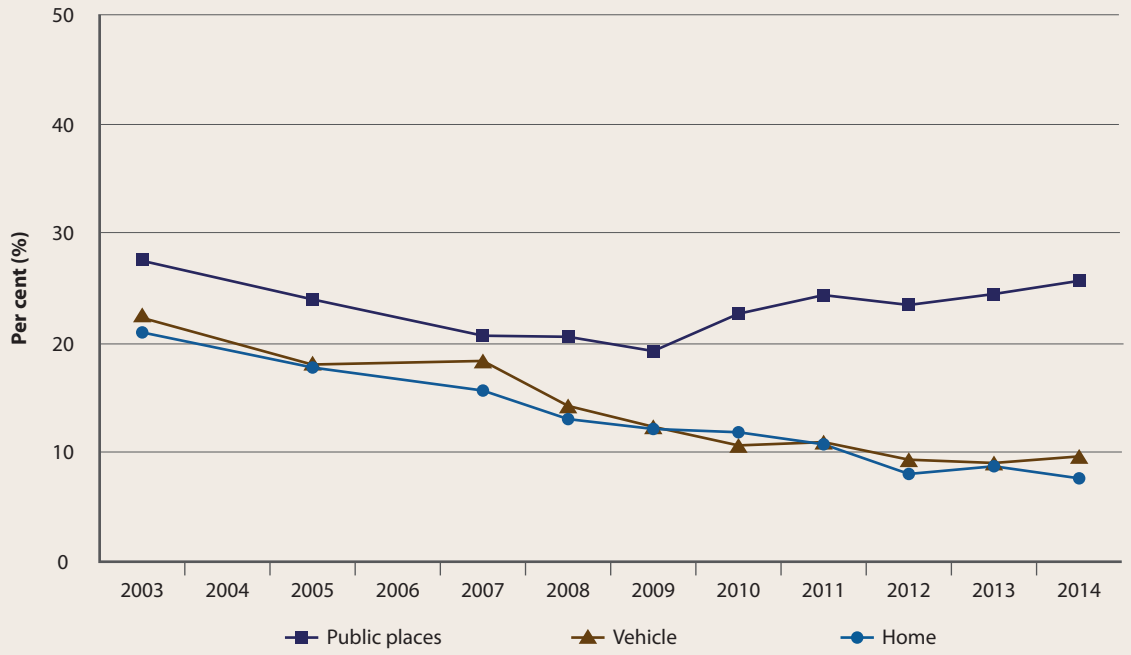
The percentage of Ontario non-smoking adults who reported being regularly exposed to second-hand smoke at home and in private vehicles declined significantly from 2003 to 2014 (Figure 2). In 2014, only 2.8 per cent of non-smoking adults reported second-hand smoke exposure at home (compared to 7.5 per cent in 2003), while 5.3 per cent reported second-hand smoke exposure in a vehicle (compared to 7.7 per cent in 2003). These declines have likely resulted from a variety of factors, such as the denormalization of tobacco use as a result of municipal smoke-free bylaws and the Smoke-Free Ontario Act, increased awareness of the health effects of second-hand smoke, the increased adoption of voluntary non-smoking practices at home and the provincial ban on smoking in vehicles when children under age 16 are present.

Consistent with the distribution of current smoking patterns, second-hand smoke exposure in non-smoking adults disproportionately affects certain sub-populations. During 2012–2014, the percentage of non-smoking adults age 30 and older who were exposed to second-hand smoke at home, in a vehicle or in public places was generally highest in those living in rural areas compared to urban areas and generally increased with decreasing income and education (Supplementary Table S3).

Second-hand smoke exposure is also higher in dwellings with multiple units, such as apartment and condominium buildings, attached houses and duplexes. In 2012, 24 per cent of Ontarians living in multi-unit dwellings reported that tobacco smoke had entered their homes from a nearby unit or from outside the building in the previous month. About one-quarter of Ontario residents live in multi-unit dwellings.[50] Public health units are working to address second-hand smoke exposure in multi-unit dwellings in their communities. In 2010, Waterloo Region Housing, which manages public housing units, implemented a 100 per cent smoke-free policy for all new leases.[51]

FIGURE 3

Percentage of non-smoking adolescents (ages 12–19) in Ontario who were exposed to second-hand smoke in the past month, by location of exposure, 2003–2014



Source: Canadian Community Health Survey, 2003, 2005, 2007–2014 (Statistics Canada)
Note: Data are presented in Supplementary Table S4.

Trends in the percentage of non-smoking Ontario adolescents ages 12 to 19 reporting regular exposure to second-hand smoke (in public places, at home and in private vehicles) are similar to those observed for adults; however, for all locations of exposure, a substantially higher percentage of non-smoking adolescents than adults reported regular exposure to second-hand smoke (Figure 3). The prevalence of second-hand smoke exposure in public places decreased significantly from 2003 to 2008, and then increased significantly from 2008 onwards, reaching 25.6 per cent in 2014. The percentage of adolescents who were exposed to second-hand smoke at home and in private vehicles decreased significantly from 2003 to 2014, but was still much higher than for adults. In 2014, 7.6 per cent of adolescents reported exposure to second-hand smoke at home and 9.6 per cent reported exposure in a vehicle.

Smoking cessation

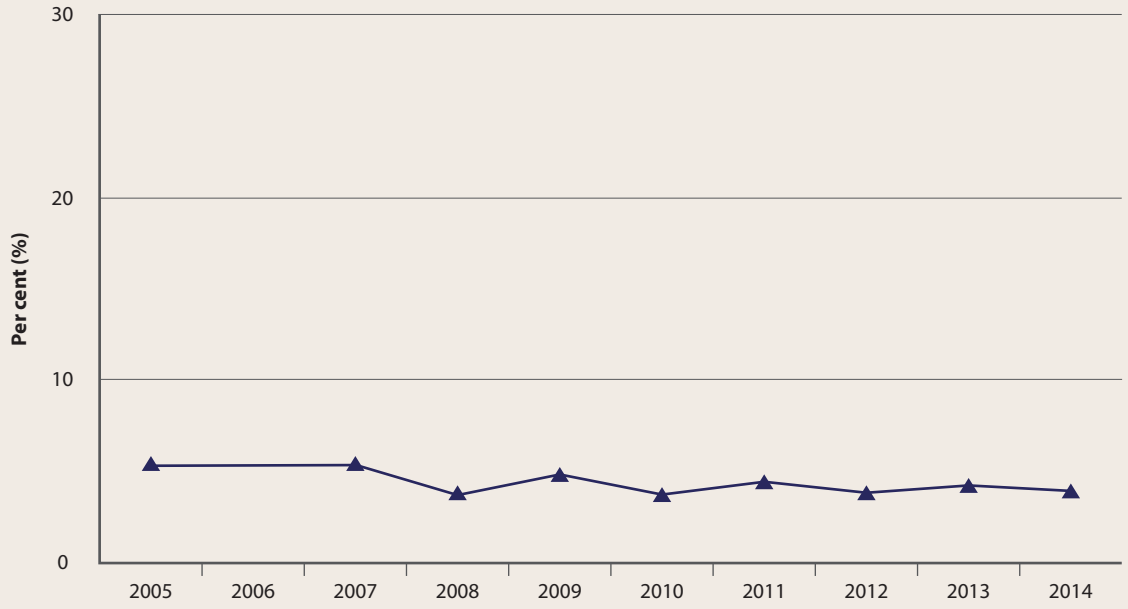
A sustained focus on smoking cessation would help substantially reduce the prevalence of smoking in Ontario. As discussed in this section, the population-level smoking cessation rate reflects, in part, the impact of tobacco control policies and programs.

Indicator: Long-term smoking cessation

This indicator measures long-term smoking cessation, which is expressed as the percentage of recent daily smokers in Ontario who have successfully quit smoking for at least one year. In 2014, 3.9 per cent of

recent daily smokers age 20 and older had achieved long-term smoking cessation, a significant decrease from 5.4 per cent in 2005 (Figure 4). The long-term smoking cessation rate in men decreased significantly from 2005 to 2014, while the long-term smoking cessation rate in women remained stable (Supplementary Table S5).

FIGURE 4
Percentage of recent daily smokers (age 20+) in Ontario who have quit smoking for at least one year, 2005–2014



Source: Canadian Community Health Survey, 2005, 2007–2014 (Statistics Canada)
Notes: Estimates are adjusted to the age distribution of the 2011 Canadian population. Recent daily smokers: smokers who were smoking daily 1 to 2 years ago. Data are presented in Supplementary Table S5.

A sustained focus on smoking cessation would help substantially reduce the prevalence of smoking in Ontario.

3.9%

In 2014, 3.9 per cent of recent daily smokers had achieved long-term smoking cessation.

Due to variations in indicator methodology, the long-term smoking cessation rate reported here is higher than the Ontario rate reported in other publications.[24] Nonetheless, long-term smoking cessation is low. This is not surprising, given that smokers typically make many attempts to quit and relapse is common.[24] A quit attempt is usually defined as a cessation of smoking lasting for at least 24 hours.[52-54] Successful quitting often requires repeated quit attempts.[55] The chance of future relapse declines with a longer duration of cessation. Therefore, long-term smoking cessation is commonly considered to be achieved when a smoker has quit for at least one year.[24]

In Ontario, 43 per cent of smokers reported in 2014 that they had made a quit attempt in the past year. This percentage has not changed significantly in the past decade.[24] Many smokers (52 per cent) who attempt to quit do so without the use of quit aids, such as behavioural supports and nicotine replacement therapy.[56] Experts suggest that increasing quit attempts in the population could have the greatest impact on increasing the cessation rate.[55] Therefore, tobacco control policies and programs should aim to increase the number of smokers making a quit attempt and the number of times they make a quit attempt.[55] To increase quit attempts in the population, an emphasis on population-level tobacco control policies and programs is recommended. As noted above, tobacco taxation and smoke-free legislation increase the number of smokers who try to quit and avoid relapsing. Mass media campaigns to promote smoking cessation implemented within the context of a comprehensive tobacco control strategy are also effective at increasing quit attempts and reducing smoking prevalence in adults.[20, 57, 58] The effectiveness of mass media campaigns on cessation depends on several factors, such as the level of exposure to the messages, the content of the messages and the duration of the campaign. For example, messages that emphasize the negative health consequences of smoking and use personal testimonials tend to be most effective. Ongoing exposure to the messages is important for sustaining behaviour change in the population, such as encouraging quit attempts.[48]

Brief smoking cessation counselling interventions by physicians or other healthcare providers can also support smoking cessation[59] and have the potential to reach a large number of smokers. However, population-level data show that in 2012, only 57 per cent of adult smokers in Ontario who saw a physician in the previous year reported that they had been advised to quit smoking.[24] Furthermore, in 2014, only 9.6 per cent of adult smokers in Ontario had at least one consultation with a family physician where a smoking cessation-related fee code was billed, a percentage that has decreased slightly, but significantly, since 2008 (Supplementary Table S6). The percentage of smokers that received a consultation where a smoking cessation-related fee code was billed varied by public health unit (Supplementary Table S7). These analyses may underestimate the rate of brief smoking cessation counselling in Ontario because they only take into account consultations that family physicians specifically billed to the Ontario Health Insurance Plan as being related to smoking cessation.

Many smokers require additional support to quit. In Ontario, smokers are often referred by their physicians or other health professionals to the Smokers' Helpline or to other provincial or community clinical cessation services. Clinical cessation services that provide behavioural counselling and smoking cessation medications increase the chance of successfully quitting.[59, 60] However, only 4.4 per cent of smokers in Ontario are reached by clinical cessation services funded under the Smoke-Free Ontario Strategy.[24] The Ontario government has committed to using $5 million in revenues from the 2016 tobacco tax increase to improve access to smoking cessation services for priority populations, such as First Nations, Inuit and Métis Peoples, and people with mental health and addiction issues.[32]

Increasing quit attempts and long-term smoking cessation in the population can be achieved through sustained efforts to increase tobacco taxes, expand smoke-free legislation, implement mass media campaigns and increase brief counselling by health professionals. Access to clinical cessation services should also be improved to increase smokers' chances of successfully quitting.

Opportunities to reduce tobacco use

- Substantially increase provincial tobacco excise taxes to achieve the minimum target of taxes making up 75 per cent of the total retail price of tobacco products, as recommended by the World Health Organization.
- Ensure the protection of all Ontarians from exposure to second-hand smoke by expanding the provincial smoke-free regulations and municipal bylaws to provide additional protection in public places, such as entrances to buildings.
- Increase the promotion of smoke-free housing policies in multi-unit dwellings, including market-rate rental housing, social housing, condominiums and housing cooperatives.
- Implement and sustain evidence-based smoking cessation mass media campaigns that encourage people to make quit attempts (both aided and unaided by treatment) and drive people to the Smokers' Helpline, which can refer to other cessation services. Ensure that campaigns also reach priority populations that have higher rates of smoking.
- Expand regionally based clinical cessation services to increase access for smokers.

Opportunities for improved monitoring

- Ensure that population surveys about second-hand smoke exposure ask about exposure to smoke drifting into the home, including multi-unit dwellings, and in outdoor areas.

Alcohol

INDICATORS:

Minimum retail price of alcohol sold in off-premises alcohol outlets

Private off-premises alcohol outlets

Alcohol outlet density (on- and off-premises)

Alcohol is a cause of oral, pharyngeal, esophageal, laryngeal, female breast, colorectal and liver cancers. The risk of these cancers rises with increasing levels of consumption.[17, 61]

An estimated 1,000 to 3,000 new cancer cases in Ontario in 2010 were attributed to alcohol consumption.[62] There is no "safe limit" of alcohol to prevent an increased risk of cancer. The World Cancer Research Fund/ American Institute for Cancer Research recommends limits for people who do decide to drink of no more than two drinks a day for men and one drink a day for women.[61] In 2014, 8.2 per cent of Ontario adults age 19 and older reported drinking, on average, alcohol in excess of the recommended daily limits for cancer prevention, with higher percentages at higher levels of income. The overall percentage has remained stable since at least 2003.

Policies regulating alcohol pricing and taxation, alcohol control and distribution systems, and the physical availability of alcohol may reduce alcohol consumption at the population level and are among a number of policies supported by evidence.[63-67] This section measures

indicators related to policies in the following areas: legislated minimum prices for alcohol sold in retail outlets, the percentage of off-premises alcohol outlets that are privately owned and the density of alcohol outlets. Policies and programs discussed in this section are the regulation of alcohol marketing, promotion and advertising, screening and brief interventions for moderate to high risk drinking in the general population in healthcare settings and initiatives to communicate the health risks of alcohol. Expert bodies recommend these policies and programs as part of a comprehensive alcohol strategy.[68-70] In late 2015, the Government of Ontario announced plans to develop a provincial alcohol policy framework; the content of this policy framework is currently being drafted.[71]

Pricing

Raising the price of alcohol through taxation and setting minimum prices have been shown to reduce alcohol consumption.[63, 72] A meta-analysis found that a 10 per cent increase in alcoholic beverage prices resulted in a 4.4 per cent reduction in overall alcohol consumption.[63] The estimated size of the effect varies by beverage type, drinking pattern, gender, age, income and study design.[63, 73-76] The drinking culture in the jurisdiction where a pricing intervention is implemented may also influence the impact of price increases.[68] Increasing alcoholic beverage prices may lead to a reduction in alcohol consumption in adults of higher and lower socio-economic statuses.[75]

Several pricing policies may be implemented at the provincial level, including minimum pricing for on-premises and off-premises sales that is regularly adjusted to the Consumer Price Index (CPI) and has no loopholes (e.g., discounts or free samples), average alcohol prices that align with or are above the CPI so that alcohol does not become less expensive, and pricing that is linked to alcohol content so that drinks with a higher content of alcohol per volume are more expensive than drinks with lower alcohol per volume.[77] Minimum pricing that takes into account alcohol content and changes in the cost of living is a recommended price intervention.[77-79] A 2012 modelling study estimated that, based on sales data, raising the minimum price of alcoholic beverages to $1.63 in 2015 dollars[80] per standard drink could reduce population-level alcohol consumption in Ontario between 1.2 and 2.1 per cent, with the greatest reductions occurring in the heaviest drinkers.[81]

In Ontario, the Liquor Control Act requires that the Liquor Control Board of Ontario (LCBO) set prices no lower than what is established in its regulation on minimum pricing. Of note, the regulation includes a calculation to adjust for changes in the CPI.[82] Bar and restaurant alcohol sales are subject to separate minimum pricing regulation under the Liquor Licence Act,[83] and there is no minimum pricing regulation for ferment-on-premise facilities. In the 2016 Ontario Budget, the government announced that taxes on wine will increase over the next three years, and by 2019, the minimum price of a 750 millilitre bottle of wine will be $7.95. The minimum prices of cider, fortified-wine and low-alcohol wine will also increase over the next three years.[84]

Indicator: Minimum retail price of alcohol sold in off-premises alcohol outlets

This indicator measures the minimum retail price of alcohol per standard drink set by the LCBO in 2016 for alcohol sold in off-premises outlets. In Canada, a standard drink contains 17.05 millilitres of alcohol.

Alcohol outlets

There are two types of alcohol outlets. An **off-premises alcohol outlet** is a retail store where people buy alcohol, but drink it elsewhere. An **on-premises alcohol outlet** is a bar, restaurant or other establishment where people buy alcohol and drink it on-site.

Common beverage sizes for standard drinks are 43 millilitres (1.5 ounces) of spirits with 40.0 per cent alcohol content, 142 millilitres (five ounces) of wine with 12.0 per cent alcohol content, and 341 millilitres (12 ounces) of beer or coolers with 5.0 per cent alcohol content.[85]

Table 4 lists the 2016 minimum retail price per standard drink for each of the most commonly purchased[86] alcoholic beverage types. As of March 2016, none of the minimum prices per standard drink meet the minimum price estimated to achieve appreciable reductions in alcohol consumption at the population level ($1.63 in 2015 dollars).[80, 81]

The minimum retail price of alcohol per standard drink varies with the type of alcoholic beverage. For example, spirits containing 40.0 per cent alcohol have a higher minimum price per drink ($1.46) than wines containing 12.5 per cent alcohol ($0.96 for Ontario wine and $1.15 for imported wine). However, minimum prices per standard drink are not consistently higher for beverages that have higher alcohol content. For example, wines containing 12.5 per cent alcohol have a lower minimum price than beer and coolers containing 4.9 per cent alcohol ($1.23). Additionally, beer and

coolers containing 5.59 per cent alcohol have a lower minimum price ($1.08) than those containing 4.9 per cent alcohol.

Beers, coolers and similar beverages that contain 5.6 per cent or more alcohol by volume are the only type of beverage that have minimum prices set per litre of absolute alcohol contained in a product. These beverages are consistently priced per standard drink ($1.12 based on $65.65 per litre of absolute alcohol, as of March 2016). Pricing according to litre of absolute alcohol, and therefore by the standard drink size, results in higher prices per volume of beverage for beverages with higher alcohol content, which is a recommended pricing strategy. For example, a 341 millilitre bottle of beer containing 5.6 per cent alcohol would have a minimum price of $1.25, while at 9.0 per cent alcohol, it would have a minimum price of $2.01. All other types of beverages described in Table 4 have minimum prices that are set based on the volume of the beverage, resulting in lower prices per standard drink with higher alcohol content. A 750 millilitre bottle of imported wine with a minimum price of $6.30 would cost $1.59 per standard drink at 9.0 per cent alcohol and $1.02 at 14.0 per cent alcohol.

Information on changes in the price per standard drink from 2013 to 2016 can be found in Supplementary Table S8.

Privatization of off-premises alcohol outlets

Privatization of off-premises alcohol outlets may result in increased alcohol consumption in a population.[64] Ontario has a partial government monopoly of off-premises alcohol sales through its public LCBO alcohol outlets. Private off-premises alcohol outlets in Ontario include, but are not limited to, Agency Stores (stores authorized by the LCBO to sell alcohol in rural areas); The Beer Store; stores operated by Ontario wineries away from the site of production (e.g., Wine Rack); stores at wineries, distilleries, breweries and cideries; Vintners Quality Alliance (VQA) Ontario wineries at farmers' markets; and ferment-on-premise facilities.

As part of a broader strategy to increase competition in the alcoholic beverages market, the Ontario government authorized 60 grocery stores to sell beer, effective December 2015. Over the next few years, the regulatory changes will allow beer to be sold in up to 450 grocery stores, most of which will also sell wine and cider.[87]

Indicator: Private off-premises alcohol outlets

This indicator measures the percentage of off-premises alcohol outlets that are privately owned in each public health unit. Analyses are based on address lists provided by the LCBO and the Alcohol and Gaming Commission of Ontario. This analysis includes the 60 new alcohol outlets in grocery stores that began selling beer in late 2015.

In 2015, 75.9 per cent of the off-premises alcohol outlets in Ontario were private (Figure 5). The percentage of alcohol outlets that were private varied across public health units in the province. Timiskaming and Porcupine (both 57.1 per cent) and Northwestern (59.5 per cent) had the lowest percentages of private off-premises alcohol outlets. Niagara Region (91.2 per cent), Hastings and Prince Edward Counties (85.1 per cent) and Windsor-Essex County (84.4 per cent), where wine producing regions in the province are located, had the highest percentages of private outlets. In Ontario, there has been little change since 2014 in the overall percentage of off-premises alcohol outlets that are privately owned, although changes in the

TABLE 4

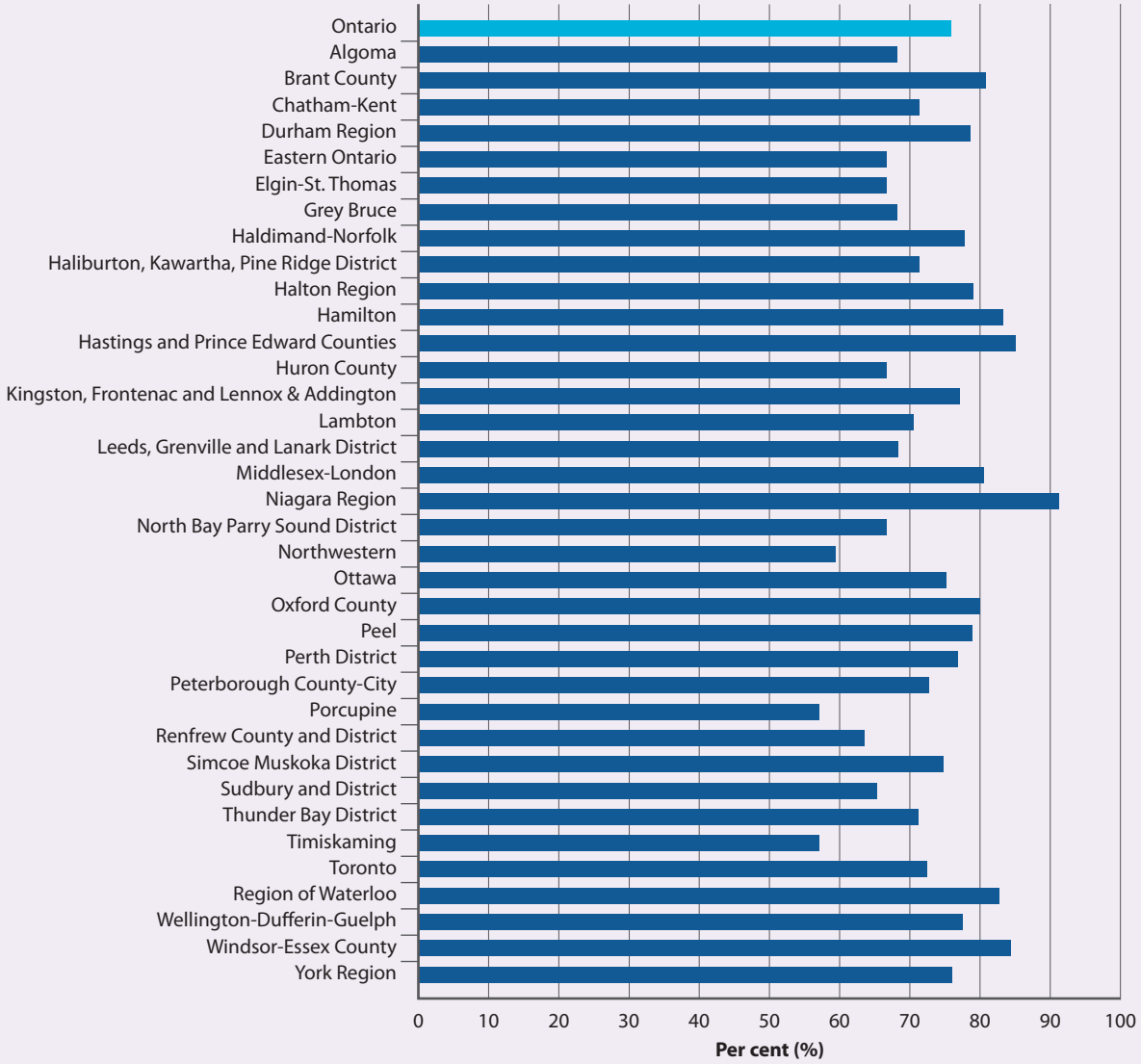
Minimum retail price of alcohol sold in off-premises alcohol outlets set by the Liquor Control Board of Ontario (LCBO) in Ontario, by alcohol type, 2016

Alcohol type	Quantity	LCBO minimum price per bottle ($)	Alcohol by volume used for price calculation	Minimum price per standard drink ($)
Spirits	750 mL bottle	25.75	40.00%	1.46
Table wine (from Ontario)	750 mL bottle	5.30	12.50%	0.96
Table wine (imported)	750 mL bottle	6.30	12.50%	1.15
Beer and coolers (alcohol content between 4.90% and 5.59%)	341 mL bottle	1.21	4.90% to 5.59%	1.23 to 1.08
Beer and coolers (alcohol content 5.60% or more)	Per LAA	65.65 per LAA	per 17.05 mL alcohol	1.12

Source: MRP Index Factor, 2016 (Liquor Control Board of Ontario)
Notes: Minimum retail prices effective as of March 1, 2016. Minimum retail prices in this table include taxes and container deposit. Alcohol type: selected types listed. LAA: litre of absolute alcohol. Standard drink: 17.05 mL of alcohol. Data for 2013–2015 are presented in Supplementary Table S8.

FIGURE 5

Percentage of off-premises alcohol outlets in Ontario that are privately owned, by public health unit, as of December 2015/January 2016



Sources: Lists of Brewers Retail (The Beer Store), farmers' markets, ferment-on-premise locations, off-site wineries, on-site wineries, on-site breweries, on-site distilleries and grocery stores, 2015–2016 (Alcohol and Gaming Commission of Ontario); Lists of Agency Stores, 2016 (Liquor Control Board of Ontario)
Note: Data are presented in Supplementary Table S9.

percentage of privately owned outlets varied by public health unit. (Supplementary Table S9).

Determining the impact of an increase in private off-premises alcohol outlets and any associated increase in outlet density on population-level alcohol consumption in Ontario requires ongoing monitoring and surveillance at the local and provincial levels. This monitoring may enable jurisdictions to identify what can be done to reduce adverse health effects.[88, 89]

Alcohol outlet density

Increasing the density of alcohol outlets (number of outlets per population unit) in a geographic area may result in higher alcohol consumption in that area.[11, 66, 67] The World Health Organization recommends controls on the density of alcohol outlets to reduce alcohol consumption.[69]

Ontario does not currently have a provincial policy limiting the density of alcohol outlets. The government's recent policy change that allows for the sale of beer and wine in grocery stores will increase the overall number of off-premises alcohol outlets in Ontario. The Alcohol and Gaming Commission of Ontario's oversight for the location of private off-premises alcohol outlets and on-premises outlets, such as bars and restaurants, may have some effect on density, since private retailers and licensed establishments must apply for authorization to open or relocate an outlet. Applications require a period for citizen input on the proposed outlet location.

At the municipal level, public health units are working to raise public awareness of alcohol-related harms, influence community social norms related to alcohol use, and monitor alcohol consumption and harms. They also develop and support local-level alcohol control strategies to strengthen local zoning regulations and regulate alcohol availability in municipal facilities or at civic events.[88, 90]

Indicator: Alcohol outlet density (on- and off-premises)

This indicator measures the density of alcohol outlets in Ontario, expressed per 10,000 people age 15 and older. Included in the analysis are on-premises alcohol outlets, such as bars and restaurants, and off-premises alcohol outlets, such as LCBO stores and beer outlets in grocery stores. Analyses are based on address lists provided by the LCBO and the Alcohol and Gaming Commission of Ontario.

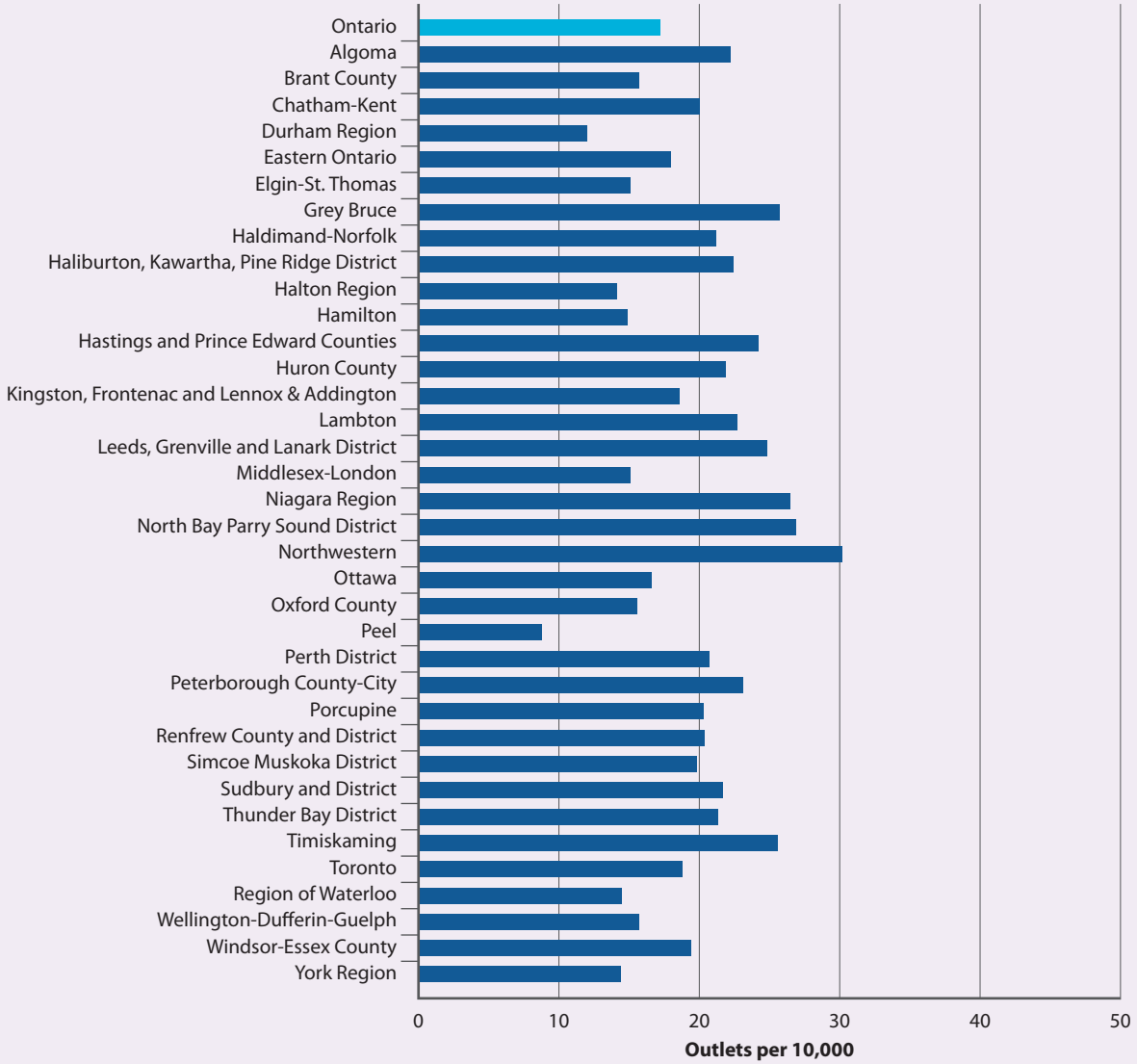
In 2015, the density of on- and off-premises alcohol outlets in Ontario was 17.2 for every 10,000 people age 15 and older (Figure 6). Of the 36 public health units, Peel (8.8 per 10,000) had the lowest density of alcohol outlets and Northwestern (30.2 per 10,000) the highest density, similar to 2014 (Supplementary Table S10).

Caution should be exercised in comparing alcohol outlet density across public health units. A public health unit with higher outlet density may not have higher alcohol consumption than a public health unit with lower outlet density. Research on the impact of increased alcohol outlet density on alcohol consumption focuses on the change over time in specific geographic areas.[65-67] There has been little change in on- and off-premises alcohol outlet density in the province since 2014 (Supplementary Table S10). The majority of public health units experienced small decreases in density from 2014 to 2015, with the greatest decreases seen in Halton Region, York Region and Oxford County. An increase in density was seen in 15 public health units, with the greatest increases seen in Haldimand-Norfolk, Perth District and Lambton. In the province as a whole, the density of on-premises alcohol outlets in 2015 decreased slightly since 2014 (from 15.1 to 14.8 per 10,000), but remained higher than the density of off-premises alcohol outlets (2.3 per 10,000), which was unchanged from 2014 to 2015. For on-premises alcohol outlets, Halton Region had the greatest decrease and Haldimand-Norfolk the greatest increase from 2014 to 2015. For off-premises alcohol outlets, Oxford County had the greatest decrease and Perth District had the greatest increase during this time period.

Determining the impact of an increase in private off-premises alcohol outlets on population-level alcohol consumption in Ontario requires ongoing monitoring and surveillance.

FIGURE 6

Number of on- and off-premises alcohol outlets per 10,000 population (age 15+) in Ontario, by public health unit, as of December 2015/January 2016



Sources: Lists of Brewers Retail (The Beer Store), farmers' markets, ferment-on-premise locations, off-site wineries, on-site wineries, on-site breweries, on-site distilleries, grocery stores and on-premises locations, 2015–2016 (Alcohol and Gaming Commission of Ontario); Lists of Agency Stores and LCBO stores, 2016 (Liquor Control Board of Ontario); Population estimates, Ministry of Finance Population Projections, 2011 (Statistics Canada)
Notes: Includes private and publicly owned alcohol outlets. Data are presented in Supplementary Table S10.

The recommended daily limits for cancer prevention are no more than one drink a day for women and two drinks a day for men.

Regulation of alcohol marketing, promotion and advertising

Alcohol marketing, promotion and advertising has been associated with increased alcohol consumption in youth.[91, 92] The World Health Organization recommends that jurisdictions regulate the content and volume of alcohol marketing, regulate direct or indirect marketing in all media and sponsorship activities, and establish independent public agencies to monitor alcohol marketing and administer enforcement and deterrence systems.[93] In Ontario, alcohol advertising is subject to regulation by national (Canadian Radio-television and Telecommunications Commission) and provincial (Alcohol and Gaming Commission of Ontario) bodies. However, these regulations do not apply to all media or meet the recommendations from the World Health Organization. Both national and provincial regulations focus on the content of alcohol advertising and the target audience. For example, advertising should not encourage irresponsible or illegal use of alcohol or target youth under the legal drinking age. There are few restrictions on the volume of advertising or marketing, online promotion and sponsorships that may target youth and young adults.[70]

As a counterbalance to alcohol marketing activities, warning labels on alcoholic beverages describing adverse health effects have been tested in some jurisdictions, but so far there are only limited data on their effectiveness.[94, 95] Public Health Ontario is collaborating with researchers and public health experts from across Canada to investigate the effectiveness of a warning label that includes information on the low risk alcohol drinking guidelines and information on the size of a standard drink.[96]

Brief interventions

There is good evidence that screening and brief interventions in primary care can be a cost-effective harm-reduction strategy for lowering alcohol consumption in adults with moderate to high risk drinking.[97] Acute care may also be an important setting for screening and brief interventions.[98] Brief interventions in healthcare settings are part of a comprehensive approach to reducing alcohol-related harm. However, these types of interventions are not currently tracked in Ontario so it is not known how widespread they are.

Community organizations, health centres, clinics and primary care providers across Ontario offer counselling for people experiencing problems with excessive alcohol consumption. The College of Family Physicians of Canada and the Canadian Centre on Substance Abuse offer a web resource and clinical guide for healthcare professionals to help assess these patients and manage their alcohol consumption.[99] Interventions in Ontario can be strengthened by offering programs to people who drink alcohol at levels that increase their cancer risk, but who may not have an identified alcohol dependence or abuse problem.[2]

Alcohol guidelines

The cancer prevention recommendation to limit alcohol to no more than two drinks a day for men and one drink a day for women was developed by the World Cancer Research Fund/American Institute for Cancer Research and is used by the Canadian Partnership Against Cancer and Cancer Care Ontario.[61] Recommendations from the Canadian Cancer Society are similar, but slightly more conservative.[100] The alcohol amounts specified in Canada's Low-Risk Alcohol Drinking Guidelines, published by the Canadian

Centre on Substance Abuse, are higher than the cancer prevention recommendations and focus on reducing alcohol-related harms. These guidelines recommend that women have no more than 10 drinks per week, with no more than two drinks per day on most days, and that men have no more than 15 drinks per week, with no more than three drinks per day on most days.[85] A single alcohol guideline for Ontario that reduces the risk of cancer would also reduce the risk of other alcohol-related harms and reduce confusion among the general public. This single guideline could be communicated to the public by health professionals and through broader mass media campaigns.

Opportunities to reduce alcohol consumption

- Develop a comprehensive provincial alcohol control strategy.
- Increase minimum alcohol prices to reach the recommended benchmark of $1.63 per standard drink in 2015 dollars in off-premises outlets.
- Limit additional privatization of the alcohol retail system.
- Ensure that the overall population density of on- and off-premises alcohol outlets does not increase.
- Enforce existing alcohol advertising regulations and expand regulations to meet the recommendations of the World Health Organization.
- Increase access in healthcare settings to screening for the general public and brief interventions to those who are moderate to high risk drinkers.
- Increase public awareness of the link between alcohol and cancer, and increase acceptance of the cancer prevention drinking guidelines among organizations working in public health in Ontario.

Opportunities for improved monitoring

- Monitor the effects on alcohol consumption of increased off-premises alcohol outlet privatization and on- and off-premises alcohol outlet density.

Healthy eating

INDICATORS:

Household food insecurity

Food literacy development in secondary schools

Healthy eating can reduce the risk of certain cancers.

There is evidence that increased consumption of foods containing dietary fibre reduces the risk of colorectal cancer.[101] Consumption of red meat or processed meat increases the risk of colorectal cancer and processed meat may increase the risk of stomach cancer.[101, 102] There is evidence that eating non-starchy vegetables and fruit probably reduces the risk of cancers of the oral cavity and pharynx, larynx and esophagus.[61] Eating fruit may also protect against lung cancer.[61]

Vegetable and fruit consumption is considered to be a good marker of overall diet quality,[103] yet most Ontarians consume less than the recommended amounts. The percentage of Ontarians that consumed vegetables and fruit fewer than five times per day was 67.8 per cent in 2014, which is relatively similar to 68.6 per cent in 2003.

Eating a healthy diet and participating in physical activity (discussed in the next section) can also contribute to maintaining a healthy weight. Excess body weight (i.e., overweight and obesity) increases the risk of colorectal and post-menopausal breast cancers, and cancers of the esophagus (adenocarcinoma), pancreas, endometrium, liver and kidney.[61, 101, 104-108] It may also cause cancers of the stomach, gallbladder and ovary, as well as advanced cancer of the prostate.[102, 109-111]

There is expert consensus across multiple sectors in Ontario that a comprehensive strategy is key to

supporting healthy eating.[112] Pricing or taxation policies that reduce the cost of healthy foods and increase the cost of unhealthy foods may help to promote healthy eating.[113, 114] There is emerging evidence to suggest that menu labelling can effectively promote healthy eating in some settings.[115-117] Evidence for the effectiveness of other types of policies and programs on increasing healthy eating is less advanced. Additionally, the nutrition component of the Canadian Community Health Survey is only administered occasionally.[118] Consistent collection of these data could allow for the development of more healthy eating indicators.

Healthy eating behaviours are likely influenced by the interaction of a variety of factors. It is necessary to have basic elements in place to support healthy eating. These include economic resources for obtaining sufficient and nutritious food, food literacy (i.e., knowledge about healthy eating, food preparation and meal planning) and food environments that supply nutritious items and support healthy choices. This section presents indicators that measure household food insecurity and food literacy, and a discussion of the impacts of the food environment on eating behaviours in Ontario.

Household food insecurity

Food insecurity at the household level occurs when a household's access to nutritious food is compromised due to limited financial resources.[119] Food insecurity is a strong determinant of health because it directly influences the quality and quantity of food eaten.[120-122] Adults and some children experiencing food insecurity tend to eat significantly fewer servings of vegetables and fruit than those who are food secure.[123]

Indicator: Household food insecurity

This indicator measures the percentage of households in Ontario that are food insecure according to level of severity: marginal, moderate or severe. Based on responses to the Canadian Community Health Survey, household food insecurity is classified as marginal (worrying about running out of food or limiting food selection), moderate (compromising on food quality and/or quantity) or severe (reducing food consumption or missing meals).[119] Certain populations that may be especially vulnerable to household food insecurity were not included in the survey, such as First Nations living on-reserve and people who are homeless. Therefore, data presented for this indicator likely underestimate the true prevalence of food insecurity in Ontario.[119]

In 2014, 11.9 per cent of Ontario households experienced food insecurity, 3.1 per cent of which were marginally food insecure, 5.8 per cent of which were moderately food insecure and 2.9 per cent of which were severely food insecure (Figure 7) (Supplementary Table S11). Overall, the prevalence of household food insecurity (marginal, moderate and severe combined) remained stable from 2005 to 2014; however, the distribution of food insecurity according to severity appears to have shifted somewhat during this period. Although the prevalence of severe household food insecurity remained stable, the prevalence of moderate food insecurity increased slightly, but significantly, from 5.3 per cent in 2005, while the prevalence of marginal food insecurity decreased slightly, but significantly, from 3.9 per cent in 2005. This suggests that some households that were previously only marginally food insecure may have become moderately food insecure during this time.

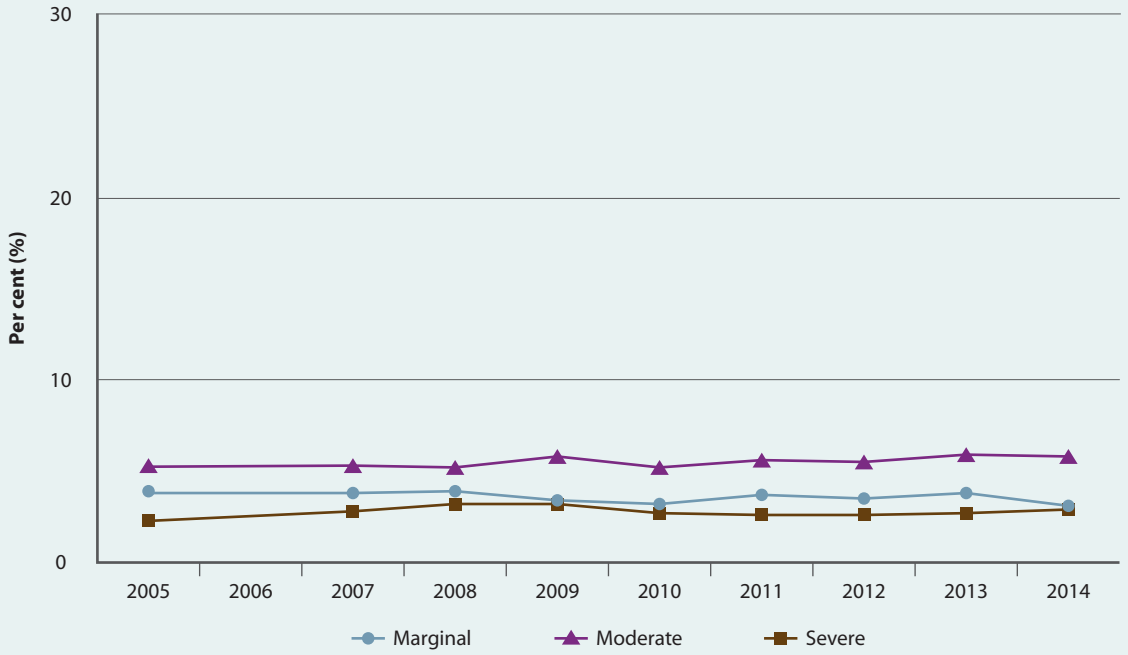
Ontarians in certain subpopulations are more likely to be living in households experiencing food insecurity. During 2012–2014, the percentage of Ontario households experiencing food insecurity was significantly higher among those in urban areas than those in rural areas (Supplementary Table S12). Household food insecurity also generally increased with decreasing income. This is consistent with other findings that indicate that lower-income households in Canada spend a larger proportion of their household incomes on food than higher-income households.[124] In 2014, 64 per cent of Ontario households that relied on social assistance (i.e., Ontario Works or Ontario Disability Support Program) were food insecure.[119] Households with children also tend to be at greater risk of food insecurity than households with no children; in 2013–2014, 17 per cent of households in Ontario with children under age 18 experienced some level of food insecurity.[119]

There is expert consensus across multiple sectors in Ontario that a comprehensive strategy is key to supporting healthy eating.

The prevalence of household food insecurity (marginal, moderate and severe combined) varied across Ontario's 36 public health units in 2012–2014 combined (Figure 8). Public health units with the lowest percentage of food insecure households included Halton Region (6.5 per cent), York Region (6.8 per cent) and Oxford County (7.0 per cent). However, estimates for Halton Region and Oxford County should be interpreted with caution due to high sampling variability resulting from a smaller number of respondents in these regions. Public health units with the highest percentage of food insecure households were Peterborough County-City (16.5 per cent), Porcupine and Toronto (both 14.9 per cent).

Household food insecurity is related to income and the cost of living, including the cost of food.[124] During 2015, the average weekly cost of a Nutritious Food Basket for a family of four in Ontario increased to $201.85, up 3.3 per cent since 2014 (Supplementary Table S14). Changes in the average weekly cost of a Nutritious Food Basket from 2014 to 2015 also varied substantially across public health units; while some public health units saw decreases of up to 6.5 per cent, others saw increases of up to 10.4 per cent.

FIGURE 7
Percentage of Ontario households that were food insecure in the past year, by level of food insecurity, 2005–2014



Source: Canadian Community Health Survey, 2005, 2007–2014 (Statistics Canada)
Note: Data are presented in Supplementary Table S11.

Nutritious Food Basket

The Nutritious Food Basket is a tool used to measure the affordability of nutritious food in Ontario and can be used to assess changes in food costs, cost disparities across regions, and the accessibility of food relative to social assistance and minimum wage levels.

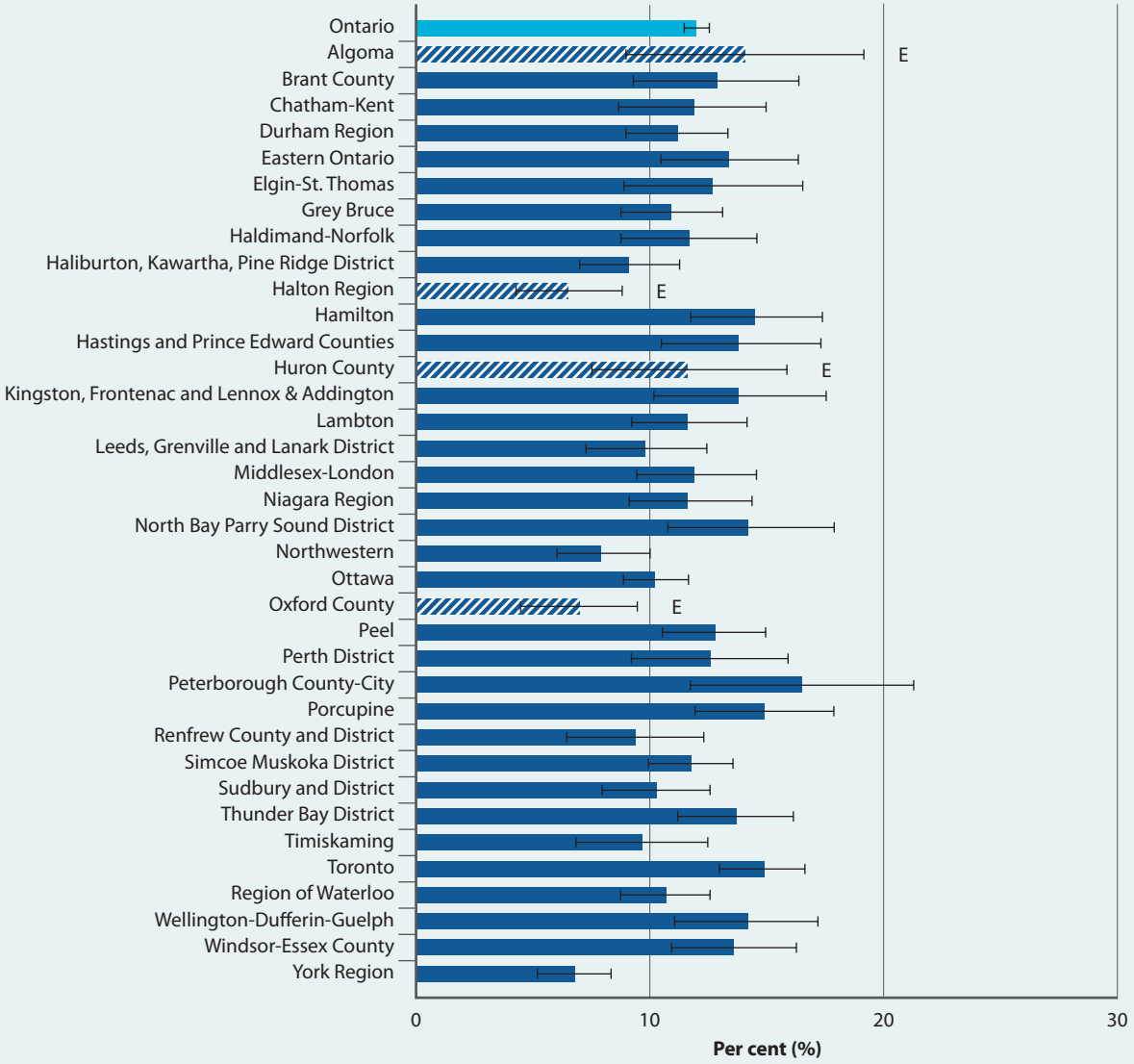
Low-income households are especially vulnerable to food insecurity.[124] While there have been some recent increases in the general minimum wage, social assistance and the employment insurance benefit, further increases could help reduce household food insecurity in Ontario. Other poverty reduction initiatives may also help to reduce household food insecurity,[124, 125] such as the Ontario government's Basic Income Pilot that was announced earlier this year.[126] Continuing to monitor the prevalence and regional variation in household food insecurity over time will help to assess the impact of these initiatives.

Food literacy

Food literacy to support healthy eating encompasses knowledge about nutritional needs and how to read nutrition labels, the ability to meal plan and budget,

FIGURE 8

Percentage of Ontario households that were food insecure (marginal, moderate and severe combined) in the past year, by public health unit, 2012–2014 combined



Source: Canadian Community Health Survey, 2012–2014 (Statistics Canada)
Notes: ⊢⊣ represents 95% confidence intervals.
E: Interpret cross-hatched estimates with caution due to high sampling variability. Data are presented in Supplementary Table S13.

Further increases to the minimum wage, social assistance and the employment insurance benefit could help reduce household food insecurity in Ontario.

the ability to prepare food and knowledge about food safety.[127, 128] Enhancing food literacy can increase the consumption of healthy foods.[129, 130] Dietary behaviours that lead to increased consumption of healthy foods, such as vegetables and fruit, and decreased consumption of unhealthy foods, such as those with excess salt, require food literacy. Because dietary behaviours that influence lifelong health are often established during childhood and adolescence, these may be critical periods for the development of food literacy.[131-133] Recent research in Ontario suggests that many adolescents benefit from and value experiential learning and school-based courses that teach food skills, including how to shop for healthy foods or prepare basic foods at home with limited resources.[134]

Food literacy may be acquired in a variety of settings, including schools, homes, community centres and workplaces. Elementary and secondary schools can provide students with high-quality instruction, allowing them to develop lifelong food literacy. The required health and physical education curriculum for Ontario's elementary schools provides guidelines for lessons regarding food and nutrition, understanding Canada's Food Guide and making healthy food choices.[135] At the secondary level, courses that teach food literacy require students to demonstrate practical knowledge and literacy, including the ability to develop healthy meal plans for themselves and others, and to prepare healthy meals. The Ontario secondary school curriculum currently offers 13 courses that include a food literacy component; however, these courses are not mandatory.[136] Some secondary schools in Ontario offer Specialist High Skills Majors programs related to hospitality and tourism, food processing, or health and wellness to students in Grades 11 and 12.[137] Students participating in these specialist programs may take courses or training related to cooking or food handling.[138]

Indicator: Food literacy development in secondary schools

This indicator measures the percentage of students who took one or more courses with a food literacy component during their secondary school education. The students included in this analysis are those who entered high school from the 2005/06 to 2009/10 school years.

Approximately one-third of students who entered Grade 9 from 2005/06 to 2009/10 earned one or more credits in a course that included a food literacy component during secondary school (Figure 9). This estimate has changed very little over time, rising only slightly from 33.8 per cent for students who entered Grade 9 in 2005/06 to 35.7 per cent for students who entered Grade 9 in 2009/10.

Changes to the Ontario secondary school curriculum could help to support healthy eating by increasing the percentage of adolescents who complete their secondary school education with food literacy knowledge. Requiring at least one secondary school credit that focuses on food literacy could effectively enhance the food literacy of Ontarians and promote healthy eating throughout the lifespan. Public health units are mandated to work with schools to help them develop, enhance or implement policies and environments that support healthy eating.[139] Increasing the role of public health units in working with secondary schools could also improve food literacy among adolescents in Ontario.

Food environment

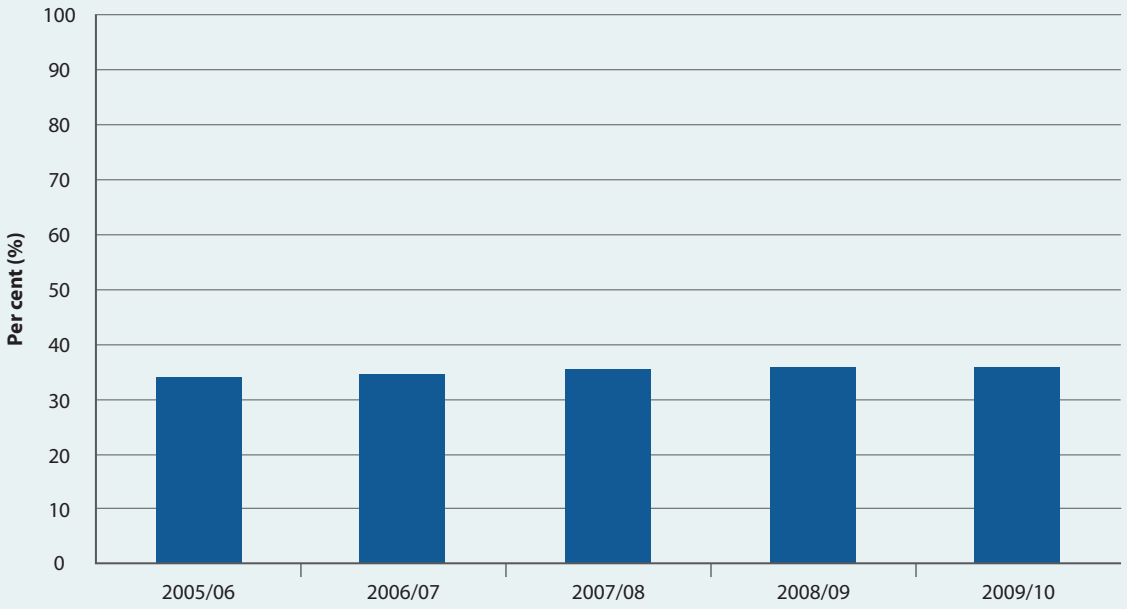
This section focuses on consumer environments in Ontario, including the types of food available from food retailers and food service providers in publicly funded settings, the environmental cues that prompt food choices (e.g., menu labelling or advertising), and the effects of pricing or taxation policies on food purchasing behaviours. Research on the food environment, as well as research that identifies effective policy interventions that support healthy eating, is currently limited, as are data sources that would support indicator development for the Prevention System Quality Index.

Food availability

Research has examined food availability as it relates to healthy eating, focusing on stores, restaurants and workplaces, as well as food service providers in publicly funded settings, such as schools, hospitals or recreational facilities. Neighbourhoods or communities that lack grocery stores, farmers markets and supermarkets are

FIGURE 9

Percentage of students in publicly funded secondary schools in Ontario who earned at least one credit in a course that included a food literacy component during their secondary school education, 2005/06 to 2009/10 cohort



Source: Ontario School Information System, 2005/06–2013/14 (Ministry of Education)
Prepared by: Cancer Care Ontario, Prevention and Cancer Control (Population Health and Prevention), based on analytic results provided by the Dissemination and Reporting Unit, Ministry of Education
Notes: Cohort year refers to the school year a student begins Grade 9. Data are presented in Supplementary Table S15.

commonly referred to as food deserts.[140] Some Ontario communities, such as London and Thunder Bay, have seen an increase in the number of food deserts over time.[140, 141] Evidence suggests that living in an urban food desert may be associated with decreased consumption of vegetables and fruit[142-144] and increased consumption of energy-dense, nutrient-deficient prepared foods.[145] Research has also examined areas that have a disproportionate number of unhealthy food providers, such as fast-food restaurants, relative to healthy food providers. These areas are commonly referred to as food swamps and are primarily located in urban areas.[146] There are food swamps in some Ontario communities, including Waterloo, Cambridge and Kitchener.[146] The availability of fast-food outlets in a given area can have a stronger influence on the diets of some people than the availability of healthy food providers, such as supermarkets.[147] Therefore, policy interventions may need to take into account both the density of fast-food outlets and healthy food providers within a region.

Increasing access and reducing barriers to healthy food is a health equity issue. Areas lacking healthy food providers are often low-income neighbourhoods or communities[140] where residents face physical and financial barriers to healthy eating.[140, 148, 149] Increasing the availability of healthy food through policy interventions, particularly in low-income neighbourhoods and communities, is recommended by several organizations, such as the Canadian Cancer Society, the Canadian Diabetes Association, the Heart and Stroke Foundation, Dietitians of Canada, the Ontario Public Health Association and Public Health Ontario. Specific interventions may include influencing the location of supermarkets or fast-food outlets through tax incentives or re-zoning strategies, and improving product offerings and affordability in small grocery or convenience stores in disadvantaged areas, including remote communities in northern Ontario.[140, 146, 149-151] Community food programs can also enhance the distribution of and access to nutritious food, and Ontario farmers can receive a tax credit for food that they donate to community food programs, such as food banks or student nutrition programs.[152]

Evidence suggests that healthy food procurement policies in workplaces and publicly funded institutions and facilities—including schools, healthcare centres and recreational facilities—can

Evidence suggests that healthy food procurement policies in workplaces and publicly funded institutions and facilities—including schools, healthcare centres and recreational facilities—can increase healthy eating.

increase healthy eating.[153] The *Taking Action* report recommends that provincial workplaces and publicly funded institutions implement policies to promote healthy eating.[2] In 2010, the Ministry of Education issued the School Food and Beverage Policy (Policy/Program Memorandum No. 150), which established nutrition standards for food sold in schools in Ontario. The policy's impact on healthy eating in students has not been comprehensively evaluated, but some positive behaviour changes have been reported, along with challenges in implementing the policy.[154]

Environmental cues

Environmental cues that may impact food purchasing choices include menu labelling, in-store promotions and mass media advertisements. In 2014, Ontarians spent 29 per cent of their household food costs on food from restaurants,[155] which suggests that interventions to enhance healthy eating in the restaurant environment are warranted. Menu calorie labelling is a relatively low-cost strategy that may reduce the number of calories bought and consumed by some people.[115-117] There is some evidence that menu labelling can also result in nutritionally beneficial product reformulations by restaurants.[156] In January 2017, the Healthy Menu Choices Act will come into effect in Ontario. It will require restaurants and other food service providers with 20 or more locations in the province—including convenience stores, grocery stores and movie theatres—to display the calorie content of standard food and beverage items on their menus.[157]

Environmental cues can also influence the food preferences of children. Children exposed to advertising of unhealthy, processed food products are more likely to request, purchase and consume these foods.[158]

Emerging evidence suggests that statutory regulations of food advertising can reduce children's exposure to and consumption of unhealthy food items.[159] Recent recommendations from the Canadian Senate include a ban on the advertising of food and drink to children; this type of ban is not in place in Ontario.[160]

Taxation and pricing

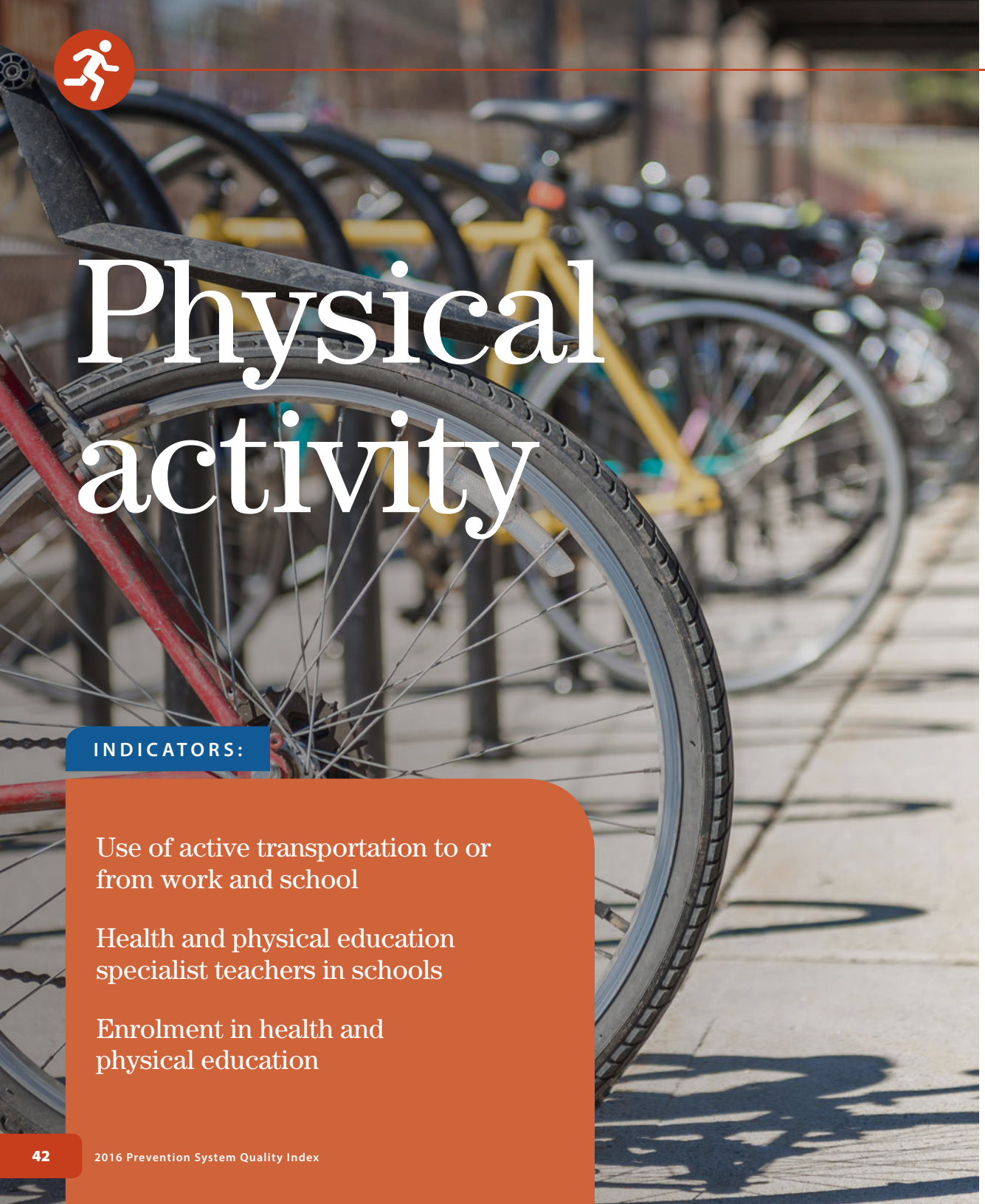
Taxation and pricing policies can promote healthy eating.[161, 162] Increasing the cost of unhealthy foods through interventions such as taxation may discourage consumers from buying these items.[113, 114] The Canadian Senate recently recommended a new tax on sugar-sweetened and artificially sweetened beverages that are sold in Canada. Similarly, Dietitians of Canada recommends that a tax of at least 10 to 20 per cent be applied to sugar-sweetened beverages sold in Canada.[160, 163] Reducing the price of healthy foods at grocery stores and supermarkets can also increase the purchase and consumption of healthy items, including vegetables and fruit;[114, 164] however, the potential impact of these policies on the financial viability of the agricultural sector should be considered. Pricing interventions may also include agricultural subsidies to increase the local production, distribution and affordability of healthy foods, particularly in northern communities, although further research on the effects of these interventions is needed.[165, 166]

Opportunities to improve healthy eating

- Reduce household food insecurity through poverty reduction policies.
- Modify the Ontario secondary school curriculum to include at least one compulsory credit in a course that focuses on food literacy.
- Integrate healthy food access provisions into city and regional land use policies and community planning to establish healthy food environments.
- Evaluate and improve compliance with the School Food and Beverage Policy and update the policy as required.
- Consider developing legislation based on the Canadian Senate's recommendation to ban the advertising of food and drink to children.

Opportunities for improved monitoring

- Increase the frequency of the nutrition component of the Canadian Community Health Survey and allow for the development of additional indicators related to healthy eating.
- Assess the impact of social assistance programs on household food insecurity by monitoring changes in social assistance and general minimum wage over time, and by continuing to monitor prevalence and regional variation in household food insecurity.
- Evaluate the implementation and outcomes of the Healthy Menu Choices Act.



Physical activity

INDICATORS:

Use of active transportation to or from work and school

Health and physical education specialist teachers in schools

Enrolment in health and physical education

Physical activity reduces the risk of colon cancer, and probably reduces the risk of post-menopausal breast cancer and endometrial cancer.[101, 104, 106]

To reduce the risk of these cancers, the World Cancer Research Fund and the American Institute for Cancer Research recommend that adults ages 18 to 64 be moderately physically active, which is equivalent to brisk walking for at least 30 minutes every day. As fitness improves, adults should aim for 60 minutes or more of moderate or 30 minutes or more of vigorous physical activity every day.[61] These recommendations for cancer prevention are higher than the Canadian Physical Activity Guidelines, which recommend 150 minutes of moderate- to vigorous-intensity aerobic physical activity per week for adults.[167] For children and adolescents ages five to 17, the Canadian Physical Activity Guidelines recommend 60 minutes of moderate to vigorous physical activity every day.[167] In 2014, 48.5 per cent of Ontario adults age 18 and older and 30.6 per cent of adolescents ages 12 to 17 were inactive during leisure time.

Policies and programs that may be effective at increasing population levels of physical activity include built environment changes to support walking and bicycling, physical activity programs in community settings (e.g., workplaces), expanding or enhancing

health and physical education in schools, healthcare provider prescriptions for physical activity and community-wide social marketing campaigns.[168]

Supportive built environments and school-based health and physical education programs provide the infrastructure, settings and skills that help adults and children incorporate physical activity into their daily routines and develop a commitment to lifelong healthy, active living. This section focuses on measuring the use of active transportation—walking and bicycling—and school-based health and physical education policies and programs in Ontario.

Active transportation

Active transportation is generally defined as using human-powered travel to move between destinations, with an emphasis on walking and bicycling. Active transportation can also include other types of transportation, such as manual wheelchairs. The focus of this section is on walking and bicycling, the most common forms of active transportation. Adults and children who use active transportation have higher overall levels of measured and self-reported physical activity.[169-171] Programs focused specifically on increasing active transportation to school have also been found to be effective in increasing overall physical activity levels.[171]

Features of the built environment that can increase active transportation include ensuring that a variety of destinations (e.g., businesses, schools and workplaces) are within walking distance of residences. Streets and sidewalks should connect well to these destinations and should be easy to navigate. Bicycle lanes should be available and appropriate for the population density of neighbourhoods.[172] Public transit also has an impact on overall physical activity: on average, adults who use public transit walk an additional eight to 33 minutes a day.[173]

The Ontario government's policy direction on land use planning for municipalities, the Provincial Policy Statement, was updated in 2014 to explicitly include the term "active transportation." The updates related to active transportation include policies for increasing connectivity between different modes of transportation and ensuring that public facilities, such as schools and libraries, are accessible by active transportation and public transit. The new policies build on previously existing policies in the Provincial Policy Statement that promote compact and safe neighbourhoods.[174] Municipalities and regions are legally required to ensure their official plans are consistent with the Provincial Policy Statement.

Therefore, municipal and regional plans are expected to include provisions for supporting active transportation when they are updated over the next few years, if provisions are not already in place.[175] Also at the municipal level, public health units are mandated to work with municipal planning and transportation departments to support active transportation through policy and strategy development, building coalitions, public education, research and knowledge exchange.[176]

The indicators in this section measure the use of active transportation (walking or bicycling) in adults age 19 and older and youth ages 11 to 18 using the most recent available data from the Transportation Tomorrow Survey. The 2011 Transportation Tomorrow Survey was carried out with the cooperation of 23 local and provincial government agencies. It looked at travel by members of households in all Greater Golden Horseshoe regions, except Northumberland and Haldimand. There is no comparable data set for regions in the rest of Ontario, so the indicators in this section are not representative of the province. However, regions included in the Transportation Tomorrow Survey represent 66 per cent of Ontario's population.

The Transportation Tomorrow Survey asks about all trips taken by each member of a household on the previous day, the origin and destination for each trip and the mode of transportation. The following indicators measure the percentage of trips that used active transportation to or from work and school.

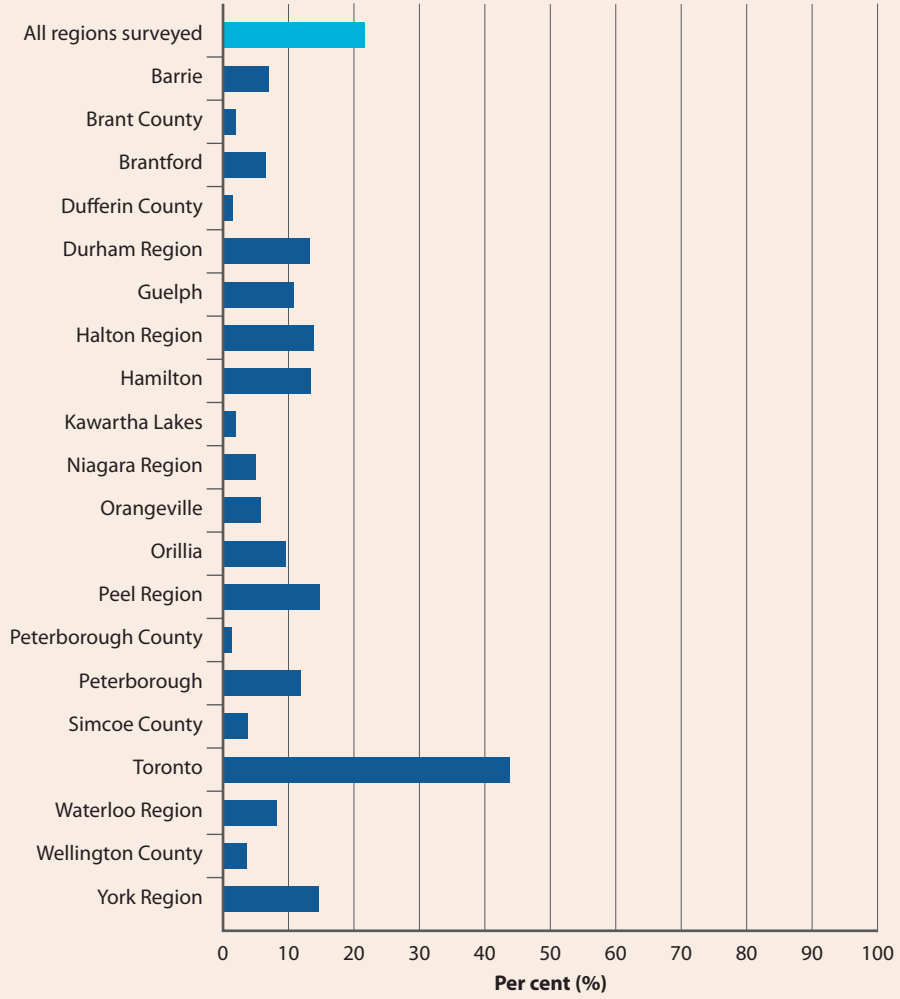
Indicator: Use of active transportation to or from work

In 2011, active transportation was used in 21.6 per cent of trips taken to or from work by adults age 19 and older in the Greater Golden Horseshoe regions that were surveyed (Figure 10). The percentage of trips that used active transportation was highest in Toronto (43.7 per

Adults and children who use active transportation have higher overall levels of measured and self-reported physical activity.

FIGURE 10

Percentage of trips taken to or from work by adults (age 19+) that included active transportation, Greater Golden Horseshoe regions in Ontario, 2011



Source: Transportation Tomorrow Survey, 2011 (Data Management Group, University of Toronto)
Notes: Active transportation: walking or cycling used as the only mode of transportation to or from work, and to or from public transit. Data are presented in Supplementary Table S16.

cent), followed by Peel Region and York Region (both 14.7 per cent).

Active transportation can be used as the only mode of transportation or it can be used to connect to or from public transportation. Active transportation was the only mode of transportation for 4.8 per cent of the trips taken to or from work in all regions surveyed (Supplementary Table S16). Toronto (9.6 per cent), Peterborough (8.7 per cent) and Orillia (7.4 per cent) had the highest percentages of trips that used active transportation as the only mode of transportation. Dufferin County (0.9 per cent), Peterborough County (1.3 per cent) and Brant County (1.4 per cent) had the lowest percentages of trips that used active transportation as the only mode of transportation. Some of these regions are predominantly rural, where using active transportation to get to or from work may not be feasible for a variety of reasons, such as large geographic areas that make active transportation impractical, or walking and cycling routes that are unsafe, underdeveloped or non-existent.

Overall, for work-related commutes, adults more often used active transportation as a way to get to or from public transit (16.8 per cent), including regional commuter trains or buses (e.g., GO Transit), than active transportation as their only mode of travelling (Supplementary Table S16). This suggests the importance of public transit in contributing to physical activity. In seven out of the 20 regions surveyed, the majority of active transportation trips took place to or from public transit. Toronto had a higher percentage of active transportation trips that took place to or from public transit (34.2 per cent) than the other Greater Golden Horseshoe regions that were surveyed. This is

likely due to Toronto's extensive public transit system, including subways, streetcars and buses. Many of the other regions included in this survey have minimal or no public transit, so public transit contributes to very few active transportation trips in these regions.

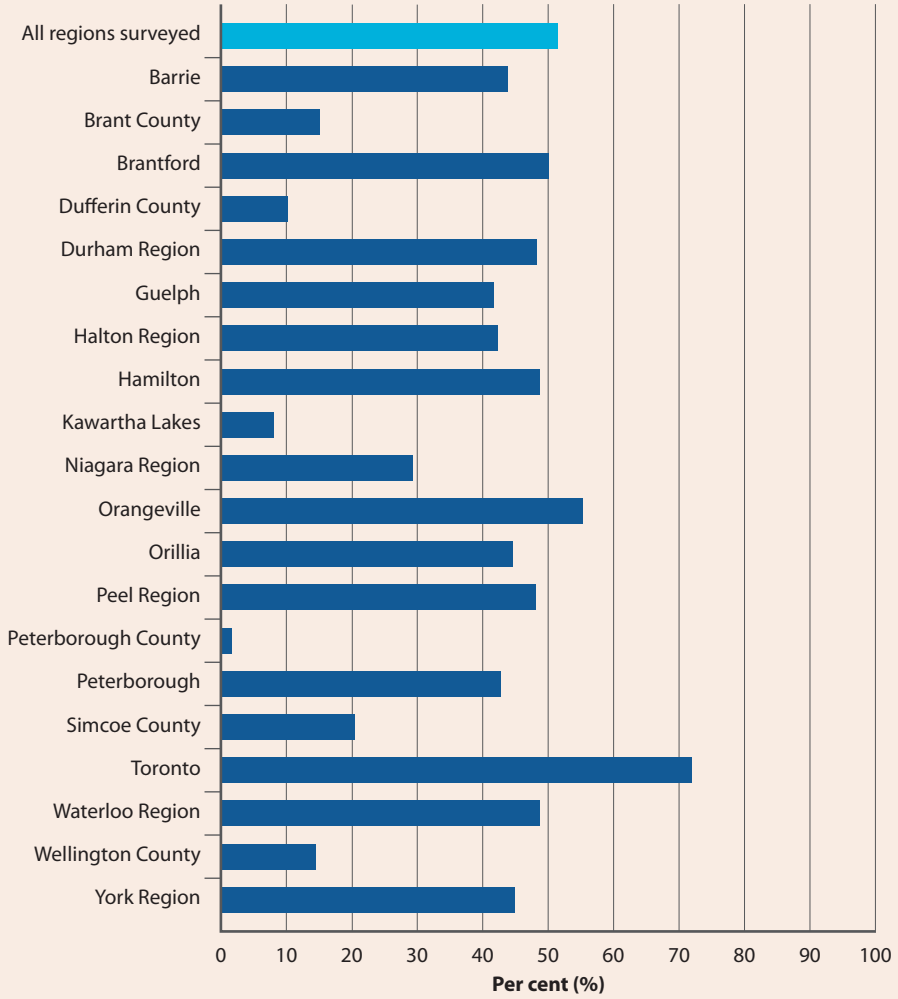
Indicator: Use of active transportation to or from school

In 2011, youth ages 11 to 18 used active transportation in 51.4 per cent of their trips to or from school in all regions surveyed (Figure 11). The percentage of trips that used active transportation was highest in Toronto (71.9 per cent), Orangeville (55.2 per cent) and Brantford (50.1 per cent).

Overall, youth used active transportation as their only mode of commuting to or from school more often (33.9 per cent) than active transportation that connected them to or from public transit (17.5 per cent) (Supplementary Table S17). School buses were not included as a type of public transit in the survey. Orangeville (54.8 per cent), Brantford (46.2 per cent) and Orillia (44.1 per cent) had the highest percentages of trips in which active transportation was the only mode of transportation to or from school. Peterborough County (1.7 per cent), Kawartha Lakes (8.0 per cent) and Dufferin County (10.2 per cent) had the lowest percentages of trips in which active transportation was the only mode of transportation. Some of these regions are predominantly rural, where children are driven or bused to school and active transportation is not feasible. Toronto (35.8 per cent), Waterloo (15.8 per cent) and Hamilton (14.3 per cent) had the highest percentages of trips to or from school that used active transportation to connect with public transit. Regions that reported the highest percentages of trips in

FIGURE 11

Percentage of trips taken to or from school by youth (ages 11–18) that included active transportation, Greater Golden Horseshoe regions in Ontario, 2011



Source: Transportation Tomorrow Survey, 2011 (Data Management Group, University of Toronto)
Notes: Active transportation: walking or cycling used as the only mode of transportation to or from school, and to or from public transit. Data are presented in Supplementary Table S17.

which youth used active transportation as their only mode of transportation to or from school may have more schools that are closer to homes and on safe routes.

Implications and limitations

To increase active transportation to and from work and school, further emphasis may be placed on enhancing the built environment for pedestrians and cyclists[172] and improving access to public transit.[173] Workplaces and schools can also play a role in increasing the use of active transportation in their employees and students. Workplaces that provide on-site facilities (e.g., bike racks, lockers, places to change clothes) and disincentives for non-active transportation, such as high parking prices, may help increase active transportation.[177, 178] Programs that can support active transportation to and from school include "walking school buses," which are programs that facilitate two or more families walking to school together, walk-to-school days and bicycling programs. These interventions should be part of a comprehensive program to promote active transportation to school, such as Active and Safe Routes to School, a Canadian community-based initiative.[179]

The active transportation indicators have some limitations. Active transportation is defined as walking or bicycling and does not include other forms of active transportation. The indicators reported here focus on travel to or from work and school. Therefore, they do not include the active transportation trips that respondents may have taken during their leisure time. In addition, the Transportation Tomorrow Survey was developed to facilitate transportation planning, rather than to specifically assess respondents' active transportation behaviours. The data measure trips based on the previous day's travels at the time of the survey, and may not be representative of respondents' typical modes of travel. However, the survey asked respondents about their travel to work and school on a weekday, and the survey was administered in the early fall, when weather-related barriers to active transportation were less likely to be present. The Transportation Tomorrow Survey is conducted every five years; when new data are available, this indicator may be included in future Prevention System Quality Index reports.

Physical activity in schools

Schools provide the most accessible and, in the case of publicly funded schools, equitable way to support children and adolescents in Ontario in attaining the recommended 60 minutes of physical activity a day. Health and physical education classes can increase overall physical activity levels and physical fitness in children and adolescents.[180] In an Ontario-based study of 30 elementary schools, students that received more health and physical education classes in the previous week reported higher levels of physical activity.[181] Structured, high-quality health and physical education in schools also provides an opportunity for children and adolescents to increase their physical literacy, a central goal of Ontario's curriculum for health and physical education. Physical literacy refers to "the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life."[182] Developing physical literacy at a young age helps people gain the confidence and motivation to be physically active throughout their lives.[183]

In Ontario, elementary schools are required to ensure that students in Grades 1 to 8 receive a minimum of 20 minutes of sustained moderate to vigorous physical activity each day (referred to as Daily Physical Activity) during instructional time,[184] but the number of physical education classes per week may vary.[181] Public Health Ontario has evaluated the implementation of the Daily Physical Activity program and the results are in press. The government also funds a program to support and recognize school communities that provide students the opportunity to reach 60 minutes of physical activity as part of the school day.[185, 186] In Ontario secondary schools, one credit in health and physical education is required to graduate and this class is typically taken in Grade 9.

In most publicly funded schools in Ontario, classroom teachers provide health and physical education classes. In a smaller number of schools, health and physical education specialist teachers provide these classes. The majority of specialist teachers in Ontario have taken specialized training recognized by the Ontario College of Teachers or have a university background in physical education;[187] however, there are currently no standardized criteria for health and physical education specialists in Ontario.

Among the wide-ranging requirements of the Ontario College of Teachers' additional qualification course for health and physical education, teachers receive training to support the development of physical literacy in students, including demonstrating knowledge of fundamental movement skills, planning how to develop motor skills and game strategies, and knowing basic equipment standards. Teachers also receive training to help them foster a positive learning

environment that contributes to the students' enjoyment of physical activity and ensures that students' self-perception of their body does not deter them from being active.[188] In 2004, Ontario's Chief Medical Officer of Health recommended that schools ensure that physical education is taught by teachers who have training in physical education.[189] More recently, the Ontario Society of Physical Activity Promoters in Public Health, along with several local, provincial and national partners, recommended that health and physical education in Ontario schools should be delivered by specialists to best support the development of physical literacy.[190]

Professional development for teachers in physical education can be an effective way to increase the time students spend being physically active during physical education classes because teachers learn effective activity selection, and class organization, management and instruction strategies.[191] Students whose teachers receive professional development may also benefit from a greater amount of overall daily physical activity, as well as improved movement skills and cardiorespiratory fitness, than students whose teachers have no specialized training.[192] Teachers who receive certification in physical education may help their students be more physically active than students whose teachers have only participated in a limited number of professional development training sessions in physical education.[193]

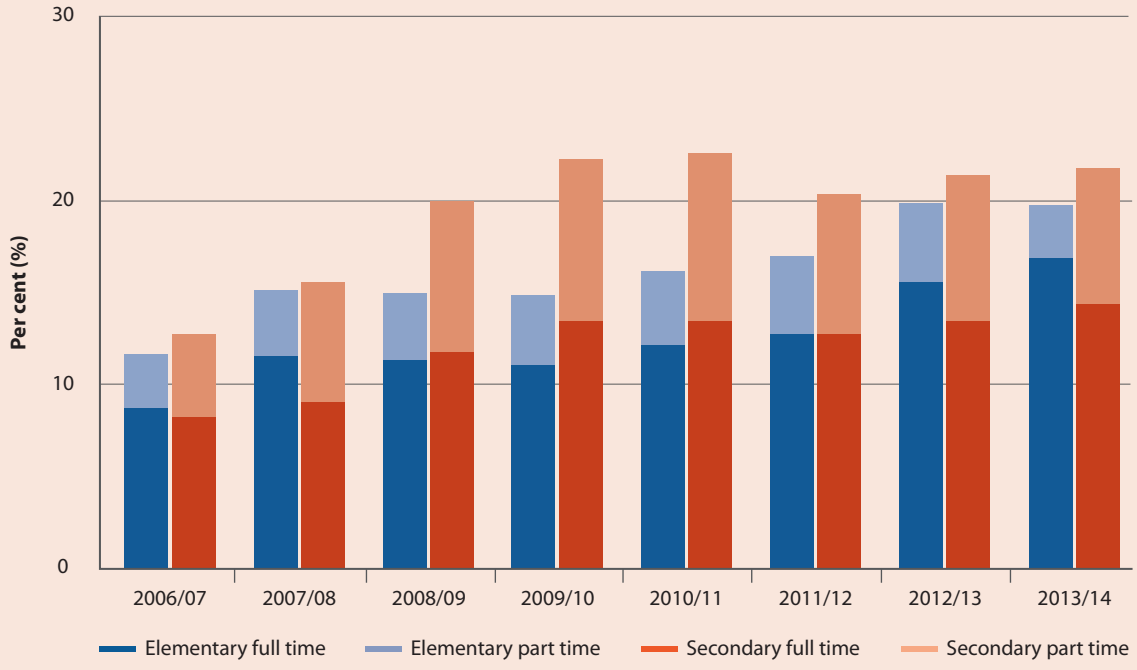
The indicators in the following section measure the percentage of publicly funded elementary and secondary schools in Ontario that have health and physical education specialist teachers, and the percentage of secondary school students in Ontario who earned one or more credits in health and physical education courses. The data used in these analyses come from the Ministry of Education's Ontario School Information System.

Indicator: Health and physical education specialist teachers in schools

In the 2013/14 school year, 19.7 per cent of elementary schools and 21.7 per cent of secondary schools reported having full-time and/or part-time specialist teachers assigned to teach health and physical education (Figure 12) (Supplementary Table S18). Over the eight-year period from 2006/07 to 2013/14, the overall percentage of schools with specialist teachers increased from 11.5 per cent at the elementary level and 12.7 per cent at the secondary level.

FIGURE 12

Percentage of publicly funded elementary and secondary schools in Ontario with full- and/or part-time specialist teachers assigned to teach health and physical education, 2006/07 to 2013/14 school year



Source: Ontario School Information System, 2006/07–2013/14 (Ministry of Education)
Notes: Full time: ≥1.0 full-time equivalent (FTE); note that ≥1.0 FTE does not necessarily mean there are 1 or more full-time specialist teachers because 2 or more part-time specialist teachers may account for ≥1.0 FTE. Part time: >0 and <1.0 FTE. Data are presented in Supplementary Table S18.

There was an improvement in the average ratio of students to health and physical education specialist teachers in individual elementary and secondary schools.

The percentage of publicly funded elementary schools with health and physical education specialist teachers varied widely by public health unit during the 2013/14 school year (Figure 13). York Region (63.3 per cent), Porcupine (48.1 per cent), Thunder Bay District (47.9 per cent) and Chatham-Kent (47.5 per cent) had the highest percentages of elementary schools with specialist teachers, while Perth District and Huron County had no elementary schools with specialist teachers. Across most public health units, a larger proportion of elementary schools had full-time specialist teacher positions compared to part-time positions.

Similar to elementary schools, the percentage of publicly funded secondary schools with specialist teachers during the 2013/14 school year varied by public health unit (Figure 14). Oxford County (71.4 per cent), the Region of Waterloo (69.6 per cent) and Grey Bruce (64.3 per cent) had the highest percentages of schools with specialist teachers. Perth District, Huron County and Halton Region had no secondary schools with specialist teachers.

These analyses examine the percentage of schools with health and physical education specialist teachers; however, they do not compare the number of full- or part-time specialist teachers to the number of students at each school. To understand the distribution of specialist teachers, an analysis of the ratio of students to teachers at the school level was conducted. Schools that do not have specialist teachers were not included in the analysis.

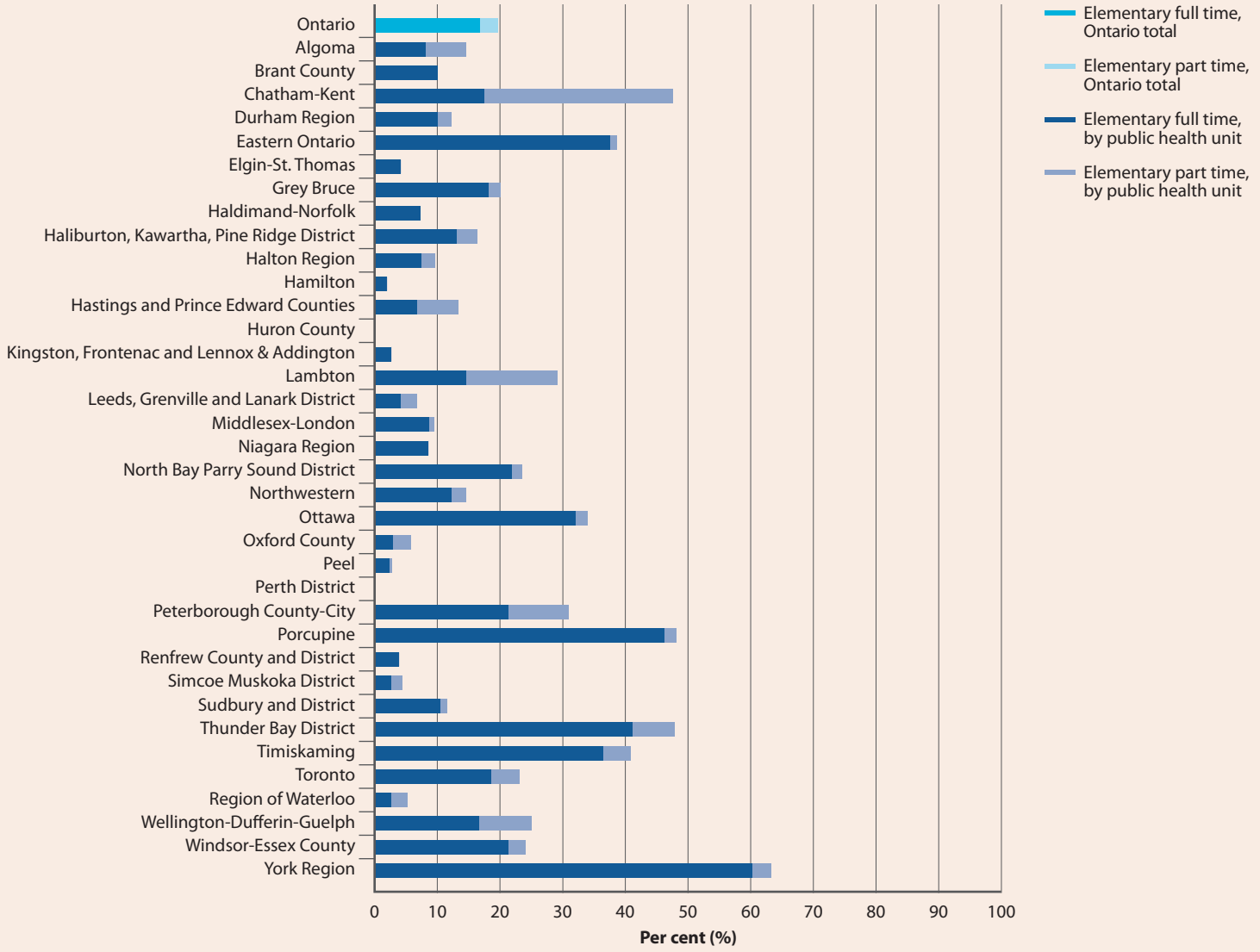
Among schools with at least one full- or part-time specialist teacher, there was an overall improvement (i.e., a decrease in the ratio) in the average number of students in individual elementary and secondary schools for each full-time equivalent health and physical education specialist teacher. The average ratio of students to specialist teachers in Ontario elementary and secondary public schools with health and physical education specialist teachers was 428:1 in 2013/14, compared to 528:1 in 2012/13 (Supplementary Table S21). In schools with health and physical education specialist teachers, Sudbury and District (146:1), North Bay Parry Sound District (151:1) and Thunder Bay District (166:1) had the smallest student-to-teacher ratios in 2013/14, while Peel (2,533:1), Simcoe Muskoka District (1,752:1) and Hastings and Prince Edward Counties (952:1) had the largest student-to-teacher ratios.

Despite the overall improvement in the number of students for each specialist teacher assigned to teach health and physical education, the majority of schools in Ontario continue to have no health and physical education specialist teachers. Teachers who specialize in health and physical education can enhance health and

Approximately one in five schools reported having full-time and/or part-time specialist teachers assigned to teach health and physical education in the 2013/14 school year.

FIGURE 13

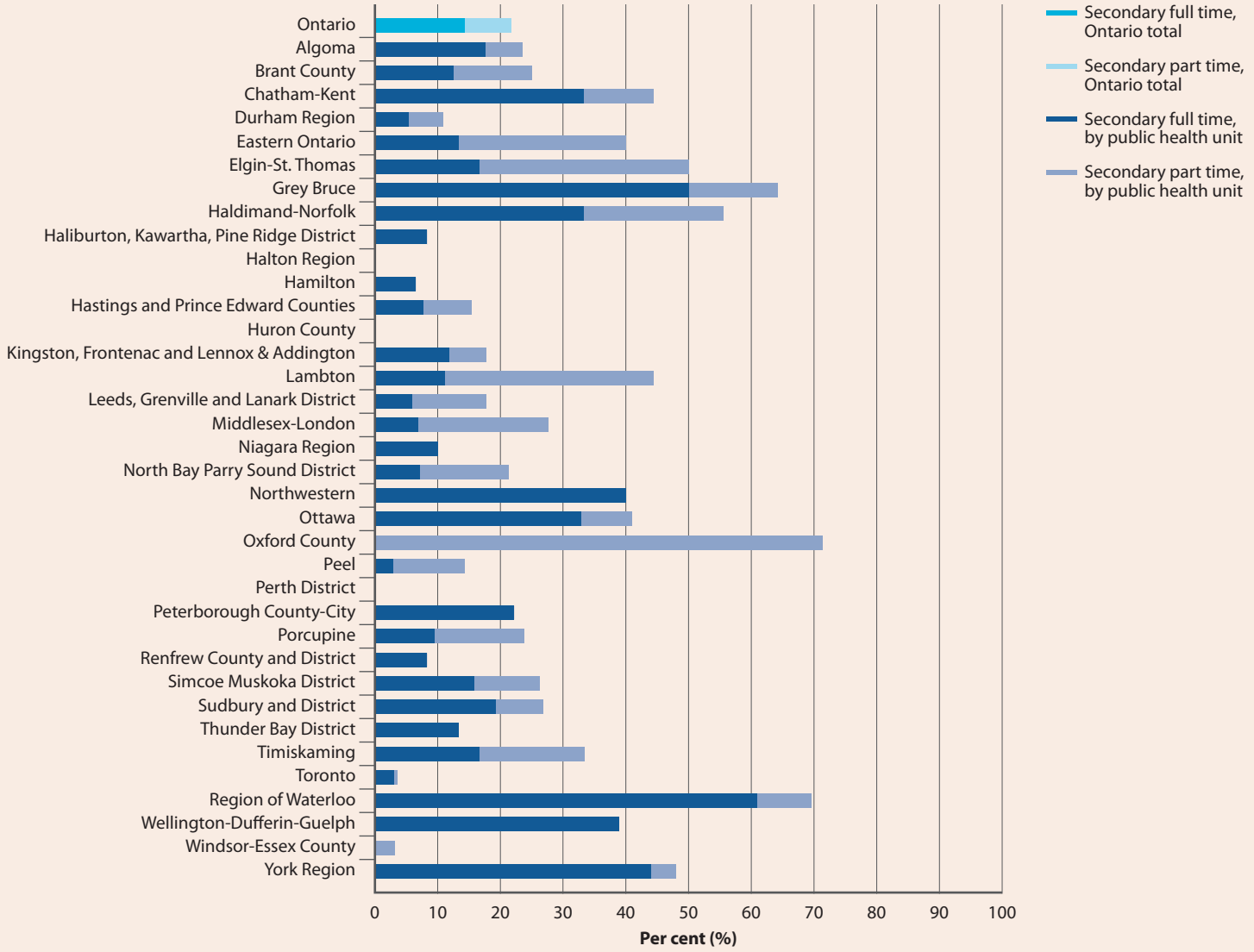
Percentage of publicly funded elementary schools in Ontario with full- and/or part-time specialist teachers assigned to teach health and physical education, by public health unit, 2013/14 school year



Source: Ontario School Information System, 2013/14 (Ministry of Education)
Notes: Full time: ≥1.0 full-time equivalent (FTE); note that ≥1.0 FTE does not necessarily mean there are 1 or more full-time specialist teachers because 2 or more part-time specialist teachers may account for ≥1.0 FTE. Part time: >0 and <1.0 FTE. Data are presented in Supplementary Table S19.

FIGURE 14

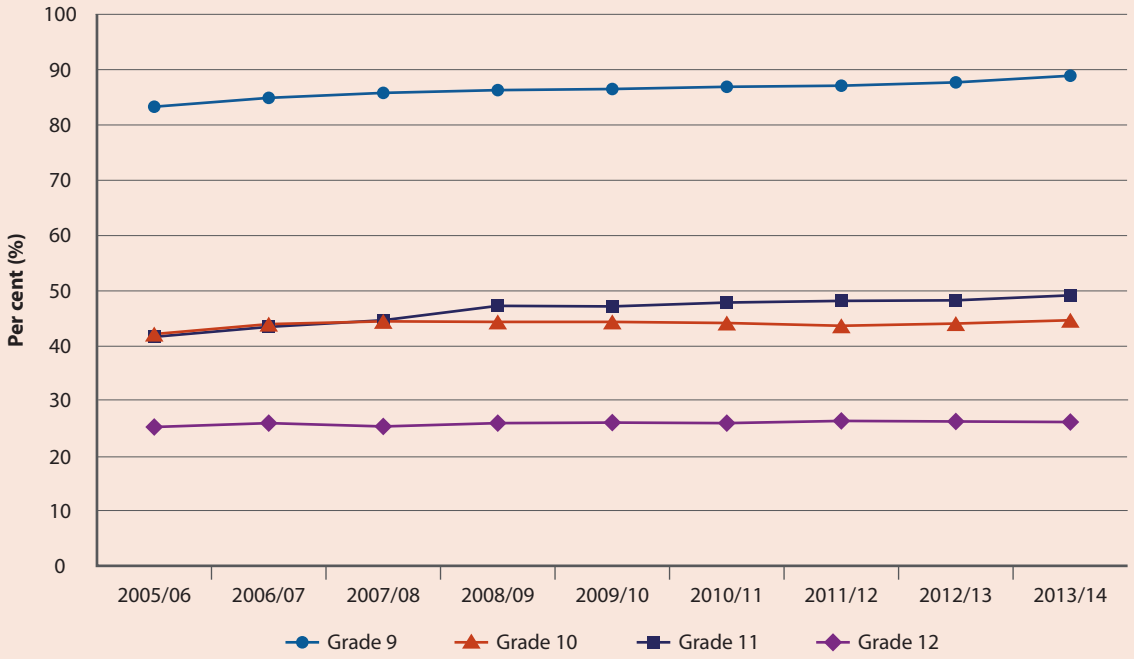
Percentage of publicly funded secondary schools in Ontario with full- and/or part-time specialist teachers assigned to teach health and physical education, by public health unit, 2013/14 school year



Source: Ontario School Information System, 2013/14 (Ministry of Education)
Notes: Full time: ≥1.0 full-time equivalent (FTE); note that ≥1.0 FTE does not necessarily mean there are 1 or more full-time specialist teachers because 2 or more part-time specialist teachers may account for ≥1.0 FTE. Part time: >0 and <1.0 FTE. Data are presented in Supplementary Table S20.

FIGURE 15

Percentage of students in publicly funded secondary schools in Ontario who earned one or more health and physical education credits, by grade, 2005/06 to 2013/14 school year



Source: Ontario School Information System, 2005/06 to 2013/14 (Ministry of Education)
Prepared by: Cancer Care Ontario, Prevention and Cancer Control (Population Health and Prevention), based on analytic results provided by the Dissemination and Reporting Unit, Ministry of Education
Note: Data are presented in Supplementary Table S22.

physical education classes and increase physical literacy in students. Therefore, developing evidence-based standardized criteria for health and physical education specialists in Ontario and professional training that meets these criteria is recommended.

Indicator: Enrolment in health and physical education

In the 2013/14 school year, 88.6 per cent of Grade 9 students in publicly funded secondary schools earned one or more health and physical education credits, compared to 26.0 per cent of Grade 12 students (Figure 15). Since the 2005/06 school year, there has been a significant increase in the percentage of Grades 9 and 11 students, and a slight, but significant, increase in the percentage of Grade 12 students who have earned one or more health and physical education credits. However, students in Grades 10, 11 and 12 are still less likely to earn health and physical education credits than students in Grade 9, when students are most likely to earn their one mandatory health and physical education credit. Furthermore, some Grade 11- and 12-level health and physical education credits do not have a physical activity component because they are focused on health or physiology.[136]

These data suggest that the majority of Ontario secondary school students earn their one mandatory health and physical education credit in Grade 9. Health and physical education classes increase overall physical activity levels and physical fitness in youth,[180] yet physical activity declines in adolescence.[194] Requiring a health and physical education credit that has a focus on physical activity in every grade from 9 to 12 would help increase adolescents' levels of physical activity.

Opportunities to increase physical activity

- Continue to develop and replicate successful provincial and municipal policies, and community-wide programs that increase active transportation.
- Based on evidence, develop standardized criteria for health and physical education specialists in Ontario and ensure that professional training meets these criteria.
- Require a health and physical education credit that has a focus on physical activity in every grade from 9 to 12.

Opportunities for improved monitoring

- Expand the number of regions surveyed on the use of active transportation to inform planning at the provincial and municipal levels.

Ultraviolet radiation

INDICATOR:

Shade policies in local municipalities

Ultraviolet radiation (UVR) from the sun and UVR-emitting tanning devices is a cause of most skin cancers, including cutaneous melanoma, the most deadly form of skin cancer, and basal and squamous cell carcinomas, which are the most common types of skin cancer.[195]

UVR-emitting tanning devices also cause ocular melanoma, a type of eye cancer.[195] In 2014, there were an estimated 39,400 cases of skin cancer in Ontario, making it the most common type of cancer.[196] National surveys found that in 2006, Ontario residents spent more time in the sun without improving their sun protection behaviours than in 1996. In addition, the proportion of Ontarians who used UVR-emitting tanning devices increased during this period.[197] Increased exposure to UVR in Ontario has likely contributed to

the rise in new melanoma and non-melanoma skin cancer cases over the past decade, a trend that is expected to continue.[196, 198, 199] Cases of non-melanoma skin cancer are not routinely reported in Ontario. Data on UVR exposure patterns in the general population are also unavailable. These are potential areas for improved monitoring.

UVR exposure can be reduced in the population through interventions in specific settings (e.g., child care settings, elementary schools, workplaces, recreational settings) and in the community as a whole. Sun protection interventions in these settings are likely to be most effective when multiple components are implemented at the same time. These components can take the form of environmental supports, such as shade structures; policy measures, such as reducing the time children and staff in child care settings spend outdoors during peak UVR hours; public education strategies; and programs that help people improve their use of personal sun protection.[200] Health promotion strategies that emphasize the damaging effects of UVR on the appearance of the skin are particularly effective,[201] as is behavioural counselling in primary care settings; both have been shown to reduce indoor tanning in young women.[202]

This section describes examples of interventions that reduce UVR exposure in Ontario and it presents an indicator on the number of local municipalities with strong policies on shade. Efforts to reduce UVR exposure for priority populations and initiatives to support community-wide public education are also discussed. Data to assess policies and programs to reduce UVR exposure are currently limited.

Shade policies

Shade provided by built structures and tree canopies can protect people from UVR exposure more effectively than sunscreen, and may be an alternative form of sun protection when protective clothing, such as long-sleeved shirts, pants and a hat may not be practical. A national survey in the United States showed that those who sought shade reported fewer sunburns than those who used sunscreen.[203] This may be in part because people typically apply considerably less sunscreen than recommended.[204] One study found that 71 per cent of children at a soccer camp made use of shade tents during rest periods.[205] Shade policies can help increase the availability of shade in areas where people spend extended time outdoors, such as public parks and bus stops.

Indicator: Shade policies in local municipalities

In Ontario, municipalities establish guidelines that are used when evaluating plans for developing or redeveloping a site. These guidelines are found in planning policy documents, such as official plans and urban design guidelines. Statements on the provision of shade ("shade policies") may be included in these guidelines. Guidelines can apply to municipally and privately owned sites.

This indicator looks at the number of local municipalities in Ontario that have guidelines with shade policies and the strength of the policies. The strength of the shade policies is defined as follows:

- **Strong shade policies:** Guidelines that the municipality follows when evaluating plans for developing or redeveloping sites state that shade *should be provided* for a *broad* range of municipally *and* privately owned sites.
- **Moderate shade policies:** Guidelines that the municipality follows when evaluating plans for developing or redeveloping sites state that shade *should be provided* for only a *few* types of municipally *and/or* privately owned sites.
- **Limited shade policies:** Guidelines that the municipality follows when evaluating plans for developing or redeveloping sites state that the provision of shade *should be considered* for one or more types of municipally *and/or* privately owned sites, but it is not essential.
- **Shade policies not included:** A statement on the provision of shade is *not included* in guidelines found in planning policy documents at the present time for the local municipality.

Only shade policies that have been adopted by the local council and approved by the Ontario Municipal Board, if required, are included in this indicator. This assessment of shade policies may not reflect how well the policies are implemented and the actual availability of shade in each municipality.

Shade provided by built structures and tree canopies can protect people from UVR exposure more effectively than sunscreen.

For feasibility purposes, analysis was limited to local municipalities with populations of 100,000 or more. Twenty-six local municipalities met this threshold based on February 2016 population estimates, accounting for 68 per cent of Ontario's population. Regional municipalities were excluded so that local municipalities—some of which fall under a regional municipality—were not counted more than once.

Municipal planning policy documents available on the web were reviewed for each of the 26 local municipalities to identify whether the documents included shade policies. The 26 municipalities were then contacted and asked to confirm the information that was retrieved from the web and to identify additional relevant policies in their municipalities.

Supplementary Table S23 provides the content of the shade policies assessed and information about whether the municipality provided verification.

The primary outcome of interest for this indicator is the number of local municipalities with a population of 100,000 or more in Ontario that have strong shade policies. Secondary outcomes are also assessed by identifying municipalities with moderate and limited shade policies, and those that do not currently include shade policies in their planning policy documents.

As of March 2016, three local municipalities with a population of 100,000 or more—Ajax, Kitchener and Waterloo—have strong shade policies (Table 5). Kitchener and Waterloo identify shade as "an essential

As of March 2016, three local municipalities with a population of 100,000 or more—Ajax, Kitchener and Waterloo—have strong shade policies.

TABLE 5

Strength of shade policies in the planning policy documents of local municipalities in Ontario with populations of 100,000 or more, as of March 2016

Strong shade policies	Moderate shade policies	Limited shade policies	Shade policies not included
Ajax	Barrie	Brampton	Whitby
Kitchener	Greater Sudbury	Burlington	
Waterloo	Guelph	Cambridge	
	Hamilton	Chatham-Kent	
	Kingston	Mississauga	
	London	Oshawa	
	Markham	Ottawa	
	Milton	Vaughan	
	Oakville		
	Richmond Hill		
	St. Catharines		
	Thunder Bay		
	Toronto		
	Windsor		

Sources: Municipal planning policy documents (e.g., official plans, urban design guidelines, site plan control bylaws) posted on the web and/or additional documents sent via email from the municipality for each of the 26 Ontario local municipalities with populations of 100,000 or greater, 2016
Note: The shade policies assessed and information about whether they were verified by the municipality can be found in Supplementary Table S23.

component" when planning, developing, retrofitting or refurbishing municipal facilities and parks. Ajax is notable as the only municipality among those noting shade as a requirement to link shade to UVR exposure, stating that shade should serve "to create protection against ultraviolet radiation at the right time of day and at the right time of year."[206] All three municipalities also state that shade should be provided in development or redevelopment plans for privately owned sites.

In the municipalities assessed, there are 14 with shade policies that are of moderate strength, stating that shade should be provided for only a few types of sites. The number and types of sites that should have shade as part of development or redevelopment plans vary according to municipality. For example, Thunder Bay identifies shade as a requirement for parks, playgrounds, areas adjacent to transit shelters and key street corridors, and Barrie requires shade for its pedestrian and bicycle network. Eight municipalities have limited shade policies, noting shade only as an element for consideration. For example, Brampton's policy states that shade structures, among several other elements, could be considered for parks. Whitby does not currently include shade policies in its municipal planning policy documents.

Municipal shade policies do not require projects to be undertaken for the sole purpose of increasing the availability of shade. In the planning policy documents reviewed, where a shade policy was identified, shade was noted only as an element to be incorporated into plans for new developments or redevelopments and in ongoing municipal landscaping (e.g., shade trees).

In many of the municipal policies, shade was frequently described as a way to mitigate the urban heat island effect, which is from heat generated by sunlight on paved areas. In these instances, with the exception of Ajax, there were no specific requirements mandating that shade provide UVR protection. Similarly, shade was often noted as a benefit of improving a municipality's tree canopy with no requirement for trees to have leaf coverage sufficiently dense to filter UVR to levels recommended for skin protection.

In the City of Toronto, the Toronto Cancer Prevention Coalition developed the Shade Policy and Shade Guidelines, a comprehensive policy framework for increasing the availability of shade for UVR protection. The policy and guidelines address shade for a variety of outdoor facilities and sites used by the public, such as parks, playgrounds and sidewalks.[207, 208] The policy was the first in North America to specifically address shade and has influenced the development of shade policies in other jurisdictions in Ontario.[209] The Toronto Board of Health endorsed the Shade Policy in 2007;[207] however, the policy has not been adopted by Toronto City Council.[210]

Shade policies can help ensure that new developments and redevelopments incorporate shade, and that redevelopments do not remove existing sources of shade. Future monitoring that assesses the impact of shade policies on improving shade coverage and increasing shade-seeking behaviours would be useful.

Reducing UVR exposure in priority populations

Policies that increase shade benefit the general population. Targeted policies and programs are also important for protecting people with higher exposure or enhanced susceptibility to UVR, such as children, adolescents, young adults and outdoor workers. In addition, those who use tanning beds before age 35 are 75 per cent more likely than never-users to be diagnosed with melanoma and are at higher risk of being diagnosed with melanoma at a young age.[211] Based on the literature, several system-level interventions may effectively reduce UVR exposure in these priority populations. Data are not currently available to assess the strength of these system-level interventions in Ontario.

Children, adolescents and young adults

Children, adolescents and young adults spend more time in the sun than adults. For instance, in Ontario, children ages one to 12 are more than twice as likely as adults to spend at least two hours in the sun on a typical summer day.[197] Sun exposure during childhood is linked to a greater risk of developing some skin cancers later in life than sun exposure as an adult.[212, 213]

Multicomponent policies and programs in child care centres, elementary schools and child and adolescent recreational settings can improve sun protection practices and reduce sun exposure.[200] Components include offering instructional activities, assessing school sun protection policies and providing informational materials.[200] Adolescents and young adults' sun and UVR-protection practices are harder to change: studies show inconsistent results.[200]

Ontario does not have a specific provincial sun protection policy for child care or school settings. However, as part of their mandate, public health units often help child care centre operators develop their own site-specific sun protection policies.[90] Guidelines in the Ontario Ministry of Education's *Foundations for a*

Healthy School resource document encourage school administrators to protect students from UVR exposure and to establish community partnerships to support classroom instruction and school-wide programs.[214] The Canadian Cancer Society, Evergreen and Ophea have developed SunSense, guidelines to help schools implement sun safety policies.[215] The current sun protection activities of child care centres and schools, and their capacity to increase sun protection behaviours, would be an important area for assessment.

Legislation to reduce youth exposure to UVR from indoor tanning equipment was enacted in Ontario in 2014. The Skin Cancer Prevention Act (Tanning Beds), 2013 bans the sale and marketing of tanning services to youth under age 18 and is enforced on a complaints basis by public health units. Survey data prepared for the Canadian Cancer Society, Cancer Care Ontario and Ryerson University show that in 2014, 7.0 per cent of Ontario students in Grades 7 to 12 had used a tanning bed in the previous year, before the implementation of the tanning bed legislation.[216] Students in high school were more likely to have used tanning beds than middle school students. However, there was a decrease in use from 2012 to 2014 among students in Grades 10, 11 and 12.[3, 216, 217] These data were reported in the 2015 Prevention System Quality Index (PSQI).[3] Data from a repeat of the survey in 2015, 12 months after the legislation was enacted, were unavailable for this report, but will be discussed as an indicator in a future PSQI report.

Outdoor workers

More than half of outdoor workers in Canada spend 75 per cent or more of their time working outdoors, putting them at higher risk for developing skin cancer, particularly squamous and basal cell carcinomas. Almost seven per cent of the working population in Ontario, or 450,000 people, are outdoor workers.[218] This number does not include people in casual jobs that require them to work outdoors, such as students with summer jobs. In the 2006 Second National Sun Survey, 19.9 per cent of Ontario respondents ages 16 to 64 reported working outdoors during the summer of that year.[197]

Stand-alone educational programs about using shade, wearing protective clothing and using sunscreen can improve outdoor workers' UVR protective behaviours.[219] Multicomponent programs that include interventions such as modelling (e.g., supervisors using sun protection) and providing on-site sun protection supplies can also improve outdoor workers' UVR protective behaviours.[219] The evidence is not as strong for interventions with a single component (other than educational programs) and policy-only interventions, such as making protective clothing mandatory.[219]

In Ontario, the Occupational Health and Safety Act requires that employers take reasonable precautions to protect workers against occupational hazards, including UVR. The Ministry of Labour has published guidelines on UVR from the sun and other common workplace sources that included recommended limits for UVR exposure and control measures to prevent overexposure.[220] Implementation of workplace UVR protection in Ontario has not been evaluated, but has been found to be inconsistent in jurisdictions in the U.S. and Australia.[221] Sun Safety at Work Canada, an initiative led by Ryerson University's School of Occupational and Public Health and funded by the Canadian Partnership Against Cancer, is currently developing programs, policies and procedures to help workplaces in protecting their outdoor workers from UVR exposure.[221] Some municipalities, such as the City of Toronto, have policies that protect city employees from the effects of prolonged sun exposure.[222] A review of municipal sun protection policies for city employees may be conducted in a future PSQI report.

Public education

Sustained, multicomponent, community-wide public education strategies that reach a broad audience have been shown to improve UVR protective behaviours in the general population.[200] These strategies include a combination of information materials or small media, such as posters or brochures, and mass media, such as television advertising. Public education can also support the implementation of shade policies and legislation banning the sale and marketing of tanning services to children and adolescents.

Stand-alone educational programs about using shade, wearing protective clothing and using sunscreen can improve outdoor workers' UVR protective behaviours.

Information provided to the public about sun protection practices, such as the importance of protective clothing, should be delivered in a way that is easy to remember and supported by organizations working in the field. Jurisdictions such as Australia have reduced their population's UVR exposure through an integrated, multicomponent public education campaign that uses branding, a mascot and slogans to target the country as a whole.[223] This type of campaign has not been implemented in Canada or Ontario, but could be adopted.[224] To set the foundation for integrated public education, the Ontario Sun Safety Working Group—in partnership with Cancer Care Ontario, the Canadian Cancer Society and the Canadian Dermatology Association—has recently completed a national consensus process that has developed agreed-upon content for sun protection messaging for public education materials.

Opportunities to reduce UVR exposure

- Broaden the scope and strengthen the requirement for shade in municipal policies.
- Develop targeted sun protection policies and programs in child care settings, schools, recreational settings for children and adolescents, and workplaces with outdoor workers.
- Provide sustained public education about sun and UVR protection practices using consistent messaging and incorporating multiple components.

Opportunities for improved monitoring

- Consider expanding cancer registry reporting to include non-melanoma skin cancer or conduct regular modelling studies to increase the accuracy of estimates for the burden of non-melanoma skin cancer in Ontario.
- Regularly collect data on the prevalence of sun exposure and use of UVR-emitting tanning devices in Ontario residents.
- Assess the impact of shade policies on improving shade coverage and increasing shade-seeking behaviours.
- Monitor tanning bed use in youth following the implementation of the Skin Cancer Prevention Act (Tanning Beds), 2013.

Environmental carcinogens

INDICATORS:

- Radon levels in residences
- Fine particulate matter ($PM_{2.5}$) concentrations in outdoor air

Environmental carcinogens include physical and chemical agents that people are exposed to in their surroundings and can increase the risk of developing cancer.

Some of these carcinogens, such as radon, are naturally occurring, while others, such as diesel engine exhaust, are the result of human activity. Some carcinogens are both natural and the result of human activity, such as fine particulate matter in the air.

The indicators in this section measure the levels of radon gas in Ontario homes and the concentrations of fine particulate matter, commonly referred to as $PM_{2.5}$, in outdoor air. These two carcinogens were chosen because of the large number of Ontarians who are exposed to them and the large number of cancers that are attributed to them. For additional information about environmental carcinogens in Ontario see *Environmental Burden of Cancer in Ontario*, a 2016 joint report by Cancer Care Ontario and Public Health Ontario.

Radon

Radon is a naturally occurring radioactive gas released into the air during the decay of uranium in soil and rock.[195] Radon concentrations vary across geographic regions and are usually higher in areas that have a high concentration of uranium.[225] Radon is diluted in outdoor air, but when it escapes from the ground into homes and buildings it can accumulate to high concentrations indoors, usually in basements and on ground floors.[195, 226] Radon exposure is an established cause of lung cancer. There is no known safe level of radon exposure and the risk of lung cancer increases at higher levels of exposure.[195, 227] Smokers exposed to radon are more likely to develop lung cancer than those who have not been exposed.[195] An estimated 1,310 new cancer cases diagnosed in Ontario each year are attributable to the inhalation of radon in indoor air.[228]

Radon is colourless, odourless and tasteless, so the only way to detect it is to use equipment to measure the concentration of radon in the air. Radon is measured in units of becquerels per cubic metre of air (Bq/m^3). Typical outdoor levels of radon usually range from 10 to 30 Bq/m^3.[229] The Government of Canada Radon Guideline recommends that if the average annual radon concentration in a dwelling is higher than 200 Bq/m^3, remedial action should be taken to lower the concentration.[230] The World Health Organization recommends remedial action at an average annual radon concentration of 100 Bq/m^3, but recognizes that this reference level may not be feasible for all countries due to variations in geological conditions.[231] Recommending remedial action at 100 Bq/m^3 is more health protective than 200 Bq/m^3. A 2014 study concluded that more than two times as many lung cancer deaths could be prevented each year in Ontario if all homes above 100 Bq/m^3 were remediated than if remediation was performed in homes that were above 200 Bq/m^3.[229, 231]

Indicator: Radon levels in residences

This indicator measures the percentage of surveyed homes that had radon concentrations at or above 100 Bq/m^3 in Ontario and in each public health unit. For comparison, the percentage of homes that had radon concentrations at or above 200 Bq/m^3 is also shown. The data were collected by Health Canada from 2009 to 2013 and analyzed by Health Canada as part of the Cross-Canada Survey of Radon Concentrations in Homes, Final Ontario Dataset. The survey excluded homes in apartment and high-rise condominium buildings above the second floor because radon levels tend to be highest in basements and on ground floors.[232]

From 2009 to 2013, 3,954 homes in Ontario were surveyed and 25.2 per cent had radon concentrations greater than or equal to 100 Bq/m^3, 17.0 per cent had radon concentrations of 100 to 199 Bq/m^3 and 8.2 per cent had radon concentrations greater than or equal to 200 Bq/m^3 (Figure 16). The public health units that had the lowest percentage of homes with radon concentrations greater than or equal to 100 Bq/m^3 were Durham and York Regions (4.2 per cent each), Peel (6.7 per cent) and North Bay Parry Sound District (6.8 per cent). The highest percentage of homes with radon concentrations greater than or equal to 100 Bq/m^3 were in Windsor-Essex County (44.1 per cent), Leeds, Grenville and Lanark District (41.7 per cent), and Chatham-Kent (39.8 per cent).

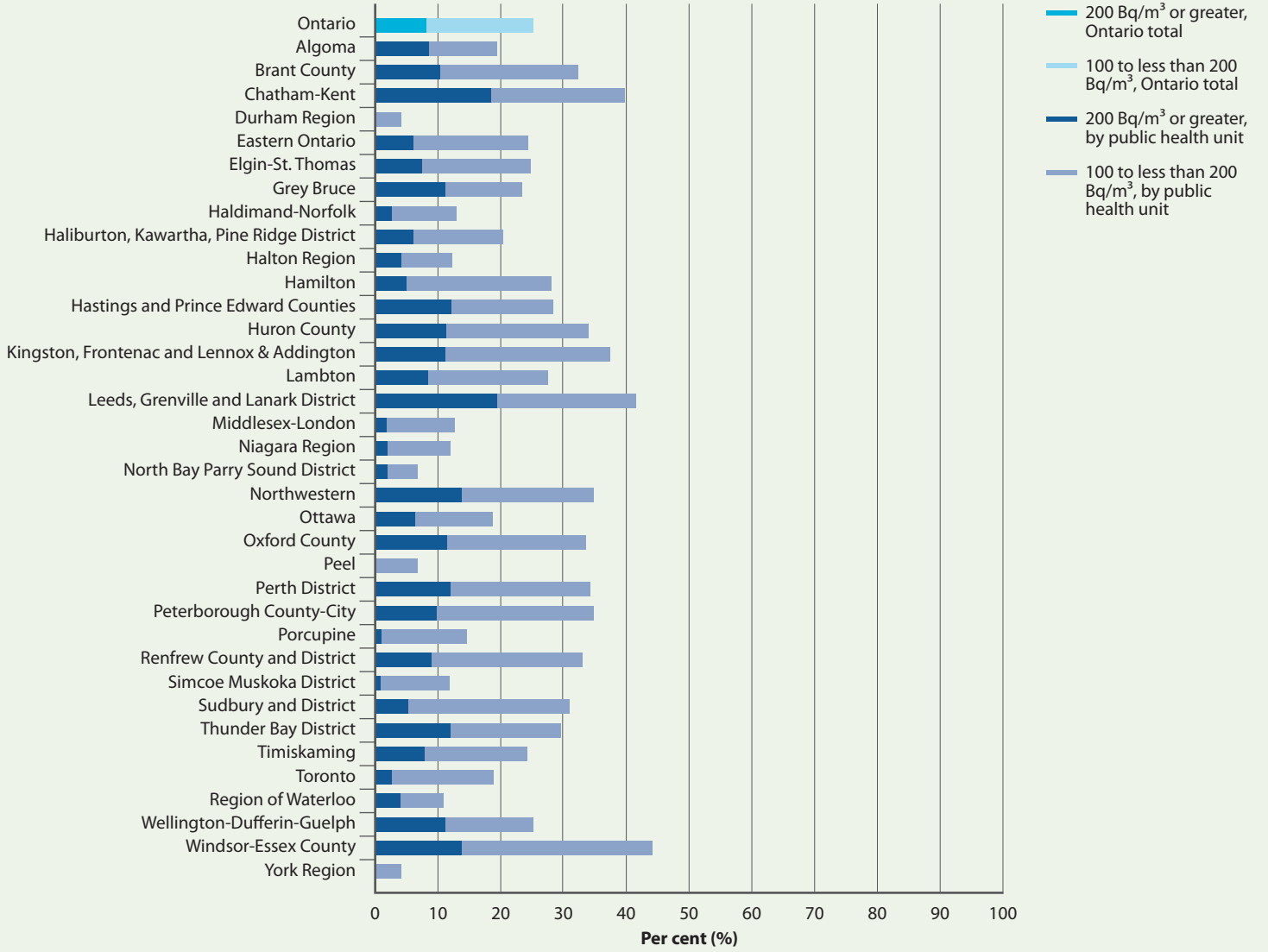
After weighting to account for the population in each area surveyed, an estimated 18.2 per cent of the Ontario population lived in homes with radon concentrations of 100 Bq/m^3 or greater (data not shown). Radon concentrations were well below 100 Bq/m^3 in most of the Ontario homes surveyed, with a median radon concentration of 40.0 Bq/m^3 (Supplementary Table S24). Median radon concentrations in public health units varied greatly, ranging from 17.0 Bq/m^3 in North Bay Parry Sound to 85.0 Bq/m^3 in Windsor-Essex County. Nonetheless, there is a risk of lung cancer even at concentrations below the recommended threshold for remedial action.

To strengthen the survey data collected by Health Canada, some cities are conducting radon tests in additional homes. A study of homes conducted from October 2014 to February 2015 in the City of Thunder Bay found that 36 per cent of homes had radon concentrations above 100 Bq/m^3.[233]

From 2009 to 2013, 25.2 per cent of homes surveyed in Ontario had radon concentrations greater than or equal to 100 Bq/m^3, the average annual radon concentration at which the World Health Organization recommends remedial action.

FIGURE 16

Percentage of tested homes in Ontario with radon concentrations of 100 Bq/m³ or greater, by public health unit, 2009–2013



Source: Cross-Canada Survey of Radon Concentrations in Homes, Final Ontario Dataset, 2013 (Health Canada)

Notes: The minimum detection limit for a three-month radon test is 15 Bq/m³ and for data points below 15 Bq/m³, a value of 8 Bq/m³ (roughly half the detection limit) was substituted to allow calculation of medians to be performed; a total of 662 homes in Ontario (16.7% of all samples) had radon concentrations below 15 Bq/m³. Data are presented in Supplementary Table S24.

Prevention and remediation of radon

The World Health Organization recommends that a radon reduction system called active soil depressurization be installed in new and existing buildings. This system, which has the best radon reduction potential and long-term performance, consists of exhaust piping that directs radon gas from under a building's foundation to the outdoors.[231] According to Health Canada, active soil depressurization systems can be inexpensively built into new construction or added to existing buildings at an approximate cost of $1,500 to $3,000 per home.[225]

The National Building Code of Canada addresses the design and construction of new buildings and substantial renovations to existing buildings. The code has radon prevention provisions, such as an air and soil gas barrier, airtight sump pits and rough-ins for soil depressurization to facilitate future remediation.[234] However, the National Building Code is a "model" code; it becomes legally binding only if it is incorporated into provincial/territorial law. Most provinces have at least partially adopted the National Building Code's radon provisions, but Ontario has not adopted them.[234] Instead, the Ontario Building Code identifies three designated areas in the province where buildings must be constructed so that the annual average concentration of radon does not exceed 200 Bq/m^3: the City of Elliot Lake (Algoma District), the Township of Faraday (County of Hastings) and the Township of Hyman (Sudbury District).[234, 235] These three areas have a history of mining operations. However, the designation of only these areas does not reflect an up-to-date assessment of indoor radon levels across Ontario.[236] Including radon prevention provisions as part of a mandatory building code has the potential to be an effective radon prevention strategy over the long term as new houses are built or major renovations occur. It is less expensive than later remediation and does not require the permission of the property owner. Based on the rate of new home builds and existing home renovations in Ontario, about half of Ontario homes would have radon prevention measures 37 years after the implementation of a building code requirement.[229] Some municipalities in Ontario, such as Guelph and Thunder Bay, now require that builders incorporate radon prevention measures into certain types of new construction.[237, 238]

Throughout Ontario, if radon exceeds the national guideline of 200 Bq/m^3 in a new home, Ontario's new home warranty protection program, administered by Tarion Warranty Corporation, will cover the cost of radon remediation, subject to certain conditions.[239, 240] Consistent with other provinces, Ontario does not require homeowners to test for radon or to remediate if high levels are discovered. Radon tests are not registered centrally, so the number of homes in Ontario that have been tested is unknown. Some population groups may be more exposed to radon, such as people who live in basement apartments. Other groups may be unable to test and remediate even if they want to, such as those with lower incomes or renters.[241, 242] The cost of radon testing is approximately $50 to $100.[243] A 2015 survey of 1,000 Ontario households with finished basements found that five per cent of participants reported having tested for radon.[244] Ontario residents have been encouraged to test their homes through campaigns by Health Canada, the Canadian Cancer Society, the Lung Association, the Canadian Partnership for Children's Health and Environment, and some public health units.

5%

A 2015 survey of 1,000 Ontario households with finished basements found that five per cent of participants reported having tested for radon.

Ontario public health units are mandated to increase public awareness of health hazards in indoor air quality and exposure to radiation, and to assist community partners in developing healthy policies related to these exposures.[90] The Ontario Public Health Standards do not include a guidance document or protocol to inform this work. However, technical assistance is available to public health units from Health Canada and Public Health Ontario. Windsor-Essex County and Thunder Bay District public health units have distributed free radon test kits to encourage testing and raise public awareness.[245, 246] Some jurisdictions in the United States are using innovative approaches to increase radon testing, such as financial incentives or mandatory testing in social housing and rental homes.[247, 248] In Canada, Manitoba Hydro provides loans to homeowners for radon abatement projects.[249]

Fine particulate matter ($PM_{2.5}$) in outdoor air pollution

Air pollutants include a variety of gases and particulate matter released from natural sources and human activity.[250] Outdoor air pollution and one of its major components, fine particulate matter ($PM_{2.5}$), are established causes of lung cancer.[250] There is no known safe level of exposure to $PM_{2.5}$ and the risk of lung cancer increases at higher levels of exposure.[250] An estimated 560 new cancer cases diagnosed in Ontario each year are attributable to the inhalation of $PM_{2.5}$ in outdoor air pollution.[228]

$PM_{2.5}$ is commonly emitted by fuel combustion and burning of organic matter, but it can also form through chemical reactions in the air.[251] The *Air Quality in Ontario 2014 Report* identified motor vehicle traffic, industrial sources, and residential fireplaces and wood stoves as key contributors to outdoor or ambient $PM_{2.5}$ in Ontario.[251] These sources of $PM_{2.5}$ have a substantial impact on human exposure because of their proximity to residential areas.[252] Other major sources of $PM_{2.5}$ in Ontario include smelters, power plants, agricultural burning and forest fires.[251] A substantial amount of $PM_{2.5}$ found in border communities in Ontario originates in the United States.[253, 254]

Indicator: Fine particulate matter ($PM_{2.5}$) concentrations in outdoor air

This indicator measures the average $PM_{2.5}$ concentrations in Ontario, by outdoor air monitoring station. Data were collected by the Ministry of the Environment and Climate Change through the Ontario Continuous Ambient Air Monitoring Network of 40 monitoring stations and presented in the *Air Quality in Ontario 2014 Report*.[251] $PM_{2.5}$ is measured in units of micrograms per cubic metre of air ($\mu g/m^3$).

In 2014, the average annual $PM_{2.5}$ concentrations ranged from 4.7 $\mu g/m^3$ in Petawawa to 10.8 $\mu g/m^3$ in downtown Hamilton (Table 6). $PM_{2.5}$ concentrations were higher than 10 $\mu g/m^3$ (the reference level set by the Canadian Ambient Air Quality Standards and the World Health Organization's Air Quality Guidelines[255, 256]) at the following monitoring stations: Hamilton Downtown (10.8 $\mu g/m^3$), Windsor West (10.7 $\mu g/m^3$) and Windsor Downtown (10.1 $\mu g/m^3$). The reference level of 10 $\mu g/m^3$ represents a health-based air quality objective, but lower concentrations of $PM_{2.5}$ can also have adverse health effects.[255]

Recent changes in the technology used to measure $PM_{2.5}$ make it difficult to directly compare annual $PM_{2.5}$ concentrations. However, based on measurements from a subset of monitoring stations across the province and on mathematical corrections to the exposure measurements to account for the change in technology, a decreasing trend for ambient levels of $PM_{2.5}$ in Ontario since 2005 is apparent.[251] The decrease in the average annual $PM_{2.5}$ concentrations is consistent with emission trends in Canada and is due in part to decreased emissions from electric utilities and industrial processes, as well as more stringent standards for fuels and engines in the transportation sector.[251]

In 2020, the Canadian Ambient Air Quality Standard for $PM_{2.5}$ will decrease from 10 to 8.8 $\mu g/m^3$.[255] This decrease is consistent with efforts to achieve continuous improvement in concentrations of air pollutants that result in adverse effects on human health. If this standard were applied today, 16 of Ontario's 40 monitoring stations would be at or above Canada's air quality standard.

The current air quality monitoring system does not provide sufficient data to reflect variations in concentration within an urban area that occur due to, for example, the varying proximity of traffic corridors and other sources of pollution.[257] Additional monitoring and modelling data are required to identify areas of higher $PM_{2.5}$ concentration and exposures at the local level, and possible disparities within a city or community.

Reduction of $PM_{2.5}$ from motor vehicle traffic, industrial sources, and residential fireplaces and wood stoves

Policies and programs that could reduce $PM_{2.5}$ include traffic reduction strategies, tighter emission standards, land-use planning policies that incorporate air quality

TABLE 6

Average annual ambient fine particulate matter ($PM_{2.5}$) concentrations in Ontario, by monitoring station, 2014

Location of monitoring station	Average ambient $PM_{2.5}$ concentrations ($\mu g/m^3$)	Location of monitoring station	Average ambient $PM_{2.5}$ concentrations ($\mu g/m^3$)
Barrie	7.6	Oakville	8.5
Belleville	6.8	Oshawa	7.7
Brampton	8.9	Ottawa Central	6.8
Brantford	9.2	Ottawa Downtown	7.0
Burlington	9.6	Parry Sound	5.8
Chatham	8.6	Petawawa	4.7
Cornwall	7.0	Peterborough	6.9
Dorset	5.3	Port Stanley	8.2
Grand Bend	8.1	Sarnia	9.0
Guelph	8.9	Sault Ste. Marie	6.0
Hamilton Downtown	**10.8**	St. Catharines	8.8
Hamilton Mountain	9.4	Sudbury	6.0
Hamilton West	9.9	Thunder Bay	6.6
Kingston	6.8	Tiverton	6.5
Kitchener	9.3	Toronto Downtown	8.7
London	8.8	Toronto East	8.9
Mississauga	8.7	Toronto North	9.2
Morrisburg	7.0	Toronto West	9.1
Newmarket	7.3	**Windsor Downtown**	**10.1**
North Bay	5.3	**Windsor West**	**10.7**

Source: Air Quality in Ontario Report, 2014 (Ministry of the Environment and Climate Change)
Prepared by: Cancer Care Ontario, Prevention and Cancer Control (Population Health and Prevention), based on analytic results presented in the Air Quality in Ontario Report, 2014
Notes: Bolded values are in exceedance of 10 $\mu g/m^3$, the $PM_{2.5}$ reference level set by the Canadian Ambient Air Quality Standards and the World Health Organization's Air Quality Guidelines. Data for 2004–2013 are presented in Supplementary Table S25.

considerations,[258-260] bans on highly polluting energy sources, and incentives to adopt clean energy sources or to decrease emissions.[261-263] In Ontario, several policies and programs may reduce traffic-related $PM_{2.5}$, such as policies that mandate municipal land-use planning that reduces reliance on single-occupancy vehicles, investment in public transit and other supports for active transportation, anti-idling policies, the Drive Clean vehicle emission testing program, cleaner-burning diesel fuel requirements and the Ontario Electric Vehicle Incentive Program. In 2017, new Canadian vehicle and fuel standards will take effect. These new standards will be consistent with the United States Environmental Protection Agency's Tier 3 standards, which is a program of increasingly stringent vehicle emission standards.[264] Some municipalities in Ontario have investigated the impact of traffic on health in their communities.[252] In 2014, four Medical Officers of Health from the Greater Toronto-Hamilton Area called on the provincial government to develop transportation and land-use planning policies to reduce traffic-related air pollution.[265]

The province has developed policies and programs that may reduce $PM_{2.5}$ caused by industrial sources. In 2015, Ontario banned coal-fired electricity generation through the Ending Coal for Cleaner Air Act.[266] A cap and trade program is currently being developed, which limits how many tonnes of greenhouse gases businesses, industries and institutions can emit,[267] or permits them to purchase allowances for carbon emissions from other businesses or industries. Reducing greenhouse gases by reducing reliance on fossil fuels may also reduce $PM_{2.5}$.[268] In 2009, Ontario enacted the Toxics Reduction Act, which requires industrial facilities in the manufacturing and mining sectors to

In 2020, the Canadian Ambient Air Quality Standard for $PM_{2.5}$ will decrease from 10 to 8.8 µg/m³. If this standard were applied today, 16 of Ontario's 40 monitoring stations would be at or above Canada's air quality standard.

report the use and release of toxic substances, including $PM_{2.5}$, and consider approaches to reducing the use of these substances.[269] At the municipal level, Oakville collects emissions information from local facilities and implements regulatory controls for major emitters through the Health Protection Air Quality Bylaw.[270] Through its ChemTRAC program, Toronto tracks emissions from smaller facilities in addition to those that report to the National Pollutant Release Inventory and works with businesses to encourage them to reduce the use and release of priority substances.[271]

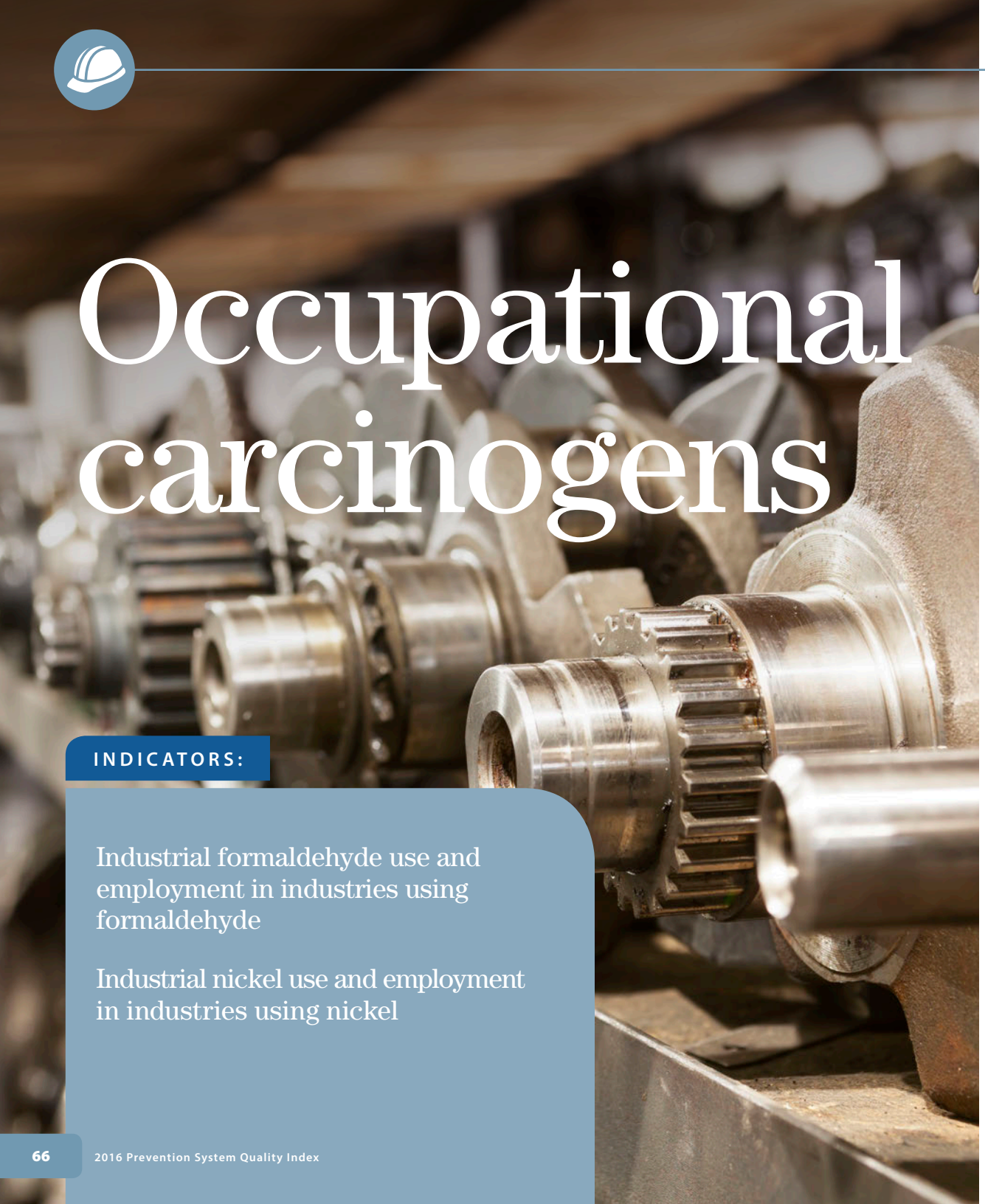
The Canadian Council of Ministers of the Environment has introduced the Code of Practice for Residential Wood Burning Appliances to help governments develop policy, bylaw and program approaches to decreasing residential wood burning emissions.[272] Some jurisdictions in Canada have begun to encourage or enforce the use of lower-emitting fireplaces and wood stoves.[273, 274]

Opportunities to reduce environmental carcinogens

- Amend the Ontario Building Code so that it requires effective radon prevention measures to be incorporated into the design and construction of new buildings and substantial renovations to existing buildings.
- Consider recommending remediation measures when radon concentrations are above 100 Bq/m³, consistent with the World Health Organization recommendation.
- Provide financial incentives to encourage radon testing and remediation in homes and other buildings, and consider policy approaches to protect vulnerable populations.
- Increase public health unit capacity to support radon testing and remediation in their communities.
- Provide sustained public education about indoor radon, its health effects, and how to test and remediate.
- Continue to implement traffic reduction strategies, including extending the availability and use of low emission public transportation systems and strengthening land-use planning policies that reduce reliance on single-occupancy vehicles.
- Continue to progressively strengthen emission standards for engines and fuel.
- Continue to encourage the adoption of clean energy sources and decreases in industrial emissions.
- Promote the adoption of lower emission residential fuels.

Opportunities for improved monitoring

- Continue to monitor radon concentrations in Ontario residences and identify disparities in exposure among sub-populations.
- Expand and coordinate local level air quality monitoring and modelling information to better understand exposure to $PM_{2.5}$ within communities and variations in exposure.



Occupational carcinogens

INDICATORS:

Industrial formaldehyde use and employment in industries using formaldehyde

Industrial nickel use and employment in industries using nickel

In Ontario, workers in a wide range of industries are exposed to many known and suspected carcinogens.

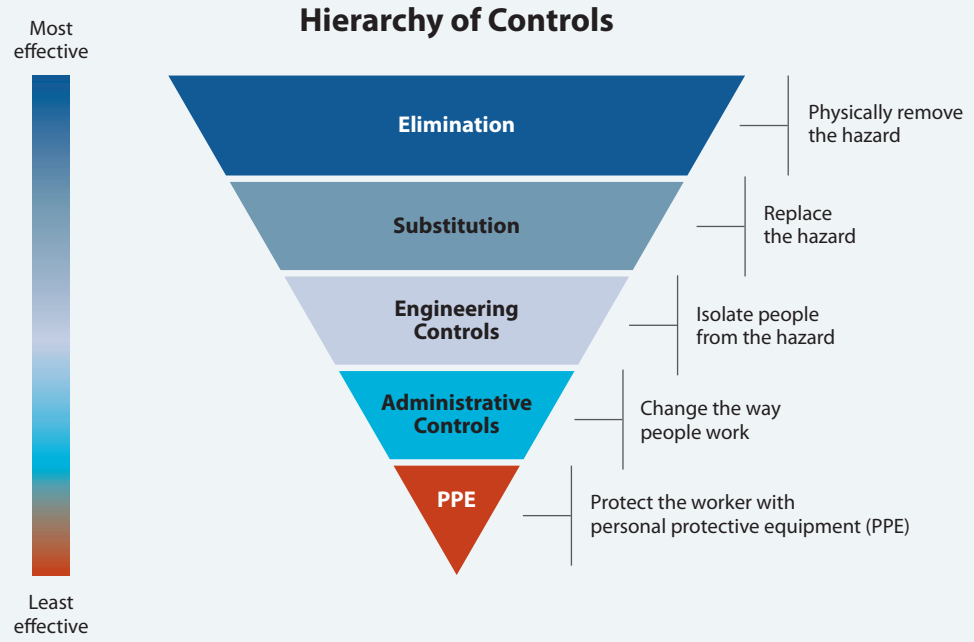
Occupational cancer is the leading cause of work-related deaths in Ontario.[275] This section focuses on four carcinogens: formaldehyde, nickel, asbestos and diesel engine exhaust. They have been selected because a large proportion of workers in Ontario are exposed to them and opportunities exist to reduce or eliminate exposure to these carcinogens in the workplace.

The Occupational Health and Safety Act, which is administered by the Ministry of Labour, is the primary occupational health and safety legislation in Ontario.[276] In addition to setting out the duties and responsibilities of supervisors, employers and workers, the act establishes the rights of workers to know what toxic substances they may be exposed to on the job and to refuse work that poses a danger to their health or safety. The Control of Exposure to Biological or Chemical Agents and the Designated Substances Regulations under the act identify occupational exposure limits for 725 substances.[277-279] The Workplace Hazardous Materials Information System (WHMIS) Regulation sets out employers' duties to educate workers about hazardous substances and provide material safety data sheets and product labels.[280]

As noted in the section on environmental carcinogens, the Ontario Ministry of the Environment and Climate Change enacted the Toxics Reduction Act in 2009, which requires industrial facilities in the manufacturing and mineral processing sectors to report the use and release of toxic substances, including carcinogens, and consider approaches to reducing the use of these substances.[269] The main purpose of this act is to protect the health of the public and the environment by reducing the use and release of toxic substances. A secondary benefit of the act is that by reducing the use of carcinogens in these industries, workers' exposure to carcinogens and occupational cancers may be reduced.

The Hierarchy of Controls (Figure 17) is a widely recognized occupational health and safety framework for protecting workers from workplace hazards and informs the actions that governments and workplaces can take to protect workers. In order of decreasing effectiveness for worker protection, the controls are elimination, substitution, engineering and administrative controls and personal protective equipment.[281] Because there is no safe level of exposure for many workplace carcinogens, the most effective ways to prevent occupational cancers are eliminating carcinogens from the workplace or substituting them with substances that are not known to cause cancer. Engineering controls (such as installing ventilation systems), administrative controls (such as ensuring employees receive the appropriate training and education) and the use of personal protective equipment (such as respirators and protective clothing) can also reduce workers' exposure to carcinogens. Personal protective equipment is the least effective measure because it shifts the burden of protection onto the worker and the equipment may fail.

FIGURE 17
Hierarchy of Controls used to protect workers from exposures to hazardous substances



Source: Available for public use without permission from cdc.gov/niosh/topics/hierarchy

The indicators in this section estimate the use of formaldehyde and nickel at industrial facilities that are required to report to the province under the Toxics Reduction Act and the number of employees working at these facilities. Occupational exposures to asbestos and diesel engine exhaust are also discussed.

Formaldehyde

Formaldehyde is a compound commonly used in glues and resins for manufacturing paper and wood products, producing plastics and coatings, and finishing textiles. It is also used in health services, mineral product manufacturing and embalming, and produced during combustion processes.[282] Formaldehyde releases a colourless gas with a strong odour. Workers that use or manufacture formaldehyde-based products have an increased risk of nasopharyngeal cancer and leukemia.[283] Approximately 64,000 Ontario workers are exposed to formaldehyde.[284]

Workers' exposure to formaldehyde depends on their level of contact with the substance, and the exposure

controls and protective measures in place. Workplaces in Ontario must adhere to the province's occupational exposure limit for formaldehyde, which is a maximum airborne concentration or ceiling limit of 1.5 parts per million (ppm), not to be exceeded at any given time.[285] Ontario's occupational exposure limit is higher than the limit of 0.3 ppm set out by the Canada Labour Code, recommended by the American Conference of Governmental Industrial Hygienists and adopted by six Canadian provinces.[284] Staying within the occupational exposure limit for formaldehyde is most comprehensively achieved by eliminating it or substituting it with a substance that is not known to cause cancer. However, achieving the limit is also possible through engineering controls, such as increasing ventilation or decreasing humidity in the workplace to minimize off-gassing.[286]

Formaldehyde use

The Toxics Reduction Act requires facilities in the manufacturing and mineral processing sectors in Ontario to report the amount of formaldehyde they use and the number of employees working at their facilities, as well as to develop plans for reducing the use of this substance.[287] In Massachusetts, use of formaldehyde decreased by almost 8.5 million pounds, or about 3,860 tonnes, from 1990 to 2010 under similar legislation,[286] which demonstrates the potential of the Toxics Reduction Act to reduce formaldehyde use in Ontario. Some reductions in formaldehyde use may be achieved by improving processes to reduce wasteful use, but this would have less impact on employees' exposure than elimination or substitution and may not lead to substantial reductions in use. Many industries in Massachusetts have substituted formaldehyde-based resins with soy- and water-based resins.[286]

Staying within the occupational exposure limit for formaldehyde is most comprehensively achieved by eliminating it or substituting it with a substance that is not known to cause cancer.

Although the Toxics Reduction Act does not require the owners and operators of industrial facilities to measure their employees' exposure to formaldehyde, gathering data on the industries in which formaldehyde use is common, their estimated formaldehyde use and the number of people employed can provide an indication of the potential level of exposure to formaldehyde. This information can identify industries that could be targeted to reduce worker exposure to formaldehyde.

Indicators: Industrial formaldehyde use and employment in industries using formaldehyde

These indicators estimate the amount of formaldehyde used at manufacturing and mineral processing facilities in Ontario and the number of employees working at these facilities in 2013. Data are reported by facilities to the Ministry of the Environment and Climate Change in accordance with the Toxics Reduction Act. Use of formaldehyde is reported in intervals of increasing magnitude (e.g., >1 to 10 tonnes, >10 to 100 tonnes, >100 to 1,000 tonnes); therefore, the exact amount of formaldehyde used cannot be quantified. To calculate estimates of the amount of formaldehyde used, the mid-point value was selected for every facility's reported range of use. These mid-point values were summed for all facilities and analyzed by industrial sector.

An estimated total of 8,220 tonnes of formaldehyde were used by Ontario facilities in 2013 (Table 7). The industries that used the most formaldehyde were paper manufacturing (5,610 tonnes), chemical manufacturing (1,760 tonnes) and wood product manufacturing (720 tonnes).

In 2013, a total of 7,467 employees worked at industrial facilities that used formaldehyde. More than half of these employees worked at facilities in the transportation equipment manufacturing industry (4,521 employees) (Table 7). The paper manufacturing industry, which has the highest reported use of formaldehyde, had five facilities that employed 1,085 employees. In northwestern Ontario, the majority of employees working in industrial facilities that use formaldehyde were employed by the paper and wood product manufacturing industries (data not shown).[288]

The paper, chemical and wood product manufacturing industries accounted for nearly 99 per cent (8,090 tonnes) of the total formaldehyde used by reporting facilities in Ontario. Of the 20 facilities reporting the use of formaldehyde in Ontario under the Toxics Reduction Act in 2013, approximately half identified the activities they were taking or had taken to reduce their use or production of formaldehyde (data not

shown). Some facilities planned to reduce the use of formaldehyde through the substitution of materials. Others, however, planned to modify equipment to reduce leaks and spills and improve process scheduling to reduce emissions,[288] which may substantially reduce use, but are less comprehensive controls for reducing worker exposure. To decrease the number of Ontario workers potentially exposed to formaldehyde, reductions in the industrial use of formaldehyde should be prioritized by facilities in the paper manufacturing, chemical manufacturing and wood product manufacturing industries.

The total amount of formaldehyde used in Ontario and the number of worksites and employees that use formaldehyde are higher than what is reported here. The Toxics Reduction Act only requires industrial facilities in the manufacturing and mineral processing sectors to report on their use of formaldehyde, and only if the amount manufactured, used or released in the environment is above a certain threshold. There are few data on industrial facilities that use formaldehyde below these thresholds or other sectors that use formaldehyde in Ontario, such as construction and service industries (e.g., nail salons). However, in Europe, workers in the health, dental, veterinary, personal and household services, and construction sectors constitute about 30 per cent of all workers exposed to formaldehyde.[283]

TABLE 7

Amount of formaldehyde used (in tonnes) and number of employees working at facilities using formaldehyde in Ontario, by industry, 2013

Industry name	Number of facilities	Formaldehyde use (tonnes)	Number of employees
Paper manufacturing	5	5,610	1,085
Chemical manufacturing	6	1,760	486
Wood product manufacturing	5	720	758
Non-metallic mineral product manufacturing	1	60	132
Computer and electronic product manufacturing	1	60	485
Transportation equipment manufacturing	2	10	4,521
Total	**20**	**8,220**	**7,467**

Source: Ontario Toxics Reduction Program, 2013 (Ministry of the Environment and Climate Change)
Notes: Excludes facilities that are exempt from the Ontario Toxics Reduction Program (i.e., use or release formaldehyde in quantities below the legislated thresholds). Formaldehyde use (tonnes): estimated by selecting the mid-point value for each facility's reported range of use, summing these values across all facilities for each sector and rounding to the nearest 10.

Nickel

Nickel is a metal that is mined in Canada, often with other minerals and ores. Exposure to nickel and nickel compounds occurs mostly through inhalation of fumes, dusts and mists.[289] Occupational exposure to nickel is often highest for workers involved in manufacturing metal products, followed by workers exposed during the mining and processing of nickel. Workplace exposures to nickel tend to be highest during tasks that involve grinding, polishing or welding of the metal.[290] Workers who work with nickel have an increased risk of lung and nasal cancers when exposed to certain nickel compounds.[291] Approximately 48,000 Ontario workers are exposed to nickel in their workplace.[292]

Ontario's occupational exposure limits for nickel[285] vary depending on the type of nickel or nickel compounds used and are the same or slightly lower (for elemental nickel) than other sets of limits, such as those set out by the Canada Labour Code, recommended by the American Conference of Governmental Industrial Hygienists and adopted by seven other provinces. Only British Columbia's occupational exposure limits for nickel are much lower than in the rest of the country.[292] The occupational exposure limits are best achieved by elimination or substitution. It is also possible to achieve them through the use of engineering and administrative controls, as well as personal protective equipment.[288]

Nickel use

The Toxics Reduction Act requires facilities in the manufacturing and mineral processing sectors in Ontario to report the amount of nickel they use and the number of employees in the facility, as well as develop a plan for reducing the use of this substance.[287] The act does not require the owners and operators of industrial facilities to measure their employees' exposure to nickel. However, knowing which industries use nickel, the estimated use and the number of people employed can provide an indication of the potential level of exposure

to nickel. This information can identify industries that could be targeted to reduce worker exposure to nickel.

While some reductions in nickel use and occupational exposures may occur over time with the implementation of toxics use reduction practices, large-scale reductions in nickel use may not be as feasible as for other substances, such as formaldehyde. In some industries, it is possible to substitute nickel used in the manufacturing of products with a substance that is not known to cause cancer and in other industries, substitution may not be possible.

Indicators: Industrial nickel use and employment in industries using nickel

These indicators estimate the amount of nickel used at facilities in Ontario and the number of employees at these facilities in 2013. Data are reported by facilities to the Ministry of the Environment and Climate Change as part of the Toxics Reduction Act. As with formaldehyde, use of nickel is reported in intervals of increasing magnitude and the mid-point values were used as estimates.

An estimated total of 874,580 tonnes of nickel were used by various Ontario facilities in 2013 (Table 8). The industries that used the most nickel were primary metal manufacturing (733,360 tonnes), and mining and quarrying (122,880 tonnes).

In 2013, a total of 40,199 employees worked at facilities that used nickel. The majority of these employees worked in the primary metal manufacturing industry (12,682 employees) and the transportation equipment manufacturing industry (12,219 employees), where smaller amounts of nickel were used (Table 8). The mining and quarrying facilities employed a smaller number of workers (4,266 employees), yet historically exposures have tended to be higher in nickel-producing industries, such as mining, compared to nickel-using industries, such as manufacturing.[290]

Primary metal manufacturing, and mining and quarrying accounted for nearly 98 per cent (856,240 tonnes) of the total nickel used by reporting facilities in Ontario. Of the 122 facilities reporting the use of nickel in Ontario under the Toxics Reduction Act in 2013, fewer than 30 identified activities they were taking or had taken to reduce their use or production of nickel (data not shown). The facilities that had plans in place were mostly involved in nickel use (metal manufacturing), rather than production (mining and quarrying). Plans mainly focused on the use of engineering and administrative controls to reduce nickel use and exposure, such as modifying equipment operations and increasing employee training regarding toxic substances.[288] To reduce the number of Ontario workers potentially exposed to nickel, reductions in exposure should be prioritized by facilities in the primary metal manufacturing industry. The data likely underestimate the amount of nickel used and the number of employees that

TABLE 8

Amount of nickel used (in tonnes) and number of employees working at facilities using nickel in Ontario, by industry, 2013

Industry name	Number of facilities	Nickel use (tonnes)	Number of employees
Primary metal manufacturing	30	733,360	12,682
Mining and quarrying	14	122,880	4,266
Transportation equipment manufacturing	28	9,970	12,219
Fabricated metal product manufacturing	29	5,150	6,102
Machinery manufacturing	6	1,510	1,380
Electrical equipment, appliance and component manufacturing	5	770	591
Chemical manufacturing	5	720	1,112
Petroleum and coal product manufacturing	3	110	1,592
Plastics and rubber products manufacturing	1	60	180
Miscellaneous manufacturing	1	50	75
Total	**122**	**874,580**	**40,199**

Source: Ontario Toxics Reduction Program, 2013 (Ministry of the Environment and Climate Change)
Notes: Excludes facilities that are exempt from the Ontario Toxics Reduction Program (i.e., use or release nickel in quantities below the legislated thresholds). Nickel use (tonnes): estimated by selecting the mid-point value for each facility's reported range of use, summing these values across all facilities for each sector and rounding to the nearest 10.

work in industries using nickel because the legislation only requires facilities in the manufacturing and mineral processing industries to report on their use of nickel, and only if the amount used is above a certain threshold.

Limitations of data reported under the Toxics Reduction Act

Reporting formaldehyde and nickel use in ranges of values under the Toxics Reduction Act, as opposed to reporting numeric values, poses a significant limitation in establishing data trends for these indicators and could be improved in the future. By requiring facilities to report exact numeric values for the use of substances as opposed to ranges of values, the data could demonstrate more subtle changes in use over time and the success of the Toxics Reduction Program could be more readily assessed.

Asbestos

Asbestos is a commercial term for a group of fibrous minerals that are found in some rocks and soil. As a result of its structural strength and resistance to heat, asbestos has been used for a wide range of industrial applications and consumer products, including insulation, textiles, roofing, brake pads and cement pipes. Asbestos causes mesothelioma (a cancer affecting the protective lining of the lungs), and is a cause of cancers of the lung, larynx and ovary.[282] Cancer may occur 25 to 50 years after exposure to asbestos.[293]

In Canada as a whole, use of asbestos peaked in the 1960s and 1970s, but has since declined.[294] Historically, asbestos mines were located in areas where large deposits of the mineral were found (British Columbia, Quebec, Newfoundland and the Yukon), but smaller mines were also located in Ontario. The last asbestos mine in Canada ceased operation in Quebec in 2012.[295] However, Canada continues to import asbestos and asbestos-containing materials, and these products continue to be used in Ontario.[296]

In the past, workers were exposed to asbestos fibres during mining and milling, as well as through the primary use of asbestos in manufacturing and construction. Today, most occupational exposure to asbestos occurs when asbestos-containing materials in older buildings or other products deteriorate or are disturbed during maintenance, repair or remediation. Based on historical data, approximately 52,000 workers in Ontario are exposed to asbestos in the workplace.[294] In 2006, workers in the construction industry accounted for 92 per cent of those exposed to asbestos in Ontario (Figure 18). Data on occupational use or exposure to asbestos are not regularly collected in Ontario. Therefore, identifying an indicator for assessing the effectiveness of the province's prevention measures was not possible for this report.

Over 55 countries have banned asbestos. A comprehensive ban on asbestos is the best way to protect workers from harm and prevents future cases of asbestos-related disease. The federal government recently announced its commitment to banning asbestos in Canada. Government policies in Ontario aim to reduce occupational exposure to asbestos, and include measures such as occupational exposure limits, worker training and an asbestos register. Like many other jurisdictions, Ontario has adopted occupational exposure limits for asbestos, although no level of exposure is considered safe. Under the Occupational Health and Safety Act, Regulation 278/05: Designated Substance—Asbestos on Construction Projects and in Buildings and Repair Operations came into force in 2005 to promote the safe handling of asbestos and to prevent exposure to asbestos-containing materials during construction projects, building repairs and other operations in every building where asbestos-containing materials are known or suspected to be present. This regulation also requires inspections and the recording of the location of asbestos-containing materials, remedial action on asbestos-containing materials that have deteriorated and the training of asbestos abatement workers.[297, 298]

The Ontario Ministry of Labour also implemented the Asbestos Workers Register in 1986, which collects data on workers' exposures to asbestos and advises workers

Most occupational exposure to asbestos occurs when asbestos-containing materials in older buildings or other products deteriorate or are disturbed during maintenance, repair or remediation.

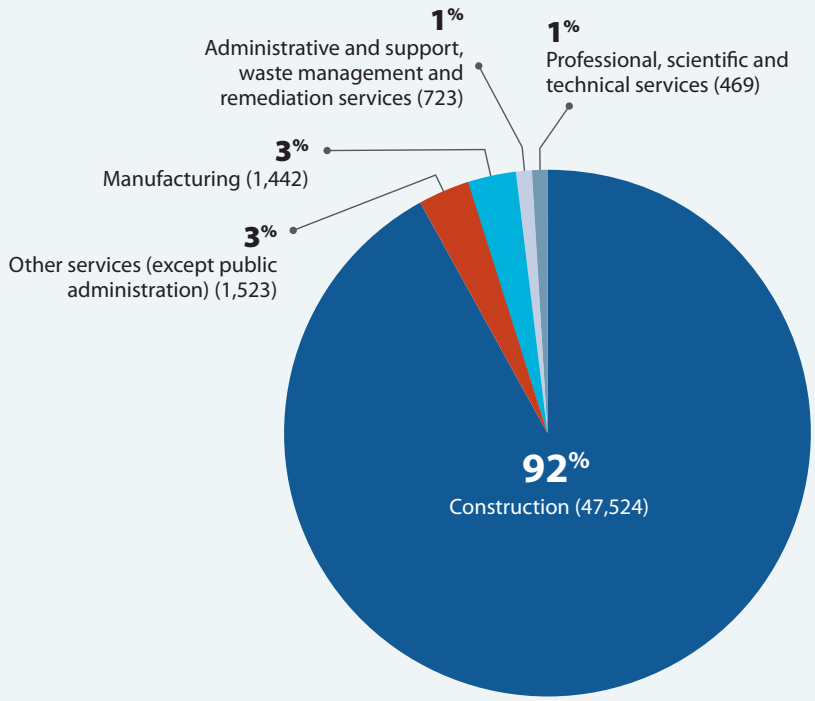
to be examined by a ministry physician once they have accumulated 2,000 hours of exposure in certain types of operations.[299] This register could be expanded to collect data on all workers exposed to asbestos and to identify asbestos-containing public buildings in the province. It could also be used for surveillance, identification of high risk workers, research, and worker education and training, as well as to facilitate medical diagnoses, treatment and workers' compensation claims. Under its Public Health Act, Saskatchewan has a legally mandated register of asbestos-containing public buildings, such as those owned by the provincial government, health regions, crown corporations and school boards.[300]

Diesel engine exhaust

Diesel engine exhaust, produced by the combustion of diesel fuel, is a complex mixture of gases (such as carbon dioxide, and sulfur and nitrogen compounds) and particulates (such as metals, elemental carbon and polycyclic aromatic hydrocarbons). Diesel engine exhaust is a cause of lung cancer.[291, 301]

Approximately 275,000 workers are exposed to diesel engine exhaust in Ontario, 90 per cent of whom are male (Figure 19).[302] The transportation and warehousing industry has the highest number of workers exposed to diesel engine exhaust, at approximately 152,000. The construction industry exposes more than 27,000 workers. Similar to asbestos, data on occupational use or exposure to diesel engine exhaust are not collected on a regular basis in Ontario. Therefore, identifying an indicator to assess current exposure levels and prevention measures was not possible for this report.

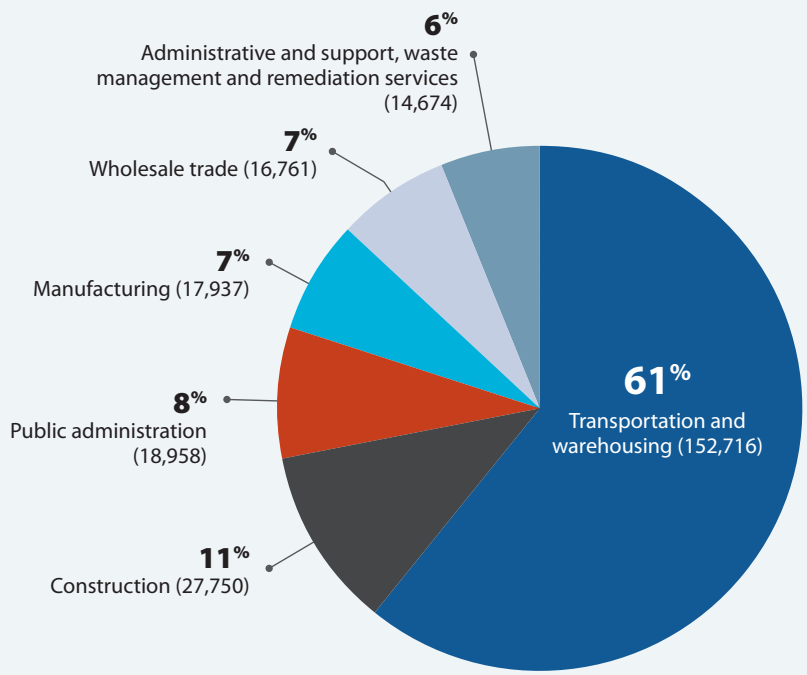
FIGURE 18
Distribution of occupational exposure to asbestos in Ontario, by industry, 2006



Source: eWORK Online, 2006 (CAREX Canada)
Note: Number of employees displayed in brackets.

Environmental concerns about diesel engine exhaust have increased over the past 20 years, resulting in stricter environmental emissions standards for diesel engines in North America.[301] While these standards have helped reduce ambient air pollution and occupational exposures in certain instances (e.g., for workers involved in trucking), specific policies for controlling occupational exposure to diesel engine exhaust are still lacking in Ontario. The most protective policies to reduce occupational exposures to diesel engine exhaust involve the elimination or substitution of diesel with a safer alternative fuel. Natural gas, for example, produces fewer carcinogens.[303] Other measures, which are not as comprehensive, include requiring employers to increase ventilation levels, use tailpipe extraction systems, perform regular engine maintenance, restrict areas where equipment can be used and turn off engines that are not in use.

FIGURE 19
Distribution of occupational exposure to diesel engine exhaust in Ontario, by industry, 2006



Source: eWORK Online, 2006 (CAREX Canada)
Note: Number of employees displayed in brackets.

There is currently no occupational exposure limit for diesel engine exhaust in Ontario or in other jurisdictions in Canada. Workplace protection from diesel engine exhaust in Canada has focused historically on underground miners. In Ontario, the Occupational Health and Safety Act Regulation 854: Mines and Mining Plants, which came into effect in 2002, introduced ventilation and equipment maintenance requirements for underground mines where diesel equipment is operating.[304]

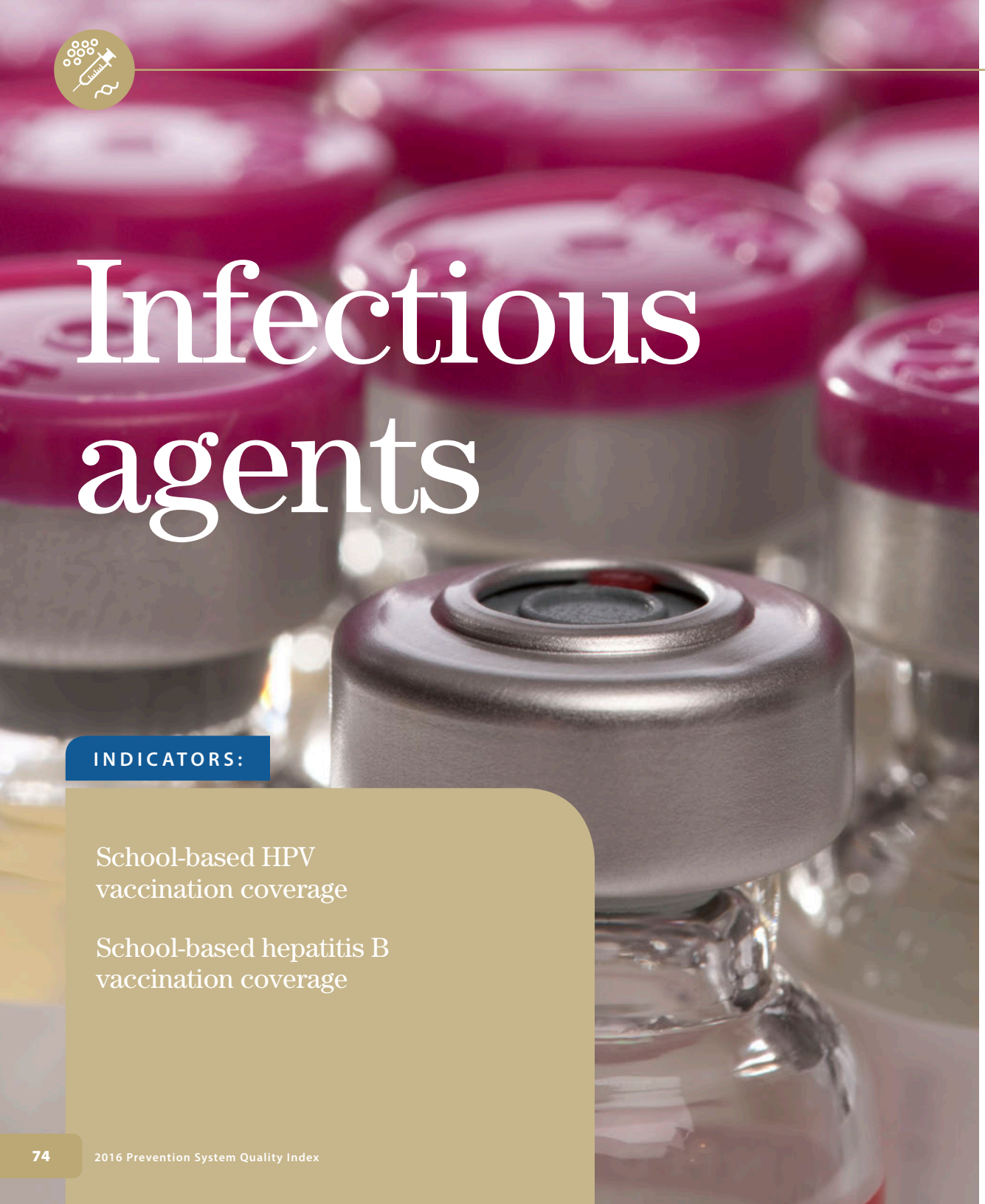
Despite the lack of an occupational exposure limit for diesel engine exhaust as a whole, Regulation 833: Control of Exposure to Biological or Chemical Agents, which came into effect in 2002 under the Occupational Health and Safety Act, prescribes occupational exposure limits for many of the gases and particulates contained in diesel engine exhaust.[278] However, standardized approaches to using individual gases and particulates as markers for levels of diesel engine exhaust have not been established. The United States, Australia and Finland use elemental or total carbon for diesel engine exhaust occupational exposure limits.[305] Current exposure limits for elemental or total carbon as a marker for diesel engine exhaust vary widely, but a review of them can serve as a starting point for developing and enforcing occupational exposure limits in Ontario.

Opportunities to reduce occupational carcinogens

- Encourage the substitution of formaldehyde with less toxic alternatives in manufacturing processes, particularly in sectors with the highest use of this carcinogen.
- Amend Ontario's Regulation 833 to reduce the ceiling limit for formaldehyde to 0.3 ppm.
- Expand Ontario's current Asbestos Workers Register to collect data on all workers who may have been exposed to asbestos and develop an Ontario register of public buildings containing asbestos.
- Develop occupational exposure limits that address diesel engine exhaust exposure as a whole using an appropriate marker (e.g., elemental or total carbon), based on a review of best practices.

Opportunities for improved monitoring

- Ensure regulatory requirements are developed that incorporate the use of statistically valid sampling strategies that could improve the prevention of exposures to harmful substances in the workplace and promote compliance with occupational exposure limits.[306]



Infectious agents

INDICATORS:

School-based HPV vaccination coverage

School-based hepatitis B vaccination coverage

Chronic infections with viral, bacterial and parasitic infectious agents are estimated to cause 7.4 per cent of cancers in developed countries.[307]

Most cancers attributed to infectious agents are caused by hepatitis B virus, hepatitis C virus, the human papillomavirus (HPV) family of viruses and *Heliocobacter pylori*.[307] Preventing cancers related to infectious agents involves stopping people from becoming infected, and screening for and treating the changes caused by chronic infections.

This section focuses on HPV and the hepatitis B virus because these infections can be prevented through vaccination and other public health strategies. Indicators of school-based vaccination coverage for HPV and hepatitis B in Ontario are described, and vaccination in other populations and prevention strategies are discussed.

Human papillomavirus (HPV)

HPV is a family of viruses that is easily transmitted through skin-to-skin or skin-to-mucosa sexual contact.[308] Most sexually active people have at least one anogenital (anus and genital) HPV infection in their lifetime. Incidence of HPV infection is highest in young adults and declines with age. The main risk

factor for anogenital infection with HPV is being sexually active and risk increases with the number of sexual partners.[308] Most HPV infections are asymptomatic and clear up on their own, particularly in healthy people. However, some infections can become chronic.[309]

There are over 100 types of HPV. Some can cause anogenital warts or respiratory papillomatosis, but do not cause cancer. These types are commonly referred to as "low risk" HPV. Other HPV types are called "high risk" because they can cause cancer. As in the rest of the world, virtually all cervical cancers in Ontario are caused by chronic infection with high risk HPV types.[309] Several contributing factors appear to increase the chance that an HPV infection will lead to cervical cancer: immunosuppression, a higher number of pregnancies, tobacco smoking, low nutrient intake, use of hormonal contraceptives and co-infections, such as chlamydia and herpes simplex virus.[308] HPV is also a cause of cancers of the vulva, vagina, anus, penis, oral cavity, oropharynx and tonsil.[310] In Ontario, HPV is estimated to cause 1,090 new cancers each year; the most common are cervical cancer (528 cases), anal canal cancer (219 cases), and head and neck cancers (206 cases).[309]

Population-based vaccination programs and sexual health promotion and education are system-level policies and programs that can prevent HPV infections. Secondary prevention of HPV-related cancers occurs through regular screening with Pap tests and HPV-testing programs for women over age 30.

HPV vaccination

There are three HPV vaccines approved for use in Canada targeting key high risk HPV types, two of which also protect against low risk HPV types.[308, 311] Ontario funds the HPV vaccine that protects against four HPV types: HPV 16 and 18, which can cause cancer, and HPV 6 and 11, which can cause anogenital warts.[312, 313] Vaccinating against HPV before sexual activity begins is most effective in preventing HPV infection and HPV-associated disease.[313] In high-income countries, where at least 50 per cent of girls were vaccinated for HPV, infections have decreased significantly in adolescent girls. At the same time, there were significant reductions in anogenital warts in males under age 20 and in women, ages 20 to 39, suggesting broader population benefits.[314]

School-based vaccination program

A publicly funded school-based HPV vaccination program supports broad vaccination coverage. A meta-analysis found greater declines in HPV-related outcomes for both sexes in countries that delivered HPV vaccination in schools. The authors suggested that school-based programs can be implemented more quickly and lead to greater vaccination coverage than programs implemented in other settings, such as in clinical settings.[314] A school-based program is an efficient way to reach adolescents in particular, because they are required to attend school, but tend not to visit primary care physicians as often as younger children.[31]

In 2007, Ontario was one of the first provinces to introduce a school-based HPV vaccination program for girls in Grade 8.[313, 316] The vaccine was initially administered in a three-dose schedule, but since September 2015, it has been given in two doses, which was shown to be as effective for adolescents under age 15. As of September 2016, the publicly funded school-based HPV vaccination program in Ontario was expanded to boys.[317] Also in 2016, the timing of the vaccine administration changed from Grade 8 to Grade 7,[317] consistent with a recommendation made by the Provincial Infectious Diseases Advisory Committee on Immunization. The change to Grade 7 may increase vaccination coverage rates in the school-based program because students who are absent for one dose of the vaccine will have more time to receive the second dose before they move to a new school for Grade 9.[312] Eligible students can complete the vaccination series up to the end of Grade 12 through catch-up programs offered by public health units.[312]

Indicator: School-based human papillomavirus (HPV) vaccination coverage

The indicator in this section measures vaccination coverage for the school-based HPV vaccination program in female Grade 8 students in Ontario by public health unit, for the 2012/13 school year. More recent data are not available at this time due to a

As of September 2016, the publicly funded school-based HPV vaccination program in Ontario was expanded to boys.

transition to a new data collection system. Data were collected from public health units and analyzed by Public Health Ontario.

At the end of the 2012/13 school year, the vaccination coverage rate for the school-based HPV vaccination program in Grade 8 girls in Ontario was 80.2 per cent (Figure 20). This coverage rate included girls who completed the three-dose vaccine series through the program in addition to those who were not yet overdue to initiate the series or who were not yet overdue for a subsequent dose of the vaccine by the end of the school year. Coverage rates varied across the province, with the highest coverage reported in Wellington-Dufferin-Guelph (87.4 per cent), Durham Region (85.7 per cent) and Brant County (85.6 per cent), and the lowest coverage reported in Lambton County (68.2 per cent), Haldimand-Norfolk (68.7 per cent) and Halton Region (70.7 per cent).

Vaccination coverage for the school-based HPV vaccination program in Ontario increased by 10 per cent from the 2011/12 and 2012/13 school years.[315] The rate for Grade 8 girls is still below the provincial target of 90 per cent for the 2011/12 school year;[315] however, Ontario's rate is higher than the national rate of 72 per cent for girls ages 12 to 14.[318]

Vaccination coverage in the school-based HPV vaccination program could be increased by having healthcare providers further educate students and their parents regarding the benefits and safety of the HPV vaccine.[319] One Canadian study found that providing a positively framed message that focuses on the protective value and safety of the vaccine, as opposed to a fear-based message that focuses on the seriousness of contracting HPV, may increase parents' intentions to have their children vaccinated.[320]

Vaccination for other populations

Health Canada has approved the HPV vaccine for use in females ages nine to 45 and males ages nine to 26.[313] In 2014, the Canadian Immunization Committee expanded the goal of publicly funded Canadian HPV immunization programs from solely preventing cervical cancer to reducing all diseases and deaths caused by vaccine-preventable HPV infections.[321] The expanded goal recommends vaccinating other populations, in addition to girls, using a "thoughtful risk-based approach."[321]

In September 2016, Ontario expanded the school-based vaccination program to include boys and began publicly funding HPV vaccination through local public health units for men who have sex with men, up to age 26.[317] The prevalence of HPV infection and related diseases is high in men who have sex with men, and they do not benefit from the group immunity provided by the vaccination of females only.[321] Several other provinces include boys in their school-based vaccination program, including Alberta, Prince Edward Island, Manitoba and Quebec.[321-324] The HPV vaccination program in British Columbia includes boys and men up to age 26 who are at higher risk for HPV, such as men who have sex with men.[325]

The current HPV vaccines are preventive and not therapeutic; therefore, they must be administered before exposure to the HPV types they protect against.[326] Although the vaccines are less effective in people who are sexually active,[321] those who have never been infected by one or more of the HPV types targeted by the vaccine can still benefit from vaccination.[313, 327] Ontarians who wish to be vaccinated and are not eligible for the publicly funded vaccine must pay out-of-pocket or through a private insurance plan. The current data collection system in Ontario does not track those who have received the vaccine outside of the school-based program, unless parents or guardians provide immunization information to local public health unit staff. This limits our understanding of the true percentage of Ontarians who have received the vaccine. A population-based registry is needed to fill this gap.

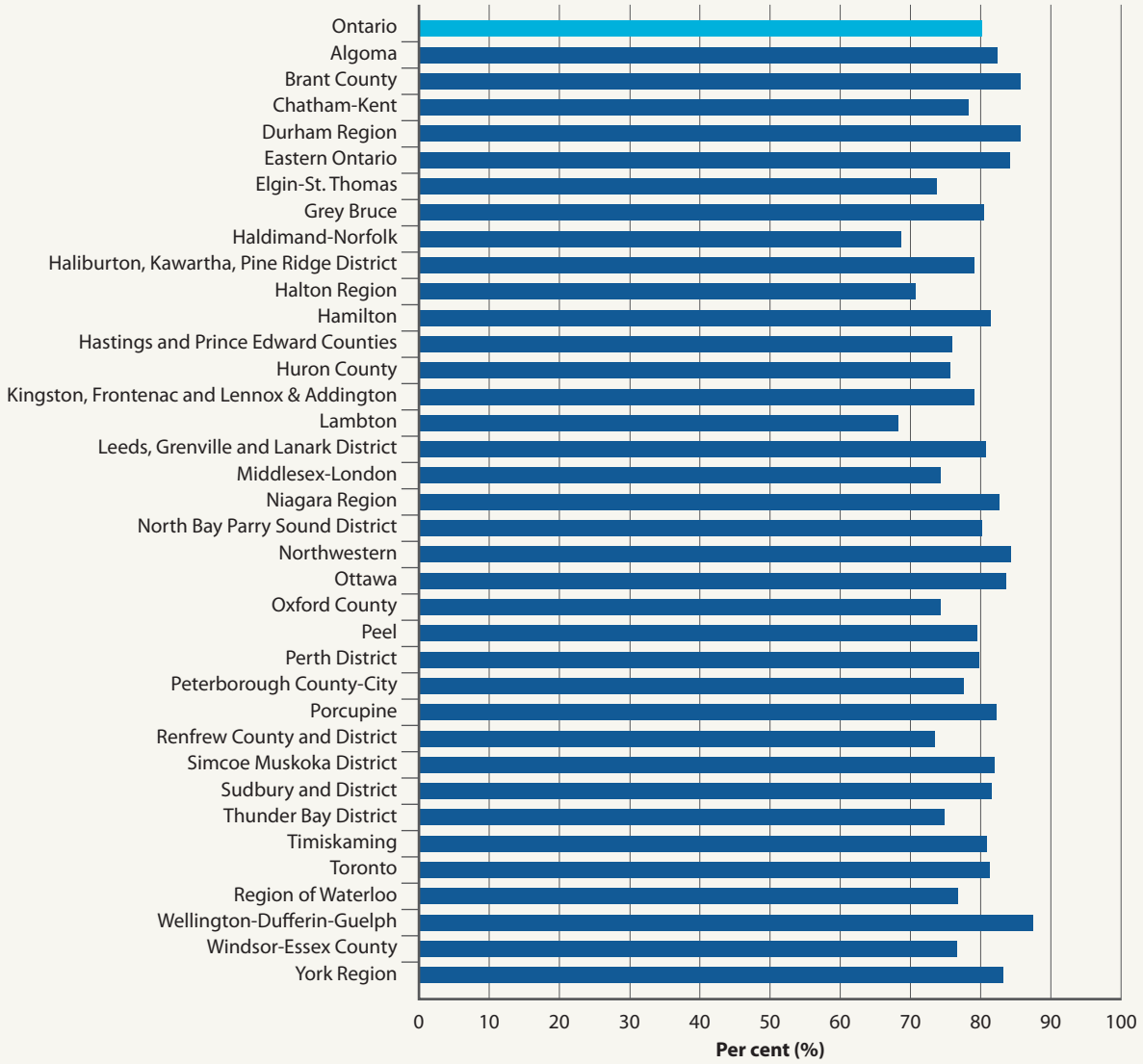
Other prevention strategies

In addition to administering the publicly funded vaccination program, public health units in Ontario work in other ways to prevent infection with HPV. Staff work with school boards and communities on sexual health promotion, and provide input on the sexual education portion of the health and physical education curriculum to ensure it addresses issues around sexually transmitted infections and use of condoms.[135, 328] In communities, public health units offer sexual health clinics that provide a range of services for priority populations and distribute condoms at no cost.[328]

Secondary prevention of cervical cancer occurs through an organized, population-based cervical screening program.[329] Cancer Care Ontario recommends that Pap tests be given every three years, starting with women age 21 who are or ever have been sexually active and stopping at age 70 if they have had three normal tests in the previous 10 years.[330] If an abnormality is found, a woman is followed up accordingly. HPV DNA testing is recommended for women over age 30, with cytology

FIGURE 20

Vaccination coverage (%) for the school-based HPV vaccination program in female Grade 8 students in Ontario, by public health unit, 2012/13 school year



Source: Immunization Records Information System, 2012–2013 (Ministry of Health and Long-Term Care)
Prepared by: Cancer Care Ontario, Prevention and Cancer Control (Population Health and Prevention), based on analytic results provided by Immunization and Vaccine Preventable Diseases, Public Health Ontario
Note: Data are presented in Supplementary Table S26.

used in the event of a positive result. Presently, HPV DNA testing is not funded for primary screening in Ontario.[331]

Hepatitis B virus

The hepatitis B virus infects the liver and is transmitted through blood and other body fluids, most commonly by sexual contact, through unsafe drug injection practices and by mothers to their infants in utero or during childbirth.[308, 332] Chronic hepatitis B virus infections can lead to hepatocellular carcinoma, the most common type of liver cancer.[308] While the prevalence of chronic hepatitis B infection is low in Canada, there are a number of groups that are at increased risk for infection, such as people with multiple sexual partners; babies born to hepatitis B-positive mothers; injection drug users; First Nations, Inuit and Métis Peoples; inmates in correctional facilities; and immigrants from areas with a high prevalence of hepatitis B.[332] Globally, East Asia and sub-Saharan Africa have the highest prevalence of hepatitis B.[333]

In Ontario, the annualized rate of acute infections with the hepatitis B virus was 0.7 per 100,000 people, and 16.2 cases per 100,000 people for chronic infections in 2013.[334] Among people with an acute infection, five per cent of adults and 80 to 90 per cent of infants are estimated to be unable to clear their infection and will go on to develop a chronic hepatitis B infection.[309] Many people who are infected with the hepatitis B virus are unaware of it. A Canadian study found that 46 per cent of those infected with the hepatitis B virus did not know that they were infected.[335]

System-level policies and programs that can prevent infection with the hepatitis B virus include population-based vaccination programs, vaccination for high risk groups, blood screening strategies, sexual health promotion and education, and harm reduction with respect to unsafe injection drug use. Methods of secondary prevention of the cancers caused by hepatitis B include monitoring, screening and treatment of people with chronic hepatitis B infections.[333]

Hepatitis B vaccination

All Canadian provinces and territories have had a childhood or infant hepatitis B vaccination program since the 1990s.[336] The vaccine protects against infection with the virus, thereby reducing the risk of hepatocellular carcinoma.[337] When the vaccine series is given before exposure to the virus, it is 95 to 100 per cent effective. Children ages five to 15 have the best response to the vaccine.[338] The World Health Organization recommends that all infants receive the hepatitis B vaccine at birth and in countries with a low prevalence of hepatitis B, such as Canada, it recommends vaccinating all unvaccinated children and adolescents, along with high risk groups.[333] In Ontario, the hepatitis B vaccine is publicly funded for babies of hepatitis B-positive mothers (ascertained through prenatal testing),[328] the universal school-based program and certain other high risk groups, to be described in this section.[328] The number of acute cases of hepatitis B infections in Canada has decreased since the vaccine was introduced.[332]

School-based vaccination program

In 1994, a national working group on hepatitis B recommended that all jurisdictions in Canada implement a universal hepatitis B vaccination program in schools for children ages nine to 13.[339] Ontario's publicly funded school-based hepatitis B vaccination program for all students in Grade 7 started that year. If

46%

A Canadian study found that 46 per cent of those infected with the hepatitis B virus did not know that they were infected.

students miss a dose of the two-dose series in Grade 7, they can receive the missed dose before the end of Grade 8.[315]

Indicator: School-based hepatitis B vaccination coverage

The indicator in this section measures vaccination coverage for the school-based hepatitis B vaccination program in Ontario for the 2012/13 school year, the most recent year that data were available. Data were collected from public health units and analyzed by Public Health Ontario.

At the end of the 2012/13 school year, the vaccination coverage rate for the school-based hepatitis B vaccination program in Grade 7 students in Ontario was 86.9 per cent (Figure 21). The vaccination rate included students who completed the two-dose hepatitis B vaccine series through the program, those who reported that they completed the series before entering Grade 7, and those not yet overdue to initiate the series or who were not yet overdue for a subsequent dose of the vaccine by the end of the school year. The rate for the school-based program varied across the province, with the highest coverage reported in Perth District (95.6 per cent), Thunder Bay District (95.5 per cent) and Porcupine (94.4 per cent), and the lowest coverage reported in Haldimand-Norfolk (79.2 per cent), York Region (80.1 per cent) and Toronto (83.8 per cent).

As with the HPV vaccination program, ongoing education by public health and healthcare providers for students and their parents regarding the benefits and safety of vaccination is important for increasing the uptake of the hepatitis B vaccine.[319]

Ontario publicly funds the hepatitis B vaccine for the school-based program and for certain high risk groups.

The hepatitis B vaccination coverage rate of 86.9 per cent in Ontario for the school-based program is lower than the national target of 95 per cent for hepatitis B vaccination programs. It should be noted that Ontario does not systematically track vaccination in high risk groups and others who receive the vaccine outside of the school program.[315]

Vaccination for high risk groups

Ontario publicly funds the hepatitis B vaccine for the school-based program and for certain high risk groups. These groups include infants born to hepatitis B virus-positive mothers; people who have had household or sexual contact with chronic hepatitis B carriers or those with acute cases; people who are awaiting liver transplants, frequently receive blood products or are recipients of renal dialysis (second and third doses only); people who have chronic liver disease, including those with hepatitis C; people with multiple sex partners; men who have sex with men; those who have had a sexually transmitted infection; injection drug users; those with needle-stick injuries in a non-healthcare setting; and children under age seven whose families immigrated from countries with a high prevalence of the virus.[328]

The Canadian Immunization Guide states that all people without immunity from the hepatitis B virus could benefit from hepatitis B vaccination, particularly immigrants from countries with a high prevalence of the hepatitis B virus and the people they are in contact with in their household or sexually.[340] Ontario receives many immigrants from countries that have a high prevalence of hepatitis B;[328] however, except for children under age seven, students in Grade 7 and people with the risk factors outlined above, vaccination for new immigrants is not publicly funded in Ontario.

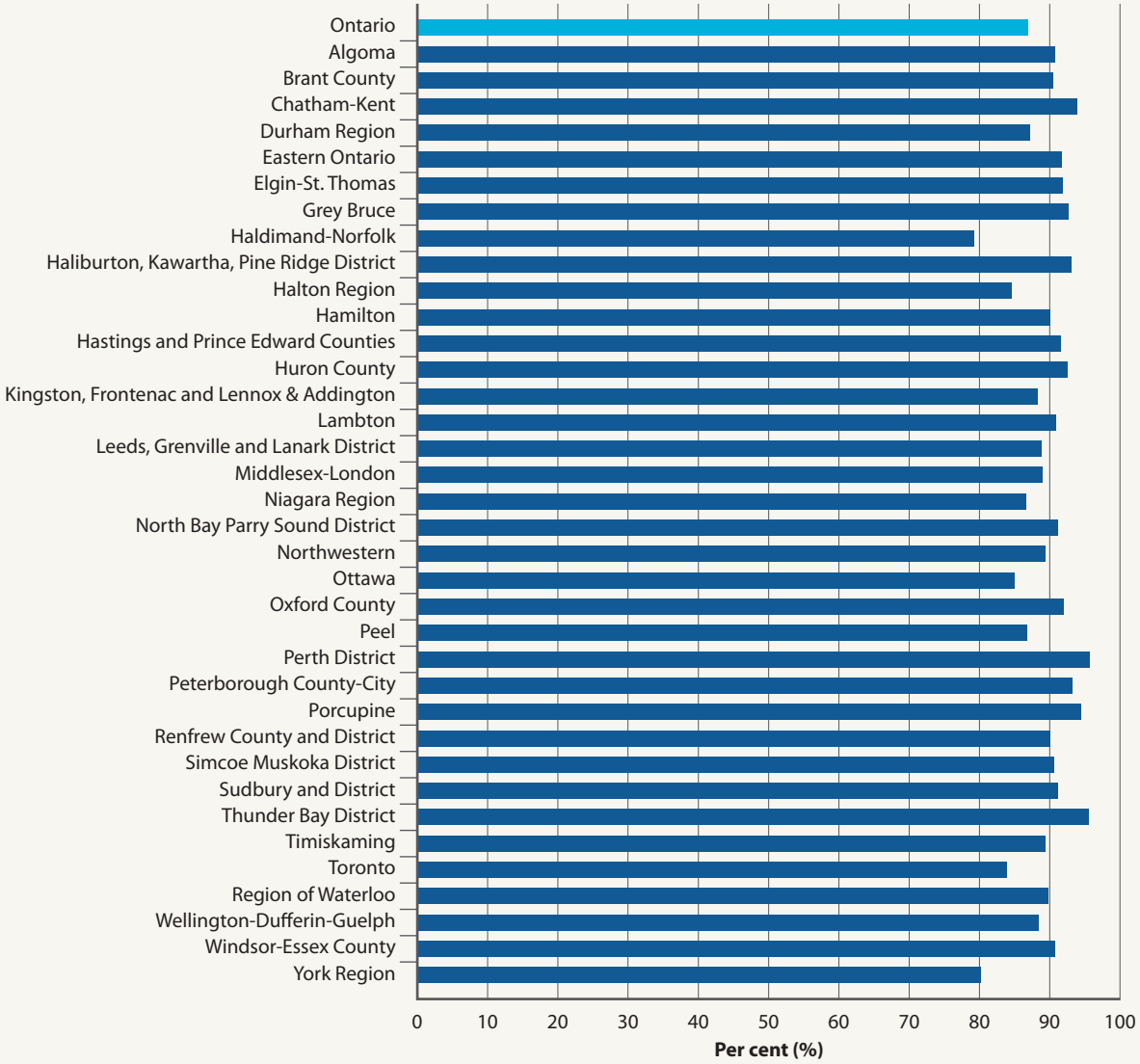
Other prevention strategies

Public health units in Ontario undertake many strategies to prevent the transmission of the hepatitis B virus, along with other blood-borne infections.[341] Hepatitis B virus infections are reported to local public health units who, along with healthcare providers, ensure counselling, post-exposure vaccination and vaccination of contacts.[328] Sexual health clinics are available for priority populations and include testing, counselling, condom distribution and follow up of people with hepatitis B.[342]

Public health unit staff inspect the infection prevention and control practices of personal services settings where there is a risk of exposure to blood and bodily fluids, such as services for tattoos, body piercings and nail salons.[341, 343] Universal precautions are used in healthcare settings to prevent transmission of infections.[341] Harm reduction supplies are offered through Needle Syringe Programs, which are supported by the Ontario Harm Reduction Distribution Program, a provincially-funded program that provides supplies,

FIGURE 21

Vaccination coverage (%) for the school-based hepatitis B vaccination program in Grade 7 students in Ontario, by public health unit, 2012/13 school year



Source: Immunization Records Information System, 2012–2013 (Ministry of Health and Long-Term Care)
Prepared by: Cancer Care Ontario, Prevention and Cancer Control (Population Health and Prevention), based on analytic results provided by Immunization and Vaccine Preventable Diseases, Public Health Ontario
Note: Data are presented in Supplementary Table S27.

education, knowledge translation and exchange to intravenous drug users.[342] The Canadian Blood Services conducts donor screening and testing of blood donations for the hepatitis B virus, among other infections.[344]

As part of the 2015 Ontario health and physical education curriculum for Grades 1 to 8, public health units work with school boards on sexual health education and equip teachers to discuss topics related to increased risk of the hepatitis B virus infection, such as lack of condom use and substance abuse, including intravenous drug use.

Secondary prevention for people with chronic hepatitis B virus infection includes appropriate monitoring and antiviral treatments to control the infection, which can reduce the risk of liver cancer and other liver diseases.[308]

Opportunities to reduce HPV and hepatitis B virus infections

- Ensure there are sufficient resources for local public health units in Ontario to deliver the expanded HPV vaccination program.
- Publicly fund HPV DNA testing for women over age 30.
- Consider publicly funding hepatitis B vaccination for additional high risk groups, such as all people who immigrate to Ontario from countries with a high prevalence of the virus and their household contacts, regardless of age.

Opportunities for improved monitoring

- Develop a province-wide registry for HPV and hepatitis B vaccination.

Conclusion

The Prevention System Quality Index (PSQI) monitors system-level policies and programs that can reduce the prevalence of cancer risk factors and exposures.

The 2016 PSQI reports on a larger number of indicators than the 2015 PSQI, and describes more fully the evidence supporting the indicators. The report also identifies clear opportunities for reducing cancer risk factors and exposures.

Although new sources of data were used to develop indicators for the 2016 PSQI, there were few province-wide data sources available for developing indicators that monitor system-level policies and programs. Therefore, the report describes opportunities for improved monitoring and tracking important system-level interventions that lack adequate data for developing indicators.

The main findings of the 2016 PSQI indicators show that while there are many policies and programs in place in Ontario that can reduce cancer risk factors and exposures, there are also many opportunities for improvement (Table 9). Implementing comprehensive strategies that have dedicated, sustained funding, provincial coordination and a mix of policies and programs would help reduce risk factors and exposures. In addition, it is important to focus attention on the health of the population when developing policies in all government sectors. Reducing the risk factors and exposures reported on in the 2016 PSQI would decrease the burden of cancer and other chronic diseases, and result in cost savings to the healthcare system.[7]

TABLE 9
Main findings of the 2016 Prevention System Quality Index (PSQI) indicators

Domain	Indicator	Desired direction	Main findings of the 2016 PSQI
Tobacco	Tax as a percentage of tobacco retail price	Higher	As of April 2016, taxes were 65 per cent of the average total tobacco retail price in Ontario, well below the World Health Organization's recommendation of at least 75 per cent.
	Exposure to second-hand smoke	Lower	Following a period of decline from 2003 to 2007, there was a significant increase in the percentage of non-smoking adults age 20 and older in Ontario exposed to second-hand smoke in public places, rising from 10.1 per cent in 2007 to 14.2 per cent in 2014. Exposure at home and in private vehicles declined significantly from 2003 to 2014. Similar trends were seen for adolescents ages 12 to 19, but a substantially higher percentage of adolescents than adults reported regular exposure to second-hand smoke. In 2014, the percentage of adolescents exposed to second-hand smoke in public places was 25.6 per cent.
	Long-term smoking cessation	Higher	In 2014, 3.9 per cent of recent daily smokers age 20 and older in Ontario reported quitting smoking for at least one year, a significant decrease from 5.4 per cent in 2005.
Alcohol	Minimum retail price of alcohol sold in off-premises alcohol outlets	Higher	As of March 2016, none of the minimum retail prices for beer, table wine and spirits in Ontario met the minimum price per standard drink estimated to achieve appreciable reductions in alcohol consumption at the population level ($1.63 in 2015 dollars).
	Private off-premises alcohol outlets	Same or lower	In 2015, 75.9 per cent of the off-premises alcohol outlets in Ontario were privately owned, similar to 2014. Percentages varied by public health unit.
	Alcohol outlet density (on- and off-premises)	Same or lower	In 2015, the density of on- and off-premises alcohol outlets in Ontario was 17.2 for every 10,000 people age 15 and older, similar to 2014. Percentages varied by public health unit.

Domain	Indicator	Desired direction	Main findings of the 2016 PSQI
Healthy eating	Household food insecurity	Lower	In 2014, 11.9 per cent of Ontario households experienced food insecurity. Percentages varied by public health unit. From 2005 to 2014, the prevalence of severe household food insecurity remained stable. However the prevalence of moderate food insecurity increased slightly, but significantly, and the prevalence of marginal food insecurity decreased slightly, but significantly.
	Food literacy development in secondary schools	Higher	Approximately one-third of students in Ontario who entered Grade 9 from the 2005/06 to 2009/10 school years earned one or more credits in a course that included a food literacy component during their secondary school education. This estimate has changed very little over time.
Physical activity	Use of active transportation to or from work	Higher	In 2011, active transportation was used in 21.6 per cent of trips taken to or from work by adults age 19 and older in the Greater Golden Horseshoe regions surveyed in Ontario. Percentages varied by region. Most of these active transportation trips took place to or from public transit.
	Use of active transportation to or from school	Higher	In 2011, active transportation was used in 51.4 per cent of trips that youth ages 11 to 18 took to or from school in the Greater Golden Horseshoe regions in Ontario. Percentages varied by region.
	Health and physical education specialist teachers in schools	Higher	In the 2013/14 school year, 19.7 per cent of elementary schools and 21.7 per cent of secondary schools in Ontario reported having full-time and/or part-time specialist teachers assigned to teach health and physical education. Percentages varied by public health unit. From the 2006/07 to the 2013/14 school years, the overall percentage of schools with specialist teachers increased at the elementary and secondary levels.
	Enrolment in health and physical education	Higher	In the 2013/14 school year, 88.6 per cent of Grade 9 students in Ontario earned one or more health and physical education credits, compared to 26.0 per cent of Grade 12 students.
Ultraviolet radiation	Shade policies in local municipalities	Higher	As of March 2016, three local municipalities in Ontario with a population of 100,000 or more have strong shade policies. The guidelines that these municipalities follow when evaluating plans for developing or redeveloping sites state that shade should be provided for a broad range of municipally and privately owned sites.
Environmental carcinogens	Radon levels in residences	Lower	From 2009 to 2013, 25.2 per cent of homes surveyed in Ontario had radon concentrations greater than or equal to 100 Bq/m^3, the average annual radon concentration at which the World Health Organization recommends remedial action. Percentages varied by public health unit.
	Fine particulate matter ($PM_{2.5}$) concentrations in outdoor air	Lower	In 2014, the average annual $PM_{2.5}$ concentrations at 40 monitoring stations across Ontario ranged from 4.7 $\mu g/m^3$ to 10.8 $\mu g/m^3$. $PM_{2.5}$ concentrations were higher than the reference level of 10 $\mu g/m^3$ at three monitoring stations: Hamilton Downtown (10.8 $\mu g/m^3$), Windsor West (10.7 $\mu g/m^3$), and Windsor Downtown (10.1 $\mu g/m^3$).
Occupational carcinogens	Industrial formaldehyde use and employment in industries using formaldehyde	Lower	In 2013, 20 industrial facilities with 7,467 employees used an estimated total of 8,220 tonnes of formaldehyde. The paper, chemical and wood product manufacturing industries accounted for nearly 99 per cent of the total formaldehyde used by reporting industries in Ontario.
	Industrial nickel use and employment in industries using nickel	Lower	In 2013, 122 industrial facilities with 40,199 employees used an estimated total of 874,580 tonnes of nickel. Primary metal manufacturing, and mining and quarrying accounted for nearly 98 per cent of the total nickel used by reporting facilities in Ontario.
Infectious agents	School-based human papillomavirus (HPV) vaccination coverage	Higher	At the end of the 2012/13 school year, the vaccination coverage rate for the school-based HPV vaccination program in Grade 8 girls in Ontario was 80.2 per cent. Rates varied by public health unit.
	School-based hepatitis B vaccination coverage	Higher	At the end of the 2012/13 school year, the vaccination coverage rate for the school-based hepatitis B vaccination program in Grade 7 students in Ontario was 86.9 per cent. Rates varied by public health unit.

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