First Nations and Diabetes in Ontario

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[a]Dr. Tu died on May 30, 2018, during the preparation of this report.

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About the Organizations Involved in This Report

Chiefs of Ontario

The Chiefs of Ontario is a political forum and secretariat for collective decision-making, action, and advocacy for the 133 First Nations communities located within the province of Ontario. Guided by the Chiefs in Assembly, we uphold self-determination efforts of the Anishinaabek, Mushkegowuk, Onkwehonwe, and Lenape Peoples in protecting and exercising their inherent and Treaty rights. Keeping in mind the wisdom of our Elders, and the future for our youth, we continue to create the path forward in building our Nations as strong, healthy Peoples respectful of ourselves, each other and all creation.

ICES

ICES (formerly the Institute for Clinical Evaluative Sciences) is an independent, not-for-profit organization that produces knowledge to enhance the effectiveness of health care for Ontarians. Internationally recognized for its innovative use of population-based health data and information, ICES evidence supports health policy development and guides changes to the organization and delivery of health care services in Ontario.

Glossary of Terms

First Nations terminology

First Nations Refers to individuals who are registered in the Indian Register as Status Indians.

In community Refers to First Nations individuals living in their First Nations community; formerly referred to as *on reserve*.

Indian Register The official record identifying persons registered as Status Indians under the *Indian Act*.

Indigenous Includes Status First Nations, Inuit and Métis individuals.

Outside of community Refers to First Nations individuals who do not live in their First Nations community, formerly referred to as *off reserve*.

Regional Health Survey (RHS) The First Nations-governed national health survey collecting information about on-reserve and northern First Nations communities in Canada.

Other terminology used in this report

Aboriginal Health Access Centre (AHAC) A community health centre specific to Aboriginal health.

Ambulatory care–sensitive condition A condition for which emergency department use and hospital admission could likely be prevented by interventions in primary care.

Community Health Centre (CHC) A community-based centre delivering primary health care.

Continuity of care Refers to ongoing access to the same health care provider over time. It is measured in this report as 3 or more visits to the same primary care physician in a 2-year period.

Diabetes Population Risk Tool (DPoRT) A population-based risk algorithm for the development of diabetes. This tool was applied to risk factor data from the RHS to estimate 10-year diabetes incidence and future diabetes burden among First Nations people living in First Nations communities in Ontario.

Johns Hopkins Adjusted Clinical Groups (ACGs) A term used descriptively as a measure of comorbidity and a case-mix methodology for aggregating conditions into diagnostic groups that are similar in expected resource use. The ACG system assigns all ICD-9 and ICD-10 codes to one of 32 diagnosis clusters known as Adjusted Diagnosis Groups (ADGs). We categorized the number of conditions into 4 groups: 0, 1–4, 5–9 and 10 or more.

Johns Hopkins Aggregated Diagnosis Groups (ADGs) Aggregations of similar types of health conditions that can be used to count the number of comorbid condition types that a patient has. Individual diseases or conditions are placed into a single ADG cluster based on five clinical dimensions: duration of the condition, severity of the condition, diagnostic certainty, etiology of the condition and specialty care involvement.

Local Health Integration Network (LHIN) In Ontario, one of 14 geographically defined regions responsible for planning, integrating and funding local health services.

Patient enrolment model The model of primary care in which patients in Ontario are rostered (enrolled).

Rurality Index for Ontario An index that broadly measures rurality based on the dissemination area of a person's postal code.

Rostering The process by which a patient formally registers with a comprehensive primary care physician or practice.

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Chapter 5 Patterns of Diabetes Prevalence and Incidence

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Forewords

Message from Jan Hux

Over the last three decades, health care atlases have become an effective way to describe the burden of disease and care patterns and outcomes, both over time and across geographic regions. These atlases can support health policy and planning decisions and, at a broader level, allow affected individuals and communities to see their health and illness in a larger context. It is a pleasure to be asked to provide comment on this important new addition to the genre: First Nations and Diabetes in Ontario. One of the editors of this work, Baiju Shah, collaborated with me and other colleagues on the inaugural Ontario diabetes atlas nearly 20 years ago. Since that time, a number of Indigenous researchers have pursued careers in health services research, and while I don't know them individually, I know that it is their wisdom, work and vision that have made the current volume possible.

As a child, I would often spend a Sunday afternoon "reading" the world atlas with my father. Snuggled together in a big armchair on a rainy day, the colourful maps would give us access, in our imaginations, to places we would never visit in reality. The maps told many stories about those places. The place names told the history of the lands – in particular, European place names in non-European contexts, which served as a jarring reminder of a colonial past. With vast swaths of nearly uninhabited beige deserts and artistic sculpting or more prosaic contour lines denoting formidable mountains, they showed where the challenges to habitation were. And they showed, by concentration of population, where people had found what they needed – generally along water, where a communication lifeline and a transportation route for needed resources was provided or available.

Similarly, the maps and charts in this volume tell important stories that reflect history. The impacts of colonization and intergenerational trauma are writ large in these statistics, showing both a heavier burden of diabetes among First Nations people and worse health outcomes for those living with it. The findings in this atlas also point to a major challenge: the geographic dispersion of those living in the north that inevitably reduces access to tertiary health care services and economic and educational opportunity. While not visible on the maps, the accompanying charts and text describe the socioeconomic barriers to achieving the healthy lifestyles necessary for the prevention and management of type 2 diabetes that were the consequence of colonialism, and the loss of a culturally rooted approach to care, one that emphasizes wellness and resiliency rather than deficits and illness.

Finally, this atlas represents not merely a description of things as they are but also the beginnings of a way forward to better outcomes. Some encouraging trends are already seen, including a slowing of the rate of growth in the incidence of diabetes and declines in the risk of major complications. However, gaps in outcomes between First Nations and other people persist. At a broad level, these gaps will require addressing the social determinants of health that both fuel the epidemic and thwart its management. In the clinical realm, the challenges of providing high-quality and consistent primary care and good access to specialist services may be in part addressed by innovative virtual care solutions; but, in adopting such models, care must be taken to ensure that they do not widen equity gaps. Ultimately, as the authors point out, what is needed are "wholistic approaches to preventing and managing diabetes that account for physical, spiritual, emotional and mental well-being and acknowledge the impact of trauma on diabetes."

Congratulations to the Chiefs of Ontario for their visionary leadership in this research and to all of the research staff who brought the vision to life. It is my hope that these data will become an indispensable resource for health system decision makers, an effective advocacy tool in the hands of First Nations communities and a critical reference point from which progress toward effective and appropriate health care, as called for by the Truth and Reconciliation Commission, can be measured.

Dr. Jan Hux
President and CEO
Diabetes Canada

Message from RoseAnne Archibald

Since European contact, many diseases have plagued First Nations people in Canada. One of the most prolific diseases is diabetes. According to the First Nations Regional Health Survey, diabetes is one of the top chronic health conditions impacting First Nations peoples in Ontario. Ontario First Nations community members want to be healthy and strong and are challenging the health industry to provide health care quality and equity. This challenge will weaken colonial policies that still exist today and forge a path forward to eradicate this disease.

In 2014, the Chiefs of Ontario, in partnership with Queen's University, Laurentian University, the Institute for Clinical Evaluative Sciences (now ICES), the Northern Ontario School of Medicine and the Centre for Rural and Northern Health Research, began a groundbreaking research study entitled Reducing the Burden of Diabetes on First Nation people in Ontario. The study was funded with a grant from the Canadian Institutes of Health Research through the Ontario SPOR Support Unit (OSSU). The OSSU promotes real research engagement with patients on what is important to them to improve the health care system. This important study has resulted in findings that are described in the following pages.

At the heart of this study has been the remarkable partnership developed with the Chiefs of Ontario Patient Advisory Group (PAG). The members of the PAG were from various Ontario First Nations communities and provided advice and guidance by reaching into their lived experience with diabetes. The PAG was key in shaping the way the report was written, specifically, by understanding the results while considering the impacts of colonization and deciphering how the social determinants of health affect access to health.

This research project is an example of how meaningful collaboration using First Nations population data can be achieved. The Chiefs of Ontario would like to thank the Health Research Team, working groups, researchers, the Patient Advisory Group and the communities and participants who consented to this study. Working together toward health vitality is paramount. It is hoped that this important study is one of many collaborative approaches in linking our ways of knowing with contemporary research methods.

Ninanaskamon!

Wishing you Peace beyond all understanding,

RoseAnne Archibald
Ontario Regional Chief
Chiefs of Ontario

Executive Summary

Inside

Context and Issue

This report is a first-of-its-kind, First Nations-specific study of diabetes in Ontario. It is the outcome of a collaborative project between the Chiefs of Ontario, ICES, and other First Nations and academic partners. Over three years, the project team worked with a patient advisory group to better understand First Nations people's experiences with diabetes and diabetes-related health services in Ontario.

Understanding diabetes and its consequences is very important to First Nations organizations and communities. Decisions made at the health-system and policy levels can affect the ability of First Nations people and communities to prevent and manage diabetes and cope with the disease's long-term complications. Reducing the impact of diabetes requires First Nations–specific population-based and individual-level initiatives and a contextualized understanding of the social determinants of health.

While our findings are grounded in the historical context of First Nations experiences with colonization, they also focus on opportunities that could lead to healthier individuals, families and communities.

Study Goals and Overview

The overall aim of the project was to describe diabetes among First Nations populations in Ontario with a view to informing health policy and practice. We analyzed administrative health data held at ICES and governed by First Nations in Ontario to examine trends in diabetes incidence, prevalence and outcomes and access to health care for First Nations people with diabetes. We also analyzed the results of the First Nations Regional Health Survey, Phase 3 to better understand diabetes risk. Together with a qualitative study to be published in a separate report, these important perspectives paint a picture of diabetes among First Nations people and the experiences with the health care system among First Nations people with diabetes.

Key Findings

First Nations people in Ontario

First Nations people as a group are younger than other people in Ontario. They are more likely to live in the northern part of the province. One-third of First Nations people live in First Nations communities and tend to have fewer chronic conditions than those who live outside of First Nations communities. This may be because those living in First Nations communities tend to be younger or because they move elsewhere as they age or experience illness to be closer to health care services. First Nations people living with diabetes have noted that a major barrier to receiving care is the lack of health care providers in their communities, resulting in the need to travel to receive appropriate care.

Risk factors for diabetes

The First Nations have long recognized that individual and community health and well-being are linked to factors that are rooted in their historical, political, geographic, environmental, economic, cultural and social foundations. These factors contribute to inequity and marginalization, which are connected to high rates of diabetes, lack of access to care and poor diabetes-related outcomes.

From the Regional Health Survey analysis, the **three dominant individual risk factors** for type 2 diabetes among First Nations people living in First Nations communities are physical inactivity, overweight/obesity and smoking. Efforts to address these risk factors must consider the cumulative effects of ongoing racism, dispossession from land, childhood and intergenerational trauma, changes in diet and an increase in sedentary lifestyles associated with colonization.

Prevalence and incidence of diabetes

The **number of First Nations people living with diabetes** is at an all-time high and the prevalence of diabetes is much higher among First Nations people than other people in Ontario. The proportion of First Nations people with diabetes increased from 6.1% in 1995 to 14.1% in 2014, with the largest increase occurring among those over age 50 (from 27.7% in 1995/96 to 38.9% in 2014/15). Diabetes prevalence is increasing at a faster rate among First Nations children compared with other children in Ontario. From the data available, we cannot tell if this increase is driven by type 1 or type 2 diabetes, but we expect that it is likely type 2.

While the overall number of diabetes cases is still high, the **number of new cases** (incidence) diagnosed each year has decreased in First Nations people. Between 1995/96 and 2014/15, the proportion of First Nations people newly diagnosed with diabetes decreased from 2.0% to 1.5%; however, First Nations children continue to account for the majority of new cases.

Control and management of diabetes

Compared with other people in Ontario, fewer First Nations people with diabetes are **monitored for key indicators of diabetes control**. In 2014/15, 37.0% of First Nations people with diabetes living in First Nations communities had their **blood sugar levels** monitored compared to 39.9% of those living outside of First Nations communities and 45.0% of other people in Ontario. A similar pattern was shown for **lipid level monitoring**, with 48.3% of First Nations people living in First Nations communities, 54.0% of First Nations people living outside of First Nations communities and 65.8% of other people in Ontario having recorded lipid measurements.

On average, First Nations people with diabetes receive **more medications** for treatment than other people in Ontario. In 2014/15, for those aged 65 and older with diabetes, 71.7% of First Nations people were prescribed an **anti-diabetic medication**, compared to 59.9% of other people in Ontario. A higher proportion of First Nations people (28.1%) were prescribed **insulin** with or without an oral agent compared to other people in Ontario with diabetes (15.1%). Prescriptions for **oral agents** alone were similar: 43.6% of First Nations people and 44.8% of other people in Ontario.

Despite receiving similar or more intensive medical treatment, First Nations people with diabetes are less likely than other people in Ontario to have **good long-term blood sugar control**. Among people with diabetes in 2014/15, 39.3% of First Nations people living in First Nations communities and 48.1% of those living outside of First Nations communities had good control of their blood sugar, compared to 56.5% of other people in Ontario. Although we were not able to explore this finding further, our advisors highlighted the importance of wholistic and culturally grounded approaches to managing diabetes that recognize the important impact of trauma on diabetes control and go beyond medical intervention.

Access to **comprehensive primary care physicians and specialist care** for control of diabetes is lower for First Nations people in Ontario, particularly those living in First Nations communities. Among First Nations people with diabetes in 2014/15, 92.6% of those living outside of First Nations communities had a comprehensive primary care physician, compared to 79.5% of those living in First Nations communities. About 6 in 10 First Nations people in Ontario have regular visits with their care provider (evidence of **continuity of care**). The level of continuity of care is higher among those living outside of First Nations communities compared to those living in First Nations communities (64.5% vs. 54.4% in 2014/15).

Complications of diabetes

As a result of the observed lower monitoring, lower levels of diabetes control, less access to primary care and other complex factors that affect health, First Nations people are more likely to experience complications of their diabetes at an earlier age and sooner after their diagnosis. After First Nations people experience a complication of diabetes, the quality of their care is similar to other people in Ontario for most conditions.

First Nations people with diabetes have higher rates of **acute complications** that require **emergency department visits** and hospital stays than other people with diabetes in Ontario. Emergency department visits for diabetes are most common for First Nations people living outside of First Nations communities (1.8 people with at least one visit to the emergency department per 100 people with diabetes in 2014/15) compared to those living in First Nations communities (1.1 per 100) and to other people in Ontario (0.8 per 100). The difference in the rate of emergency department visits between First Nations people living in and outside of First Nations communities is likely due to the greater accessibility of emergency departments outside of First Nations communities. First Nations people living with diabetes also have higher rates of **hospitalization** for acute complications (1.1 people with at least one hospital stay per 100 people with diabetes in 2014/15) compared to other people in Ontario (0.7 per 100).

Cardiac disease: Rates for major cardiac events among people with diabetes declined by more than half for both First Nations people and other people in Ontario between 1996/97 and 2015/16, and the gap narrowed between the two groups. For those who had a cardiac event, the mortality rates for First Nations people and other people in Ontario were similar and stable over the 20-year study period.

Stroke: The rate of hospitalization for stroke and transient ischemic attack declined for both First Nations people and other people in Ontario between 1996/97 and 2015/16; however, this decline was less pronounced among First Nations people.

Amputation: While rates of major and minor amputation have declined over time, First Nations people with diabetes had 4.5 times the amputation rate of other people in Ontario in 2014/15. The rate is particularly high for First Nations people living in rural areas.

Eye disease: First Nations people with diabetes were more likely to undergo treatment for advanced vision-threatening diabetic retinopathy.

Kidney disease: In 2014/15, 2.9% of First Nation people with diabetes had end-stage kidney disease compared to 1.0% of other people in Ontario, a three-fold difference. To receive chronic dialysis treatment, First Nations people with diabetes had to travel a greater distance than other people in Ontario (median,11 km vs. 7 km).

Pregnancy

Pre-existing diabetes was more prevalent among pregnant First Nations women than other women in Ontario. From 2002/03 to 2014/15, the prevalence of pre-existing diabetes decreased among pregnant First Nations women (from 52.3 to 40.7 per 1,000 deliveries) and increased among other pregnant women in Ontario (from 13.9 to 20.5 per 1,000 deliveries).

Overall Implications

- Despite receiving more medications (on average) for treatment, First Nations people with diabetes are less likely to have their blood sugar levels under good control over the long term.
- Access to comprehensive primary care physicians and specialty care for control of diabetes is lower for First Nations people in Ontario and screening for complications and control of diabetes is lower, with larger gaps for those living in First Nations communities. Use of medications to prevent complications is similar to the general population and has improved over time.
- Complication rates are decreasing over time but remain significantly higher for First Nations people and occur at earlier ages and in many cases sooner after diagnosis. Once complications are identified, standard quality of care for First Nations people appears to be similar to that in the general population for most conditions.

Priority Areas for Improvement

1. First Nations–developed initiatives to prevent and control diabetes, including the promotion of physical activity, healthy weight and healthy eating, especially for children and young female adults.

2. Access to consistent primary and secondary care with an emphasis on local, community-based services.

3. Early screening for complications and screening for hemoglobin A1c.

4. Consideration of wholistic approaches to preventing and managing diabetes that account for physical, spiritual, emotional and mental well-being and acknowledge the impact of trauma on diabetes.

1 Introduction

Inside

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Overview

This report is a first-ever First Nations–specific population report on diabetes in Ontario. It is the outcome of a collaborative project between the Chiefs of Ontario, ICES (formerly the Institute for Clinical Evaluative Sciences) and other First Nations and academic partners. Over three years, the project team worked closely with a six-member patient advisory group to better understand First Nations people's experiences with diabetes and diabetes-related health services in Ontario. Included in this report is information about rates of diabetes and its complications, as well as the results of interviews from five First Nations communities. This includes information about diabetes-related complications (both acute and chronic). We also explored what health services people use, why, and how often.

Approximately 2.4 million people are affected by diabetes in Canada, with prevalence rates reported to be three to five times higher for First Nations people compared with other people in Canada.[1,2] Diabetes in First Nations populations has been found to have a younger age of onset, more rapid progression and higher complication rates than those experienced by the general Canadian population.[2-5] Understanding diabetes and its consequences is very important to First Nations organizations and communities. In particular, decisions made at health systems and policy levels can impact how well First Nations people and communities prevent and manage diabetes and cope with the long-term complications of the disease. Reducing the effects of diabetes among First Nations people requires specific population-based and individual-level targeting and a contextualized understanding of the social determinants of health.[6]

The overall aim of the project was to describe diabetes in First Nations populations in Ontario to inform policy and practice. We analyzed health administrative data held at ICES that are governed by First Nations in Ontario to examine trends in the incidence, prevalence, outcomes and access to health care for First Nations people with diabetes. We also analyzed responses to the First Nations Regional Health Survey to better understand diabetes risk.[5] Together, these important perspectives paint a picture of diabetes in First Nations communities and patient encounters with the health care system.

Patient Consultation

The members of the patient advisory group, who have a lived experience of type 2 diabetes, provided essential guidance, and their contributions shaped our approach to the research and this report. One of the important messages from the group was that the findings of this work needed to be grounded in the context of the history of First Nations people in Ontario and their experiences with colonization to better understand the environment that has been created where diabetes can take hold at a population level. This context is important to consider as we look at how diabetes affects First Nations people differently from other people in Ontario.

Indigenous peoples globally have experiences of discrimination that are entrenched in historical and colonial policies,[8] and First Nations populations in Canada are no exception.[4] Recognizing that First Nations people in Canada have been negatively impacted by government-implemented assimilation tactics is important in the discussion about diabetes. The patient advisory group stressed that this framing is critical to having this discussion in a respectful way that promotes equity, reduces individualized attribution of risk and is considerate of inherent treaty rights.[9] First Nations people continue to experience intergenerational trauma (trauma passed from one generation to the next) as a result of disruptive and assimilative practices, such as the implementation of the residential school system, the Sixties Scoop, and persistently high rates of incarceration and child apprehension.[8,10] This trauma continues to impact the lives, cultures, socioeconomic conditions, access to services, health and overall equity of First Nations communities in Ontario, and in Canada more broadly.[8,10]

Policies that impact health service availability, accessibility and quality for First Nations people in Ontario are shaped by current social and political realities.[4,11] First Nations people represent the largest of the three Aboriginal groups named in *Canada's Constitution Act of 1982*, which recognizes "existing

aboriginal and treaty rights of the [Aboriginal] peoples of Canada", who are explicitly defined as "the Indian [now referred to as 'First Nations'], Inuit, and Métis Peoples."[9] First Nations people registered under the *Indian Act*[1,2] are entitled to certain rights and benefits provided by the Government of Canada, including some health services; however, health services are generally made available under provincial jurisdiction in the Canadian health care system, and this fragmentation increases the complexity of health service access and provision.

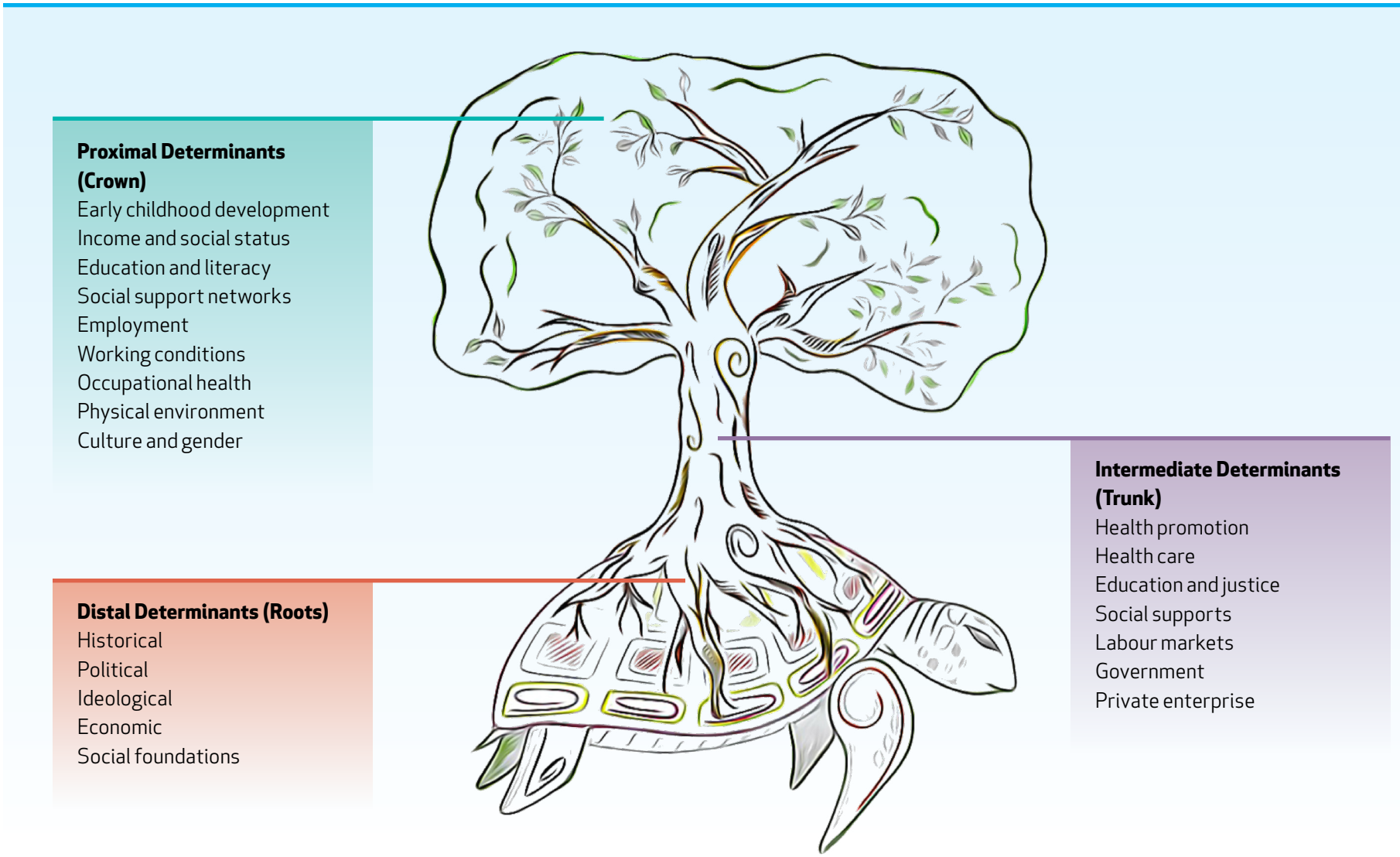
Indigenous-specific Determinants of Health

Countless studies and inquiries have highlighted the poor health status of First Nations populations relative to that of the general population in Canada.[4,8,10] Low socioeconomic status, limited access to health care services and education, and challenges associated with screening, primary prevention, management and continuity of care are among the many social realities that challenge the health and wellness of First Nations populations.[8,13] Additionally, First Nations people in Canada experience health challenges that arise from Indigenous-specific determinants of health – lifestyle, historical, political, ideological and psychosocial factors – and a shared history rooted in colonization and its oppressive and ongoing impact (exhibit 1.1).[4,8] National, institutional, legal and cultural factors that influence Indigenous-specific determinants of health have been shown to have a profound and disruptive impact on the mental, spiritual, emotional and psychological well-being of First Nations people.[8,13]

Truth and Reconciliation

This work is a response to the calls to action contained in the 2015 report of the Truth and Reconciliation Commission of Canada.[14] Specifically, we "acknowledge that the current state of Aboriginal health in Canada is a direct result of previous Canadian government policies, including residential schools" (call to action #18) and have worked to "establish measurable goals to identify and close the gaps in health outcomes" (call to action #19). We also recognize the diversity of First Nations in Ontario (call to action #20) and have addressed this by ensuring that our quantitative data included First Nations people living both in and outside of First Nations communities. In addition, our patient advisory group had diverse representation from communities across Ontario.

EXHIBIT 1.1 Indigenous-specific determinants of health



Source: Reading C. Structural determinants of Aboriginal peoples' health. In: Greenwood M, de Leeuw S, Lindsay NM, Reading C (editors). *Determinants of Indigenous Peoples' Health*. Toronto, ON: Canadian Scholars' Press, 2015. p. 3–15. Illustration by Robyn Rowe.

Just as there are many factors that have contributed to the increased risk of adverse health outcomes among First Nations people in Canada, there are many factors that have contributed to their resilience. Prior to settler contact, First Nations populations lived autonomously with languages, cultures, traditions and healing practices that were, and continue to be, unique to each group and reflective of their worldview.[8] In 2017, the Assembly of First Nations released *The First Nations Health Transformation Agenda*,[15] a recent example of how First Nations populations in Canada are reclaiming and reframing the deficits-based approaches that are commonly used when discussing and interpreting the health of First Nations people. First Nations populations across the country continue to develop and improve the health and wellness services and programs available in their communities, despite the many associated challenges, such as underfunding, remote locations and jurisdictional disputes.[15] In the face of disproportionately poor health outcomes,[2] First Nations communities continue to thrive and take steps to improve well-being through health system transformations that offer sustainable, culturally-based and wholistic care options for First Nations people.[15]

Recognizing and understanding the determinants of health that impact First Nations people while working toward eliminating the resulting health inequities is one way that researchers can provide meaningful results that will benefit the health and wellness of First Nations people now and in the future. The project team prioritized First Nations perspectives through the development, interpretation, presentation and sharing of this work by and with First Nations people.[16] Beyond simply presenting descriptions of complications and rates of health services utilization, this report provides important insights into some of the experiences of First Nations people living with diabetes both in and outside of First Nations communities in Ontario. The project team employed approaches from community-engaged participatory research; honoured foundational principles of First Nations Ownership, Control, Access and Possession (OCAP®) of First Nations data and information;[17] and participated in mutual capacity building where all partners developed knowledge and skills.

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2 Data Sources and Methods

Inside

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Overview

This study is a result of a partnership between researchers at the Chiefs of Ontario (COO), ICES, Queen's University, Laurentian University and the Northern Ontario School of Medicine. As outlined in a formal partnership agreement, all researchers, including those at COO, actively participated in the conception, design, analysis and interpretation of the results as co-investigators through ongoing participation in study team meetings at all stages of the project. In addition, COO established a patient advisory group, which was made up of seven First Nations people with personal connection to diabetes as either a patient or family member. Members of the patient advisory group were selected from different communities to acknowledge the diversity of First Nations people in Ontario. The patient advisory group provided additional insight and reflections at regular intervals throughout the project.

A data governance agreement between COO and ICES was established prior to the beginning of this project to ensure First Nations governance of Indian Register data held at ICES, in accordance with OCAP® principles. This project has served as a pilot for the application of the First Nations–led review process established in the agreement. It is the first project to be approved by the First Nations Data Governance Committee, a body whose members are appointed by the Ontario Chiefs' Committee on Health.[1]

Data Sources

This study uses three different sources of information to understand the landscape of diabetes among First Nations people in Ontario. First, we conducted in-depth analyses of First Nations–specific health outcomes and service utilization for the first time. Key to the analyses presented in chapters 5 through 15 is the ability to link Ontario population-based health information at the individual level with the Indian Register,[2] which provides information on all registered or Status First Nations people in Canada.[3]

Administrative databases available at ICES were used to access diabetes-related data for both registered First Nations people and other people in Ontario. Determining individuals with diabetes in our study was established through the Ontario Diabetes Database (ODD). Data from this source have been validated against primary care health records and are demonstrated to be accurate for determining incidence and prevalence of diabetes with a sensitivity of 86% and a specificity of 97%.[4] A listing of all data sources used in this study are presented in exhibit 2.1A in the chapter appendix.

Second, using the First Nations Regional Health Survey (Phase 3) for Ontario, we analyzed diabetes in relation to social determinants of health and risk. This data was accessed and analyzed at the Chiefs of Ontario offices.

Methods for the Analysis of ICES Data

Cohort creation

We created 20 cohorts, one for each 12-month period from April 1, 1995, to March 31, 2015. Each cohort described in chapter 5 was created by taking all individuals from the Registered Persons Database (RPDB) who were Ontario residents eligible for a health card, were alive for the entire year of the cohort (April 1 to March 31 of the following year), had contact with the health care system in the previous 7 years, and were aged 105 years or younger. The cohorts described in chapters 6 to 15 were created by taking all individuals from the RPDB who were Ontario residents eligible for a health card, alive on March 31 of the current year, diagnosed with diabetes in the previous cohort year or earlier according to the ODD, had contact with the health care system in the previous 7 years, and were aged 105 years or younger.

Two sets of inclusion criteria were used in this study. In chapter 5, all people who were alive on March 31 of the following year, irrespective of their diabetes status, were included. This was done to ensure the capture of all new cases of diabetes in that year (the incidence rate). For chapters 6 to 15, all people alive with diabetes on March 31 of the current year were

included. This was done to capture all complications in that 12-month period. Excluding deaths would have resulted in the loss of many diabetes complication records.

Determining First Nations status and community of residence

As the Indian Register includes all Status First Nations people in Ontario, individuals not included in the register were considered to be the population of *other people in Ontario*.

To determine if a First Nations person lived in a First Nations community in each year of our study, we used a combination of residence codes and postal codes. Residence codes are unique to each municipality or First Nations community and are recorded in the NACRS and CIHI-DAD databases when individuals are admitted to emergency departments or hospitals. If an individual had no emergency department visit or hospitalization and therefore did not have a recorded residence code, we used their postal code from the RPDB to map their home address to a census subdivision. Some census subdivisions are clearly and exclusively within or outside of a First Nations community. We classified First Nations individuals who lived in the few census subdivisions that included both First Nations communities and other communities as living in a First Nations community. Through this process, the place of residence for First Nations people was categorized as being either in a First Nations community, outside of a First Nations community, out of province (based on a postal code from outside Ontario), or unknown (there was no available residence code or postal code for the individual) each year. Because the geographic information available for the 1990s is less reliable, we relied on the living in/outside of a First Nations community classification for the period from 2001 onward.

Analysis

In described in chapter 5, prevalence rates were calculated on an annual basis using each annual cohort as the denominator for that year. The numerator was calculated as those in the denominator who were diagnosed with diabetes on or before the end of the year according to the ODD. Incidence rates were calculated in a similar fashion using all newly diagnosed cases in a particular 12-month period as the numerator and all individuals exposed to risk who had no previous diagnosis of diabetes as the denominator.

Both crude and age- and sex-adjusted rates of prevalence and incidence of diabetes were calculated for First Nations people and other people in Ontario, and the two populations were stratified by a number of covariates, including age group, rurality and comorbidity, and for First Nations people, on- or off-reserve status. Age- and sex-adjusted rates were calculated to account for differences in the distribution of these population characteristics over time. The direct standardization method was used in the calculation, with the 2001 census population of Ontario serving as the reference population. A 95% confidence interval based on Gamma distribution was computed for each rate.

Each outcome measure (listed in exhibit 2.1) was calculated on an annual basis using each annual cohort as the denominator for that year. The numerator was calculated as those in the denominator who experienced the outcome during the one year of follow-up. Definitions for chapter-specific outcomes are described in the relevant chapter. In addition to crude rates, age- and sex-adjusted rates were calculated in order to adjust for differences in population distribution between First Nations people and other people in Ontario.

EXHIBIT 2.1 Outcome measures reported in chapters 6 to 15

Chapter	Outcome measure
6	HbA1c and lipid monitoring and control
7	Rostering, continuity of care, access to specialists (endocrinology and general internal medicine)
8	Diabetes-related emergency department visits and hospitalizations for hypo- and hyperglycemia
9	Emergency department visits, hospitalizations and medications related to cardiac disease (acute myocardial infarction, unstable angina and congestive heart failure)
10	Incidence of strokes (ischemic, hemorrhagic and transient ischemic attack), length of hospitalization, discharge to rehabilitation or long-term care, mortality at 7 days, 30 days and one year post-stroke
11	Peripheral vascular disease–related amputations and bypass surgeries
12	Diabetic retinopathy–related eye examinations and treatment
13	Dialysis, screening, follow-up monitoring, medications and nephrologist visits for kidney disease
14	Mother outcomes: gestational diabetes, deliveries and complications, visits to comprehensive primary care physicians and specialists
	Baby outcomes: types of birth and birth-related complications, deaths (neonatal, post-neonatal and infant)
15	Above complications for children younger than 20 years, visits to pediatricians and endocrinologists

Time to event/survival analyses

Additional analyses were done for specific complications of diabetes (peripheral vascular disease [amputations] and eye disease). To conduct Kaplan-Meier time-to-event analyses for these outcomes, a cohort was created consisting of all individuals with diabetes first diagnosed (incidence diabetes) between April 1, 2007, and March 31, 2016. Individuals with records of complications in the 5 years following their diabetes diagnosis (the wash-out period) were excluded. Any individual not having experienced the event was tracked for at least one year to the end of the follow-up period, March 31, 2017. A survival analysis (Cox hazard model) with competing risk was carried out in order to adjust for age, sex and year of diagnosis. Death before the event of interest was considered to be the competing risk because it impeded the occurrence of the event. Any patient not experiencing the event of interest by the end of the follow-up period was flagged as censored.

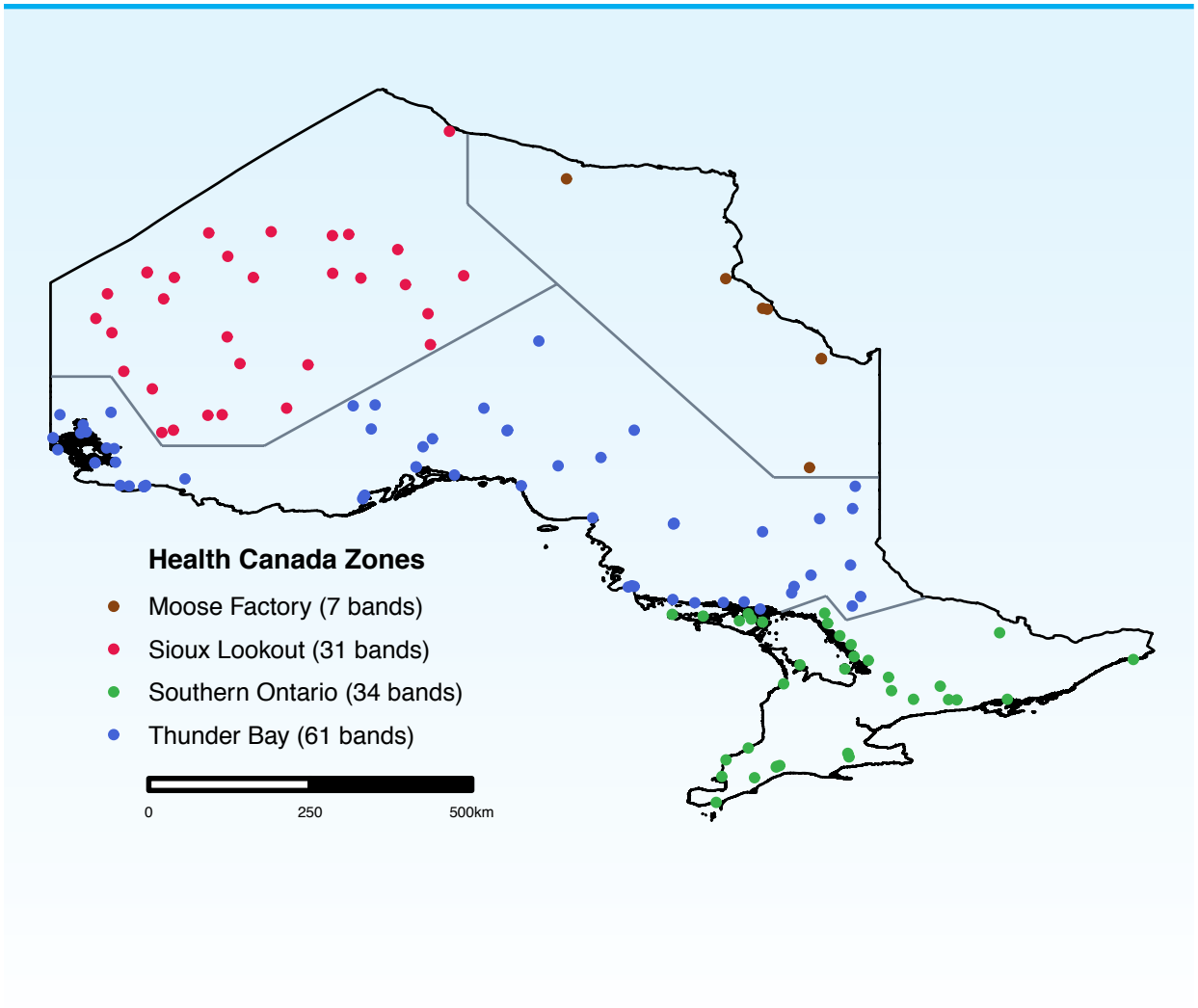
Covariates

Many other variables were considered in the analysis, including age at index, sex, multimorbidity, urban/rural location, Local Health Integration Network and Health Canada zone. Multimorbidity was assessed using the Johns Hopkins Aggregate Diagnosis Groups (ADGs), which are aggregations of similar types of health conditions that can be used to count the number of comorbid condition types that a patient has.[5] ADGs are therefore used descriptively as a measure of comorbidity.

Urban-rural location was assigned using the Rurality Index for Ontario (RIO).[6] The RIO is a broad measurement of rurality, based on the dissemination area of a person's postal code. A RIO score of 0 to 9 indicates a major urban centre, 10 to 39 specifies a non-major urban centre (referred to as semi-urban in this report) and 40 or higher is considered rural. We categorized individuals with a missing RIO score as 'no score', as this captures primarily remote and small rural areas. Health Canada zones are geographical units used by Health Canada for the determination and allocation of regional benefits. Often, these units are helpful in informing policy discussions and in analyzing geographic distributions. The four Health Canada zones in Ontario are mapped in exhibit 2.2.

Whole population data sets were used in all analyses, and therefore we did not use formal statistical tests to evaluate whether rates generated for one region or community were higher or lower than the provincial average or from each other.

EXHIBIT 2.2 Distribution of First Nations communities in Ontario, by Health Canada zone, 2019



Source: Based on the First Nations directory available on the Chiefs of Ontario website (http://www.chiefs-of-ontario.org) as at February 27, 2019.

Data limitations

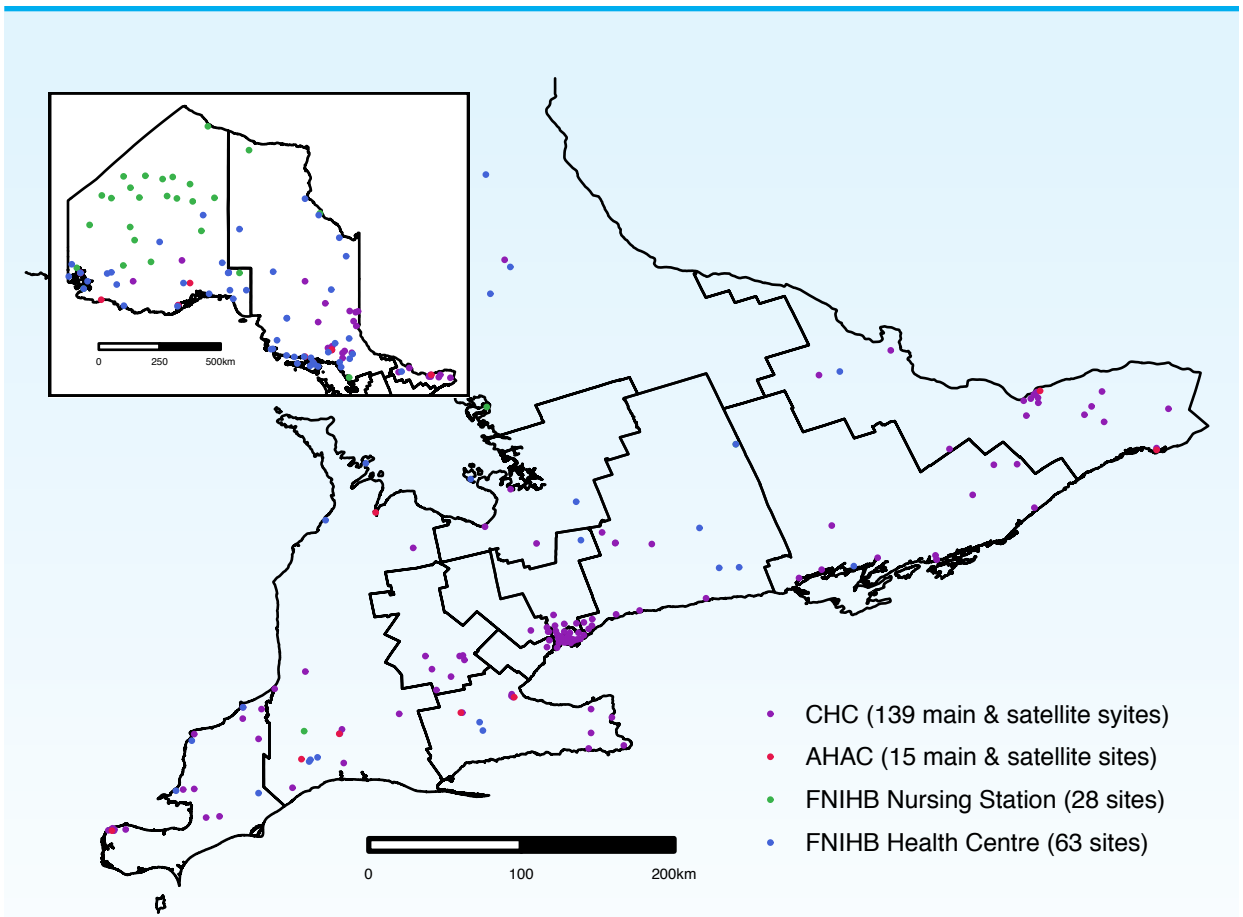
There are several limitations to the use of administrative data generally[7] and First Nations data specifically.

The Ontario Diabetes Database (ODD) does not distinguish between type 1 and type 2 diabetes. While this may not influence rates generated for the entire population with diabetes (90%–95% of whom have type 2 diabetes), it may be a greater factor in populations with a younger age distribution, such as First Nations populations.[8] The ODD is also unable to capture those individuals whose diabetes is undiagnosed. However, a recent study found high rates of screening among Ontarians aged 40 years and older (approximately 90% over 5 years),[9] suggesting that the percentage of all cases that remain undiagnosed is likely to be small.

Population denominators based on the Registered Persons Database (RPDB) will not capture individuals who have had a lapse in their health care coverage, which may lead to rates of diabetes being overestimated in some regions or communities. The RPDB may not have up-to-date postal codes for all individuals living in the province, and this may influence the diabetes rate generated for a given region or community.

Health data from Aboriginal Health Access Centres (AHACs) and Community Health Centres (CHCs) were not available to be included in the analyses. Similarly, care provided at federally funded nursing stations or health centres are not billed to OHIP and are not captured in our data sources. Locations of AHACs, CHCs and federally funded nursing stations and health centres are shown in exhibit 2.3. In addition, visits to non-physician health care providers (e.g., those in a nurse-led clinic) or visits to out-of-province physicians (e.g., by individuals who live in northwestern Ontario and receive care in Manitoba or who live in southeastern Ontario and receive care in Quebec) would not be captured.

EXHIBIT 2.3 Distribution of Community Health Centres, Aboriginal Health Access Centres, nursing stations and health centres in Ontario, by Local Health Integration Network, 2018*



CHC: Community Health Centre; AHAC: Aboriginal Health Access Centre; FNIHB: First Nations and Inuit Health Branch, Government of Canada.
Sources: CHC and AHAC locations were taken from the Association of Ontario Health Centres website (https://www.aohc.org). Locations of nursing stations and health centres in the North West and North East Local Health Integration Networks (LHINs) were taken from the 211 Ontario North website (http://search.211north.ca/); for the other LHINs, these locations were taken primarily from THEHEALTHLINE.CA Information Network (http://www.thehealthline.ca/).

Most administrative data–based studies conducted at ICES use income quintiles for a defined geographic area as a proxy for individual level socioeconomic status. In the general population this works well in most areas but is known to be less accurate in large rural regions.[10] Prior work at ICES on cancer among First Nations people[11] and a preliminary analysis using our data set suggest that this proxy method is not sufficiently accurate for use in the status First Nations population so we are unable to include this important covariate in these analyses.

Data availability

The data set from this study is held securely in coded form at ICES. While data sharing agreements prohibit ICES from making the data set publicly available, access may be granted to those who meet prespecified criteria for confidential access. The data set creation plan is available from the authors upon request.

Methods for the Analysis of RHS Data

In chapter 12, the Regional Health Survey (RHS), Phase 3, was used to describe the distribution of diabetes risk factors among First Nations people living in First Nations communities in Ontario. The RHS is a national First Nations health survey that collects health, social determinants and well-being information on First Nations people living on reserve and in northern communities across Canada.[12,13] In addition, the Diabetes Population Risk Tool (DPoRT) was applied to risk factor data from the RHS to estimate 10-year diabetes incidence and future diabetes cases among First Nations people living in First Nations communities in Ontario. DPoRT is a population-based risk prediction algorithm that estimates the 10-year incidence of physician diagnosed type 2 diabetes using self-reported risk factor information from health surveys, including age, sex, body mass index, education, smoking status, heart disease and hypertension.[14,15]

Diabetes risk estimates were restricted to First Nations adults aged 20 years and older who did not self-report a diagnosis of diabetes and were not pregnant at the time of the RHS interview. After exclusions, a total of 936 RHS respondents were retained for the analysis, representing 50,703 First Nations people living in First Nations communities in Ontario.

DPoRT risk equations were applied to risk factor information in the RHS to estimate each survey respondent's 10-year risk of developing diabetes (incidence). Diabetes risk estimates were averaged across all respondents to determine the risk of diabetes in the First Nations on-reserve population starting in 2015/16. The number of new cases of diabetes expected over the 10-year period was estimated by multiplying the average risk by the population size. All estimates were weighted using sampling weights to produce estimates reflecting the population of First Nations people living in First Nations communities. All analyses were conducted at the Chiefs of Ontario office using SPSS, version 23.

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Appendix

EXHIBIT 2.1A Databases accessed at ICES

Data set	Description
Canadian Organ Replacement Register (CORR)	This data set records and analyzes the level of activity and outcome of vital organ transplantation and renal dialysis activities.
Client Agency Program Enrolment (CAPE)	The CAPE data set identifies patients enrolled in different primary care models over time. A separate file provided by the Ministry of Health and Long-Term Care (MOHLTC) identifies the physicians who were part of a Family Health Team.
Corporate Provider Database (CPDB)	This database includes physician birth date, gender, school of graduation, year of graduation, reported specialties and postal code of practice.
Discharge Abstract Database (CIHI-DAD)	The DAD is compiled by the Canadian Institute for Health Information; it captures administrative, clinical and demographic information on hospital discharges, including deaths.
ICES Physician Database (IPDB)	The IPDB contains information about physicians practicing in Ontario. It is created and maintained by ICES, using data from several sources including: the Ontario Physician Human Resources Data Centre (OPHRDC), the OHIP Corporate Provider Database (CPDB), and the OHIP database of physician billings. The IPDB includes: demographic information about each physician (i.e., age, sex), practice location, physician specialty, services provided, where each physician was trained and year of graduation.
Indian Register	The Indian Register is the official record identifying persons registered as Status Indians under the *Indian Act*. According to section 5 of the Act, Indigenous and Northern Affairs Canada is responsible for maintaining the register. The register contains band numbers that allow for the assignment of individuals to the First Nations community where they have membership; it also contains demographic and administrative information on all registered or Status First Nations people in Canada. The register was linked to the data at ICES by resolution and under a data governance agreement with the Chiefs of Ontario and is used to identify First Nations people in Ontario.
National Ambulatory Care Reporting System (NACRS)	This data set is maintained by the Canadian Institute for Health Information. It contains data for all hospital- and community-based ambulatory care, such as day surgery and emergency department visits, including chief complaint (reason for visit). NACRS data are available from 2002 onward.
Ontario Diabetes Database (ODD)	The ODD is a validated registry of all people in Ontario diagnosed with diabetes. It was created at ICES using hospital discharge abstracts (from the Discharge Abstract Database [DAD] and Same Day Surgery [SDS]), Ontario Health Insurance Plan (OHIP) claims and Registered Persons Database (RPDB).
Ontario Drug Benefit (ODB)	The ODB Program database identifies the drug, dose and date for outpatient drug dispensations through publicly funded drug programs in Ontario. Eligible recipients are all Ontario residents aged 65 and older and selected younger populations.
Ontario Health Insurance Plan (OHIP)	This database records all claims for reimbursement by Ontario physicians for inpatient and ambulatory visits, consultations and procedures. It also include claims from optometrists for publicly funded reimbursement and from laboratories for all diagnostic tests performed.
Ontario Laboratories Information System (OLIS)	OLIS provides laboratory results of individuals from all Public Health Ontario laboratories and a number of hospitals and community laboratories.

Data set	Description
Ontario Mental Health Reporting System (OMHRS)	This database contains admissions to mental health–designated hospital beds and includes the most responsible diagnosis for admission.
Ontario Mother-Baby linked data set (MOMBABY)	This data set is derived at ICES to link the inpatient admission records of delivering mothers and their newborns. Ideally, each record corresponds to a mother-child pair. However, in cases when a mother-record was identified but the corresponding child-record was not found, or vice versa, a MOMBABY record is still created with all the available information.
Ontario Population Estimates and Projections	Generated by Statistics Canada and made available by the Ontario Ministry of Health and Long-Term Care through IntelliHealth Ontario, this data set provides Ontario population estimates and projections by sex, age and geographic areas.
Primary Care Population data set (PCPOP)	PCPOP is an ICES derived population-level data set that includes all people in Ontario who are deemed eligible at the index date in question. An eligible person would be an Ontario resident who was alive at the index, has had some contacts with the health care system within 7–9 years of index and had OHIP eligibility. PCPOP data is available from 2000 onward. Each quarterly data set includes basic demographic variable, information on primary care rostering identifying a patient's attachment status (rostered, virtually rostered or not rostered /not in PEM) along with other variables such as ED visits, hospitalization, access to specialty care, continuity of care and models of care.
Registered Persons Database (RPDB)	The RPDB provides demographic information about all individuals who have received an Ontario health card number, including their date of birth, sex and home address.
Same Day Surgery (SDS)	This database includes ambulatory care visits for inpatient surgery or to the emergency department.

3 Demographic Characteristics of First Nations People in Ontario

Inside

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Overview

First Nations people account for 1.2% of the overall population of Ontario, a proportion that has remained constant from 1999/00 to 2014/15, despite the number of First Nations people increasing from 128,468 to 158,241 in that period. The proportion of First Nations people living in First Nations communities has slightly decreased, from 36.4% in 1995/96 to 35.0% in 2014/15.

First Nations people in Ontario are, on average, younger than other people in the province (exhibits 3.1 and 3.2). Those living in First Nations communities tend to be slightly younger than those living outside of First Nations communities (exhibit 3.3); 75.3% of those living in First Nations communities are under the age of 50 compared to 74.7% of those living outside of First Nations communities.

Compared to other people in Ontario, more First Nations people live in rural areas of the province (exhibit 3.4). Northern Ontario has the highest proportion of First Nations people (exhibit 3.5); however, 50% of those living outside of First Nations communities reside in southern Ontario (exhibit 3.6).

First Nations people living in First Nations communities have fewer comorbid conditions than those living outside of First Nations communities (exhibit 3.7).

EXHIBIT 3.1 Demographic characteristics of First Nations people, including those living in and outside of First Nations communities, and of other people in Ontario, 2014/15

Key Findings

- Compared to other people in Ontario, the First Nations population is younger. In 2014/15, the average age of First Nations people in Ontario was 34 years, compared to 41 years for other people in Ontario.
- The First Nations population living in First Nations communities is younger than those living outside of First Nations communities. In 2014/15, 56.0% of First Nations people living in First Nations communities were 34 years of age or younger, compared to 53.1% of those living outside of First Nations communities.
- In 2014/15, 50.2% of the First Nations population was male compared to 49.0% for the rest of Ontario.

Characteristic	First Nations people*	Other people in Ontario	First Nations people	
			Living in FN communities	Living outside of FN communities
Population	**158,241**	**13,248,443**	**55,311**	**102,889**
Age (years)				
Mean ± SD	34.11 ± 19.84	40.79 ± 22.54	33.07 ± 20.52	34.68 ± 19.45
Median (IQR)	32 (18–50)	41 (22–58)	30 (16–49)	32 (19–50)
Age group, n (%)				
0–19	44,856 (28.3)	2,829,983 (21.4)	17,965 (32.5)	26,884 (26.1)
20–34	40,855 (25.8)	2,635,661 (19.9)	13,019 (23.5)	27,815 (27.0)
35-49	32,926 (20.8)	2,745,274 (20.7)	10,660 (19.3)	22,258 (21.6)
50–64	27,606 (17.4)	2,863,509 (21.6)	9,324 (16.9)	18,279 (17.8)
65–74	8,060 (5.1)	1,213,258 (9.2)	2,885 (5.2)	5,174 (5.0)
75+	3,938 (2.5)	960,758 (7.3)	1,458 (2.6)	2,479 (2.4)
Sex, n (%)				
Female	78,877 (49.8)	6,759,006 (51.0)	26,557 (48.0)	52,299 (50.8)
Male	79,364 (50.2)	6,489,437 (49.0)	28,754 (52.0)	50,590 (49.2)

*Includes all First Nations people in the Indian Register even if their place of residence was missing or unknown; therefore, rows do not add to the totals shown for First Nations people.
SD: standard deviation; IQR: interquartile range.

EXHIBIT 3.2 Population pyramids of First Nations people and other people in Ontario, by age group and sex, 2014/15

Key Findings

- The age and sex distribution of First Nations people is different from that of other people in Ontario; in 2014/15, a greater proportion of First Nations people were younger in age and a slightly higher proportion were male.

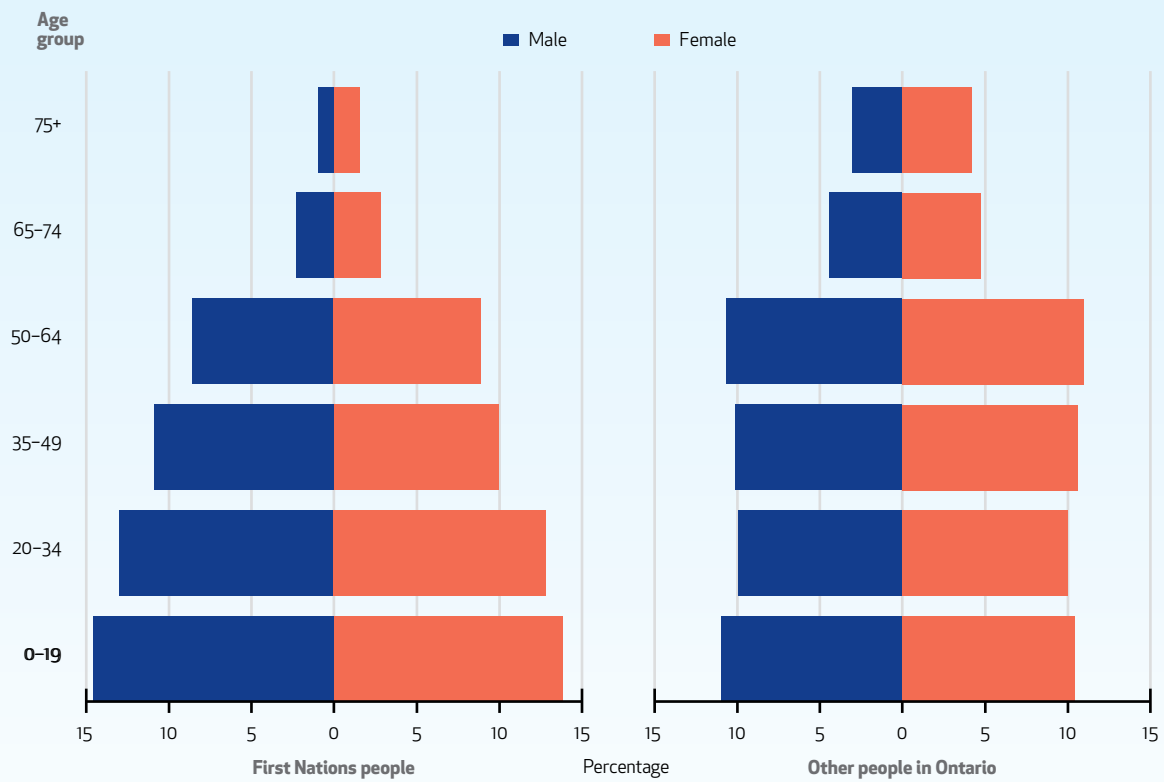


EXHIBIT 3.3 Population pyramids of First Nations people living in and outside of First Nations communities in Ontario, by age group and sex, 2014/15

Key Findings

- Compared with First Nations people living outside of First Nations communities, a greater proportion of those living in First Nations communities were young and male in 2014/15.

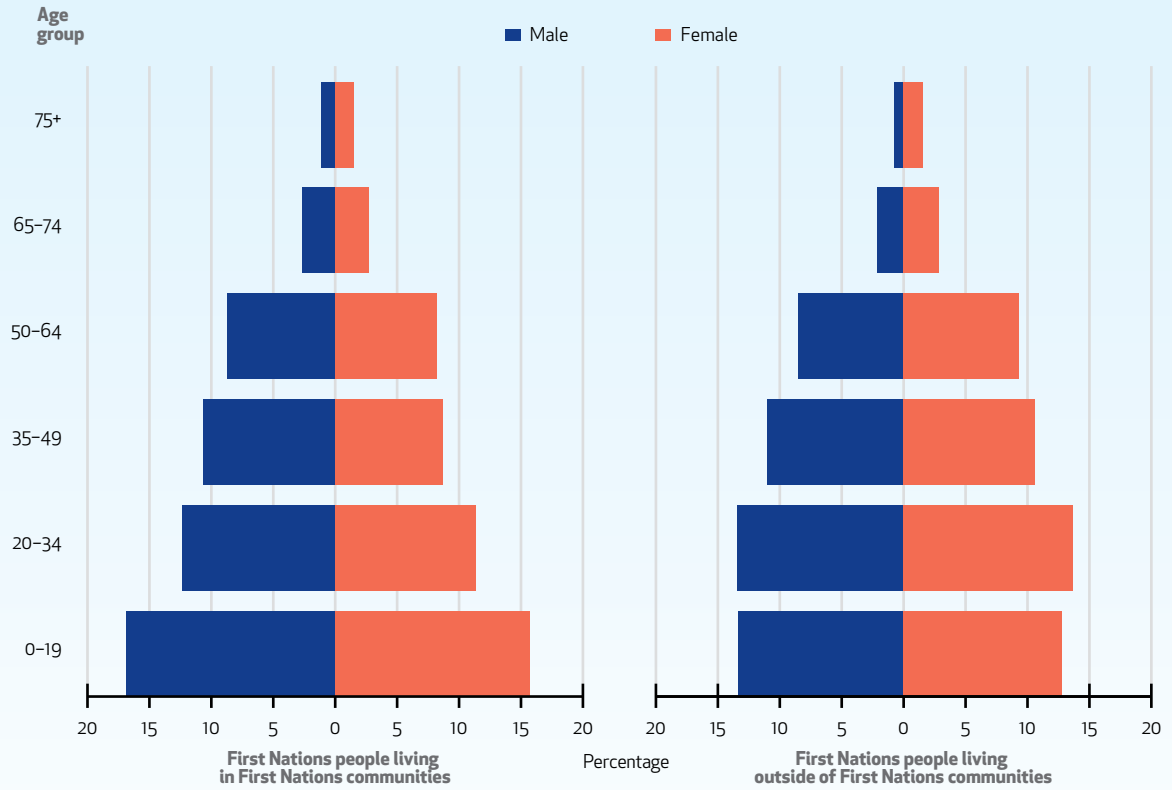


EXHIBIT 3.4 Geographic distribution of First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- In 2014/15, more than half of First Nations people in Ontario lived in semi-urban (19.1%), rural (20.3%) or remote (no RIO score, 27.5%) areas. By comparison, about a quarter of other people in Ontario lived in semi-urban (19.2%) and rural (7.1%) areas with only 0.5% having no RIO score. These proportions have remained constant over time (data not shown).

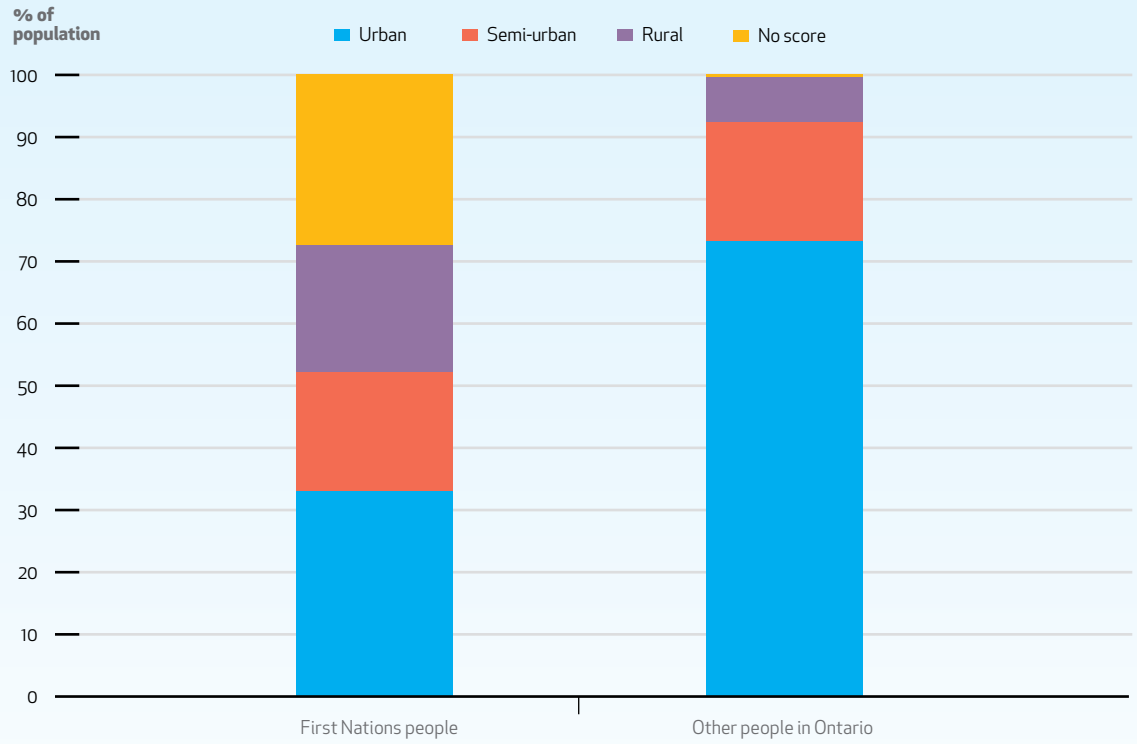


EXHIBIT 3.5 Percentage of the Ontario population identified as Status First Nations, by Local Health Integration Network, 2014/15

Key Findings

- In 2014/15, Northern Ontario had a high proportion of First Nations people; 18.1% of people living in the North West LHIN were Status First Nations. (Actual population numbers are shown in exhibit 3.1A in the chapter appendix.)

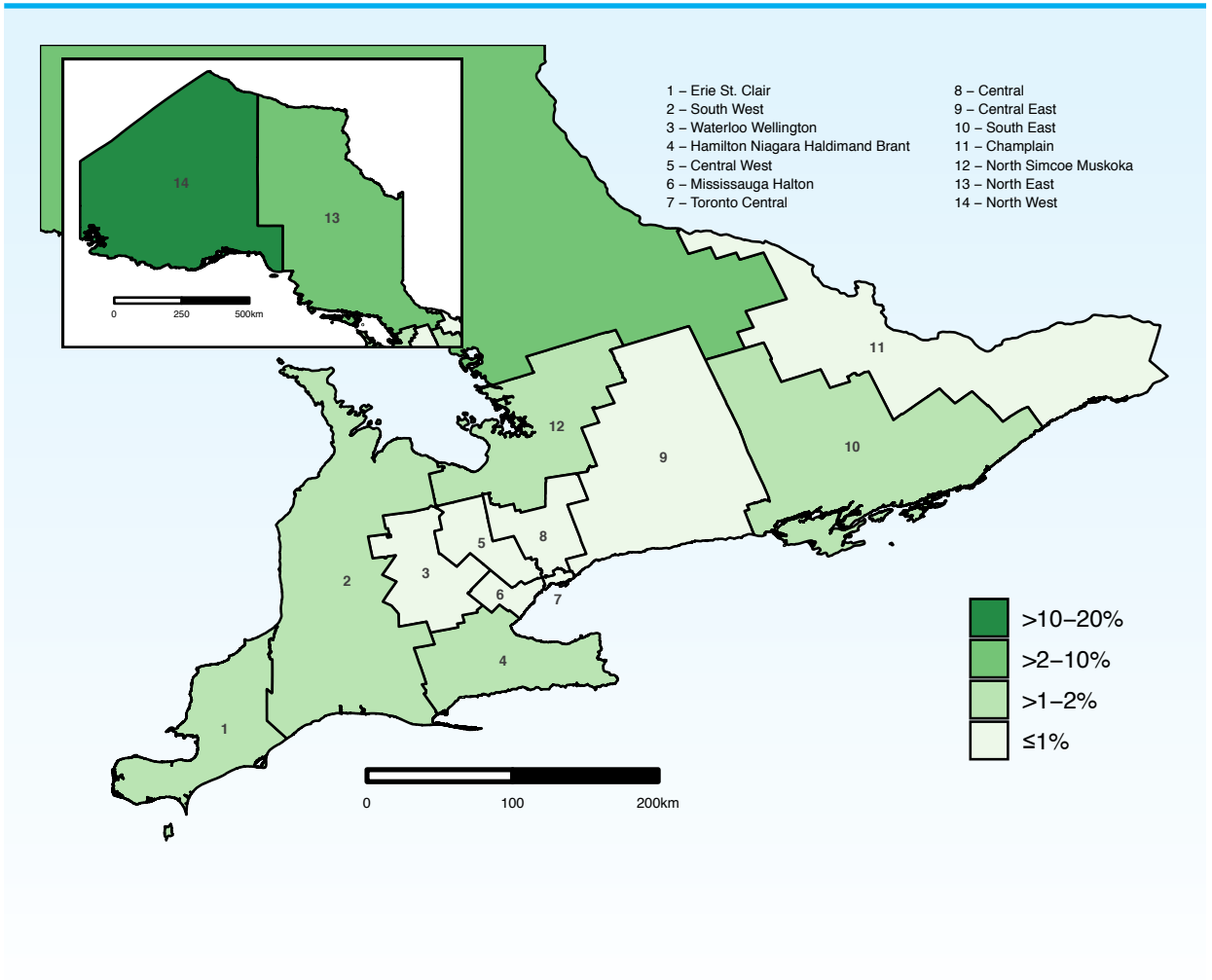


EXHIBIT 3.6 Percentage of First Nations people living in and outside of First Nations communities in Ontario, by Health Canada zone, 2014/15

Key Findings

- Of the four Health Canada zones in Ontario, the Southern Ontario zone had the highest proportion of First Nations people in 2014/15; of these, 41.4% lived in First Nations communities and 50.8% lived outside of First Nations communities.

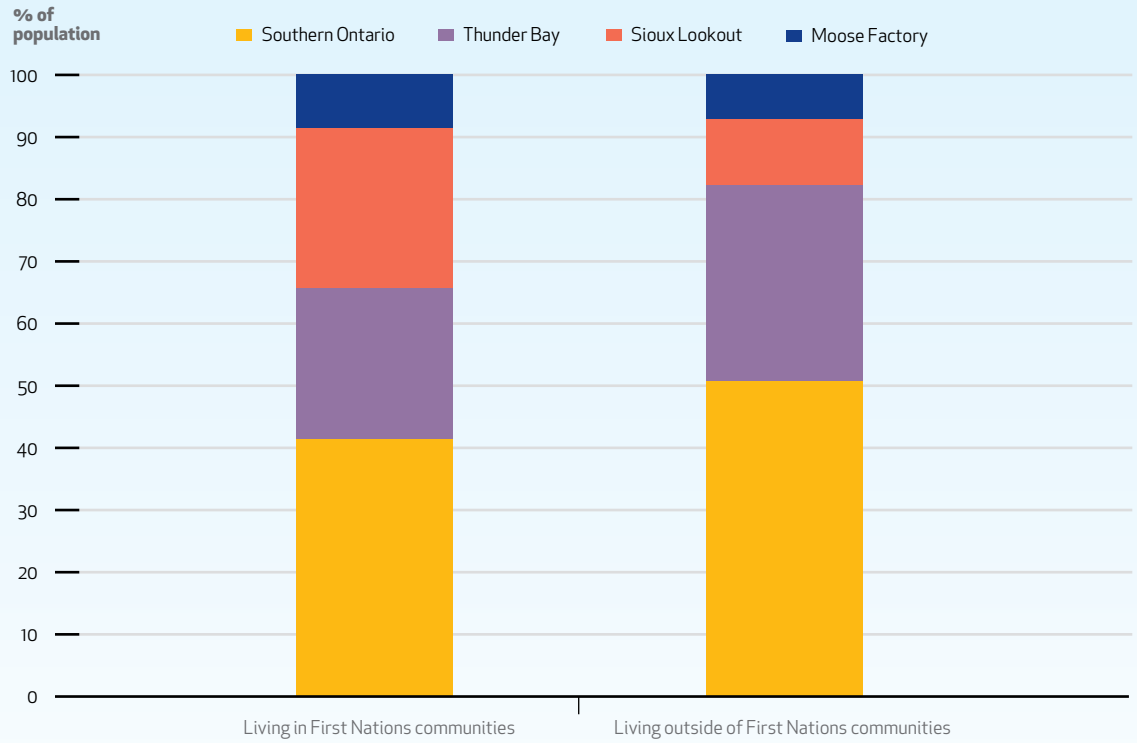
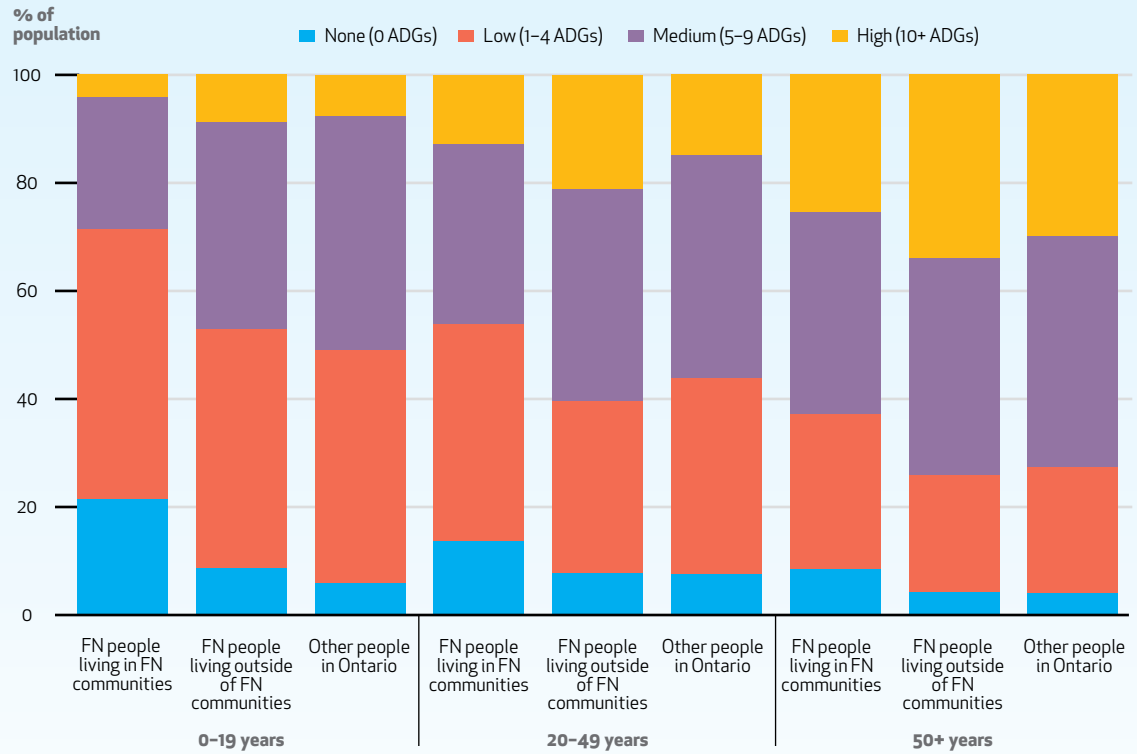


EXHIBIT 3.7 Percentage of individuals with comorbidity, among First Nations people living in and outside of First Nations communities and other people in Ontario, by age group and level of comorbidity, 2014/15

Key Findings

- In 2014/15, First Nations people living in First Nations communities had a lower rate of comorbidity than those living outside of First Nations communities.
- Among adults aged 50 and older, 8.4% of First Nations people living in First Nations communities had no comorbid conditions, compared to 4.2% of those living outside of First Nations communities and 4.1% of other people in Ontario.



ADG: Johns Hopkins Aggregate Diagnosis Group.

Discussion

In 2014/15, First Nations people accounted for 1.2% of Ontario's population. While this proportion may seem small, Ontario is Canada's most populous province; as such, Ontario has the highest number of Status First Nations people in Canada.[1]

First Nations people tend to be younger than other people in Ontario and live in the northern regions of the province. Over one-third of First Nations people live in a First Nations community. Those living in First Nations communities tend to have a lower rate of comorbid disease than those who live outside of First Nations communities; this may be due to the fact that those living outside of First Nations communities tend to be younger. However, First Nations people may be leaving First Nations communities as they age or experience illness or disease to be closer to health care services. First Nations people living with diabetes have noted that a major barrier to receiving care is the lack of health care providers in their communities, resulting in the need to travel to receive appropriate care.[2]

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Appendix

EXHIBIT 3.1A Population of First Nations people and other people in Ontario, overall and by Local Health Integration Network, 2014/15

Region	First Nations people	Other people
Ontario	158,241	13,248,433
Local Health Integration Network		
1. Erie St Clair	8,050	627,017
2. South West	10,766	935,141
3. Waterloo Wellington	2,529	751,658
4. Hamilton Niagara Haldimand Brant	20,245	1,388,633
5. Central West	1,506	898,757
6. Mississauga Halton	1,733	1,175,283
7. Toronto Central	4,675	1,180,437
8. Central	2,525	1,789,305
9. Central East	6,894	1,559,786
10. South East	5,791	483,239
11. Champlain	9,112	1,264,373
12. North Simcoe Muskoka	5,736	459,413
13. North East	35,318	534,311
14. North West	43,309	195,440

4 Diabetes Risk and the Social Determinants of Health

Inside

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Overview

There are several risk factors for the development of type 2 diabetes. Some factors related to diabetes risk are nonmodifiable, such as genetic disorders, age and ethnicity.[1] Other diabetes risk factors are potentially modifiable, such as high blood pressure, overweight/obesity, physical inactivity and smoking.[1] In addition, social determinants of type 2 diabetes risk, such as income and food insecurity, can be influenced though programming or policy interventions.[1]

Understanding how risk factors for type 2 diabetes are distributed at the population-level can help focus efforts on diabetes prevention strategies that are meaningful to First Nations people. Further, meaningful prevention efforts can be informed by decision-support tools, such as the Diabetes Population Risk Tool that predicts future diabetes burden by making use of risk factor information that is routinely collected in population surveys.[2]

This chapter uses the Regional Health Survey, Phase 3, to describe the distribution of diabetes risk factors among First Nations people living in First Nations communities in Ontario.[3,4] In addition, the Diabetes Population Risk Tool (DPoRT) was applied to risk factor data from the RHS to estimate the future number of new diabetes cases in the First Nations population living in First Nations communities in Ontario.

Methods

The Regional Health Survey collects health, social determinants and well-being information on First Nations people living in First Nations communities and in northern communities across Canada.[3,4] We used phase 3 of the survey to estimate the distribution of diabetes risk factors for the population of First Nations people living in First Nations communities in Ontario. Type 2 diabetes risk estimates were restricted to survey participants aged 20 years and older who did not self-report a diagnosis of diabetes and were not pregnant at the time of interview.

DPoRT is a validated population-based risk prediction algorithm that estimates the future risk of type 2 diabetes using self-reported risk factor information from health surveys, including age, sex, body mass index, education, smoking status, heart disease, and hypertension.[2] DPoRT risk equations were applied to risk factor information in the RHS data to generate estimates for diabetes risk and number of new cases to be expected over the 10-year period from 2015/16 to 2025/26. DPoRT was originally developed by linking a cohort of respondents from the National Population Health Survey to the Ontario Diabetes Database, an ICES-derived cohort that uses health administrative data to determine incident cases of diabetes in Ontario.[5] The model was validated in external cohorts in multiple provinces and across ethnic groups.[2,6] The appropriateness of applying DPoRT to data relevant for First Nations communities was determined in collaboration with the Chiefs of Ontario by applying the original DPoRT model and adjusted DPoRT models[b] to the RHS data and examining the model's predictive accuracy in classifying individuals with self-reported diabetes as high risk (≥20%), and by comparing predicted DPoRT risk estimates with published estimates of diabetes incidence among First Nations populations.[7] For this analysis, we used the original DPoRT model, which was determined to demonstrate the most accurate predictive performance in the RHS data. All analyses were conducted at the Chiefs of Ontario offices using SPSS, version 23, and all estimates incorporated survey weights to accurately reflect the First Nations population.

[b] DPoRT models were adjusted by adding three additional risk factors that the Chiefs of Ontario identified as relevant to diabetes risk in First Nations People: food insecurity, residential school attendance, and anxiety/mood disorders. We examined the performance of these models and found that the adjusted DPoRT models did not outperform the original model and were overestimating diabetes risk; therefore, the adapted models were not used in our analysis.

Results

Diabetes risk factors

The prevalence of key risk factors that contribute to type 2 diabetes are summarized in exhibit 4.1. Nearly all First Nations people living in First Nations communities are eating traditional foods. However, many First Nations people experience a number of risk factors and socioeconomic disadvantages that put them at risk for type 2 diabetes. Overall, First Nations adults living in First Nations communities were observed to experience a high prevalence of low household income and food insecurity. The most prevalent modifiable risk factors were physical inactivity, overweight/obesity and smoking.

Estimated future diabetes cases

DPoRT estimated that between 2015/16 and 2025/26, 3,501 First Nations people aged 20 and older living in First Nations communities will be newly diagnosed with diabetes, based on 2013 BMI levels and other risk factors. The 10-year incidence risk for developing diabetes was 9.6%, meaning that about 1 in 10 First Nations people living in First Nations communities are predicted to develop diabetes during the 10-year period. This prediction corresponds with annual diabetes incidence rates estimated for First Nations people in Ontario, as presented in chapter 5. Exhibits 4.2 to 4.5 illustrate how diabetes risk and new diabetes cases are expected to be distributed across sociodemographic and risk factors.

Diabetes cases by age

Older First Nations people living in First Nations communities are estimated to have a higher 10-year risk of developing type 2 diabetes than their younger counterparts; however, approximately the same number of new diabetes cases are expected to occur in both age groups (exhibit 4.2). This predicted distribution of new diabetes cases is partly because First Nations people exhibit a young population structure (as discussed in chapter 3).

Diabetes cases by socioeconomic factors

Socioeconomic factors were predicted to be important contributors to the incidence of diabetes in First Nation communities. Of the total number of new diabetes cases projected for First Nations people living in First Nations communities in the 10 years between 2015/16 and 2025/26, about half will occur among those with a household income of less than $50,000 and those who are experiencing food insecurity (exhibit 4.3).

Diabetes cases by modifiable risk factors

Potentially modifiable risk factors were observed to contribute to the incidence of diabetes in First Nations communities. The risk of developing type 2 diabetes among First Nations people living in First Nations communities is patterned by weight and physical inactivity. Specifically, the 10-year diabetes risk and the number of new cases is predicted to be disproportionately higher among individuals classified as overweight/obese and physically inactive and lower among those with normal weight and physically active (exhibit 4.4). Although First Nations people living in First Nations communities with high blood pressure were observed to have an elevated 10-year risk of developing type 2 diabetes, those with normal blood pressure are projected to account for a greater share of new diabetes cases. Similarly, the number of new diabetes cases is projected to be higher among current smokers, relative to the estimated number of cases in never or former smokers (exhibit 4.5).

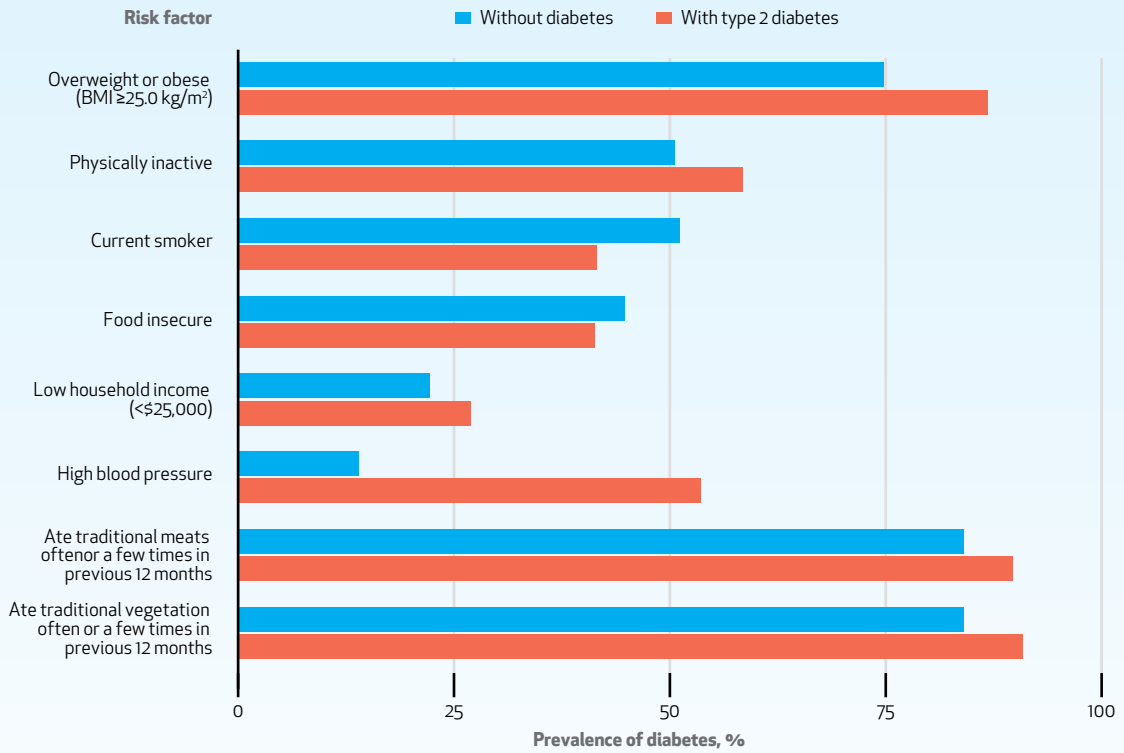
Diabetes risk associated with eating traditional foods

First Nations adults who consumed traditional vegetation (e.g., berries, wild plants and wild rice) often or a few times in the previous 12 months were predicted to have slightly lower diabetes risk than those who reported not at all. The consumption of traditional meats was not associated with differences in diabetes risk in First Nations adults (exhibit 4.6).

EXHIBIT 4.1 Prevalence* of type 2 diabetes among First Nations people aged 20 years and older living in First Nations communities in Ontario, by risk factor, 2015/16

Key Findings

- In 2015/16, most First Nations adults had consumed traditional meats (e.g., land-based animals, fresh-water fish, game birds) and vegetation (e.g., berries, wild rice) in the previous year. Among adults without diabetes, 84.0% consumed meats and 84.0% vegetation; among adults with diabetes, 89.7% consumed meats and 90.8% vegetation.
- Overweight and obesity were experienced by about three-quarters of First Nations adults living in First Nations communities (86.8% of those with diabetes, 74.8% of those without). This is higher than the prevalence in the general population (71.0% of those with diabetes, 50.6% of those without). About half of First Nations adults reported being physically inactive (58.4% of those with diabetes, 50.5% of those without).
- Of First Nations adults living in First Nations communities, almost 1 in 3 experienced food insecurity (41.3% of those with diabetes, 44.8% of those without) and about 1 in 5 had an annual household income of less than $25,000 (26.9% of those with diabetes, 22.2% of those without). In comparison, the Ontario general population had a lower prevalence of food insecurity (9.8% of those with diabetes, 7.3% of those without) and low household income (18.9% of those with diabetes, 11.3% of those without).

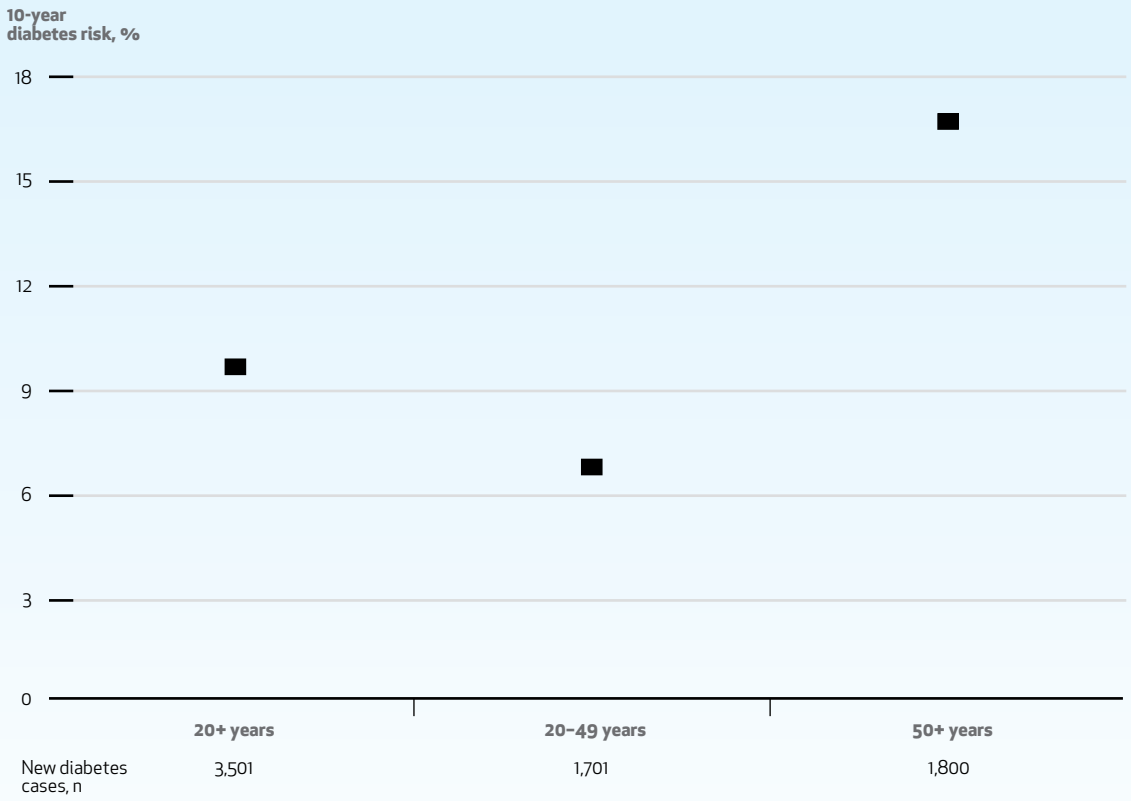


*Estimates are weighted percentages representing 39,494 First Nations people without diabetes and 11,209 First Nations people with diabetes who were 20 years of age and older and living in First Nations communities in Ontario in 2015/16.

EXHIBIT 4.2 Predicted number* of new diabetes cases and 10-year incidence risk among First Nations people living in First Nations communities in Ontario, by age group, 2015/16 to 2025/26

Key Findings

- Among First Nations people living in First Nations communities between 2015/16 and 2025/26, the estimated 10-year risk of developing diabetes is 16.7% among those aged 50 and older compared to 6.7% among those aged 20–49.
- A similar proportion of new diabetes cases is expected to occur among younger (aged 20–49) and older (aged 50 and older) adults living in First Nations communities (1,701 and 1,800 new cases, respectively).

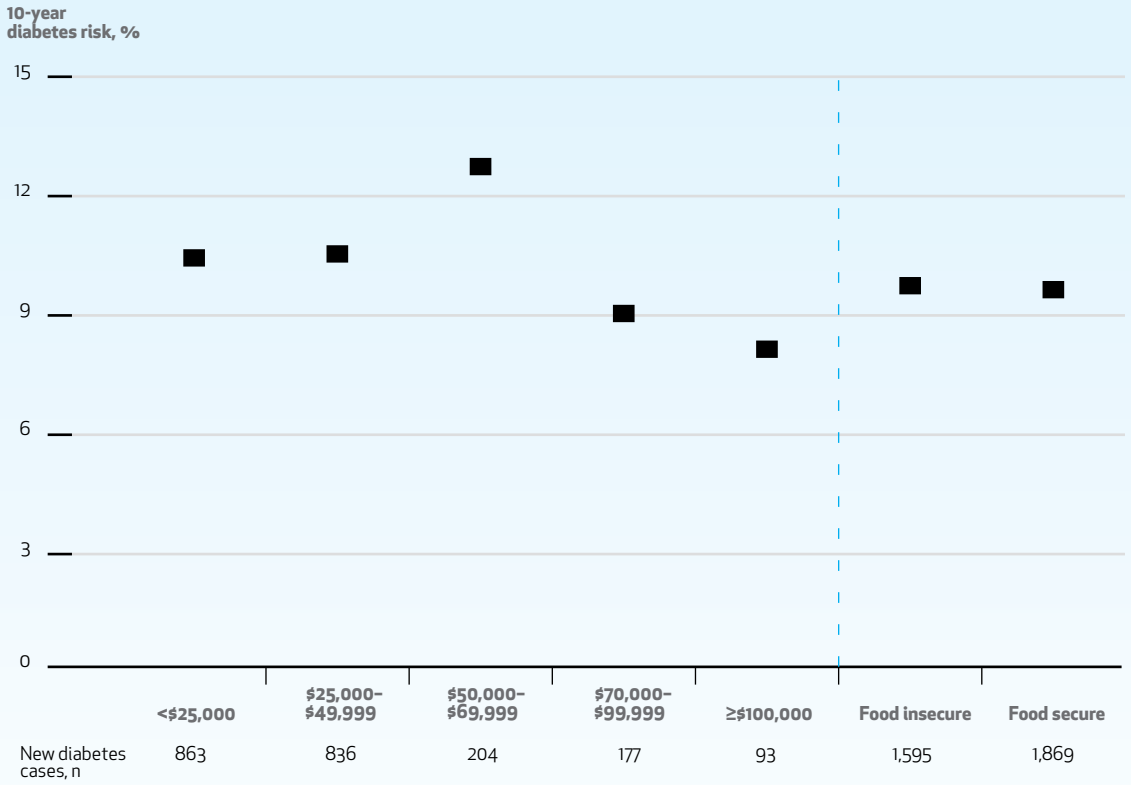


*Estimated with DPoRT.[2]

EXHIBIT 4.3 Predicted number* of new diabetes cases and 10-year incidence risk among First Nations people aged 20 years and older living in First Nations communities in Ontario, by level of income and food security, 2015/16 to 2025/26

Key Findings

- The 10-year incidence risk for diabetes among First Nations people living in First Nations communities is predicted to be 10.3% for those in the lowest income bracket (less than $25,000) and 10.4% for those in the second-lowest income bracket ($25,000–$49,999). These two income groups are predicted to account for 48.5% of new cases of diabetes (1,699 cases) expected to occur between 2015/16 and 2025/26.
- First Nations people living in First Nations communities who experience food insecurity are predicted to have a 10-year diabetes incidence of 9.6% and account for 45.6% of new cases of diabetes (1,595 cases) in the 10-year period.

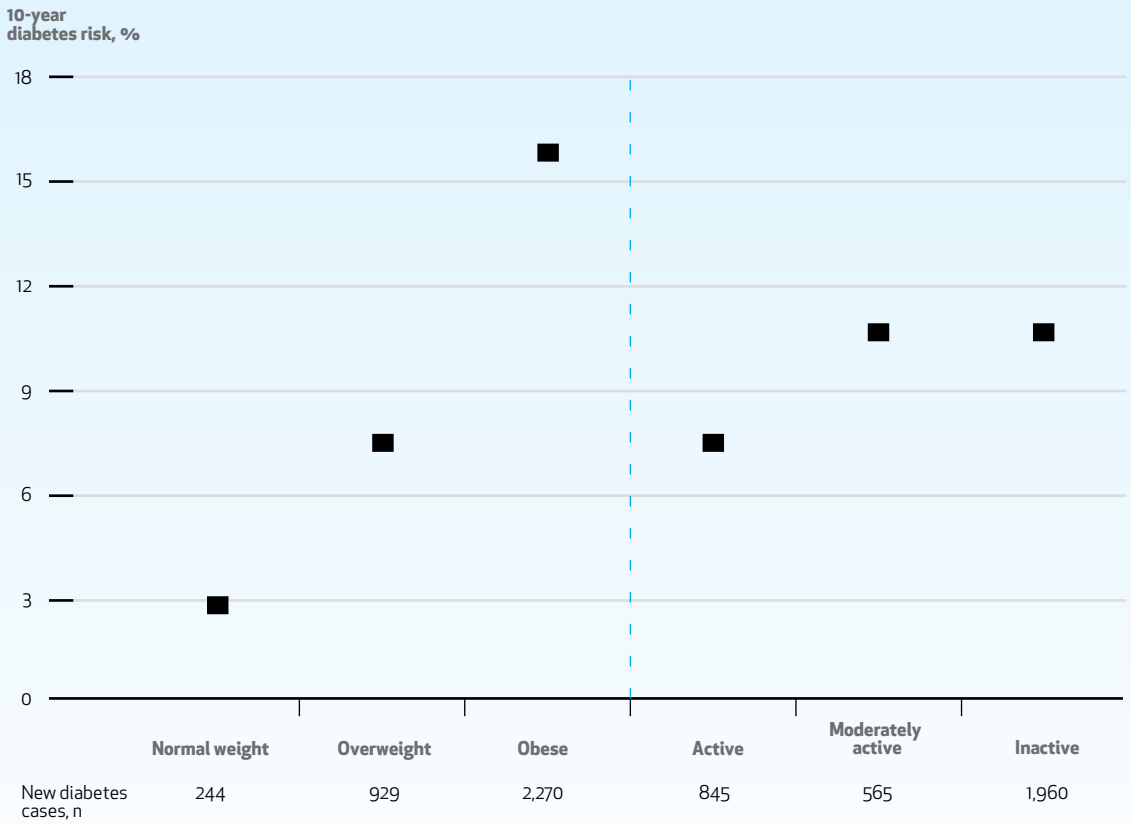


*Estimated with DPoRT.[2]

EXHIBIT 4.4 Predicted number* of new diabetes cases and 10-year incidence risk among First Nations people aged 20 years and older living in First Nations communities in Ontario, by body mass index† and level of physical activity‡, 2015/16 to 2025/26

Key Findings

- Between 2015/16 and 2025/26, the diabetes risk among First Nations adults living in First Nations communities increases with increasing body mass index and physical inactivity. The 10-year risk of developing diabetes will be highest among obese adults (15.8% risk) and moderately active or inactive adults (10.6% risk for each).
- Of the total number of new diabetes cases that are projected for First Nations adults living in First Nations communities, about two-thirds will occur among those who are obese (2,270 cases), about half among those who are physically inactive (1,960 cases) and about one-fifth among those who are overweight (929 cases).

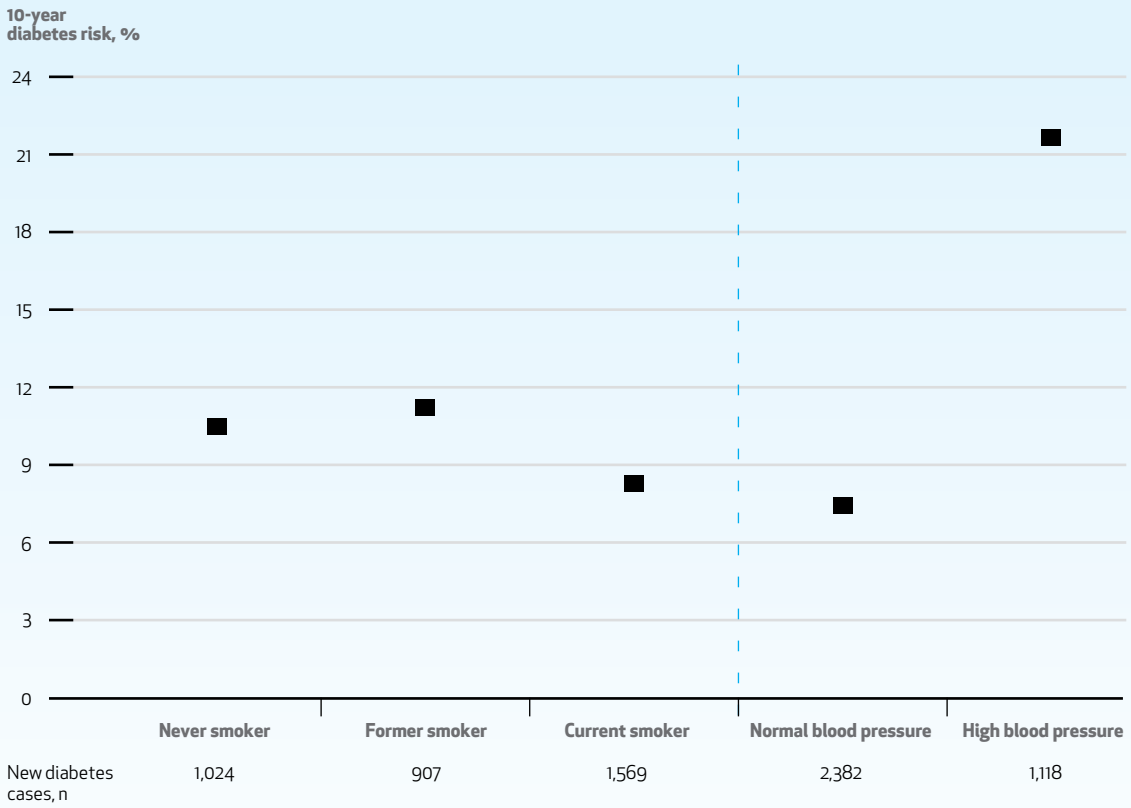


*Estimated with DPoRT.[2]
†BMI was calculated by dividing body weight by the square of body height (kg/m^2) and classified according to the international standard: normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2) or obese (≥30 kg/m^2).
‡Physical activity level was measured using the physical activity index in the First Nations Regional Health Survey, which calculates total energy expenditure by multiplying the number of times respondents engaged in each activity in the previous three months, average duration of participation in minutes, and metabolic equivalent (MET) value assigned to each activity. Respondents were categorized as being inactive (≤1.4 kcal/kg/day), moderately inactive (1.5-2.9 kcal/kg/day) or active (≥3.0 kcal/kg/day).

EXHIBIT 4.5 Predicted number* of new diabetes cases and 10-year incidence risk among First Nations people aged 20 years and older living in First Nations communities in Ontario, by smoking status and level of hypertension, 2015/16 to 2025/26

Key Findings

- Among First Nations people living in First Nations communities, current or former smokers have a predicted 10-year diabetes incidence risk of 8.4% and 11.2%, respectively. The largest number of new diabetes cases will occur among those who are current smokers (1,569 new cases), followed by never smokers (1,024 new cases) and former smokers (907 new cases).
- Among First Nations people living in First Nations communities, the 10-year diabetes incidence is predicted to be 21.1% for those with high blood pressure, compared to 7.6% among those with normal blood pressure. A larger proportion of new diabetes cases is expected to occur among those with normal blood pressure (2,382 new cases) compared to those with high blood pressure (1,118 new cases).

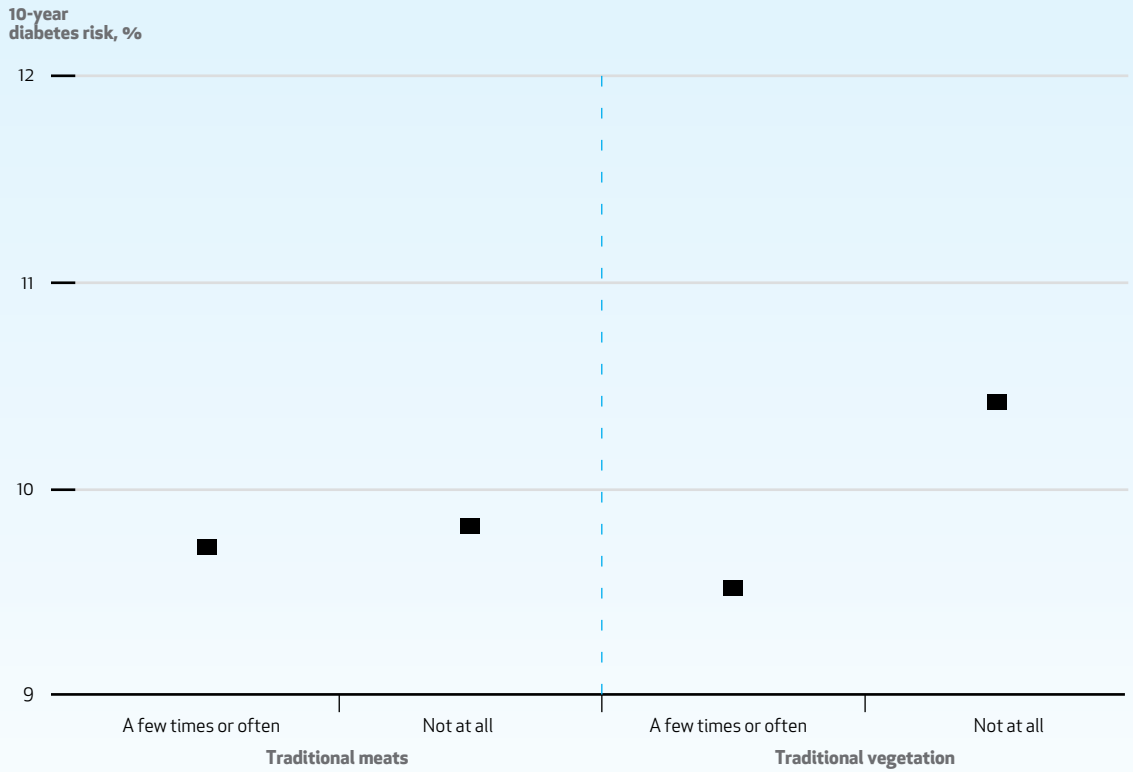


*Estimated with DPoRT.[2]

EXHIBIT 4.6 Predicted 10-year incidence risk of diabetes* among First Nations people aged 20 years and older living in First Nations communities in Ontario, by frequency of consumption of traditional foods in the previous 12 months, 2015/16 to 2025/26

Key Findings

- The predicted 10-year diabetes incidence risk was similar among First Nations adults who reported eating traditional meats either a few times/often or not at all in the previous 12 months (9.7% and 9.8%, respectively).
- Diabetes risk was predicted to be lower among First Nations adults who reported eating traditional vegetation a few times or often in the previous 12 months compared to those who reported not at all (9.5% and 10.4%, respectively).



*Estimated with DPoRT[2].

Discussion

We have shown that key socioeconomic and additional risk factors that contribute to type 2 diabetes are highly prevalent among First Nations adults living in First Nations communities in Ontario. The high prevalence of First Nations people who experience socioeconomic disadvantage relative to food insecurity and low household income is especially concerning. Moreover, overweight, obesity, and physical inactivity were shown to be among the most prevalent risk factors in First Nations adults that live in First Nations communities. However, it is noteworthy that almost all First Nations adults are eating traditional foods, demonstrating a connection to culture that is important for the health and well-being of First Nations people.[8]

Using DPoRT and risk factor information from the Regional Health Survey, we predicted that between 2015/16 and 2025/26, there will be 3,501 new cases of type 2 diabetes among First Nations people living in First Nations communities. The number of predicted cases of diabetes is a function of the diabetes risk associated with each risk factor and the prevalence of that risk factor in the First Nations population who live in First Nations communities.

We demonstrated that a large number of new diabetes cases will occur among those with the following characteristics:

- low household income (less than $50,000 per year)
- food insecure
- overweight or obese
- physically inactive

The results emphasize the importance of diabetes prevention among First Nations people and demonstrate that actions to address socioeconomic disadvantage and potentially modifiable risk factors are critical in reducing the incidence of diabetes. First Nations communities have an essential role in designing culturally appropriate policies and programming to prevent diabetes and address disparities in health and health care that are unique to First Nations communities.

Given that the diabetes burden was projected to disproportionately affect those experiencing socioeconomic disadvantage, efforts to address the factors that drive low household income and food insecurity among First Nations people living in First Nations communities are needed to realize meaningful reductions in diabetes. Remote northern First Nations communities in particular experience unique challenges in accessing healthy, inexpensive and traditional foods.[4,9] The results for diabetes risk and traditional food consumption suggest that First Nations people may particularly benefit from having access to traditional foods, such as berries, wild plants and wild rice.

Diabetes cases were also predicted to disproportionately occur among First Nations people who fall into the categories of overweight, obese or physically inactive. While high blood pressure and smoking were shown to be important factors, these risk factors are predicted to contribute to a smaller proportion of the total new diabetes cases expected among First Nations people. The findings suggest that a mix of population approaches that focus on weight loss and increasing physical activity levels, combined with targeted approaches to address hypertension and smoking have potential to reduce the incidence of new diabetes cases among First Nations people living in First Nations communities.

Limitations

The DPoRT estimates presented in this chapter should be interpreted in context, with several considerations. Although the DPoRT tool was determined to have appropriate predictive accuracy in that most First Nations people with self-reported diabetes were correctly classified as high risk, a small proportion were shown to be misclassified as low risk. Further, DPoRT was validated against physician-diagnosed diabetes as captured in the Ontario Diabetes Database, which does not capture individuals whose diabetes is not recognized by themselves or their doctor. Given these considerations, it is possible that the DPoRT estimates presented in this chapter may

understate the true diabetes risk and cases among First Nations people.

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5 Patterns of Diabetes Prevalence and Incidence

Inside

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Overview

Diabetes is now considered one of the largest global health emergencies.[1] This common, chronic condition is associated with high rates of morbidity and mortality.[2-5] The rate of diabetes is disproportionate among Indigenous peoples,[6,7] and high rates of prevalence and incidence have been documented for many First Nations populations in Canada.[5,8,9] The lifetime risk of diabetes among adults aged 18 years and older was recently estimated to be 8 in 10 for First Nations people and 5 in 10 for non-First Nations people.[10]

This chapter describes patterns of diabetes among First Nations people and compares them to those of other people in Ontario. Further, it explores the distribution of diabetes by sex, comorbidity and geographic region. Lastly, it compares mortality rates among First Nations people and other people in Ontario.

Methods

To calculate mortality rates, we created 20 cohorts, one for each 12-month period from April 1, 1995, to March 31, 2015. Each cohort consisted of all individuals listed in the Registered Persons Database who were Ontario residents eligible for a health card and alive on March 31 of the current year. All-cause mortality was estimated by following each cohort to determine which individuals had died in the current 12-month period.

Results

Diabetes prevalence

Diabetes prevalence is defined as the number of people living with a diagnosis of diabetes at a set point in time. Between 1995/96 and 2014/15, the prevalence of diabetes among First Nations people in Ontario increased (exhibit 5.1). In 2014/15, the prevalence of diabetes among all First Nations people in Ontario was 14.1%; among those aged 50 years and older, it was 38.9%. (Data on the crude prevalence of diabetes among other people in Ontario are presented in exhibit 5.1A in the chapter appendix.)

The prevalence of diabetes was higher among First Nations people than among other people in Ontario and highest among First Nations people living in First Nations communities (exhibit 5.2). In 1995/96, the prevalence of diabetes among First Nations people in Ontario was three times that of other people in Ontario; this had narrowed to a two-fold difference by 2014/15. (Age- and sex-adjusted prevalence rates of diabetes for First Nations people in Ontario from 1995/96 to 2014/15 are presented in exhibit 5.2A in the chapter appendix).

Among First Nations people, the age-adjusted prevalence of diabetes was higher among females than males; among other people in Ontario, the opposite was observed (exhibit 5.3). The variation in diabetes prevalence between men and women was much more pronounced among those living in First Nations communities compared to those who lived outside of First Nations communities. These trends have remained constant over time. (Sex-stratified rates of overall diabetes prevalence among First Nations people are presented in exhibit 5.3A in the chapter appendix.)

For both First Nations people and other people in Ontario, the prevalence of diabetes increased as the number of comorbid conditions increased (exhibit 5.4). This trend remained constant from 1995/96 to 2014/15.

First Nations people living in rural areas had a higher prevalence of diabetes compared with their urban counterparts; among other people in Ontario, the prevalence of diabetes was higher among those living in urban areas (exhibit 5.5). The highest prevalence rates for diabetes among First Nations people in Ontario were found in the North West LHIN and the South West LHIN at 19.2% and 18.1%, respectively (exhibit 5.6). (Prevalence rates for First Nations people stratified by Health Canada zone are presented in exhibit 5.4A in the chapter appendix.)

Diabetes incidence

Diabetes incidence measures the number of people newly diagnosed with the disease in a specific population over a set period of time. Between 1995/96 and 2014/15, the annual incidence of diabetes in First Nations people in Ontario slightly increased and then plateaued (exhibit 5.7). Among those aged 50 and older, the incidence of diabetes decreased from 2.0% per year in 1995/96 to 1.5% per year in 2014/15. (Data on the crude incidence of diabetes among other people in Ontario is available in exhibit 5.5A in the chapter appendix.)

Despite a decline in the incidence of diabetes among First Nations people in Ontario, the rate of new cases of diabetes remained higher among First Nations people than other people in Ontario (exhibit 5.8). The incidence of diabetes was similar for First Nations people living and outside of First Nations communities. The variation in the incidence of diabetes between First Nations people and other people in Ontario decreased from 2.2 times higher in 1995/96 to 1.6 times higher in 2014/15. (Age- and sex-adjusted incidence rates of diabetes for First Nations people in Ontario from 1995 to 2015 are presented in exhibit 5.6A in the chapter appendix).

Among First Nations people, the age-adjusted incidence of diabetes was similar for men and women; among other people in Ontario, the incidence of diabetes was higher among men (exhibit 5.9). This trend remained consistent from 1995/96 to 2014/15. The incidence of diabetes among First Nations men and women living in and outside of First Nations communities was similar (see exhibit 5.7A in the chapter appendix).

For both First Nations people and other people in Ontario, the incidence of diabetes increased as the number of comorbid conditions increased (exhibit 5.10). This trend remained constant between 1995/96 and 2014/15.

The incidence of diabetes was highest among First Nations people living in rural and remote areas; among other people in Ontario, the incidence of diabetes was highest among those living in urban areas (exhibit 5.11). In 2014/15, the incidence of diabetes among First Nations people was highest in the North West LHIN and the Central East LHIN (exhibit 5.12). The incidence rate of diabetes was higher among First Nations people living in First Nations communities in the Health Canada zone of Sioux Lookout, compared to those living outside of First Nations communities. Across all other Health Canada zones in Ontario, the incidence rates of First Nations people living in and outside of First Nations communities were similar (exhibit 5.13).

Mortality

While mortality rates decreased slightly from 1995/96 to 2014/15, they remained higher among First Nations people compared to other people in Ontario (exhibit 5.14).

EXHIBIT 5.1 Crude prevalence of diabetes for all ages and those aged 50 years and older, among First Nations people in Ontario, 1995/96 to 2014/15

Key Findings

- The prevalence of diabetes among First Nations people in Ontario rose from 6.1% in 1995/96 to 14.1% in 2014/15.
- The prevalence was much higher among those aged 50 years and older, increasing from 27.7% in 1995/96 to 38.9% in 2014/15.

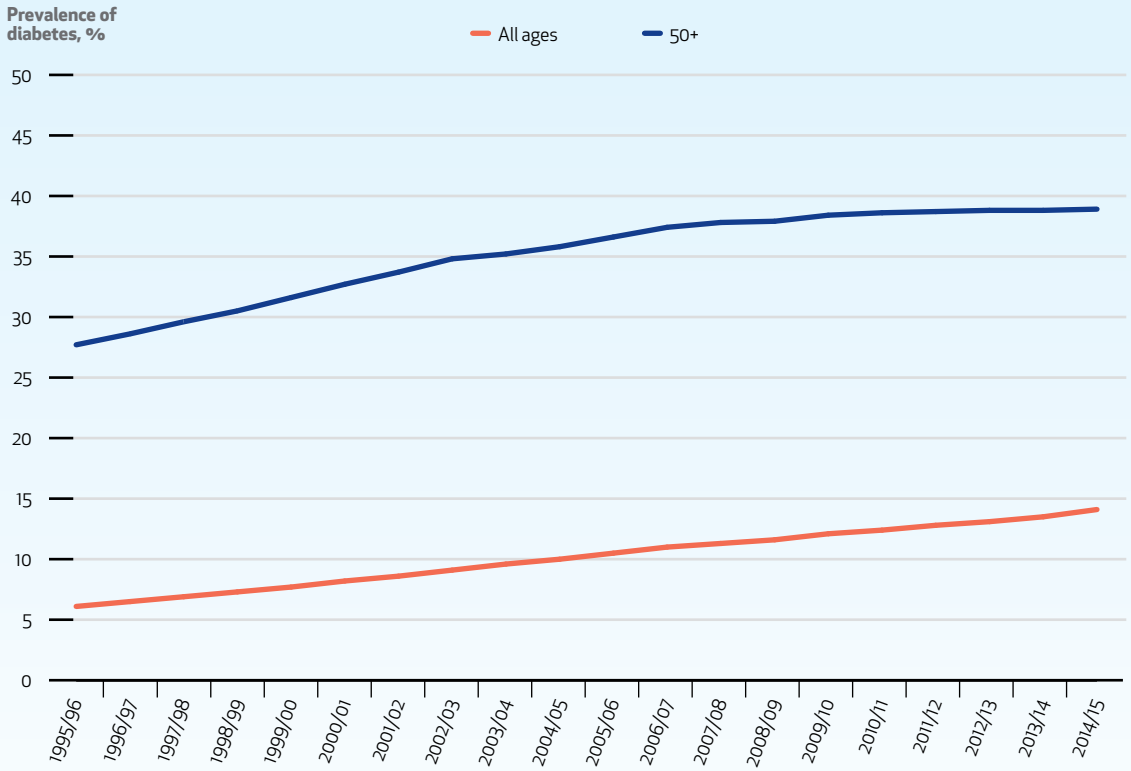
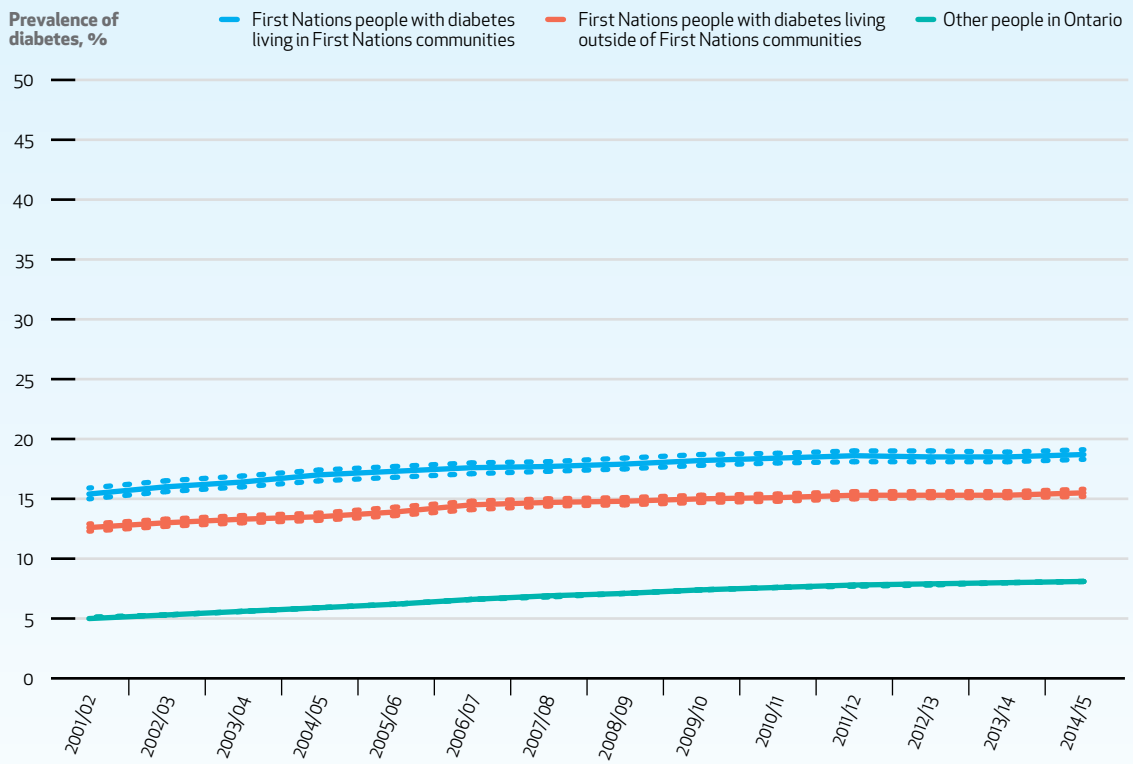


EXHIBIT 5.2 Age- and sex-adjusted prevalence of diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2001/02 to 2014/15

Key Findings

- In 2014/15, the prevalence of diabetes was highest among First Nations people who lived in First Nations communities (18.7%) compared to those who lived outside of First Nations communities (15.5%) and to other people in Ontario (8.1%).
- Between 2001/02 and 2014/15, the prevalence of diabetes increased among both First Nations people and other people in Ontario. However, the rate of increase was slower among First Nations people, increasing from 13.6% in 2001/02 to 16.6% in 2014/15 compared to 3.7% to 8.1% among other people in Ontario.

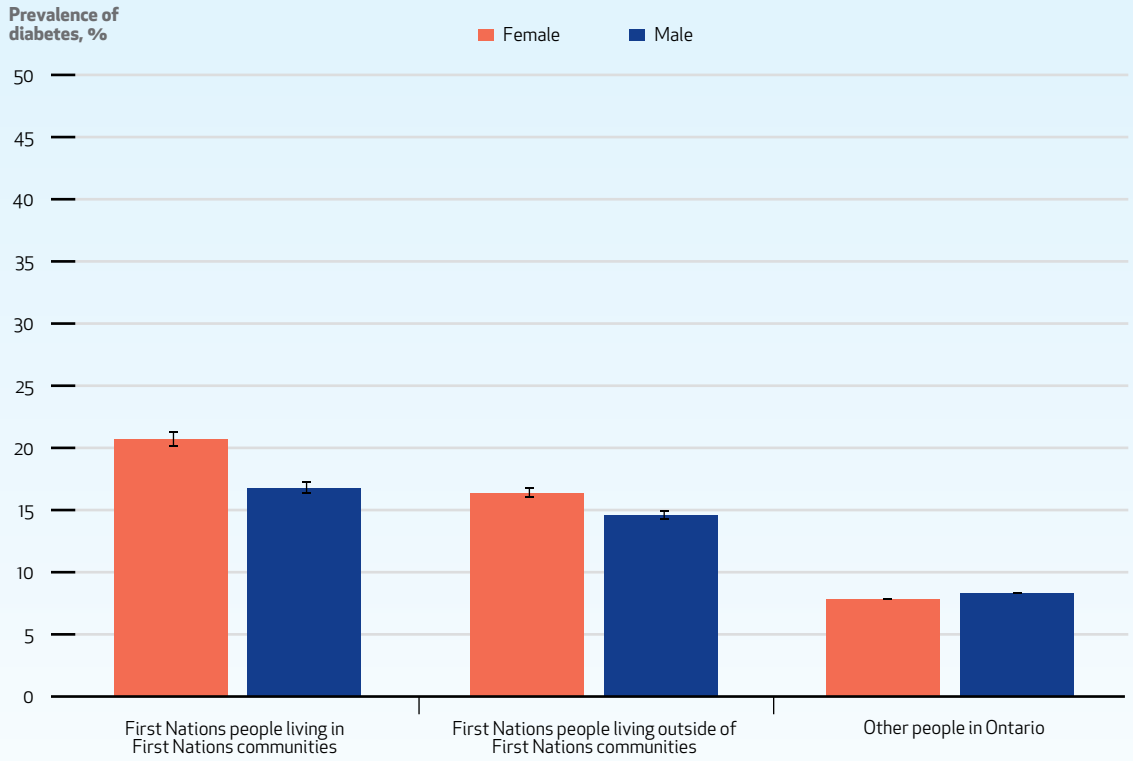


Dashed lines represent 95% confidence intervals.

EXHIBIT 5.3 Age-adjusted prevalence of diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, by sex, 2014/15

Key Findings

- Among First Nations people living in First Nations communities, the age-adjusted prevalence of diabetes was higher among women (20.7%) than men (16.8%).
- Among those living outside of First Nations communities, the difference between men and women was smaller. The age-adjusted prevalence of diabetes in 2014/15 was 16.4% among women and 14.6% among men.
- Among other people in Ontario, the age-adjusted prevalence of diabetes in 2014/15 was 7.8% for women and 8.3% for men.

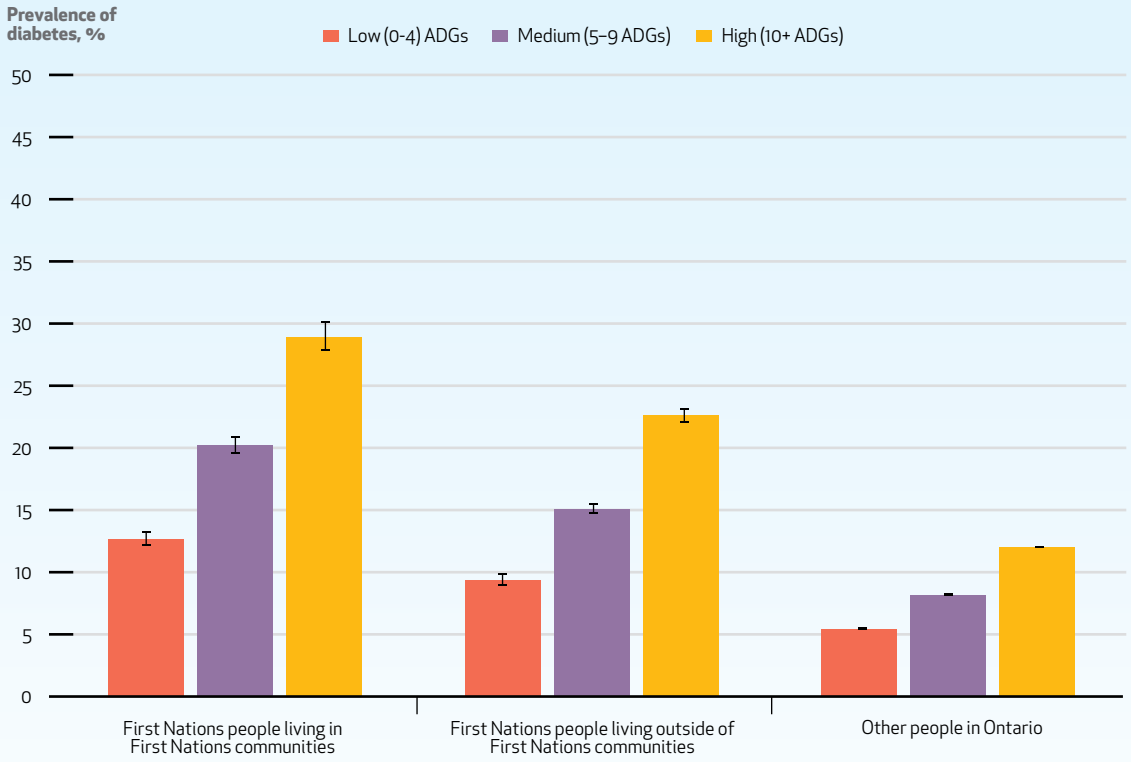


Error bars represent 95% confidence intervals.

EXHIBIT 5.4 Age- and sex-adjusted prevalence of diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- A higher prevalence of diabetes was seen among those with high levels of multimorbidity. For those with 10 or more comorbid conditions in 2014/15, the prevalence of diabetes was 2.4 times higher among First Nations people living in First Nations communities (28.9%) compared with other people in Ontario (12.0%).

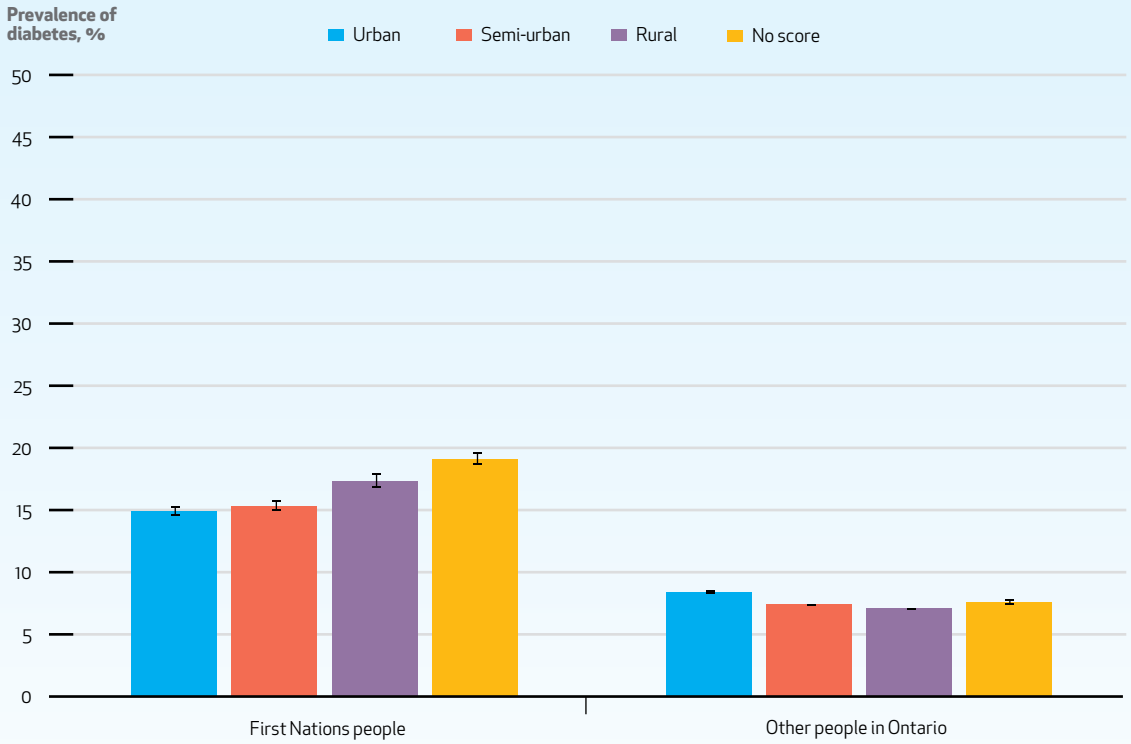


Error bars represent 95% confidence intervals.

EXHIBIT 5.5 Age- and sex-adjusted prevalence of diabetes, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- In 2014/15, the prevalence of diabetes was highest among First Nations people living in rural areas (17.3%) and in those with no RIO score (19.1%) compared to those living in urban (14.9%) and semi-urban (15.3%) areas.
- Among other people in Ontario, the prevalence of diabetes was slightly higher among those living in urban areas (8.4%) compared to those living in semi-urban (7.4%) and rural (7.1%) areas.

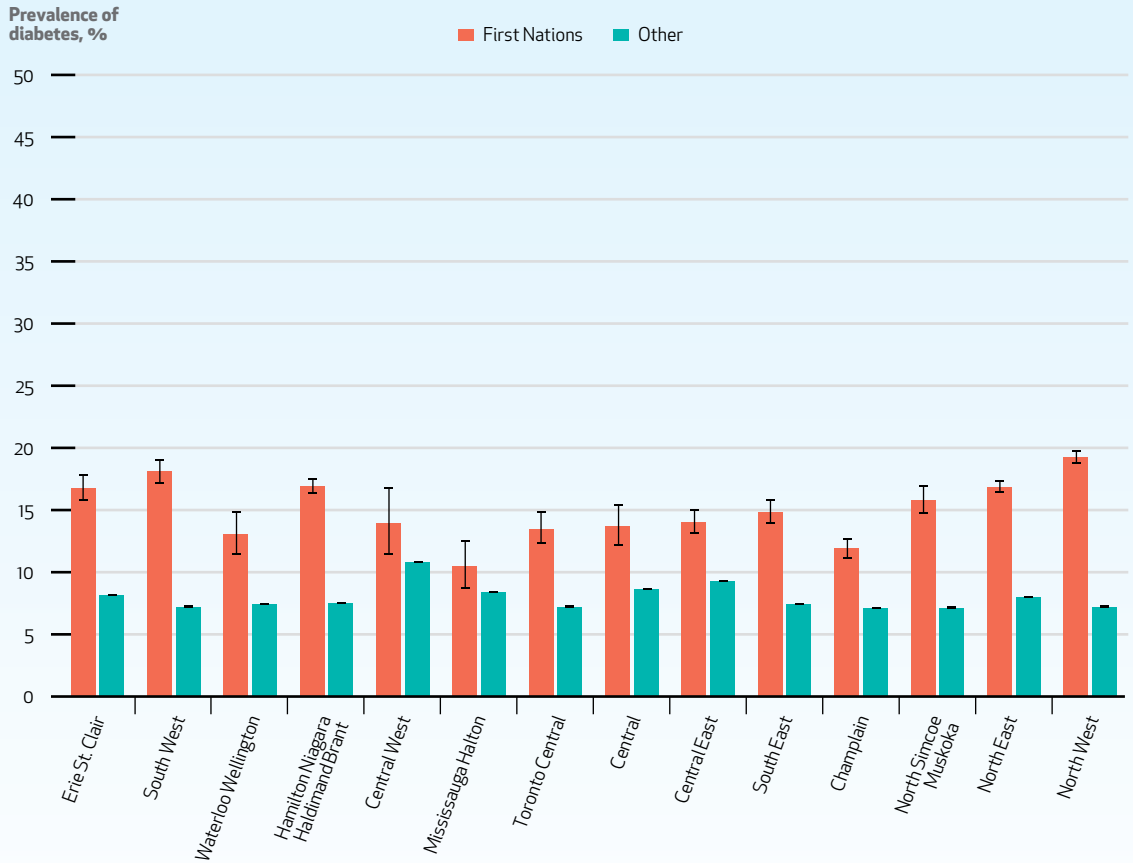


Error bars represent 95% confidence intervals.

EXHIBIT 5.6 Age- and sex-adjusted prevalence of diabetes, among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- In 2014/15, the highest prevalence rates for diabetes among First Nations people in Ontario were found in the North West LHIN (19.2%) and the South West LHIN (18.1%), and the lowest prevalence rates were found in the Mississauga Halton LHIN (10.5%) and the Champlain LHIN (11.9%).
- Differences in diabetes prevalence rates between First Nations people and other people in Ontario were greatest in the North West LHIN (rate ratio: 2.67, 95% CI: 2.59–2.75) and the South West LHIN (rate ratio: 2.50, 95% CI: 2.38–2.64) and slightest in the Mississauga Halton LHIN (rate ratio: 1.24, 95% CI: 1.04–1.49) and the Central West LHIN (rate ratio: 1.29, 95% CI: 1.07–1.55).



Error bars represent 95% confidence intervals.

EXHIBIT 5.7 Crude incidence of diabetes among First Nations people in Ontario, for all adults and those aged 50 years and older, 1995/96 to 2014/15

Key Findings

- The incidence of diabetes among First Nations people in Ontario remained relatively stable between 1995/96 and 2014/15 (0.62% and 0.75%, respectively).
- The incidence of diabetes among First Nations people aged 50 and older decreased from 2.0% in 1995/96 to 1.5% in 2014/15.

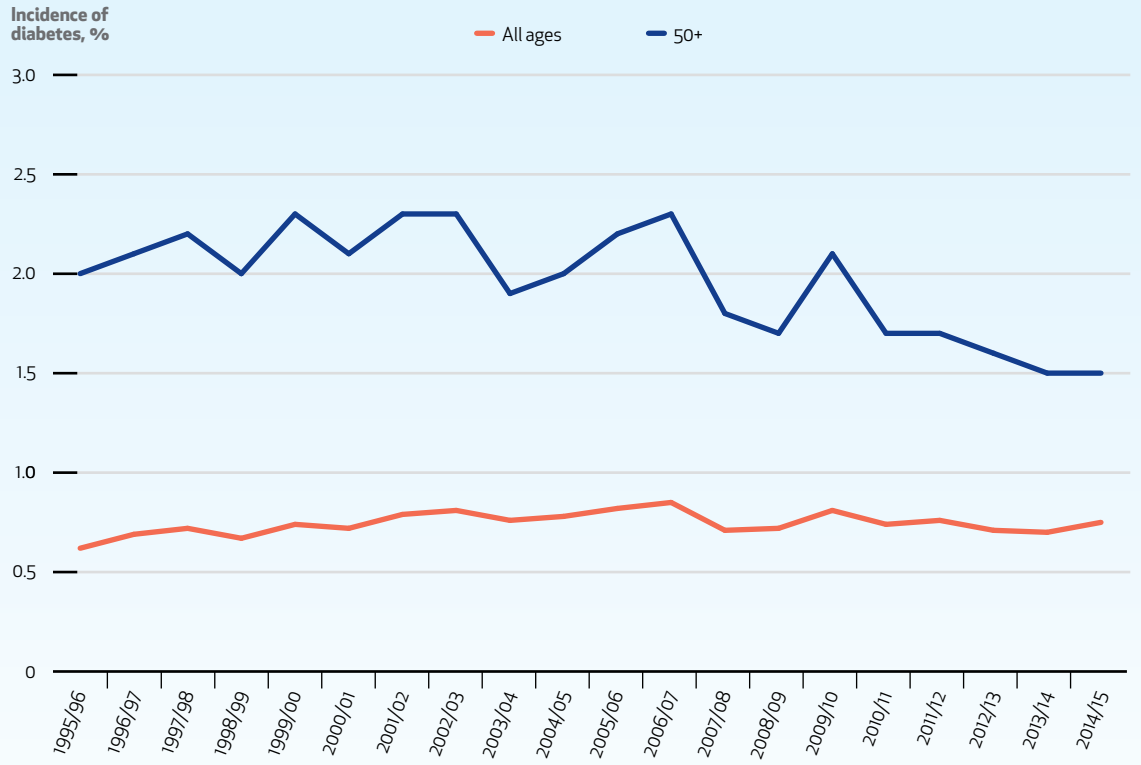
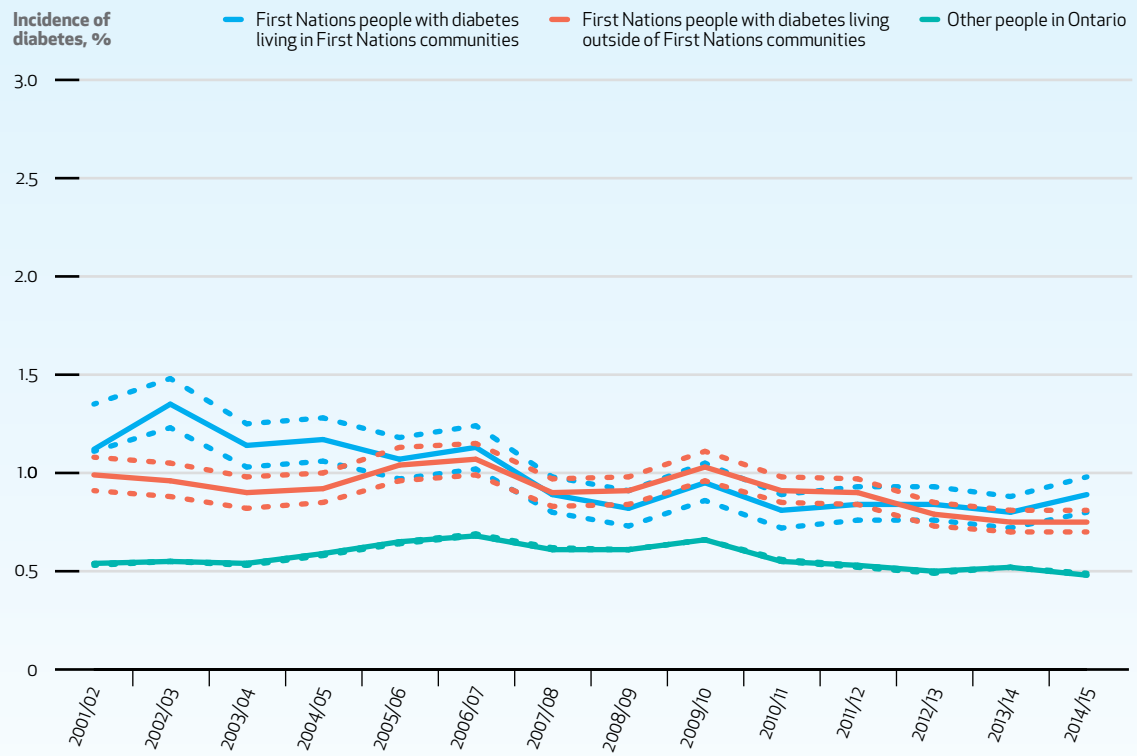


EXHIBIT 5.8 Age- and sex-adjusted incidence of diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2001/02 to 2014/15

Key Findings

- Between 2001/02 and 2014/15, First Nations people had a higher incidence of diabetes compared with other people in Ontario. Incidence rates were similar among First Nations people living in and outside of First Nations communities.
- The annual age- and sex-adjusted incidence of diabetes among First Nations people in Ontario decreased from 1.07% in 2001/02 to 0.80% in 2014/15.
- In the same time period, the annual incidence of diabetes among other people in Ontario remained relatively stable, decreasing from 0.54% in 2001/02 to 0.48% in 2014/15.

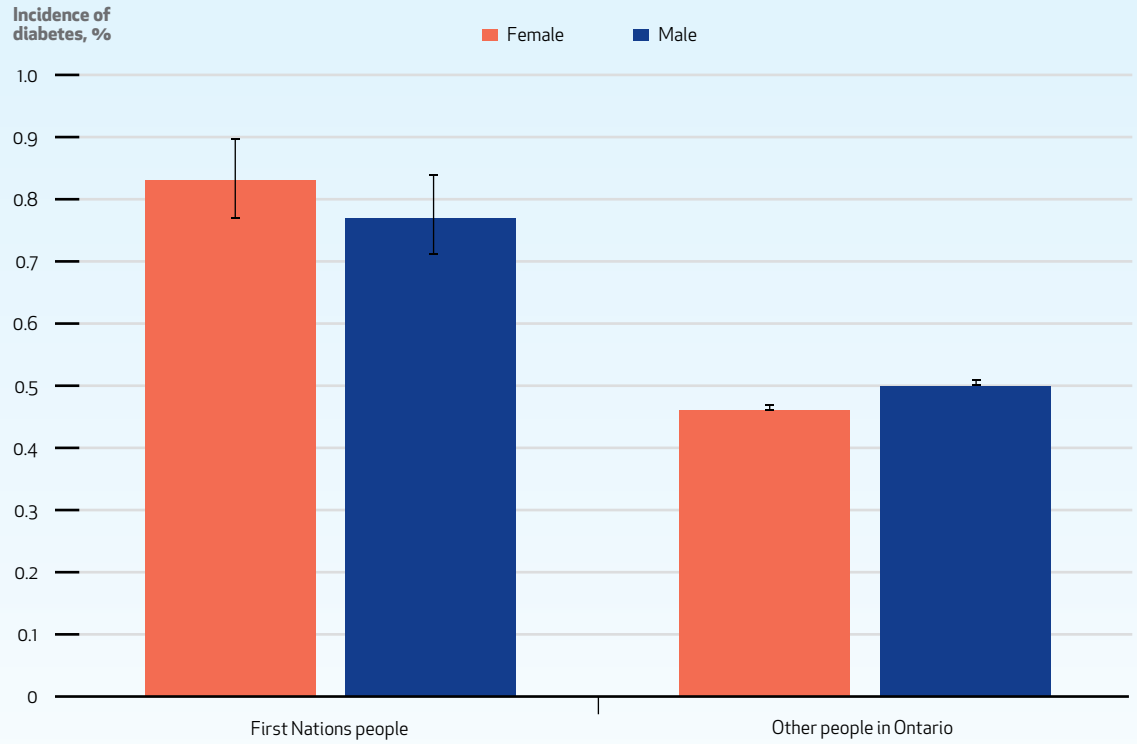


Dashed lines represent 95% confidence intervals.

EXHIBIT 5.9 Age-adjusted incidence of diabetes, among First Nations people and other people in Ontario, by sex, 2014/15

Key Findings

- In 2014/15, the incidence of diabetes was similar among First Nations men and women (0.83% and 0.77%, respectively).
- Among other people in Ontario, the incidence of diabetes was higher among men than women (0.50% and 0.46%, respectively).

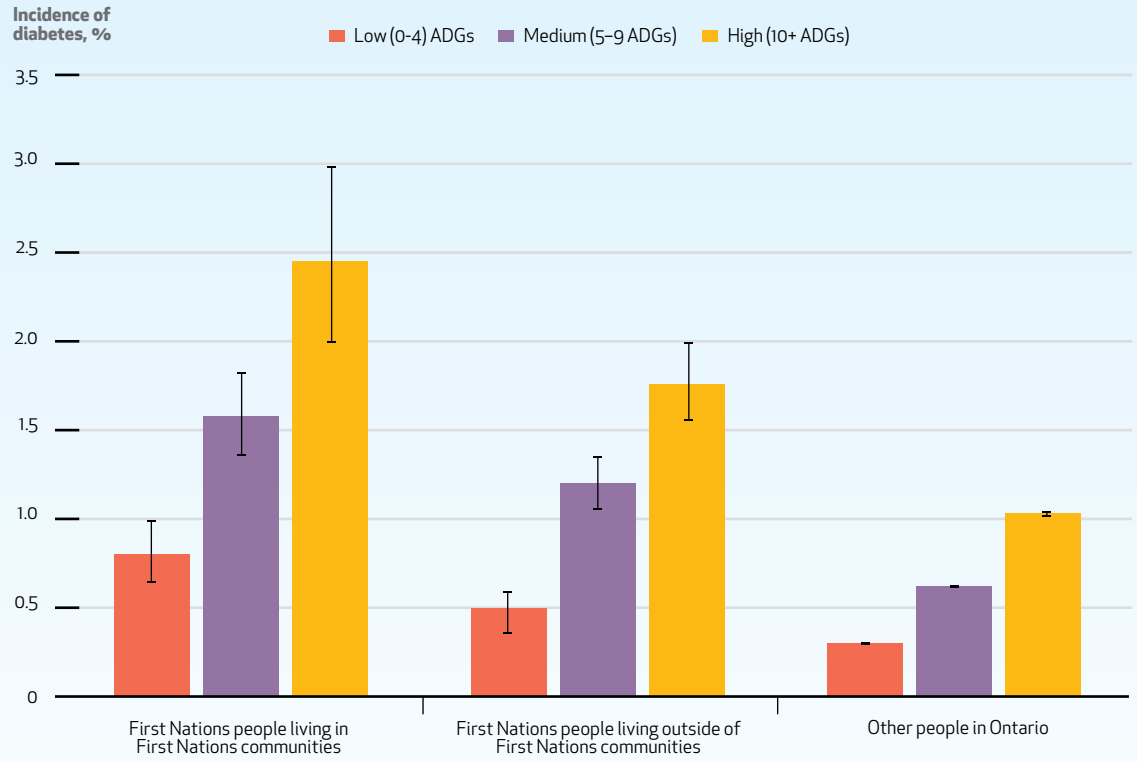


Error bars represent 95% confidence intervals.

EXHIBIT 5.10 Age- and sex-adjusted incidence of diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- In 2014/15, a higher incidence of diabetes was seen among those with high levels of multimorbidity. For those with more than 10 comorbid conditions, the incidence of diabetes was 2.5 times higher among First Nations people living in First Nations communities compared with other people in Ontario (2.5% vs. 1.0%, respectively).

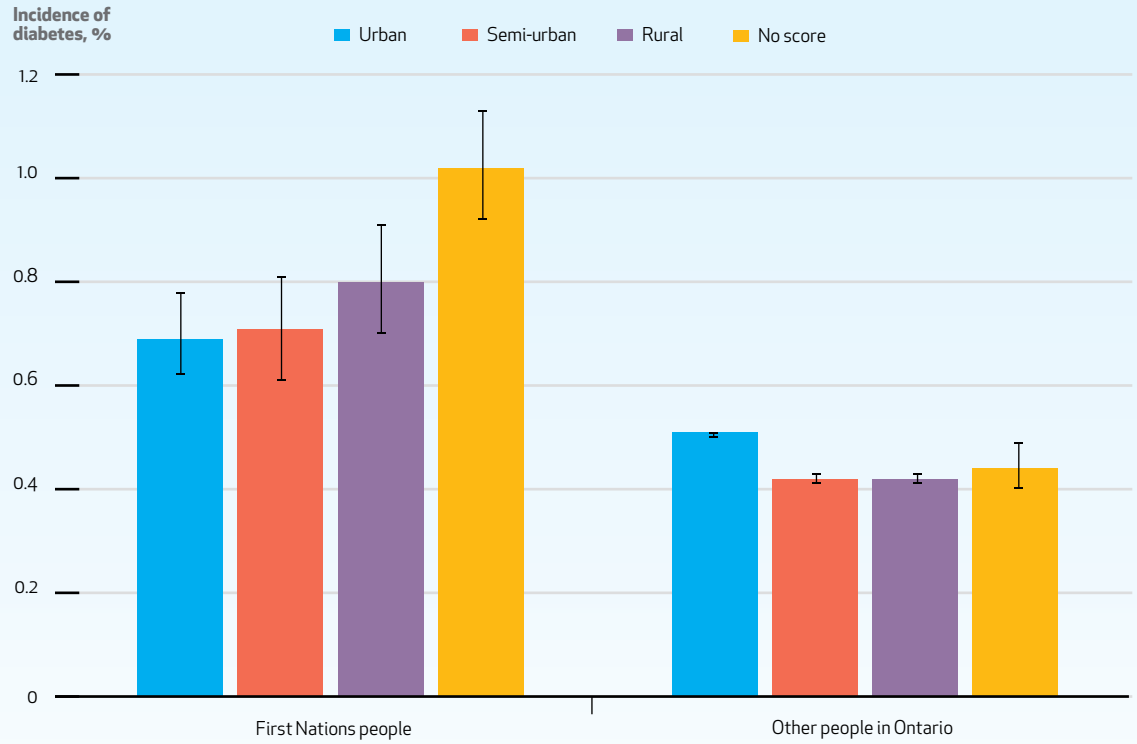


Error bars represent 95% confidence intervals.

EXHIBIT 5.11 Age- and sex-adjusted incidence of diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, by level of rurality, 2014/15

Key Findings

- In 2014/15, the incidence of diabetes was slightly higher among First Nations people living in rural areas (0.8%) compared with those living in urban or semi-urban areas. (0.7% each)
- Among other people in Ontario, the prevalence of diabetes in 2014/15 was slightly higher among those living in urban areas (0.5%) compared with those living in semi-urban or rural areas (0.4% each)

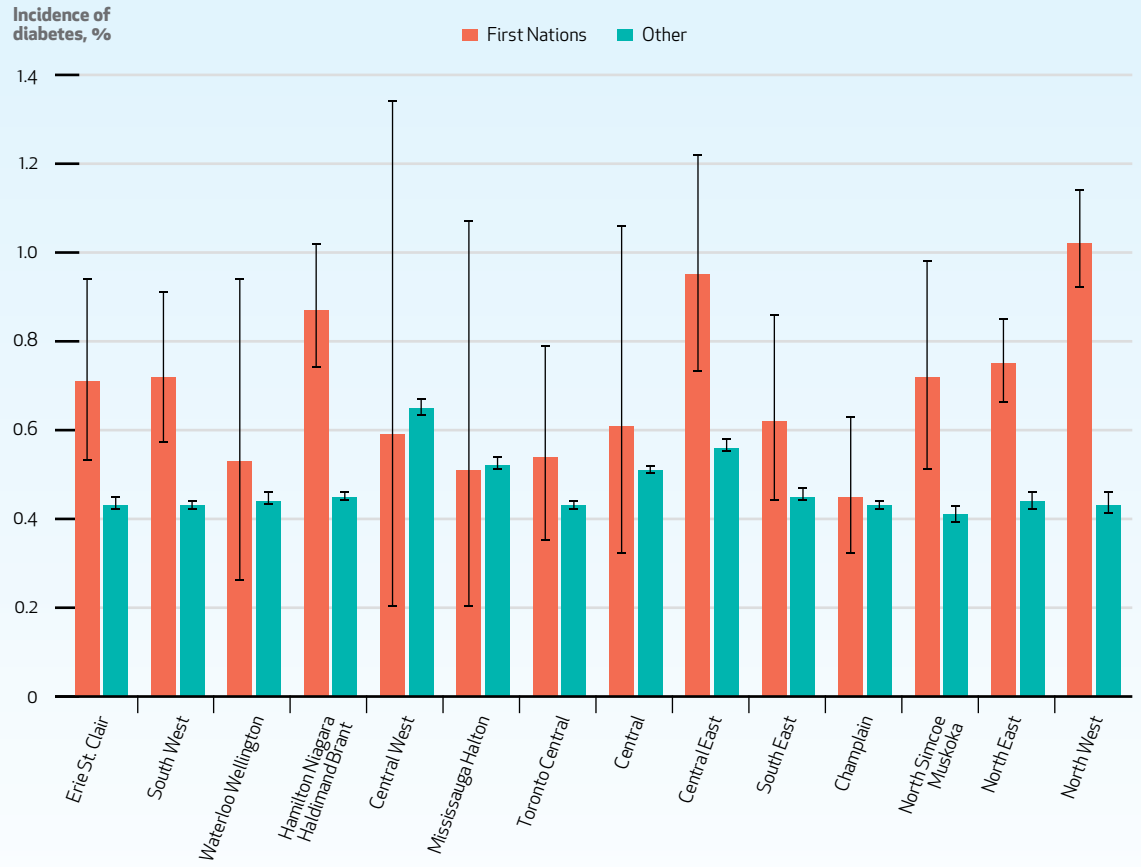


Error bars represent 95% confidence intervals.

EXHIBIT 5.12 Age- and sex-adjusted incidence of diabetes, among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- Among First Nations people in Ontario, the highest incidence rates for diabetes were found in the North West LHIN (1.02%) and the Central East LHIN (0.95%); the lowest incidence rates were found in the Mississauga Halton LHIN (0.51%) and the Champlain LHIN (0.45%).
- The greatest difference in diabetes incidence rates between First Nations people and other people in Ontario was seen in the North West LHIN (rate ratio: 2.36, 95% CI: 2.08–2.67). Conversely, the least difference in incidence rates was seen in the Central West LHIN (rate ratio: 0.91, 95% CI: 0.39–2.12) and the Mississauga Halton LHIN (rate ratio: 0.98, 95% CI: 0.47–2.08).

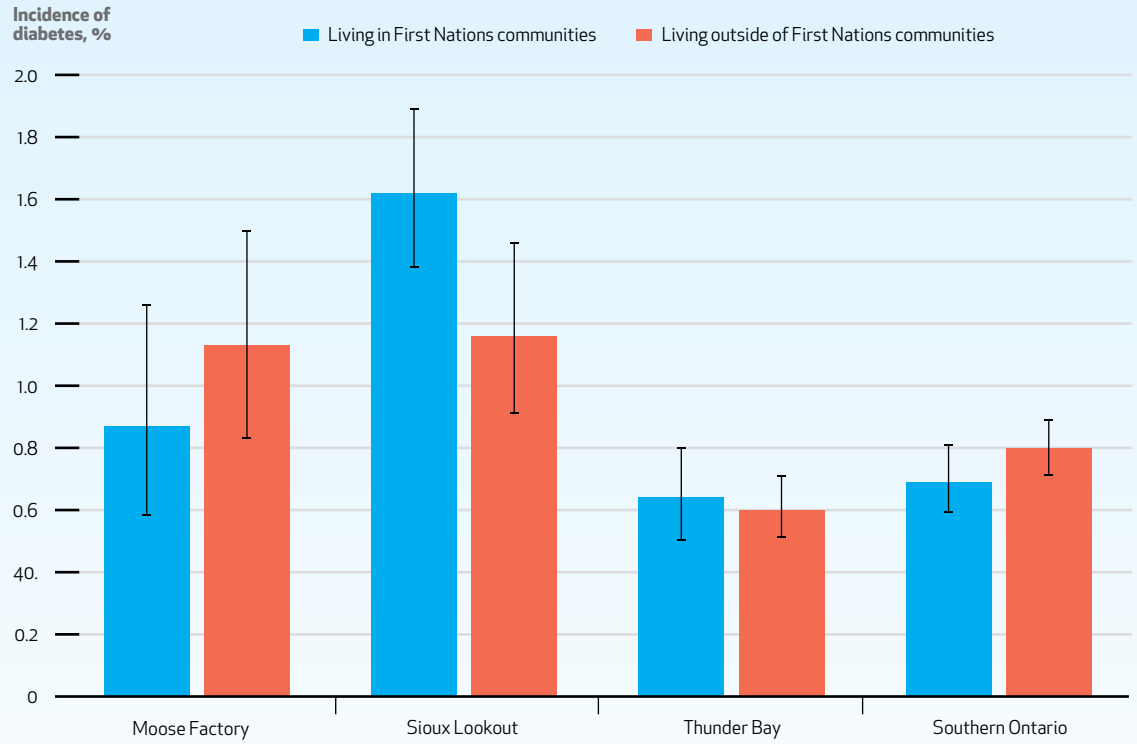


Error bars represent 95% confidence intervals.

EXHIBIT 5.13 Age- and sex-adjusted incidence of diabetes, among First Nations people living in and outside of First Nations communities, by Health Canada zone, 2014/15

Key Findings

- In 2014/15, the incidence of diabetes among First Nations people was highest among those living in the Sioux Lookout zone. Incidence was slightly higher among those living in First Nations communities (1.6%) compared to those living outside of First Nations communities (1.2%) in this zone.
- The incidence of diabetes was lowest among First Nations people living in the Thunder Bay zone (0.6%).

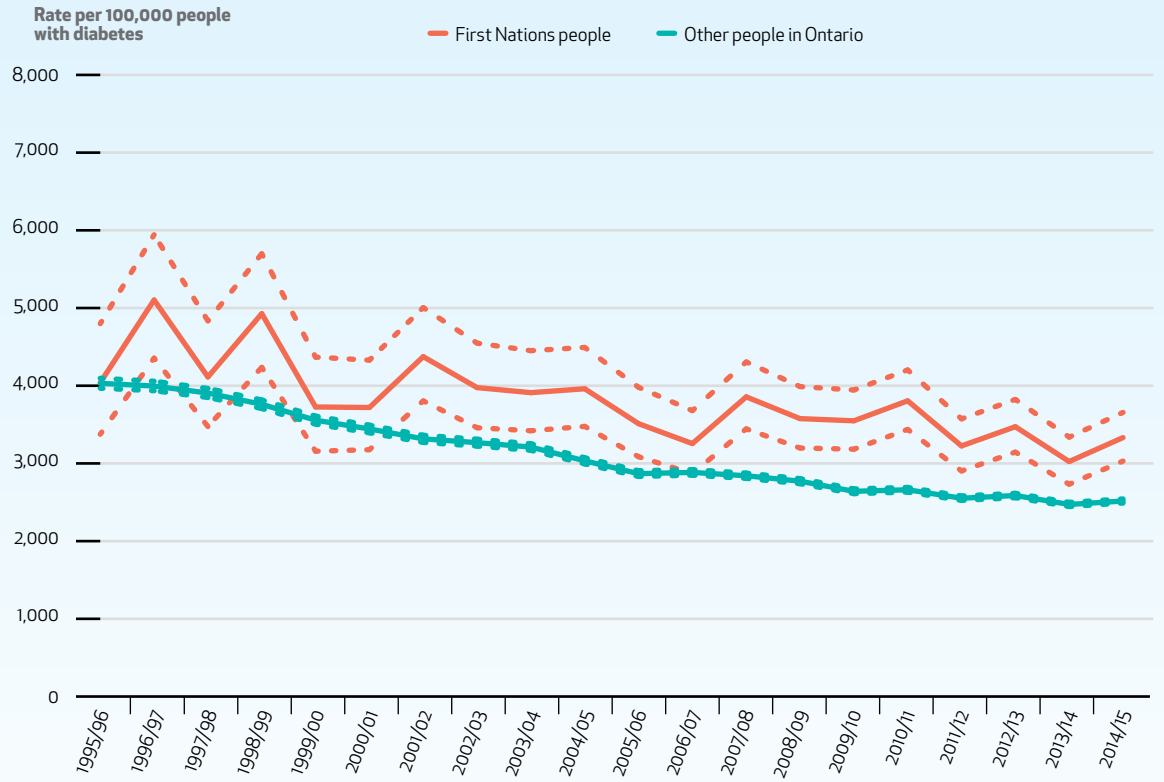


Error bars represent 95% confidence intervals.

EXHIBIT 5.14 Age- and sex-adjusted number of all-cause deaths per 100,000 people with diabetes, among First Nations people and other people in Ontario, 1995/96 to 2014/15

Key Findings

- Mortality rates for both First Nations people and other people in Ontario with diabetes decreased slightly between 1995/96 and 2014/15.
- In 2014/15, all-cause mortality rate per 100,000 people with diabetes was 3,332 deaths among First Nations people compared with 2,516 deaths among other people in Ontario.



Dashed lines represent 95% confidence intervals.

Discussion

We found several trends in diabetes among First Nations people in Ontario. First, the prevalence of diabetes has increased among both First Nations people and other people in Ontario. While First Nations people continue to experience higher prevalence rates of diabetes,[9,11] the gap in prevalence between the two groups has narrowed: In 1995/96, the prevalence of diabetes among First Nations people was three times higher than that of other people in Ontario; by 2014/15, this had decreased to a two-fold difference. A slower increase in the prevalence of diabetes has also been documented among Aboriginal people in Alberta.[12] Despite this, diabetes prevalence remains high, especially among First Nations adults aged 50 years and older.

The incidence of diabetes among First Nations people remains higher than other people in Ontario, but again the disparity in incidence rates between First Nations people and other people in Ontario has narrowed. The decrease in new cases of diabetes points to the continued increase in prevalent cases of diabetes being an historic issue as there are fewer new cases of diabetes each year. While the lifetime risk of diabetes remains high for First Nations people,[10] these findings suggest that First Nations communities may be finding ways to successfully prevent diabetes.

In contrast to other people in Ontario where men have higher rates of diabetes than women, we see the opposite trend among First Nations people: Women have higher rates of prevalence than men, and incidence rates are similar for men and women.[9,11,12] The difference may be related to an increased prevalence of diabetes complicating pregnancy and to poorer health outcomes.[11,13-15] (Diabetes in pregnancy is further examined in chapter 14.)

The prevalence of diabetes appears to be different for those First Nations people living in and outside of First Nations communities: those living within their community have higher prevalence of diabetes, though the incidence of diabetes appears to be similar for those living in and outside of First Nations communities. Interestingly, a recent study of 13 First Nations communities in Alberta found wide variation in crude prevalence rates of diabetes, ranging from 1.2% to 18.3%.[16] The investigators found that First Nations communities with a higher level of cultural continuity, as measured by knowledge of traditional Indigenous language, had significantly lower diabetes prevalence.

The incidence of diabetes dropped among both First Nations people and other people in Ontario in 2007/08. This drop has also been observed in diabetes incidence rates in other provinces of Canada and in the United States.[17]

Mortality rates have been decreasing among First Nations people[18]; however, all-cause mortality rates remain higher among First Nations people with diabetes compared to other people in Ontario with diabetes. Higher mortality rates have been reported in other Indigenous populations in Canada[12,19] and internationally.[20] Avoidable mortality, that is deaths that could potentially have been avoided through prevention or treatment, has been shown to be significantly higher among First Nations people in Canada for many causes, including diabetes.[19]

Limitations

In addition to the limitations noted in chapter 2, we calculated mortality using the Registered Persons Database (RPDB), which is known to contain a small number of individuals who are deceased or no longer living in Ontario; as such, the RPDB will underestimate mortality.

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Appendix

EXHIBIT 5.1A Crude prevalence of diabetes among other people in Ontario (excluding First Nations people), for all ages and those 50 years and older, 1995/96 to 2014/15

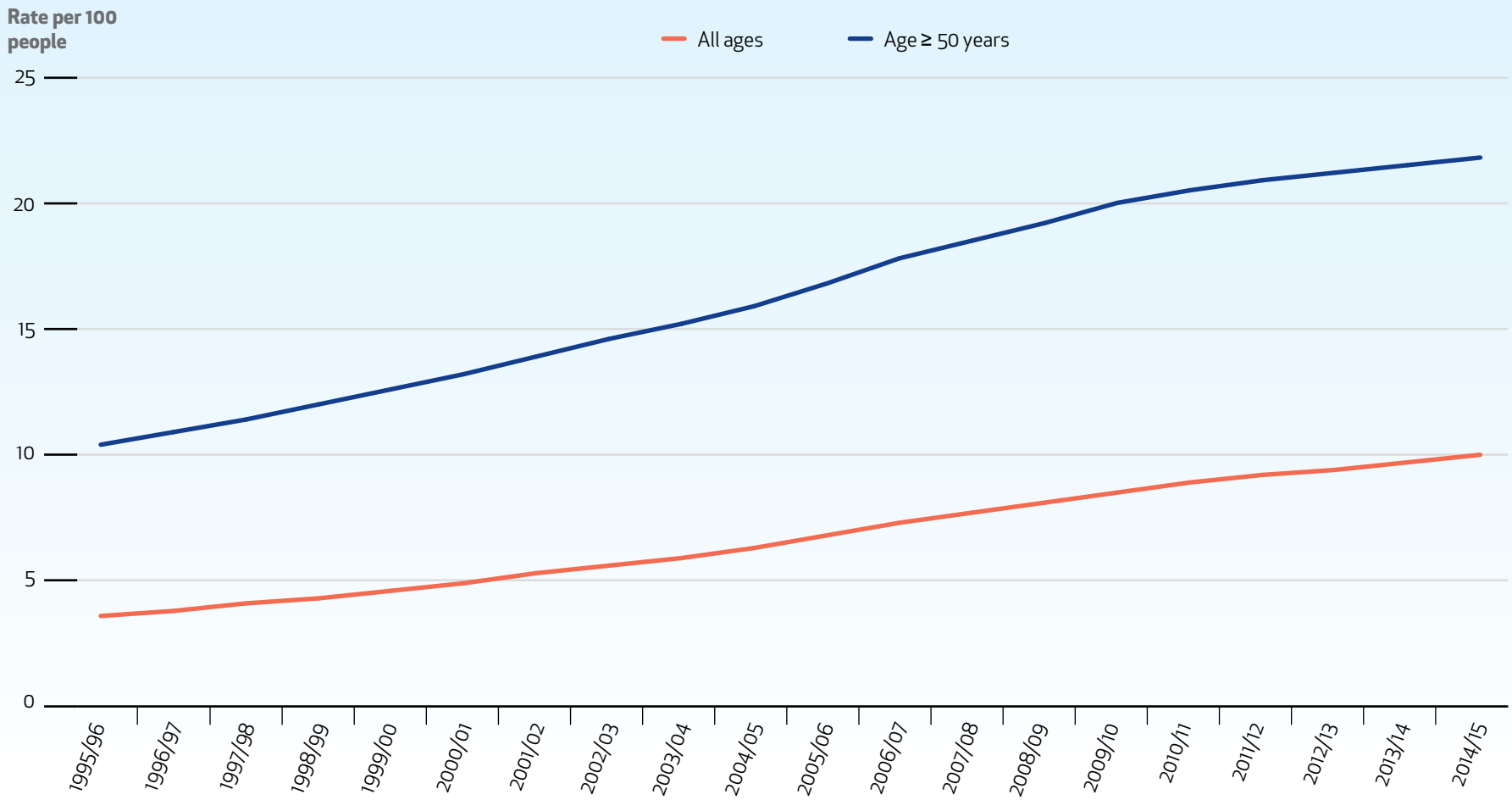

EXHIBIT 5.2A Age- and sex-adjusted prevalence of diabetes, among First Nations people and other people in Ontario, 1995/96 to 2014/15

Year	First Nations people*	Other people in Ontario
1995/96	11.07 (10.79–11.34)	3.68 (3.67–3.69)
1996/97	11.43 (11.16–11.70)	3.87 (3.85–3.88)
1997/98	11.88 (11.61–12.15)	4.08 (4.07–4.09)
1998/99	12.22 (11.95–12.49)	4.29 (4.28–4.31)
1999/00	12.68 (12.42–12.95)	4.53 (4.52–4.55)
2000/01	13.16 (12.90–13.43)	4.77 (4.76–4.78)
2001/02	13.60 (13.34–13.86)	5.05 (5.03–5.06)
2002/03	14.06 (13.80–14.32)	5.32 (5.31–5.33)
2003/04	14.39 (14.13–14.65)	5.57 (5.56–5.58)
2004/05	14.73 (14.47–14.99)	5.87 (5.86–5.88)
2005/06	15.10 (14.85–15.36)	6.22 (6.21–6.24)
2006/07	15.56 (15.31–15.82)	6.58 (6.57–6.59)
2007/08	15.73 (15.48–15.99)	6.85 (6.84–6.87)
2008/09	15.90 (15.65–16.14)	7.12 (7.10–7.13)
2009/10	16.16 (15.91–16.41)	7.42 (7.40–7.43)
2010/11	16.28 (16.04–16.52)	7.60 (7.58–7.61)
2011/12	16.42 (16.18–16.66)	7.75 (7.74–7.76)
2012/13	16.46 (16.23–16.70)	7.86 (7.84–7.87)
2013/14	16.45 (16.22–16.68)	7.98 (7.97–8.00)
2014/15	16.58 (16.35–16.81)	8.08 (8.07–8.10)

* Includes all First Nations people listed in the Indian Register regardless of whether their residence in or outside of a First Nations community could be determined.
95% confidence interval shown in parentheses.

EXHIBIT 5.3A Age-adjusted prevalence of diabetes, among First Nations people and other people in Ontario, by sex, 1995/96 to 2014/15

Year	First Nations people*		Other people in Ontario	
	Female	Male	Female	Male
1995/96	12.36 (11.95–12.78)	9.74 (9.38–10.10)	3.44 (3.43–3.46)	3.92 (3.90–3.94)
1996/97	12.72 (12.31–13.12)	10.11 (9.75–10.47)	3.63 (3.61–3.64)	4.11 (4.09–4.13)
1997/98	13.18 (12.78–13.58)	10.55 (10.19–10.90)	3.84 (3.82–3.85)	4.32 (4.31–4.34)
1998/99	13.49 (13.10–13.89)	10.92 (10.56–11.28)	4.05 (4.03–4.06)	4.55 (4.53–4.56)
1999/00	13.99 (13.59–14.38)	11.35 (11.00–11.70)	4.28 (4.26–4.30)	4.79 (4.77–4.81)
2000/01	14.45 (14.06–14.85)	11.84 (11.48–12.19)	4.51 (4.49–4.53)	5.03 (5.01–5.05)
2001/02	14.83 (14.44–15.22)	12.34 (11.99–12.70)	4.79 (4.77–4.80)	5.31 (5.29–5.33)
2002/03	15.32 (14.93–15.70)	12.77 (12.42–13.13)	5.06 (5.04–5.07)	5.59 (5.57–5.61)
2003/04	15.70 (15.31–16.08)	13.05 (12.70–13.41)	5.32 (5.30–5.34)	5.83 (5.81–5.85)
2004/05	16.03 (15.65–16.41)	13.39 (13.04–13.75)	5.62 (5.61–5.64)	6.12 (6.11–6.14)
2005/06	16.43 (16.06–16.80)	13.74 (13.40–14.09)	5.97 (5.95–5.99)	6.48 (6.46–6.50)
2006/07	16.90 (16.53–17.28)	14.19 (13.84–14.54)	6.31 (6.29–6.33)	6.85 (6.83–6.87)
2007/08	17.05 (16.68–17.42)	14.39 (14.04–14.73)	6.58 (6.56–6.60)	7.13 (7.11–7.15)
2008/09	17.12 (16.76–17.48)	14.64 (14.30–14.98)	6.85 (6.83–6.87)	7.39 (7.37–7.41)
2009/10	17.33 (16.97–17.69)	14.96 (14.62–15.30)	7.15 (7.13–7.17)	7.70 (7.68–7.72)
2010/11	17.44 (17.09–17.80)	15.09 (14.76–15.42)	7.32 (7.30–7.34)	7.88 (7.86–7.90)
2011/12	17.56 (17.21–17.91)	15.26 (14.93–15.58)	7.48 (7.46–7.50)	8.03 (8.01–8.05)
2012/13	17.61 (17.27–17.96)	15.28 (14.96–15.61)	7.59 (7.57–7.61)	8.13 (8.11–8.15)
2013/14	17.59 (17.26–17.93)	15.28 (14.96–15.60)	7.74 (7.72–7.76)	8.24 (8.22–8.26)
2014/15	17.76 (17.42–18.09)	15.38 (15.06–15.69)	7.84 (7.82–7.86)	8.33 (8.31–8.35)

* Includes all First Nations people listed in the Indian Register regardless of whether their residence in or outside of a First Nations community could be determined.
95% confidence interval shown in parentheses.

EXHIBIT 5.4A Age- and sex-adjusted prevalence of diabetes among First Nations people living in or outside of First Nations communities, by Health Canada zone, 2014/15

Health Canada Zone	First Nations people*	Living in First Nations communities	Living outside of First Nations communities
Moose Factory	19.46 (18.41–20.56)	19.62 (18.01–21.35)	19.40 (18.01–20.87)
Sioux Lookout	20.88 (20.12–21.67)	21.32 (20.34–22.34)	20.52 (19.29–21.81)
Thunder Bay	16.69 (16.24–17.16)	17.78 (16.93–18.66)	16.18 (15.63–16.73)
Southern Ontario	16.55 (16.22–16.89)	18.26 (17.68–18.85)	15.61 (15.20–16.02)

* Includes all First Nations people listed in the Indian Register regardless of whether their residence in or outside of a First Nations community could be determined.
95% confidence interval shown in parentheses.

EXHIBIT 5.5A Crude incidence of diabetes among other people in Ontario (excluding First Nations people), for all ages and those aged 50 years and older, 1995/96 to 2014/15

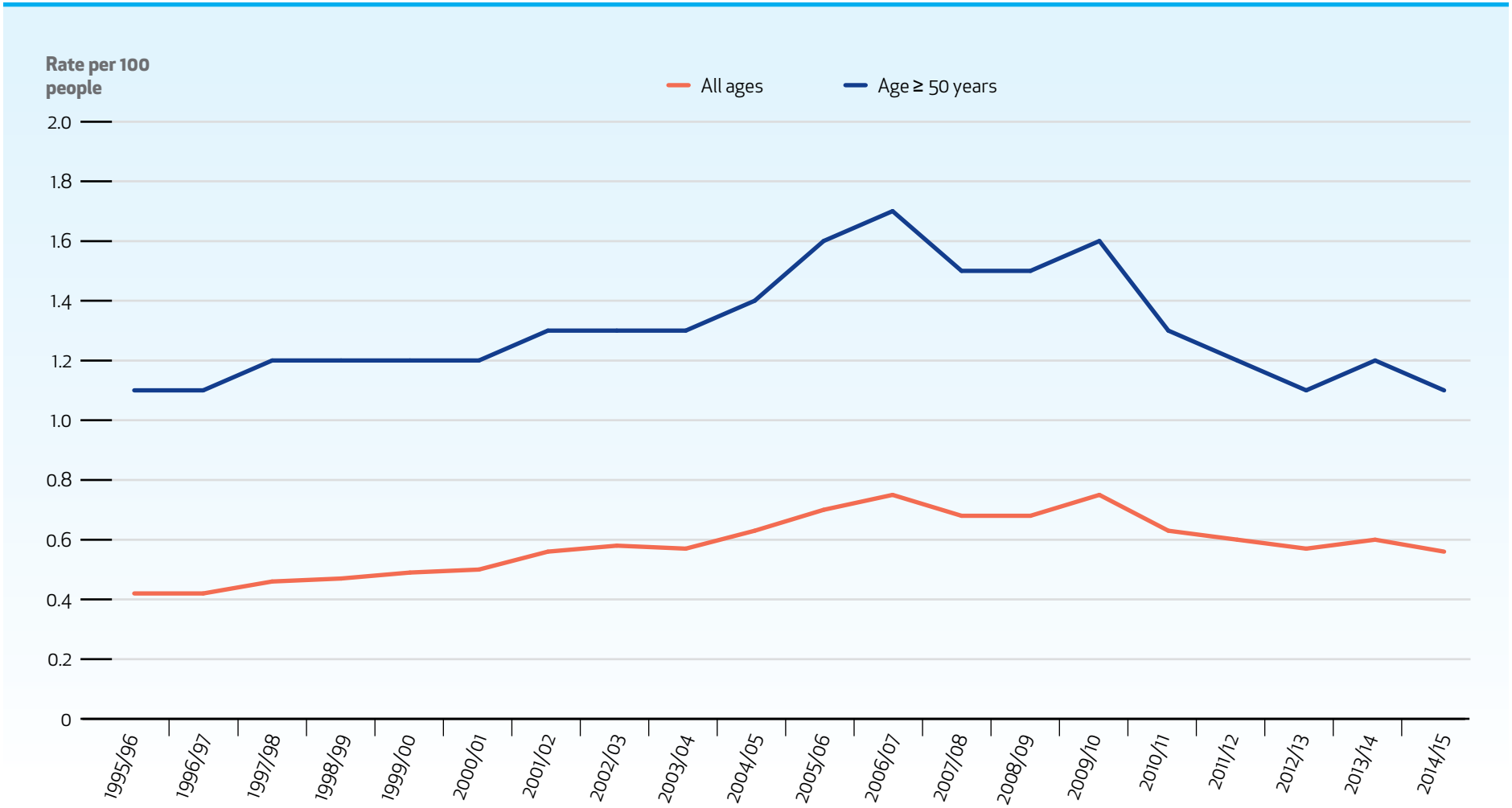

EXHIBIT 5.6A Age- and sex-adjusted incidence of diabetes among First Nations people and other people in Ontario, 1995/96 to 2014/15

Year	First Nations people*	Other people in Ontario
1995/96	0.97 (0.89–1.04)	0.43 (0.43–0.44)
1996/97	1.02 (0.95–1.09)	0.43 (0.42–0.43)
1997/98	1.09 (1.01–1.17)	0.46 (0.46–0.47)
1998/99	0.98 (0.91–1.06)	0.46 (0.46–0.47)
1999/00	1.06 (0.99–1.14)	0.48 (0.48–0.49)
2000/01	1.02 (0.95–1.08)	0.49 (0.48–0.49)
2001/02	1.07 (1.01–1.14)	0.54 (0.53–0.54)
2002/03	1.10 (1.04–1.17)	0.55 (0.55–0.55)
2003/04	0.98 (0.91–1.04)	0.54 (0.53–0.54)
2004/05	1.01 (0.95–1.07)	0.59 (0.58–0.59)
2005/06	1.05 (0.99–1.11)	0.65 (0.64–0.65)
2006/07	1.09 (1.03–1.15)	0.68 (0.68–0.69)
2007/08	0.89 (0.84–0.95)	0.61 (0.61–0.62)
2008/09	0.88 (0.82–0.93)	0.61 (0.61–0.61)
2009/10	1.00 (0.94–1.06)	0.66 (0.66–0.66)
2010/11	0.87 (0.82–0.93)	0.55 (0.55–0.56)
2011/12	0.88 (0.83–0.93)	0.53 (0.52–0.53)
2012/13	0.81 (0.76–0.86)	0.50 (0.49–0.50)
2013/14	0.77 (0.72–0.82)	0.52 (0.52–0.52)
2014/15	0.80 (0.76–0.85)	0.48 (0.48–0.49)

* Includes all First Nations people listed in the Indian Register regardless of whether their residence in or outside of a First Nations community could be determined.
95% confidence interval shown in parentheses.

EXHIBIT 5.7A Age-adjusted prevalence of diabetes among First Nations people living in and outside of First Nations communities in Ontario, by sex, 2001/02 to 2014/15

Year	First Nations people living in First Nations communities		First Nations people living outside of First Nations communities	
	Women	Men	Women	Men
2001/02	1.22 (1.06–1.40)	1.24 (1.08–1.41)	0.96 (0.85–1.09)	1.03 (0.91–1.17)
2002/03	1.43 (1.25–1.62)	1.28 (1.12–1.46)	0.99 (0.88–1.10)	0.95 (0.83–1.08)
2003/04	1.26 (1.10–1.44)	1.02 (0.88–1.17)	0.95 (0.85–1.07)	0.84 (0.73–0.96)
2004/05	1.17 (1.02–1.34)	1.17 (1.02–1.33)	0.93 (0.83–1.04)	0.93 (0.82–1.06)
2005/06	1.26 (1.10–1.43)	0.91 (0.78–1.05)	1.02 (0.91–1.13)	1.08 (0.96–1.20)
2006/07	1.20 (1.05–1.37)	1.05 (0.92–1.20)	1.07 (0.97–1.19)	1.08 (0.96–1.20)
2007/08	0.88 (0.75–1.02)	0.90 (0.78–1.04)	0.89 (0.79–0.99)	0.91 (0.81–1.02)
2008/09	0.77 (0.66–0.91)	0.85 (0.74–0.98)	0.84 (0.75–0.93)	1.01 (0.90–1.12)
2009/10	0.87 (0.74–1.01)	1.03 (0.90–1.18)	0.97 (0.88–1.08)	1.10 (0.99–1.21)
2010/11	0.81 (0.69–0.94)	0.81 (0.70–0.93)	0.91 (0.82–1.01)	0.92 (0.82–1.02)
2011/12	0.76 (0.65–0.89)	0.92 (0.79–1.05)	0.91 (0.82–1.00)	0.90 (0.81–1.00)
2012/13	0.85 (0.74–0.99)	0.83 (0.72–0.96)	0.81 (0.73–0.90)	0.77 (0.69–0.86)
2013/14	0.74 (0.63–0.86)	0.85 (0.73–0.97)	0.74 (0.66–0.82)	0.77 (0.69–0.86)
2014/15	1.01 (0.88–1.15)	0.79 (0.68–0.91)	0.75 (0.67–0.83)	0.76 (0.68–0.85)

95% confidence interval shown in parentheses.

6 Monitoring, Control and Treatment of Diabetes

Inside

Authors

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Overview

Optimal glycemic control is fundament to the management of diabetes.[1] Measuring the concentration of glycated hemoglobin (HbA1c) in the blood is a reliable way to estimate the average level of blood glucose.[2] Because evidence has shown that HbA1c levels higher than 7.0% are associated with an increased risk of microvascular complications,[3-5] treatment guidelines recommend that most adults with diabetes should aim to keep theirHbA1c levels at 7.0% or lower.[1] HbA1c should be measured approximately every three months to ensure that glycemic goals are being met or maintained; once stable, monitoring of HbA1c should occur every 6 months.[6]

Because people with diabetes have an elevated risk of cardiovascular disease,[7-9] the management and control of cardiovascular risk factors, particularly lipids such as low-density lipoprotein (LDL) cholesterol, are also important.[10-12] Guidelines recommend a full lipid profile be measured every one to three years, depending on cardiovascular risk, and suggest that LDL be consistently under 2.0 mmol/L.[13] Control of HbA1c and lipids has been shown to be associated with reduced morbidity and mortality in patients with diabetes.[3,14-17] This chapter will present age- and sex-adjusted rates of HbA1c and lipid monitoring and control for both First Nations people and other people in Ontario living with diabetes. In addition, we also report the pharmacotherapy regimen for adults aged 65 and over with diabetes. Overall rates are presented; where possible, rates are stratified by level of comorbidity and rurality and by geographic region.

Methods

Age- and sex-adjusted rates of HbA1c and lipid monitoring were calculated for each 12-month period from April 1, 1995, to March 31, 2015. HbA1c monitoring was defined as having at least two tests in one 12-month period. Lipid monitoring was defined as having at least one complete lipid profile each year (total, HDL and triglyceride testing all done on the same day). The numerator for the rate was those in the yearly cohort (defined in chapter 2) who received HbA1c or lipid monitoring. (Indicator definitions and codes are presented in exhibit 6.1A in the chapter appendix.)

In addition, we assessed the proportion of individuals with diabetes whose HbA1c and lipid values were controlled. HbA1c levels were categorized as good (HbA1c ⩽ 7.0%), fair (> 7.0 % to < 8.5 %), or poor (⩾ 8.5 %). Individuals were considered to have their lipids under control if their LDL value was ⩽ 2 mmol/L. For both HbA1c and lipid control analyses, the denominator was restricted to those individuals with at least one test recorded in the Ontario Laboratories Information System. Only data from 2014/15 were used for this analysis.

We also assessed the use of antidiabetic drugs among individuals with diabetes who were 65 years or older on April 1, 2014. To capture prescriptions for antidiabetic drugs, we used the Drug Identification Number database to identify all antidiabetic drugs and linked these to the Ontario Drug Benefit database to capture prescription information. Drug records from April 1, 2014, through March 31, 2015 were used for this analysis. We assessed the pharmacotherapy regimen, the distribution of different classes of medication and the types of insulin prescribed.

Results

Monitoring of HbA1c and lipid levels

Between 2001/02 and 2014/15, the rate of HbA1c monitoring increased for both First Nations people and other people in Ontario (exhibit 6.1; data from 1995/96 are shown in exhibit 6.2A in the chapter appendix). However, less than half of Ontarians with diabetes had up-to-date HbA1c monitoring. Monitoring rates remained lowest among First Nations people living in First Nations communities compared to those living outside of First Nations communities and to other people in Ontario.

We observe increased testing rates for other people in Ontario who had higher levels of multimorbidity, but we do not see this among First Nations people

(exhibit 6.2). The variation between First Nations people and other people in Ontario appears to be driven by rurality: HbA1c monitoring rates were lower among First Nations people in urban and semi-urban areas, but there was a significant decrease in monitoring among First Nations people living in rural areas compared to other people in Ontario (exhibit 6.3). In the North East and North West LHINs, large disparities in monitoring exist between First Nations people and other people in Ontario (exhibit 6.4).

Between 2001/02 and 2014/15, the rate of lipid monitoring increased among both First Nations people and other people in Ontario (exhibit 6.5; data from 1995/96 are shown in 6.3A in the chapter appendix). However, only two-thirds of Ontarians with diabetes had lipid monitoring completed in 2014/15. Monitoring rates remained lowest among First Nations people living in First Nations communities compared to those living outside of First Nations communities and other people in Ontario.

Among other people in Ontario, lipid monitoring was more common among those with higher levels of comorbid disease; this relationship was not seen among First Nations people (exhibit 6.6). Similar to HbA1c monitoring, rurality appears to be an important factor: There was a significant decrease in lipid monitoring among First Nations people living in rural areas compared to other people in Ontario in rural areas (exhibit 6.7). Significant disparities in lipid monitoring between First Nations people and other people were evident in the North East and North West LHINs (exhibit 6.8).

Control of HbA1c and lipid levels

Sixty percent of Ontarians with diabetes had controlled HbA1c (values ≤ 7.0%). HbA1c control was lowest among First Nations people living in First Nations communities compared to those living outside of First Nations communities and to other people in Ontario (exhibit 6.9). Increased rates of HbA1c control were seen among people with higher degrees of comorbid disease (exhibit 6.10), especially among other people in Ontario. Lower rates of HbA1c control were observed in rural areas (exhibit 6.11). Significant differences in HbA1c testing and control existed between First Nations people living in and outside of First Nations communities across the four Health Canada zones (exhibit 6.12), and there were large disparities in HbA1c control between First Nations people and other people in the North East LHIN (exhibit 6.13).

Half of Ontarians had controlled lipid values (defined as an LDL value ≤ 2 mmol/L). Lipid control was higher among First Nations people compared to other people in Ontario; little difference is seen between those living in First Nations communities and those living outside of First Nations communities (exhibit 6.14). Increased rates of lipid control are seen among people with higher degrees of comorbid disease (exhibit 6.15). Rates of lipid control are similar for First Nations people regardless of rurality, whereas rates of lipid control are lowest among other people in Ontario living in urban areas (exhibit 6.16). Few differences in lipid control exist between First Nations people living in and outside of First Nations communities across the various Health Canada zones (exhibit 6.17); however, there are large disparities in lipid control between First Nations people and other people in the North West LHIN (exhibit 6.18).

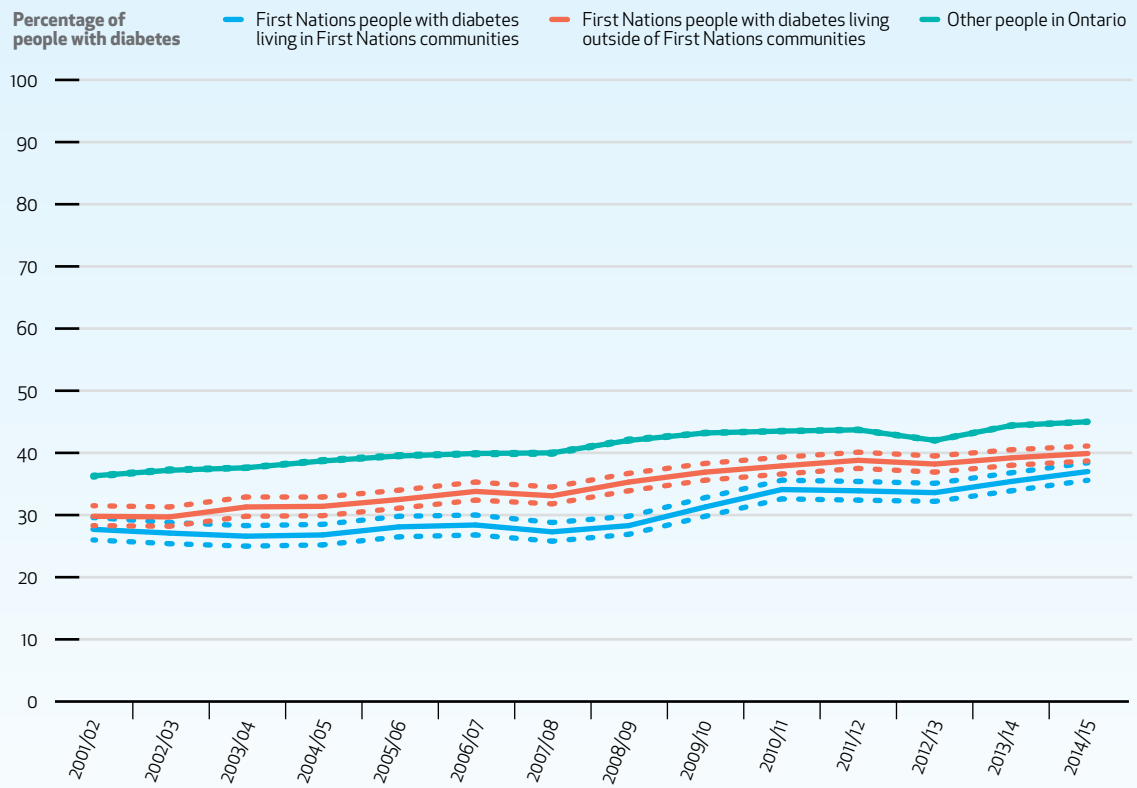
Treatment

Among people aged 65 years and older with diabetes, more than 70% of First Nations people were prescribed an antidiabetic medication compared to 60% of other people in Ontario (exhibit 6.19). The type of medication (exhibit 6.20) and type of insulin prescribed (exhibit 6.21) varied between First Nations people and other people in Ontario.

EXHIBIT 6.1 Age- and sex-adjusted number of people with at least 2 HbA1c tests in the previous 12 months per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2001/02 to 2014/15

Key Findings

- In 2014/15, less than half of Ontarians (45.0%) had their HbA1c level monitored. Among First Nations people, rates of HbA1c monitoring were lower: 39.9% of those living outside of First Nations communities and 37.0% of those living in First Nations communities had their HbA1c tested.
- From 2001/02 to 2014/15, the HbA1c monitoring rate increased by 34% among First Nations people living in First Nations communities (from 27.7% to 37.0%) and by 34% outside of First Nations communities (from 29.8% to 39.9%). Among other people in Ontario, the monitoring rate increased by 24% (from 36.3% in 2001 to 45.0% in 2014).

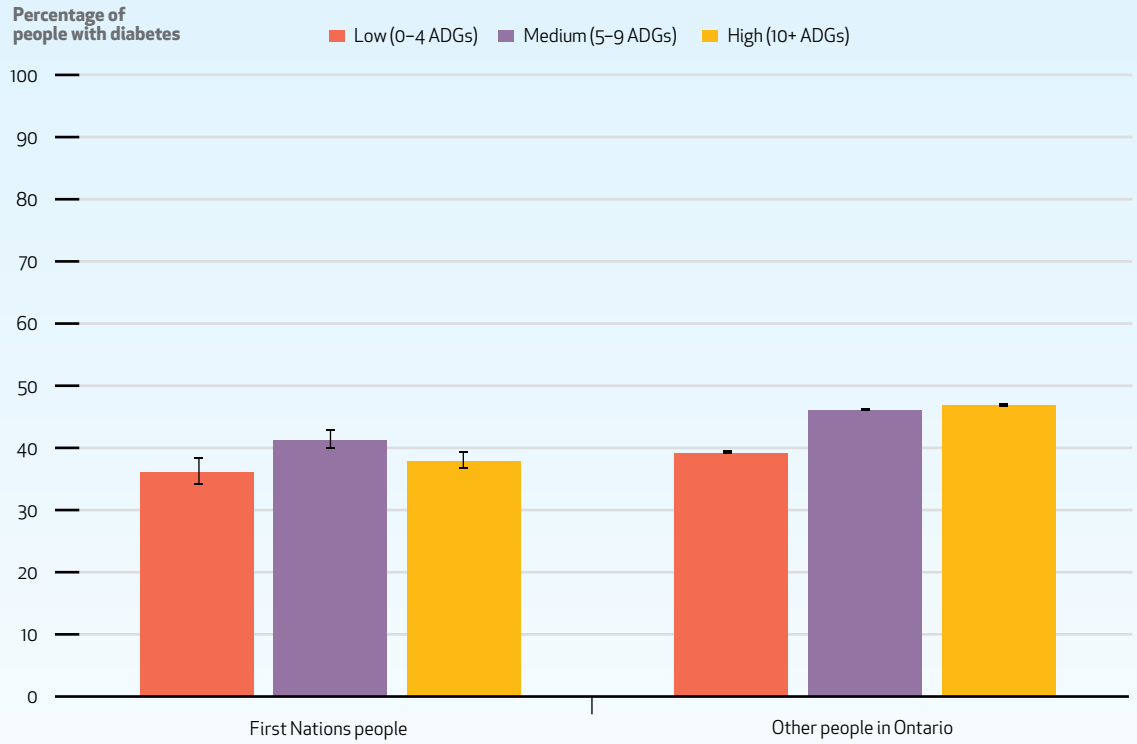


Dashed lines represent 95% confidence intervals.

EXHIBIT 6.2 Age- and sex-adjusted number of people with at least 2 HbA1c tests in the previous 12 months per 100 people with diabetes, among First Nations people and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- Among other people in Ontario, rates of HbA1c monitoring increase with increasing number of comorbid conditions. In 2014/15, 39.2% of individuals with diabetes who had a low level of comorbidity were monitored, compared to 46.0% among those with medium comorbidity and 46.8% with high comorbidity.
- Among First Nations people, HbA1c testing appears to be highest among those with a medium level of comorbid conditions (5–9 ADGs). Among First Nations people with diabetes, 41.3% with a medium level of comorbidity were monitored, compared to 36.1% with low comorbidity and 37.9% with high comorbidity.

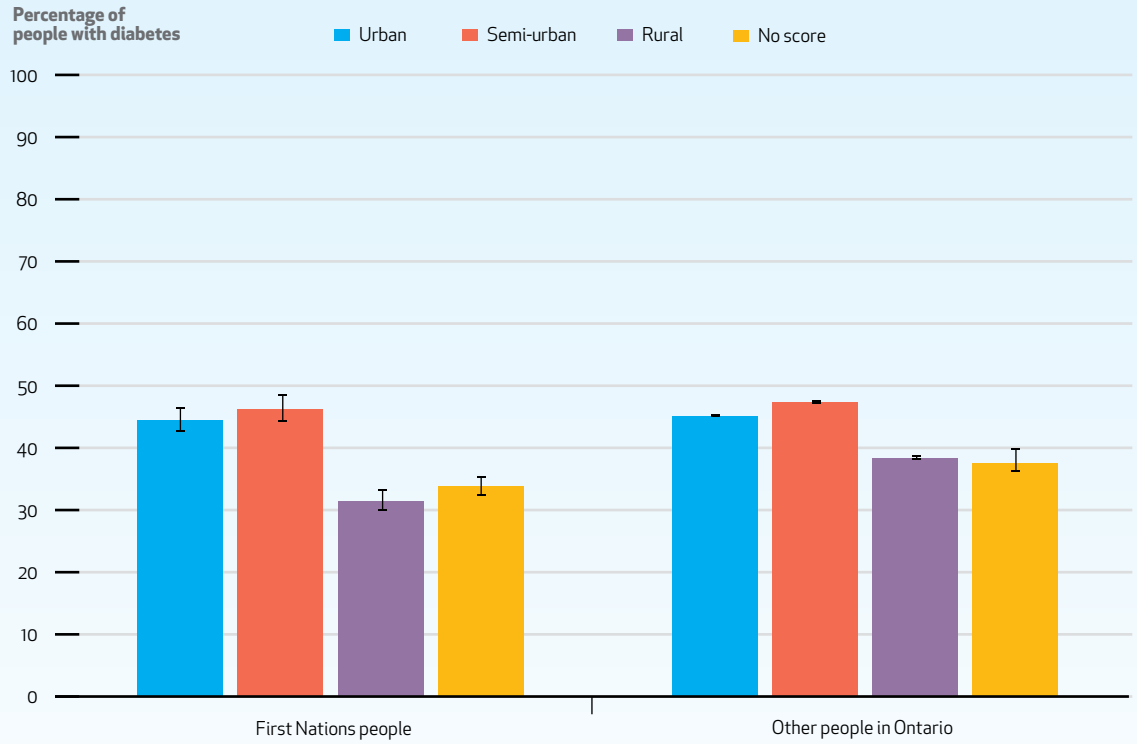


Error bars represent 95% confidence intervals.

EXHIBIT 6.3 Age- and sex-adjusted number of people with at least 2 HbA1c tests in the previous 12 months per 100 people with diabetes, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- Rates of HbA1c testing are lowest for both First Nations people and other people in Ontario among those living in rural areas. In 2014/15, 44.4% of First Nations people with diabetes living in urban areas had their HbA1c monitored compared to 46.3% of those living in semi-urban and 31.5% living in rural areas. Among other people in Ontario, HbA1c monitoring rates ranged from 45.1% in urban areas to 47.3% in semi-urban areas and 38.3% in rural areas.
- HbA1c monitoring rates among other people in Ontario were 22% higher than the rates for First Nations people in rural areas; in urban and semi-urban areas, the rates were only 1%–2% higher.

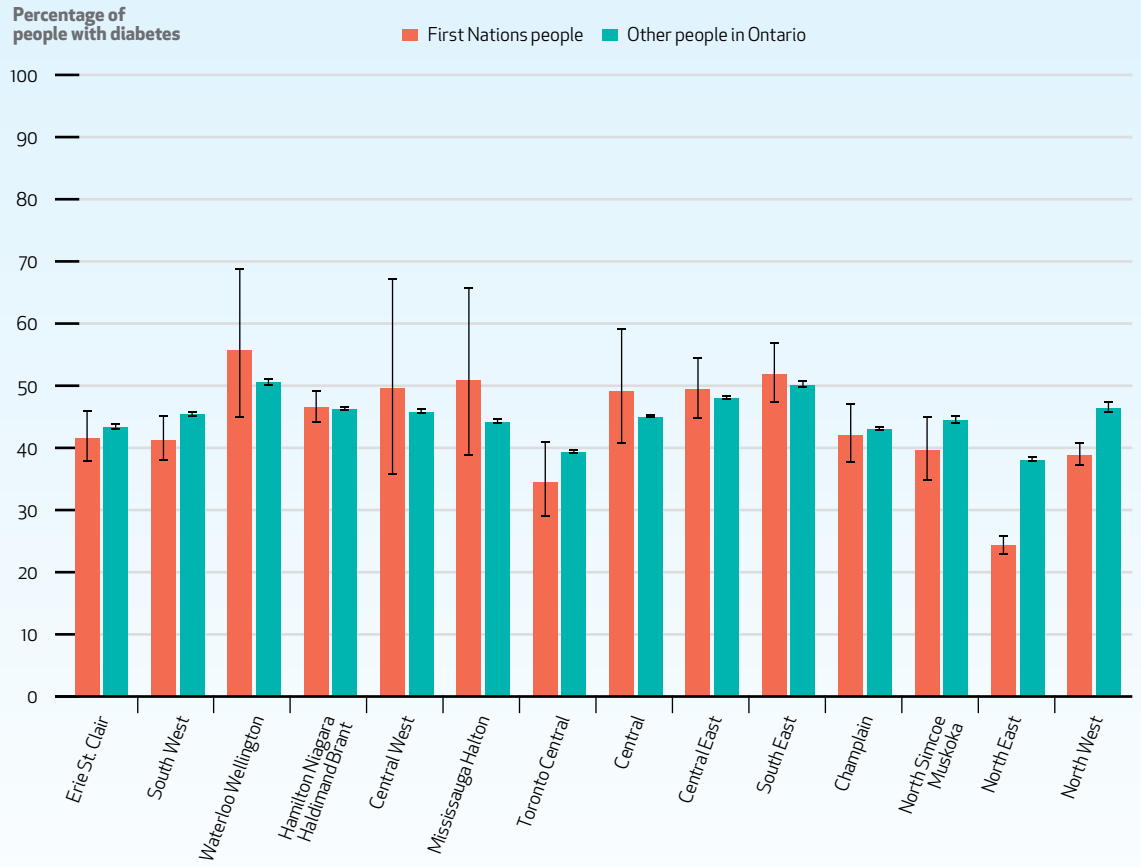


Error bars represent 95% confidence intervals.

EXHIBIT 6.4 Age- and sex-adjusted number of people with least 2 HbA1c tests in the previous 12 months per 100 people with diabetes, among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- In 2014/15, the highest HbA1c monitoring rate among First Nations people with diabetes was found in the Waterloo Wellington LHIN (55.7%) and the lowest rate was seen in the North East LHIN (24.3%).
- Among other people in Ontario, the HbA1c monitoring rate ranged from a low of 38.0% in the North East LHIN to a high of 50.5% in the Waterloo Wellington LHIN.
- The largest difference in HbA1c monitoring rates was seen in the North East LHIN, where the rate for other people in Ontario was 1.6 times that of First Nations people.

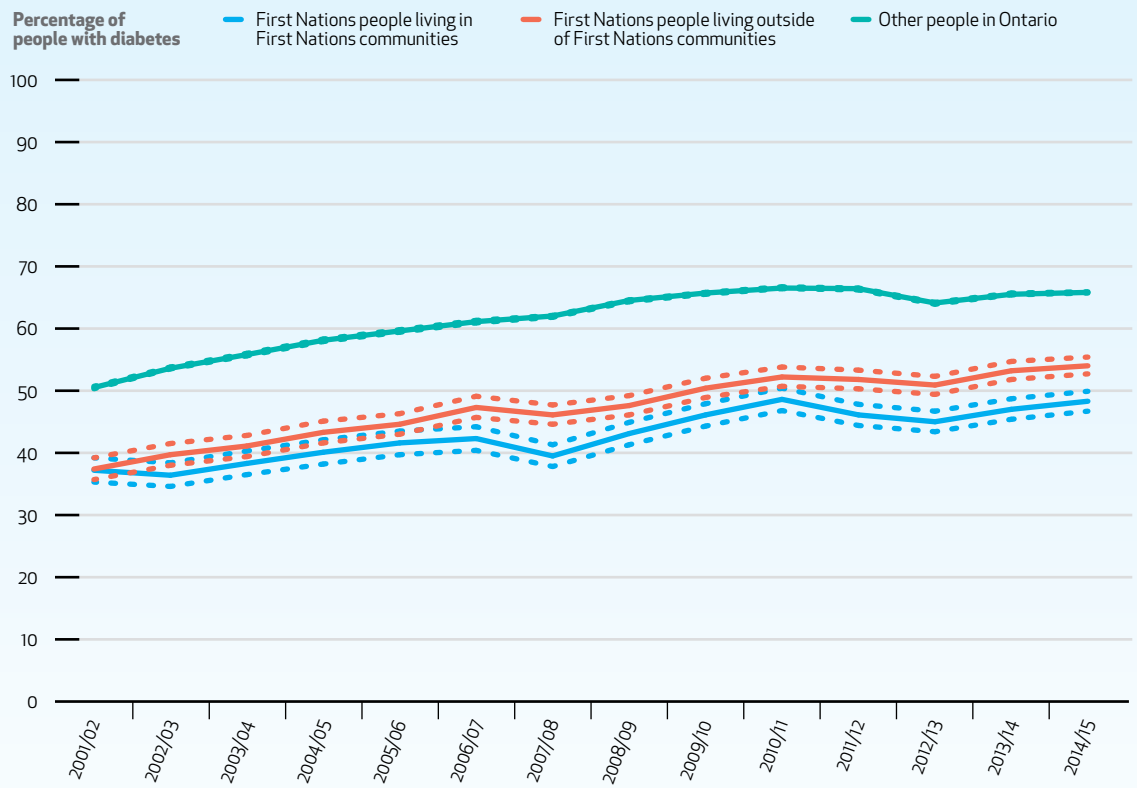


Error bars represent 95% confidence intervals.

EXHIBIT 6.5 Age- and sex-adjusted number of people with a complete lipid profile* per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2001/02 to 2014/15

Key Findings

- Between 2001/02 and 2014/15, lipid monitoring increased by 30% among First Nations people living in First Nations communities (from 37.2% in 2001/02 to 48.3% in 2014/15) and among other people in Ontario (from 50.5% to 65.8%). Among First Nations people living outside of First Nations communities, lipid monitoring increased by 44% (from 37.4% in 2001/02 to 54.0% in 2014/15).
- In 2014/15, two-thirds (65.8%) of other people in Ontario had their lipid level monitored. Among First Nations people, the rates of lipid monitoring were lower: 54.0% among those living outside of First Nations communities and 48.3% among those living in First Nations communities.

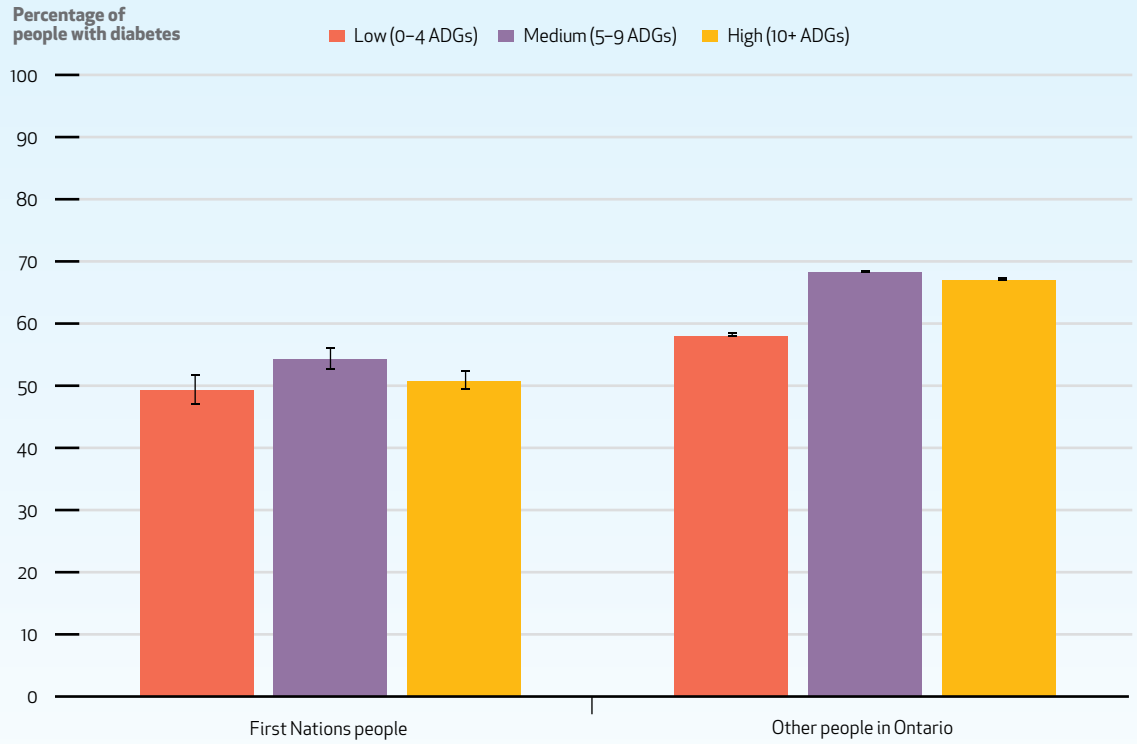


Dashed lines represent 95% confidence intervals.
*Defined as having total, HDL and triglyceride testing all done on the same day.

EXHIBIT 6.6 Age- and sex-adjusted number of people with a complete lipid profile* per 100 people with diabetes, among First Nations people and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- Among First Nations people with diabetes in 2014/15, the rate of lipid monitoring ranged from 49.3% of those with low comorbidity to 50.8% of those with high comorbidity and 54.3% of those with medium comorbidity.
- Among other people in Ontario with diabetes, the rate of lipid monitoring was lowest among those with low numbers of comorbid conditions. In 2014/15, 58.0% of individuals with a low level of comorbidity were monitored, compared to 68.2% of those with medium comorbidity and 67.0% of those with high comorbidity.

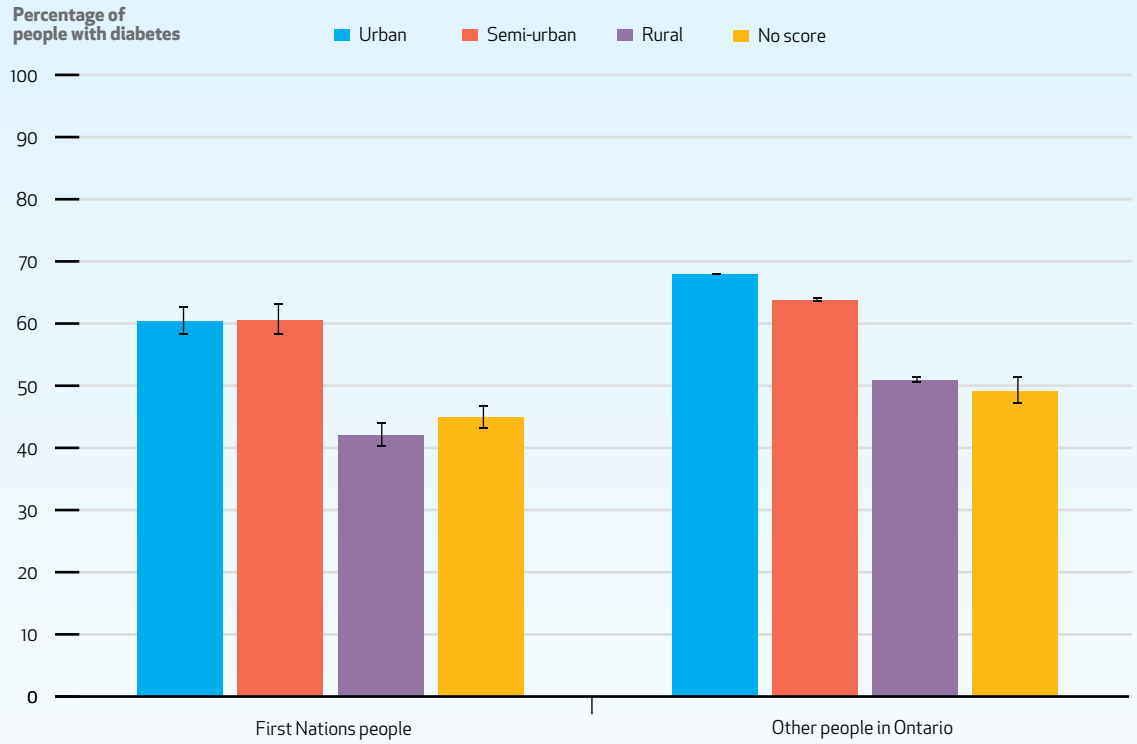


Error bars represent 95% confidence intervals.
*Defined as having total, HDL and triglyceride testing all done on the same day

EXHIBIT 6.7 Age- and sex-adjusted number of people with a complete lipid profile* per 100 people with diabetes, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- In 2014/15, rates of lipid testing were lowest for First Nations people and other people living in rural Ontario. Among First Nations people with diabetes, 60.4% of those living in urban areas and 60.6% of those living in semi-urban areas had lipid monitoring completed, compared to 42.1% of those living in rural areas. Among other people in Ontario, lipid monitoring rates ranged from 67.9% in urban areas to 63.8% in semi-urban areas to 50.9% in rural areas.
- In rural areas in Ontario, First Nations people had lipid monitoring rates that were 20% lower than those of other people.

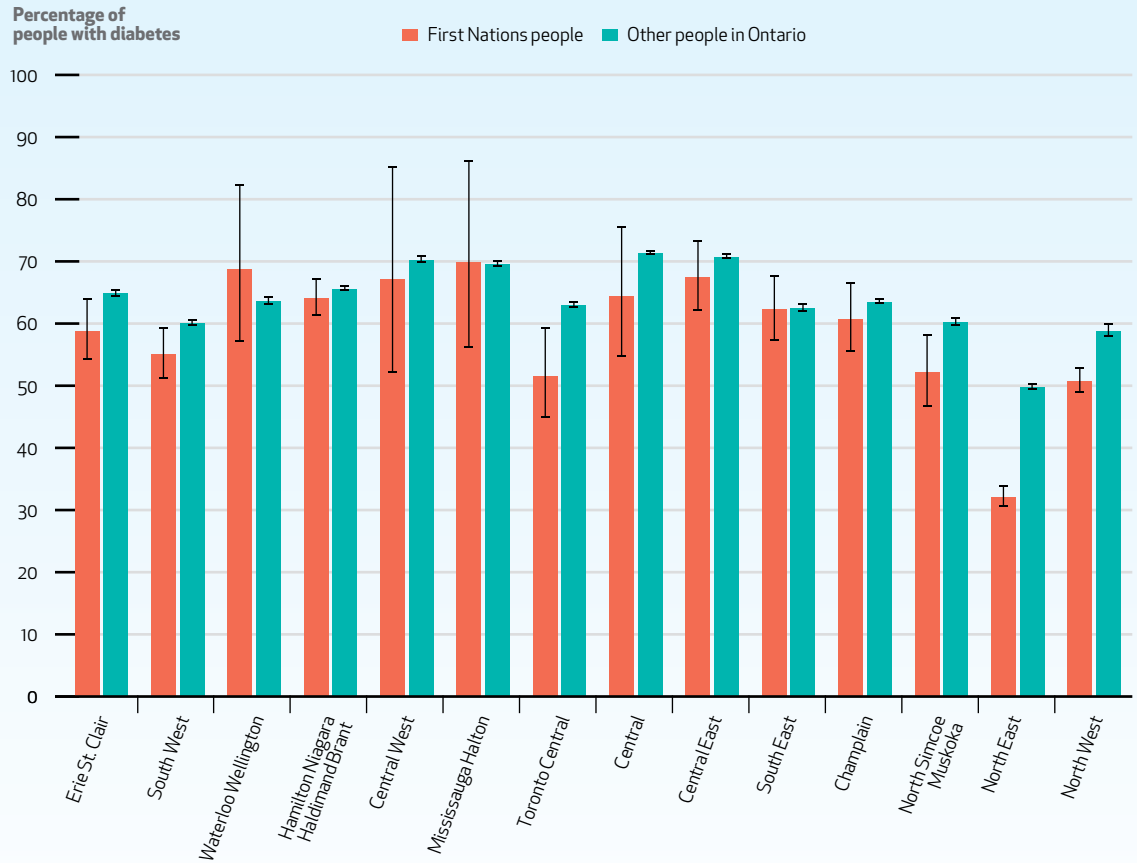


Error bars represent 95% confidence intervals.
*Defined as having total, HDL and triglyceride testing all done on the same day.

EXHIBIT 6.8 Age- and sex-adjusted number of people with a complete lipid profile* per 100 people with diabetes, among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- Among First Nations people with diabetes, the lipid monitoring rate in 2014/15 was highest in the Mississauga Halton LHIN (69.9%) and lowest in the North East LHIN (32.1%).
- Among other people in Ontario, the lipid monitoring rate ranged from a low of 49.7% in the North East LHIN to a high of 71.3% in the Central LHIN.
- The largest difference in lipid monitoring rates between First Nations people and other people in Ontario was seen in the North East LHIN, where the rate among other people was 1.5 times that of First Nations people.



Error bars represent 95% confidence intervals.
*Defined as having total, HDL and triglyceride testing all done on the same day.

EXHIBIT 6.9 Percentage of individuals with diabetes and an HbA1c test result in the Ontario Laboratories Information System, among First Nations people living in and outside of First Nations communities and other people in Ontario, by HbA1c level, 2014/15

Key Findings

- Among First Nations people living in First Nations communities in 2014/15, 39.3% had good HbA1c control (HbA1c ⩽ 7), and 67.4% had fair control (HbA1c < 8.5). Among those living outside of First Nations communities, 74.5% had fair HbA1c control.
- Among other people in Ontario, 56.5% had good control (HbA1c ⩽ 7) and 84.2% had fair control (HbA1c < 8.5).

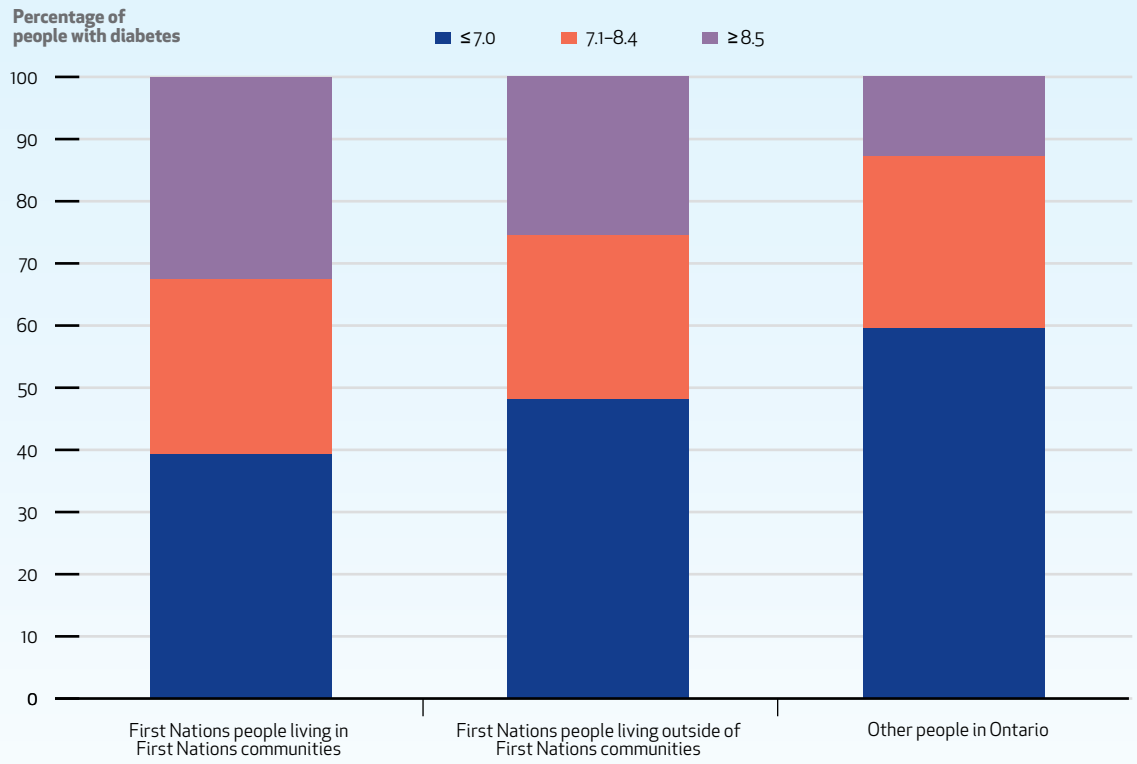
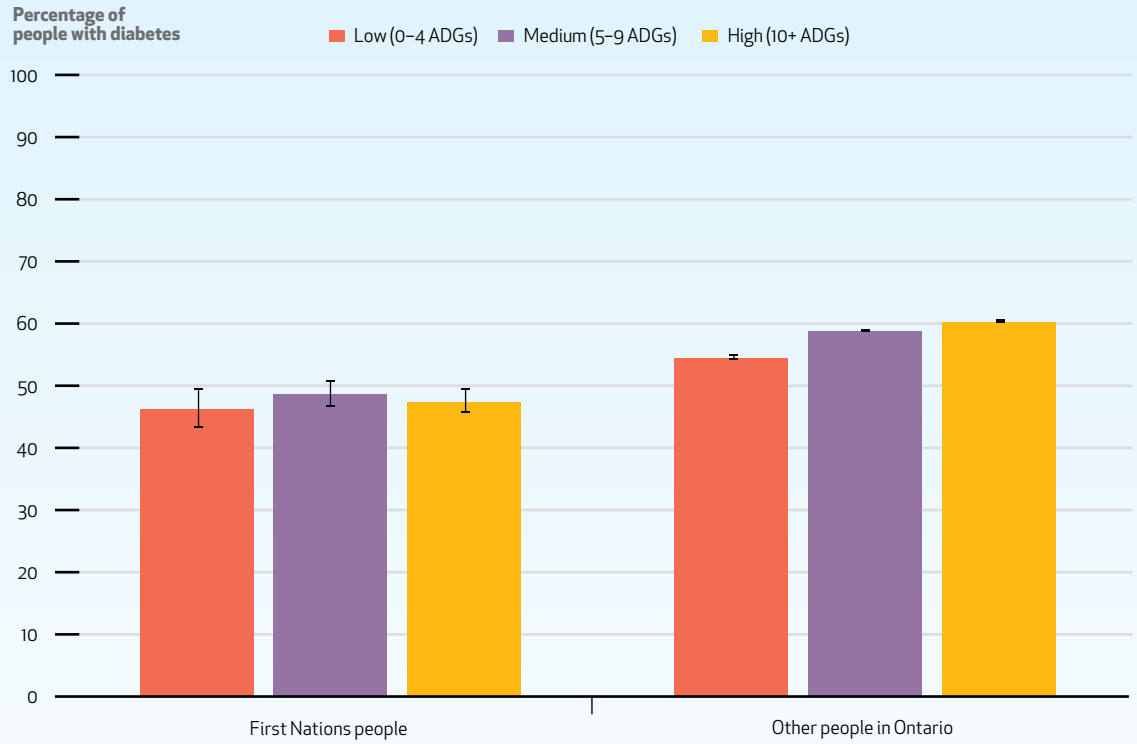


EXHIBIT 6.10 Age- and sex-adjusted percentage of individuals with diabetes who had controlled HbA1c,* among First Nations people and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- Among First Nations people with diabetes, good HbA1c control was similar regardless of the level of comorbid conditions: 46.2% of those with a low level of comorbidity had controlled HbA1c compared to 48.6% with medium comorbidity and 47.4% with high comorbidity.
- Among other people in Ontario with diabetes, the rate of HbA1c control increased with increasing number of comorbid conditions. Among those with controlled HbA1c levels in 2014/15, 54.5% had a low level of comorbidity compared to 58.8% with medium comorbidity and 60.2% with high comorbidity.

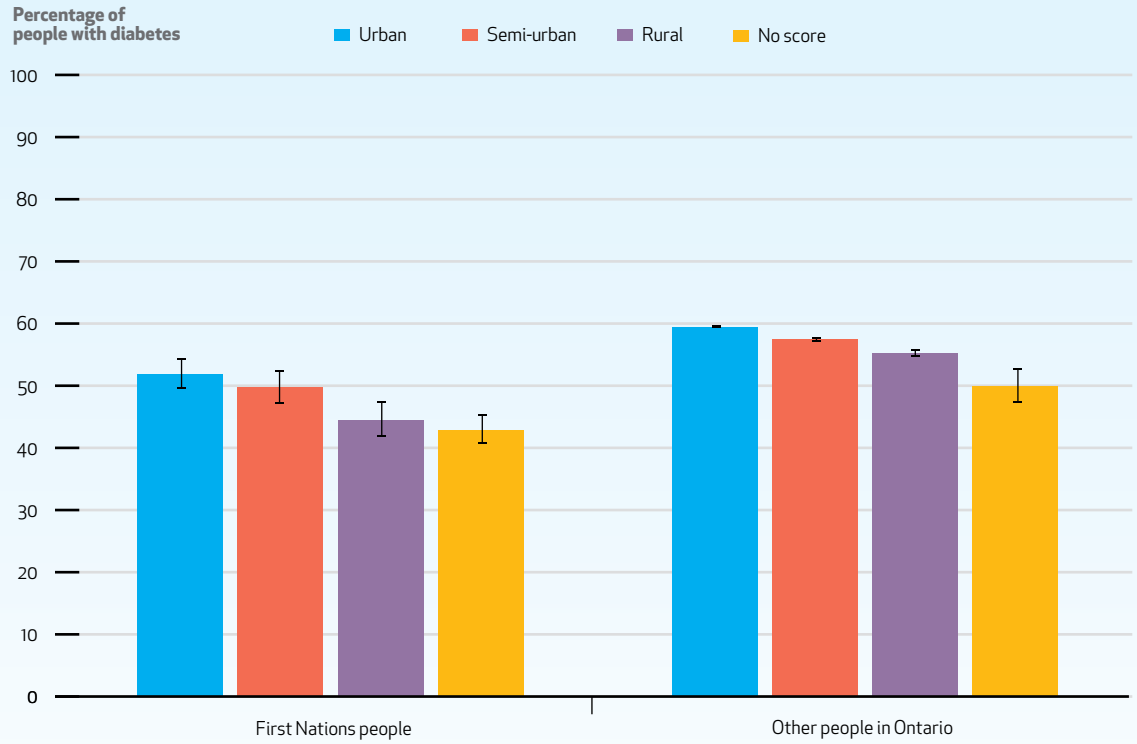


*Defined as having an HbA1c level of <7%.
Error bars represent 95% confidence intervals.

EXHIBIT 6.11 Age- and sex-adjusted percentage of individuals with diabetes who had controlled HbA1c,* among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- For both First Nations people and other people in Ontario, rates of HbA1c control were lowest among those living in rural areas. In 2014/15, 51.8% of First Nations people with diabetes living in urban areas had their HbA1c controlled, compared to 49.7% of those living in semi-urban and 44.5% living in rural areas. Among other people in Ontario, HbA1c control rates ranged from 59.4% in urban areas to 57.5% in semi-urban areas and 55.2% in rural areas.
- Rates of HbA1c control were 15% higher among other people in Ontario in urban and semi-urban areas compared to First Nations people. However, in rural areas, the disparity in rates of HbA1c control was much greater; the rate of HbA1c control was 23% higher among other people in Ontario.

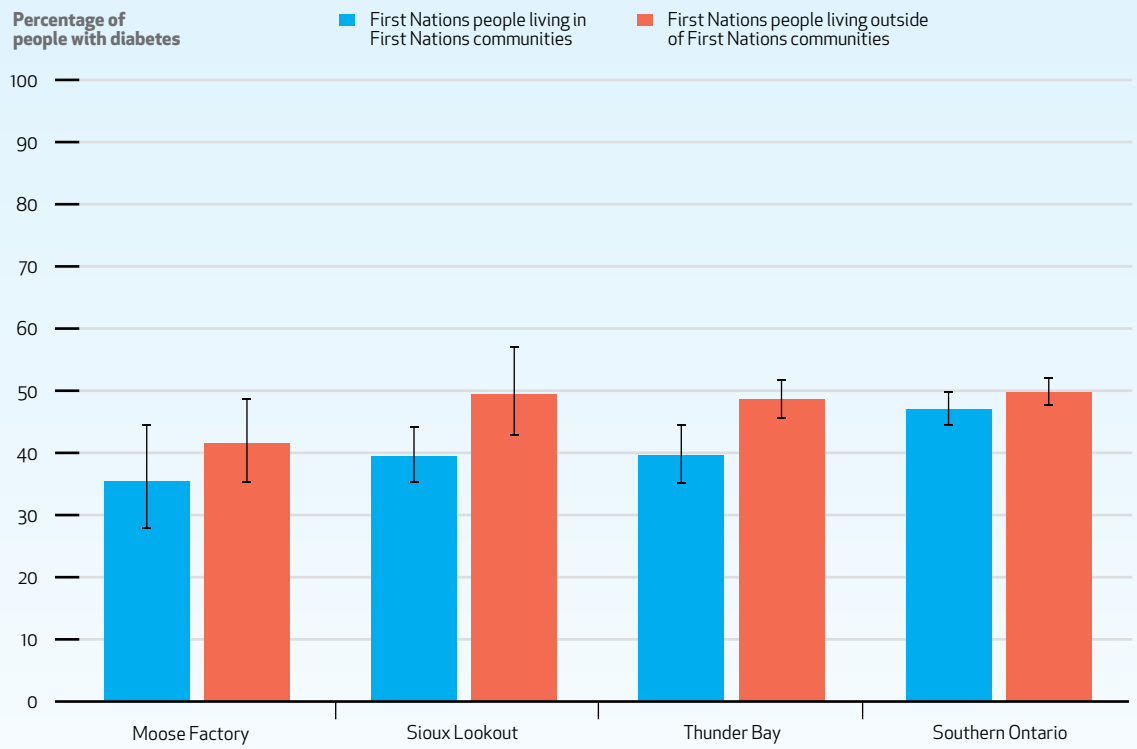


*Defined as having an HbA1c level of <7%.
Error bars represent 95% confidence intervals.

EXHIBIT 6.12 Age- and sex-adjusted percentage of individuals with diabetes who had controlled HbA1c,* among First Nations people living in and outside of First Nations communities in Ontario, by Health Canada zone, 2014/15

Key Findings

- Significant differences in HbA1c control rates were evident between First Nations people living in and outside of First Nations communities across the various Health Canada zones in 2014/15. In each zone, HbA1c control was higher among those living outside of First Nations communities.

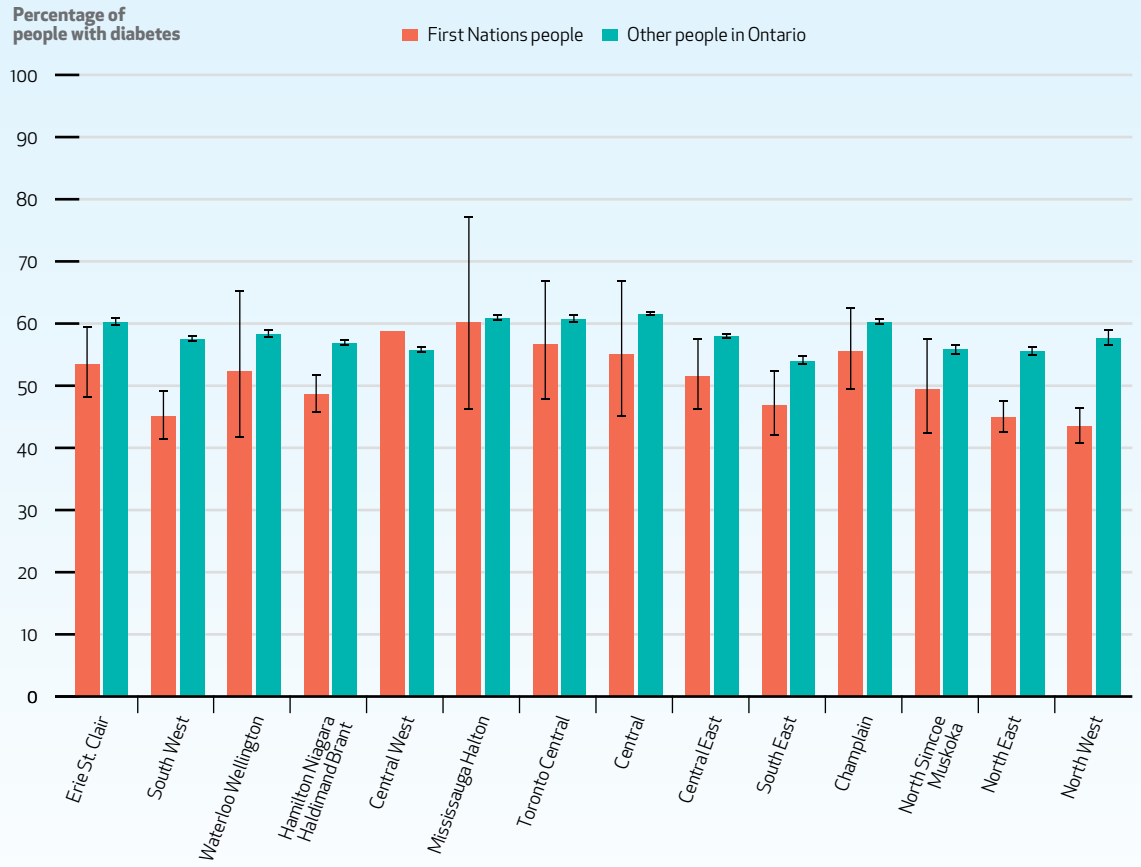


*Defined as having an HbA1c level of <7%.
Error bars represent 95% confidence intervals.

EXHIBIT 6.13 Age- and sex-adjusted percentage of individuals with diabetes who had controlled HbA1c,* among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- Among First Nations people in Ontario with diabetes, the highest rate of HbA1c control was found in the Mississauga Halton LHIN (55.7%) and the lowest rate in the North West LHIN (24.3%).
- Among other people in Ontario, the rate of HbA1c control ranged from 54.0% in the South East LHIN to 61.5% in the Central LHIN.
- The largest difference in rates of HbA1c control between First Nations people and other people in Ontario was seen in the North West LHIN, where 43.5% of First Nations people had controlled HbA1c values compared to 57.6% of other people in the LHIN.

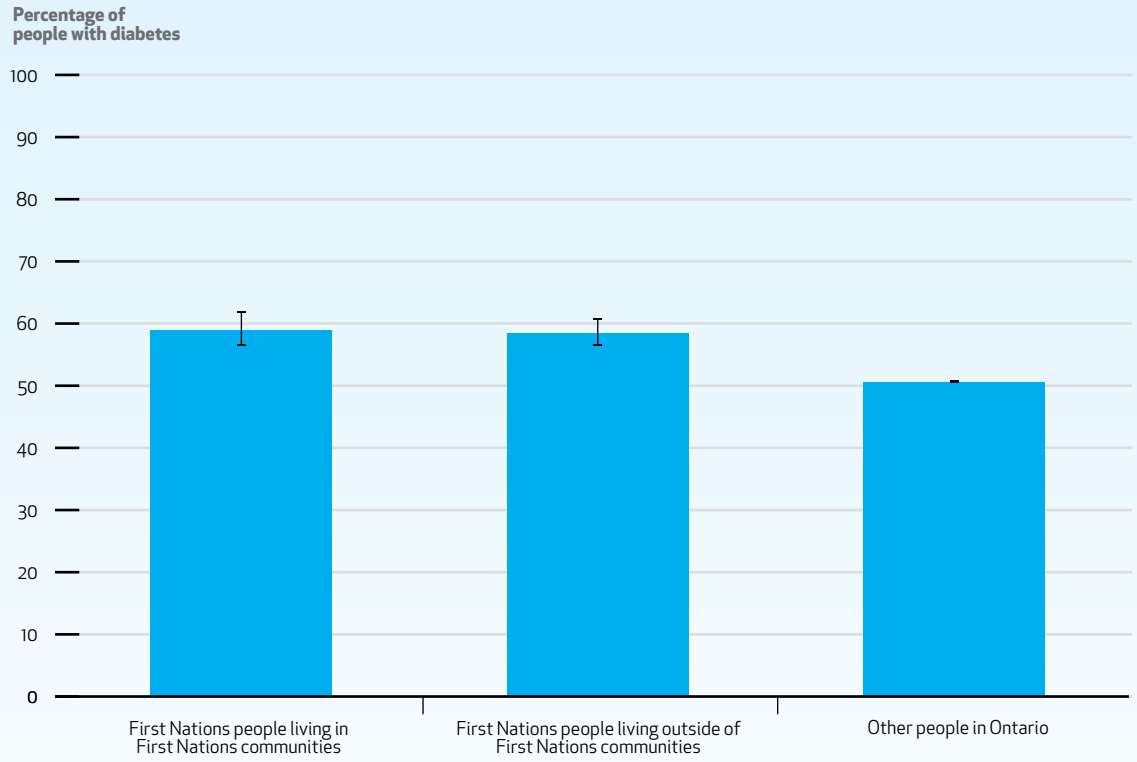


*Defined as having an HbA1c level of <7%.
Error bars represent 95% confidence intervals.

EXHIBIT 6.14 Age- and sex-adjusted percentage of individuals with diabetes who had controlled lipids,* among First Nations people living in and outside of First Nations communities and other people in Ontario, 2014/15

Key Findings

- In 2014/15, First Nations people living in and outside of First Nations communities had similar rates of lipid control at target (59.0% and 58.5%, respectively). The rate was slightly lower among other people in Ontario (50.5%).

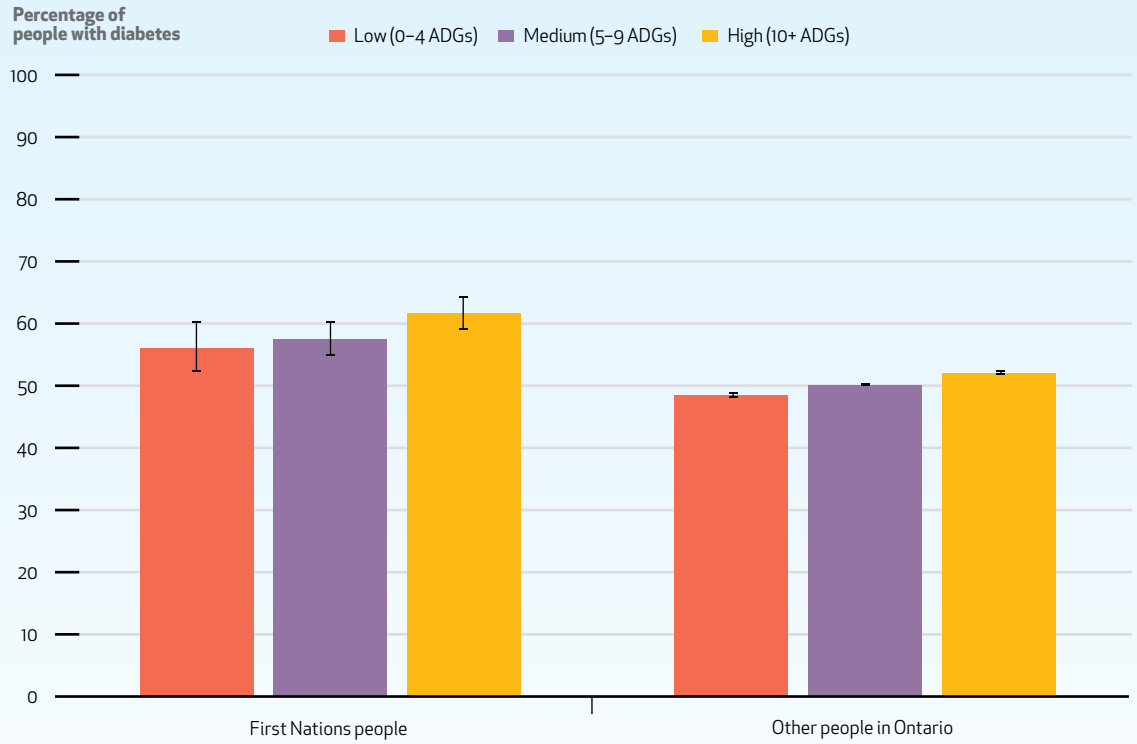


*Defined as having an LDL cholesterol level of <2 mmol/L.
Error bars represent 95% confidence intervals.

EXHIBIT 6.15 Age- and sex-adjusted percentage of individuals with diabetes who had controlled lipids,* among First Nations people and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- Among First Nations people with diabetes, the proportion of individuals who had lipid levels at target increased slightly with increasing level of comorbid disease (56.1% among those with low comorbidity, 57.5% among those with medium comorbidity and 61.6% among those with high comorbidity).
- A similar trend was seen among other people in Ontario (48.4% among those with low comorbidity, 50.1% among those with medium comorbidity and 52.0% among those with high comorbidity).

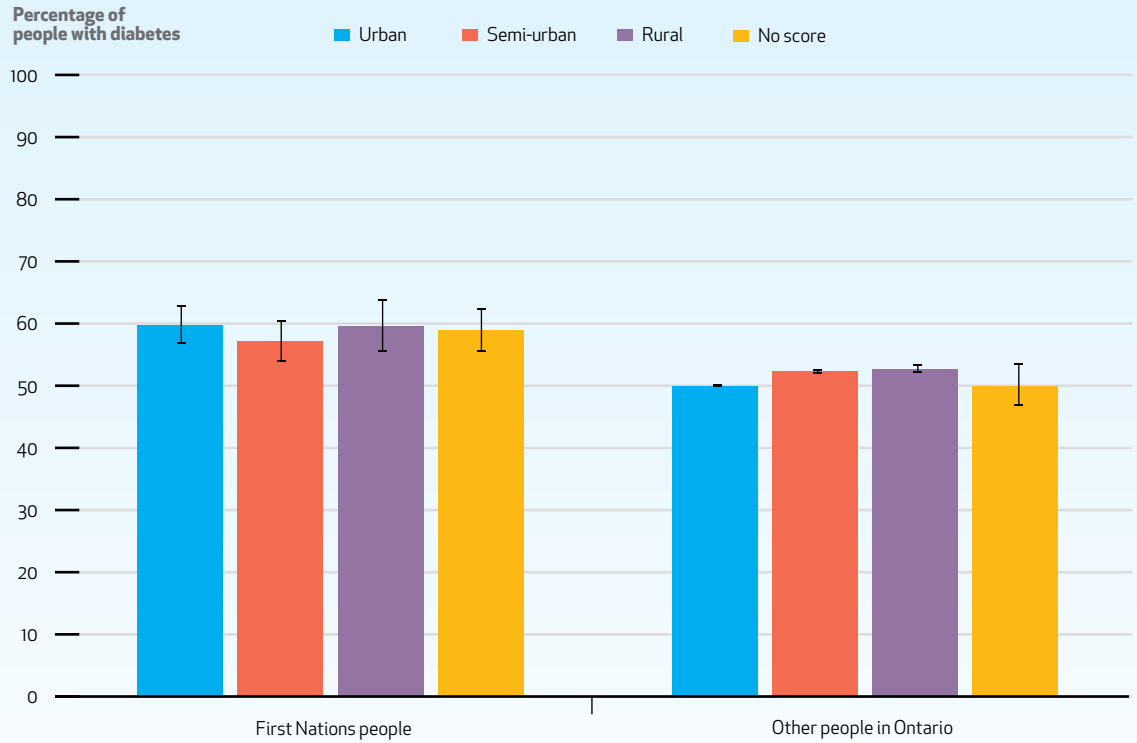


*Defined as having an LDL cholesterol level of <2 mmol/L.
Error bars represent 95% confidence intervals.

EXHIBIT 6.16 Age- and sex-adjusted percentage of individuals with diabetes who had controlled lipids,* among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- The proportion of First Nations people with diabetes and controlled lipids was similar regardless of the level of rurality. In 2014/15, 59.7% of First Nations people with diabetes living in urban areas had their lipids controlled, compared to 57.1% of those living in semi-urban settings and 59.5% of those living in rural areas.
- Among other people in Ontario with diabetes, the proportion of people with controlled lipids ranged from 50.0% of individuals in urban areas to 52.3% in semi-urban areas and 52.7% in rural areas.

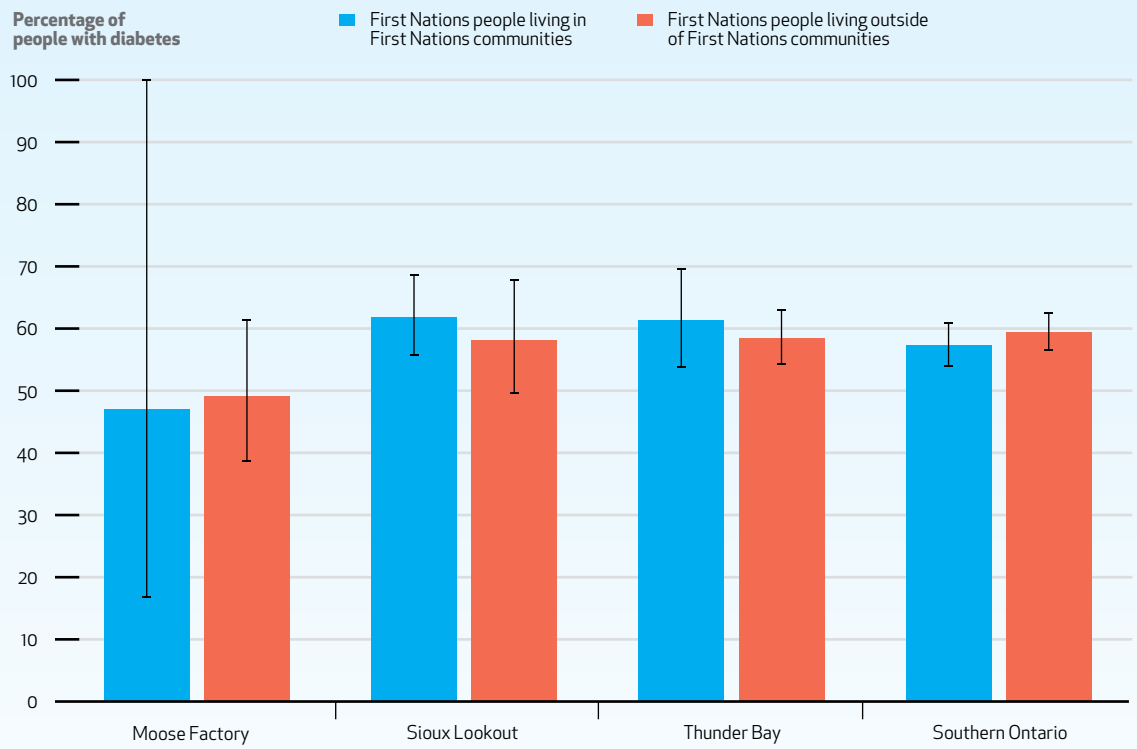


*Defined as having an LDL cholesterol level of <2 mmol/L.
Error bars represent 95% confidence intervals.

EXHIBIT 6.17 Age- and sex-adjusted percentage of individuals with diabetes who had controlled lipids,* among First Nations people living in and outside of First Nations communities in Ontario, by Health Canada zone, 2014/15

Key Findings

- Across the various Health Canada zones in 2014/15, the proportion of individuals with lipid control was similar for First Nations people living in and outside of First Nations communities.

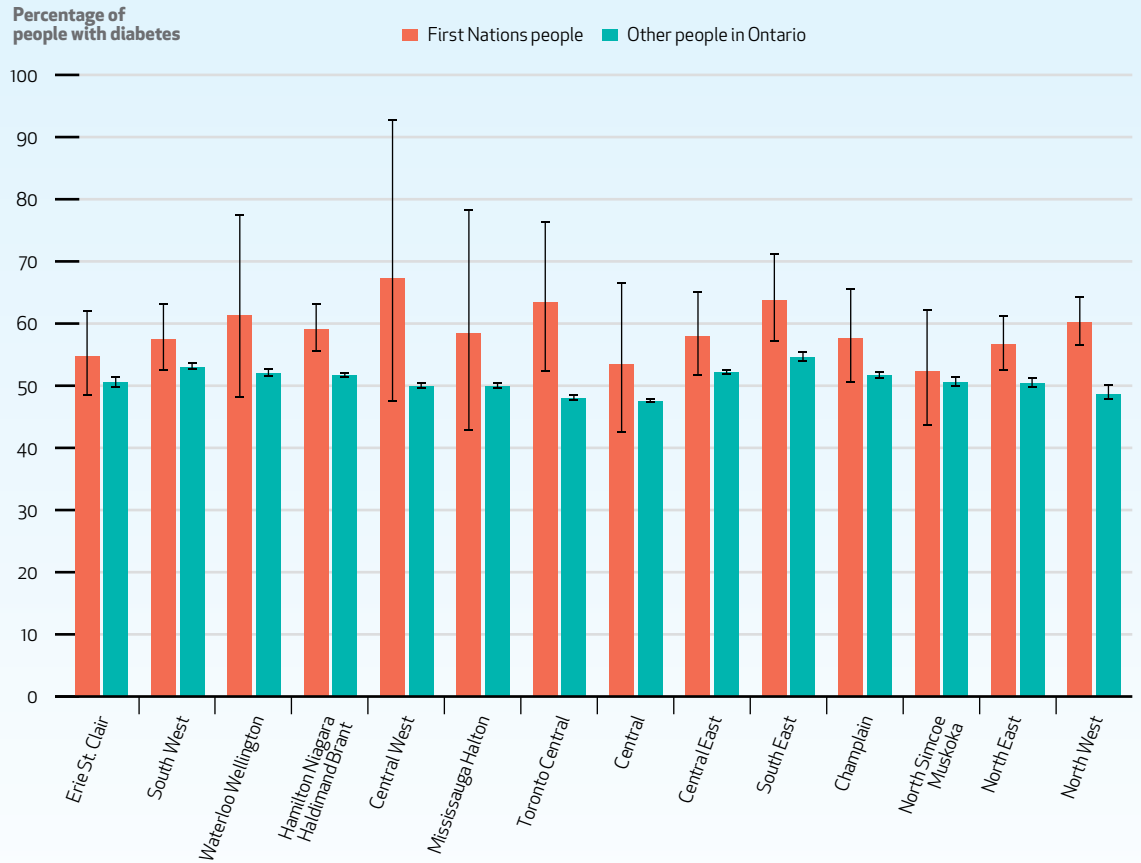


*Defined as having an LDL <2 mmol/L.
Error bars represent 95% confidence intervals.

EXHIBIT 6.18 Age- and sex-adjusted percentage of individuals with diabetes who had controlled lipids,* among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- In 2014/15, the highest proportion of First Nations people with diabetes who had controlled lipid levels was found in the Central West LHIN (67.3%); the lowest rate was seen in the North Simcoe Muskoka LHIN (52.3%).
- Among other people with diabetes, the proportion with controlled lipid values ranged from 47.5% in the Central LHIN to 54.6% in the South East LHIN.
- The greatest variation in lipid control was seen in the North West LHIN, where the proportion of First Nations people with controlled lipids was 1.24 times higher than that of other people with diabetes.



*Defined as having an LDL <2 mmol/L.
Error bars represent 95% confidence intervals.

EXHIBIT 6.19 Percentage of individuals with diabetes aged 65 and older prescribed antidiabetic medication, among First Nations people and other people in Ontario, by number and type of medication prescribed, 2014/15

Key Findings

- Among older adults with diabetes, 71.7% of First Nations people were prescribed an antidiabetic medication in 2014/15 compared to 59.9% of other people in Ontario.
- A higher proportion of First Nations people were prescribed insulin with or without an oral agent compared to other people in Ontario (28.1% vs. 15.1%). Prescriptions of only oral agents were similar for First Nations people and other people in Ontario (43.6% vs. 44.8%).
- No differences were observed in the pharmacotherapy regimens of First Nations people living in and outside of First Nations communities in Ontario.

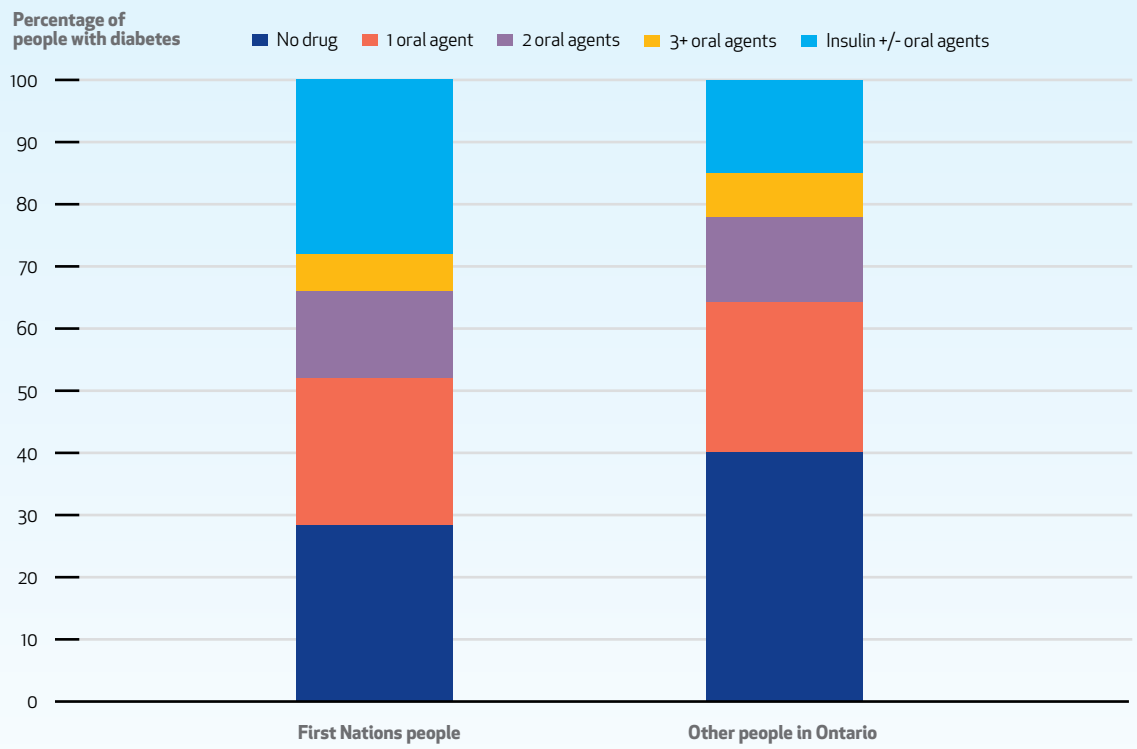


EXHIBIT 6.20 Percentage of individuals with diabetes aged 65 and older who were prescribed antidiabetic medication, among First Nations people and other people in Ontario, by type of medication, 2014/15

Key Findings

- Metformin was the most common antidiabetic medication prescribed in 2014/15. Among older adults with diabetes, 78.5% of First Nations people received a prescription for metformin compared to 81.9% of other people in Ontario.
- Among older adults with diabetes, prescriptions for insulin were more common among First Nations people (39.3% compared to 25.2% of other people in Ontario), whereas prescriptions for DPP-4 inhibitors were less common (24.1% compared to 32.5% of other people in Ontario). Similar proportions of First Nations people and other people in Ontario were prescribed sulfonylureas for diabetes (36.5% and 34.4%, respectively).
- No differences were observed in the types of antidiabetic medications prescribed to First Nations people living in and outside of First Nations communities (not indicated on graph).

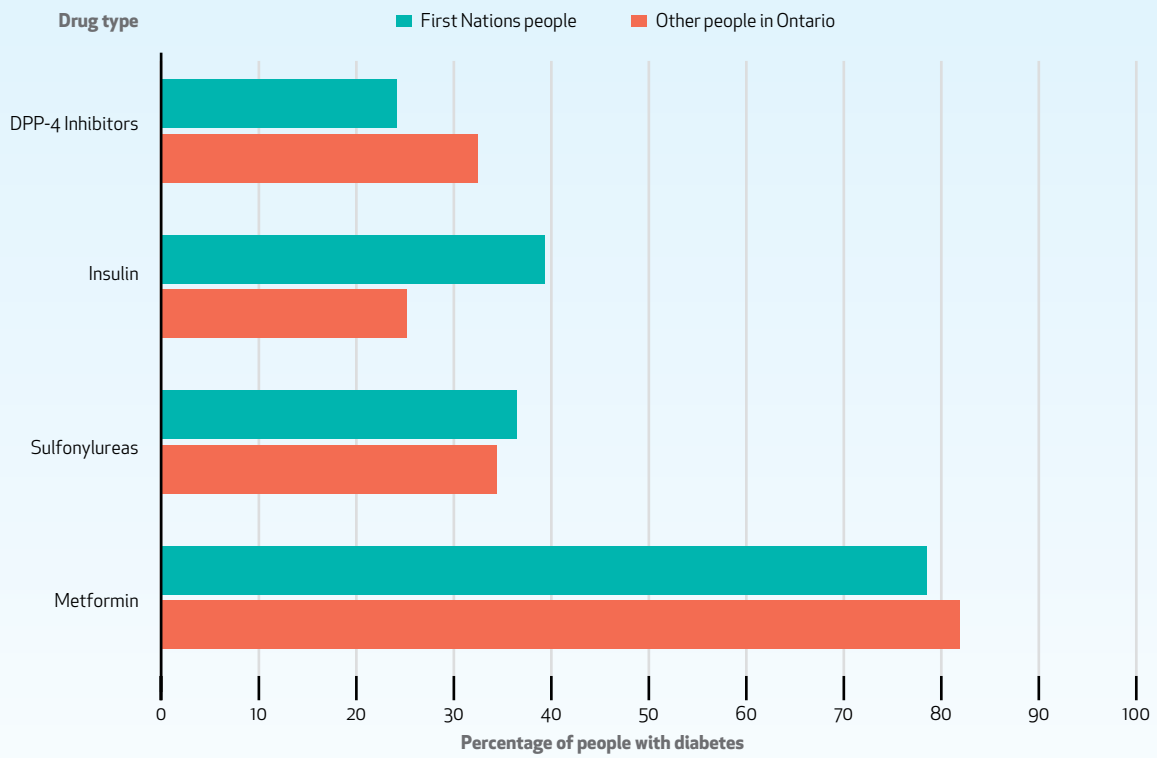
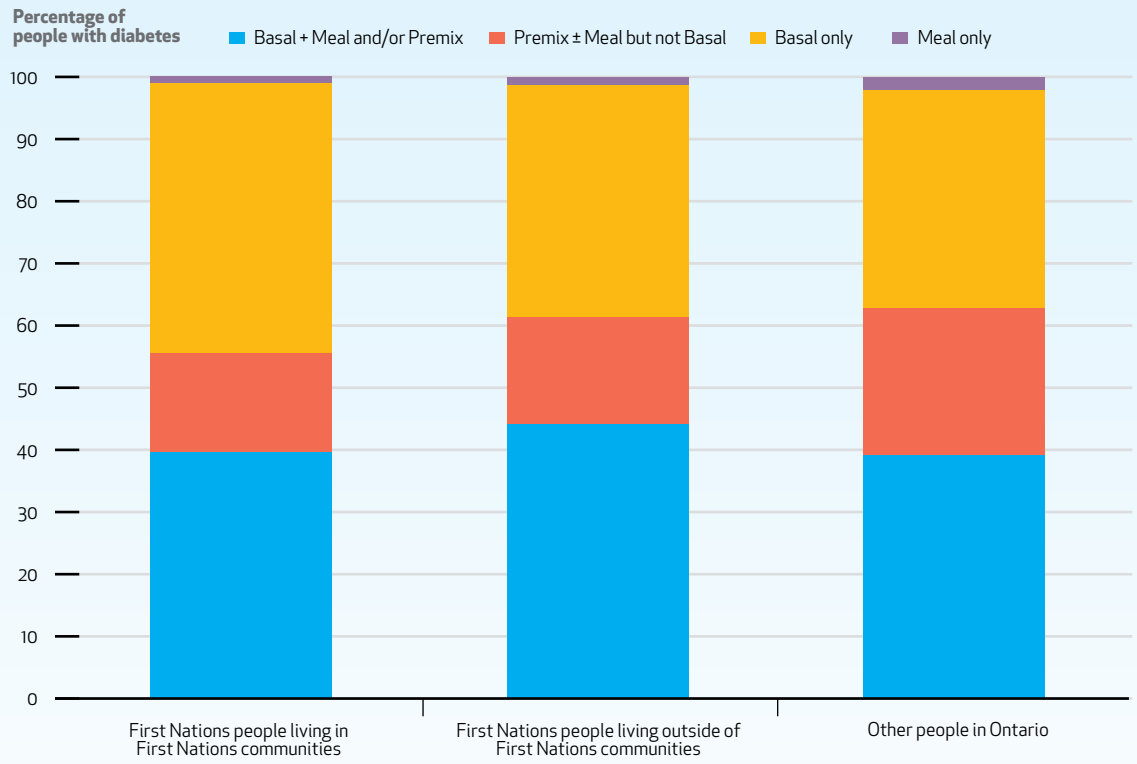


EXHIBIT 6.21 Percentage of individuals with diabetes aged 65 and older prescribed insulin, among First Nations people living in and outside of First Nations communities and other people in Ontario, by type of insulin regimen, 2014/15

Key Findings

- In 2014/15, 44.1% of First Nations people living outside of First Nations communities were prescribed basal + meal and/or premix insulin, compared to 39.7% of those living in First Nations communities and 39.2% of other people in Ontario.
- A higher proportion of First Nations people living in First Nations communities were prescribed basal-only insulin (43.4%) compared to First Nations people living outside of First Nations communities (37.2%) and other people in Ontario (35.0%).



Discussion

While rates of HbA1c and lipid monitoring have increased over the past decade among all Ontarians, they are still lower than guidelines suggest.[6,13] We found that fewer than half of Ontarians with diabetes had their HbA1c levels monitored twice in a year, despite guidelines suggesting that for most people with diabetes, HbA1c should be measured approximately every 3 months, or every 6 months when stable.[6] These results are similar to a recent study that showed that only 37% of Ontarians with diabetes received the optimal number of HbA1c tests per year.[18] Monitoring is less frequent among First Nations people in Ontario compared with the rest of the population. A higher proportion of First Nations people in Ontario have uncontrolled HbA1c levels (≥ 8.5%) compared to other people in Ontario. The proportion of First Nations people with diabetes who had controlled A1c was lowest among those living in First Nations communities. Studies conducted in Alberta show similar findings, with First Nations people, especially those living in First Nations communities, having lower levels of HbA1c control.[19,20] However, these quality indicators reflect adherence to clinical practice guidelines; cultural differences between First Nations people and other people in Ontario may affect the uptake of these practices and contribute to disparities.

While 65.8% of other people in Ontario had up-to-date lipid monitoring, only 54.0% of First Nations people living outside of First Nations communities and 48.3% of those living in First Nations communities shared that status, suggesting that guidelines for diabetes care are not being met. A 2014 Ontario study showed that 80% of Ontarians had one lipid test done, but only 59% had received two tests as recommended by guidelines.[18] The proportion of individuals with diabetes and controlled lipids (LDL ≤2 mmol/L) was higher among First Nations people than among other people in Ontario (58.8% vs. 50.5%).

Higher levels of comorbid disease are associated with higher rates of HbA1c and lipid monitoring among other people in Ontario. This is to be expected at these people are likely being seen by their physicians to manage their conditions; however, among First Nations people, monitoring rates are relatively constant regardless of the degree of multimorbidity. Interestingly, increased rates of HbA1c and lipid control are seen among First Nations people and other people in Ontario with higher degrees of comorbid disease. A study in Alberta found that for people with chronic kidney disease, First Nations people were as likely to achieve HbA1c and lipid targets as other people in the province.[19]

The difference in lipid monitoring and control between First Nations people and other people in Ontario appears to be an issue of lower access to organized care in rural areas. Monitoring of HbA1c and lipid levels is lower in rural areas for both First Nations people and other people, and there is a gap between the two groups that is not seen in urban or semi-urban areas. Interestingly, when we looked at control of HbA1c and lipids, we found it to be lower in rural areas both for First Nations people living outside of First Nations communities and for other people in Ontario. However, rates of HbA1c and lipid control are relatively stable for First Nations people living in First Nations communities, regardless of rurality.

Lastly, pharmacotherapy regimens differ between First Nations people and other people in Ontario. There is a large gap in prescriptions for DPP-4 inhibitors between First Nations people and other people in Ontario and the higher use of insulin among First Nations people may speak to the severity of the disease in this population.

Limitations

The data sources used to capture HbA1c and lipid monitoring depend on the availability of OHIP billing data for laboratory testing, which is inconsistent across hospital laboratories province-wide. They also do not include any point-of-case testing, usually used in federal facilities such as nursing stations. This data gap is quite evident when we look at rates of HbA1c and lipid monitoring in the Moose Factory zone (exhibits 10.4 and 10.9).

The results on control are dependent on the availability of OLIS data. OLIS provides laboratory results for testing done at all Public Health Ontario

labs, community labs (e.g., LifeLabs) and many hospitals; however, data collection from hospitals was rolled out across the province in a staggered fashion, with Northern Ontario hospitals brought onstream toward the end of the rollout. Hospitals in the North East LHIN, which has the lowest rates of HbA1c and lipid control in the province (exhibits 6.15 and 6.20), had just implemented OLIS in 2014/15.[21] As a result, many patients in that LHIN had testing completed, but the results were not yet available in OLIS and therefore could not be analyzed. The proportion of patients with diabetes who had HbA1c and lipid test results available in OLIS in 2014 are shown in exhibits 6.4A and 6.5A, respectively, in the chapter appendix.

It is important to note that the data presented on medications only captures people older than age 65. First Nations people in Ontario are younger, on average, than other people in Ontario. In 2014/15, 7.6% of the First Nations population was 65 years of age or older compared to 16.5% of other people in Ontario. In addition, the federal government's First Nations and Inuit Health Branch provides some coverage for medications for Status First Nations people; these medications are not included in the Ontario Drug Benefit (ODB) data. Lastly, we are only capturing data on prescriptions dispensed through the ODB. Prescriptions filled using private insurance or self-pay, including medications not in the ODB formulary, are not captured. In addition, there is no information on drug adherence or on drug prescriptions from physicians that the patient never filled.

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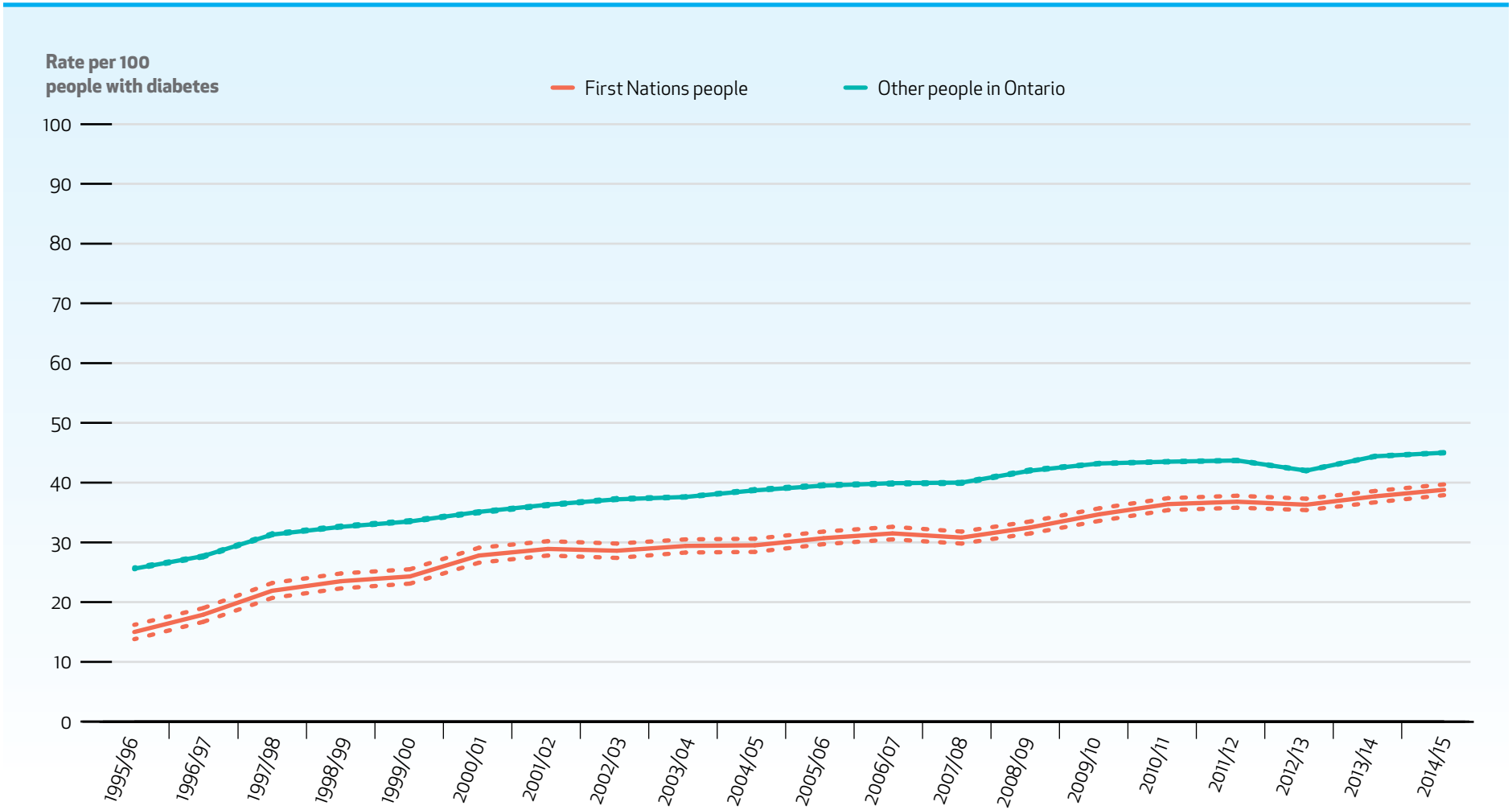
Appendix

EXHIBIT 6.1A Indicator definitions for HbA1c and lipid monitoring

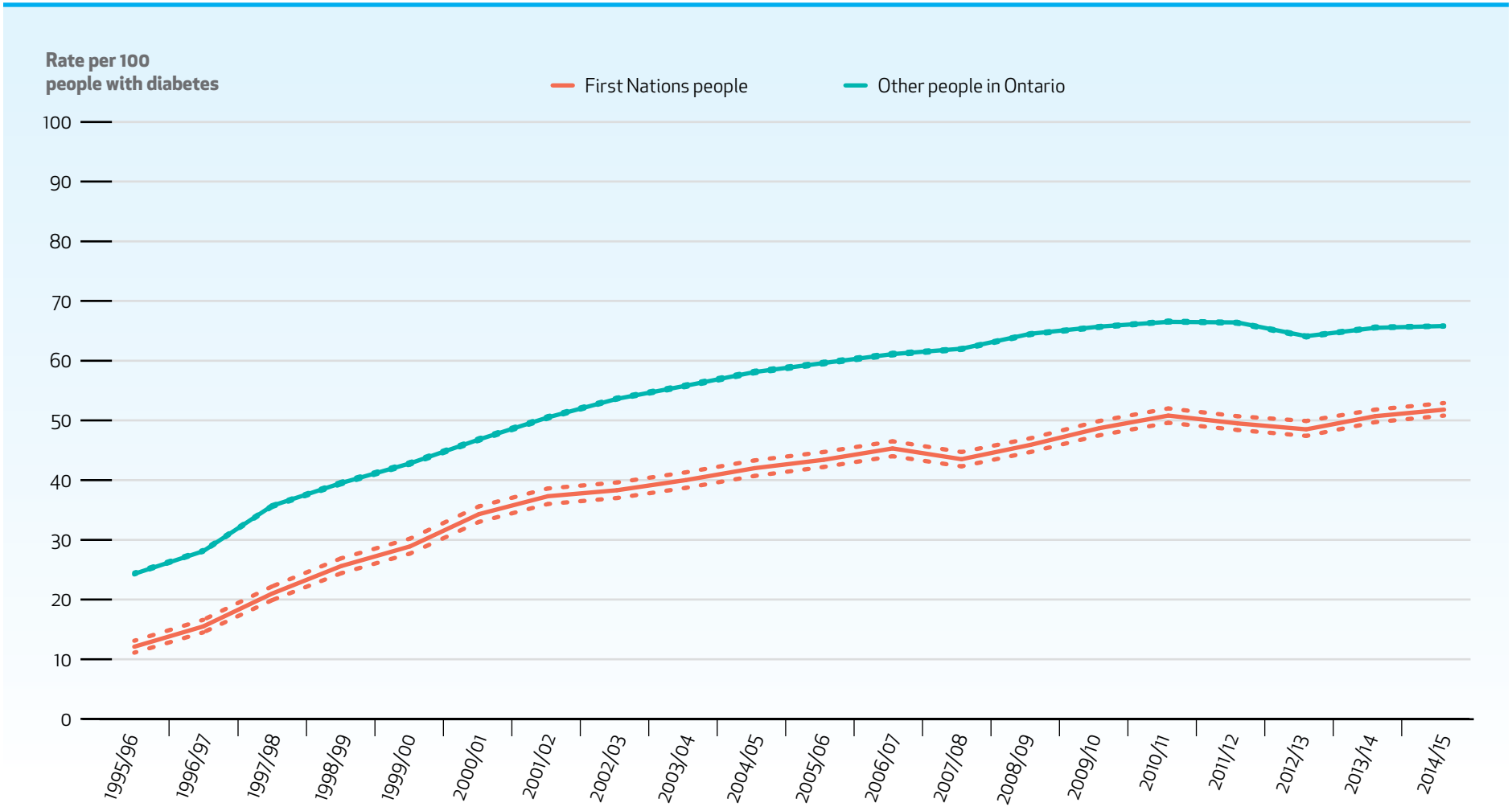
Indicator	Code
Monitoring	Ontario Health Insurance Plan
HbA1c	L093
Lipid	L055
	L117
	L243
Control	Ontario Laboratories Information System
HbA1c	4548-4
	17855-8
	17856-6
	41995-2
	59261-8
	71875-9
Lipid	39469-2

EXHIBIT 6.2A Age- and sex-adjusted number of people with at least 2 HbA1c tests in the previous 12 months per 100 people with diabetes, among First Nations people and other people in Ontario, 1995/96 to 2014/15



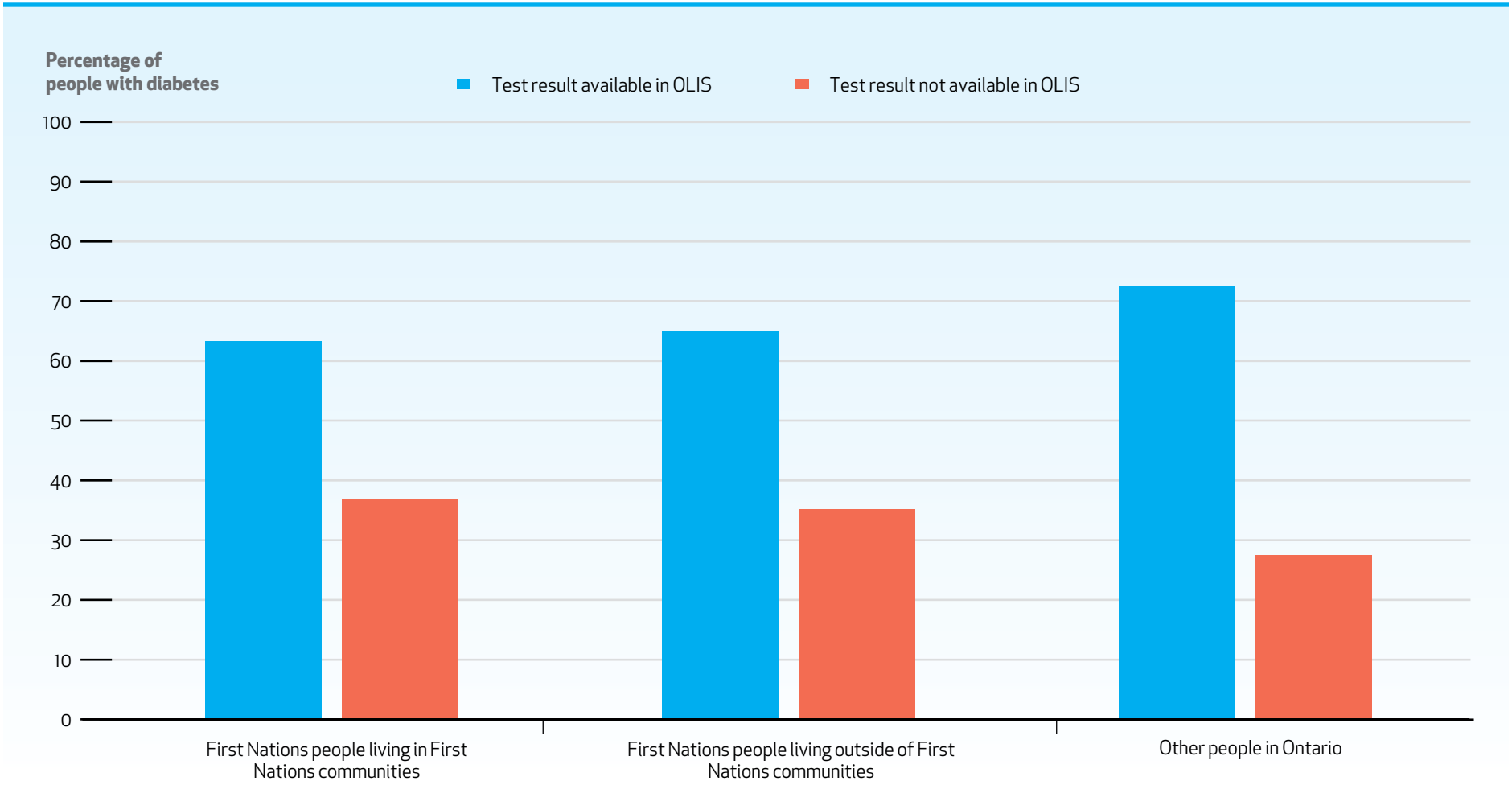
Dashed lines represent 95% confidence intervals.

EXHIBIT 6.3A Age- and sex-adjusted number of people with a complete lipid profile* per 100 people with diabetes, among First Nations people and other people in Ontario, 1995/96 to 2014/15



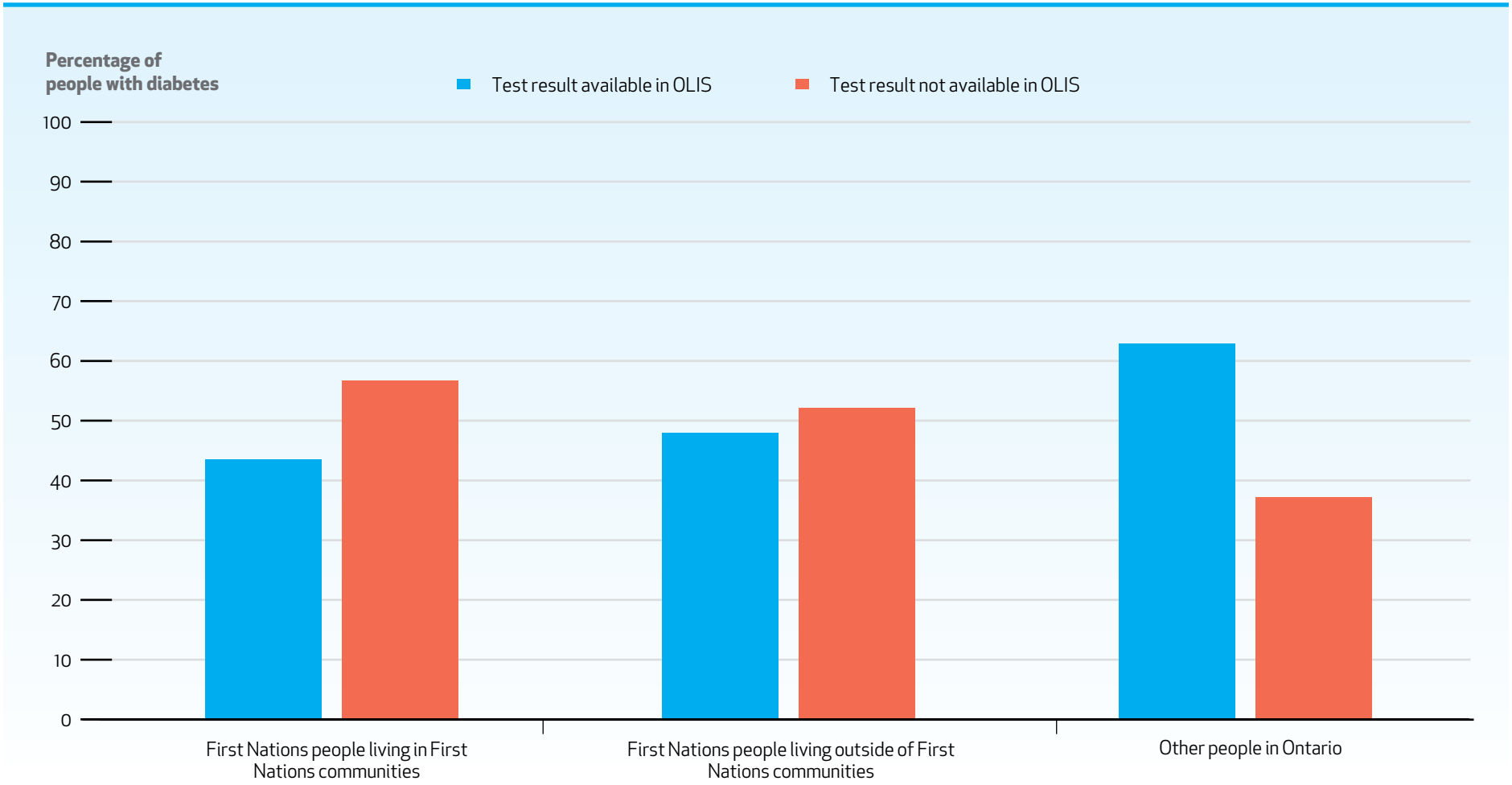
Dashed lines represent 95% confidence intervals.
*Defined as having total, HDL and triglyceride testing all done on the same day.

EXHIBIT 6.4A Percentage of individuals with diabetes who had an HbA1c test result, among First Nations people living in and outside of First Nations communities and other people in Ontario, by test result availability in the Ontario Laboratories Information System, 2014/15



OLIS: Ontario Laboratories Information System.

EXHIBIT 6.5A Percentage of individuals with diabetes who had an LDL test result, among First Nations people living in and outside of First Nations communities and other people in Ontario, by test result availability in the Ontario Laboratories Information System, 2014/15



OLIS: Ontario Laboratories Information System.

7 Health Services for Diabetes Care

Inside

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Overview

The majority of medical care for people with diabetes is delivered in primary care settings.[1] Health systems with strong primary care have better outcomes, lower costs and fewer disparities,[2-4] especially among people with chronic conditions such as diabetes.[5]

This chapter first presents data on access to primary care for First Nations people and other people in Ontario with diabetes. We also present data on key measures of access to primary care: continuity of care with the same physician over time,[6] and hospitalizations for ambulatory care–sensitive conditions (ACSCs). ACSCs, such as diabetes, are those for which accessible, timely and high-quality primary care may prevent or reduce the need for admission to hospital.[7-9] Thus, high rates of hospitalization for these conditions can be an indication of inadequate primary care.[7,10] Lastly, we present data on visits to specialists in endocrinology and general internal medicine.

Methods

This chapter makes use of the Primary Care Population data set, which identifies the models of care in which primary care providers work. More than three-quarters of comprehensive primary care physicians in Ontario have transitioned from a traditional fee-for-serve practice to a model that incorporates blended capitation payments and, in some cases, provides funding for other health care professionals.[11] There are two main payment models: enhanced fee-for-service and capitation (e.g., payment per patient per month).[11] Both models require after-hours clinics and include incentivized payments for chronic disease management and preventive care (e.g., immunization, cancer screening, smoking cessation). All models are based on patient enrolment (also known as rostering). When patients opt to participate in a primary care enrolment model, they agree to seek treatment from their physician or group first, unless they are travelling or require emergency care.[11] The physician commits to providing comprehensive primary care services to his or her rostered patients.

We examined the proportion of individuals belonging to each type of primary care patient enrolment model (details on how types of enrolment models were categorized are available in exhibit 7.1A in the chapter appendix). We also captured patients who did not belong to any of these models, including those cared for by physicians not in a patient enrolment model, and those for whom no billing claim for core primary care fee codes was submitted over two years. Patients who were not formally rostered to a specific primary care physician were virtually rostered to the provider who predominantly billed for their core primary care services. We were unable to capture primary care provided by Aboriginal Health Access Centres, Community Health Centres, and federally funded nursing stations and health centres.

We assessed continuity of care among patients who belonged to a patient enrolment model (rostered or virtually rostered) by calculating the proportion of patients who had at least three visits to their own physician in the previous 2 years.

The Primary Care Population data set also contains information on hospital admissions for ACSCs as an indirect measure of access to primary care. This indicator captures the number of acute care hospital admissions for four ACSCs: asthma, chronic obstructive pulmonary disease, congestive heart failure and diabetes (specific inclusion and exclusion criteria are listed in exhibit 7.2A in the chapter appendix). The rate of hospital admission for ACSCs is calculated as the number of acute care hospital admissions for one of the four conditions in the previous year divided by the total number of individuals with diabetes aged 75 years and younger as of March 31 of the previous year. The indicator is risk adjusted for age, sex and comorbidity.

Lastly, we determined the distribution and proportion of people with diabetes who saw specialists in endocrinology and general internal medicine. (Data on visits to these specialists were not available before 2008.)

Results

Primary care

For both First Nations people and other people in Ontario, those living with diabetes were more likely to have a primary care physician compared with the general population (exhibit 7.1). However, among First Nations people living in First Nations communities, only 61% had a comprehensive primary care physician (exhibit 7.2). First Nations people in Ontario were less likely to have a primary care physician compared to other people in Ontario (exhibit 7.3A in the chapter appendix). (Enrolment in primary care models for all First Nations people and other people in Ontario are described in exhibits 7.4A and 7.5A in the chapter appendix.)

Continuity of care

Among those who received care through a primary care enrolment model (e.g., a family health group or family health team), First Nations people with diabetes experienced lower continuity of care than other people with diabetes in Ontario (exhibit 7.3). Continuity was lowest among First Nations people living in First Nations communities. (Data for all First Nations people and other people in Ontario are available in exhibit 7.6A in the chapter appendix.) Continuity increased as the number of comorbid conditions increased (exhibit 7.4). Continuity of care was lowest among those living in rural areas (exhibit 7.5) and varies by region (exhibits 7.6 and 7.7). For both First Nations people and other people in Ontario, the lowest rates of continuity of care were found in the North West LHIN.

Hospital admissions for ambulatory care–sensitive conditions

Rates of hospital admission for ambulatory care–sensitive conditions (ACSCs) were twice as high among First Nations people compared to other people in Ontario (exhibit 7.8). There was no difference in hospital admissions for ACSCs between First Nations people living in and outside of First Nations communities. Rates were higher in rural areas among other people in Ontario, although there was no significant difference among First Nations people when considering rurality (exhibit 7.9) or Health Canada zone (exhibit 7.10).

Specialist care

Compared to other people in Ontario, First Nations people with diabetes were much less likely to visit a specialist (exhibits 7.11 and 7.12). The gap was extremely pronounced for endocrinology; in 2014, the proportion of patients with an endocrinology visit among other people in Ontario was 2.4 times that of First Nations people. Utilization of specialists was lowest among First Nations people with diabetes who lived in First Nations communities.

Comorbid conditions

Patients with more comorbid conditions were more likely to visit specialists (exhibit 7.13). Visits with specialists also varied by region (exhibit 7.14) and were highest among First Nations people living in Southern Ontario (exhibit 7.15). Accordingly, among First Nations people, the Mississauga Halton LHIN had the highest rate of specialist visits and the North West LHIN had the lowest rate (exhibit 7.16).

EXHIBIT 7.1 Percentage of people with diabetes who had a comprehensive primary care physician, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2005/06 to 2014/15

Key Findings

- Among people with diabetes in 2014/15, 79.5% of First Nations people living in First Nations communities and 92.6% of First Nations people living outside of First Nations communities had a primary care physician compared with 97.7% of other people in Ontario.

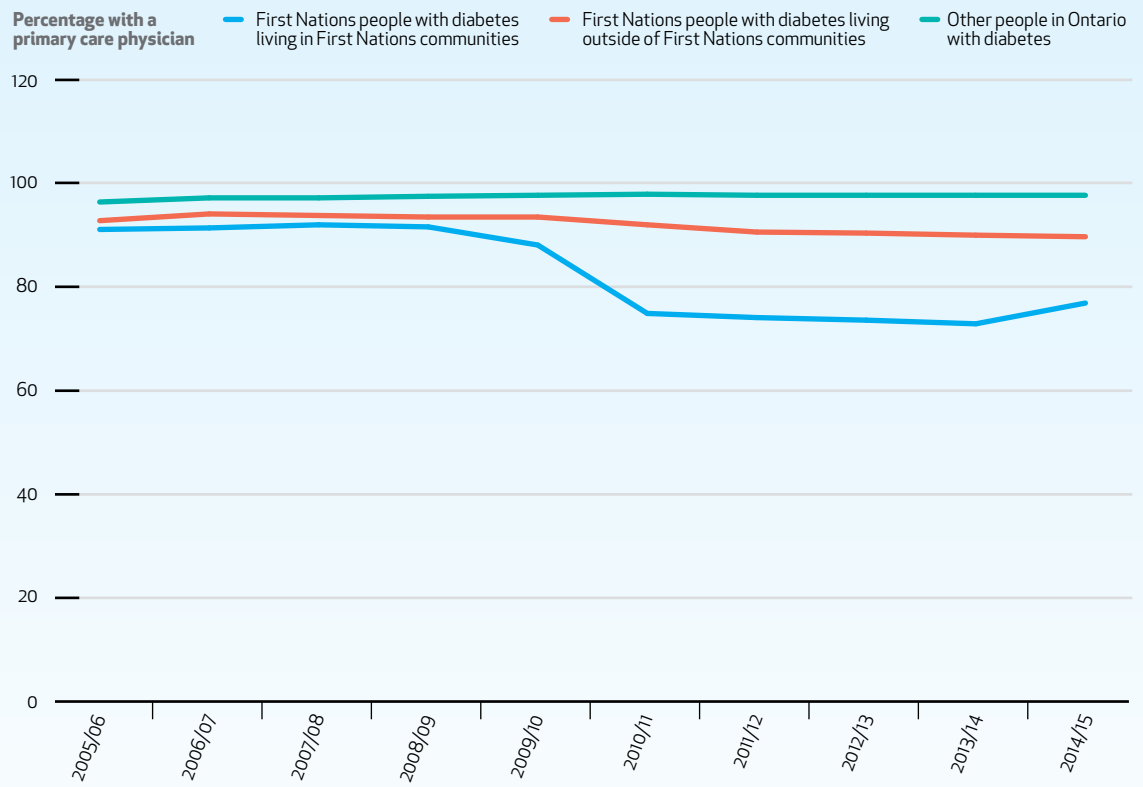
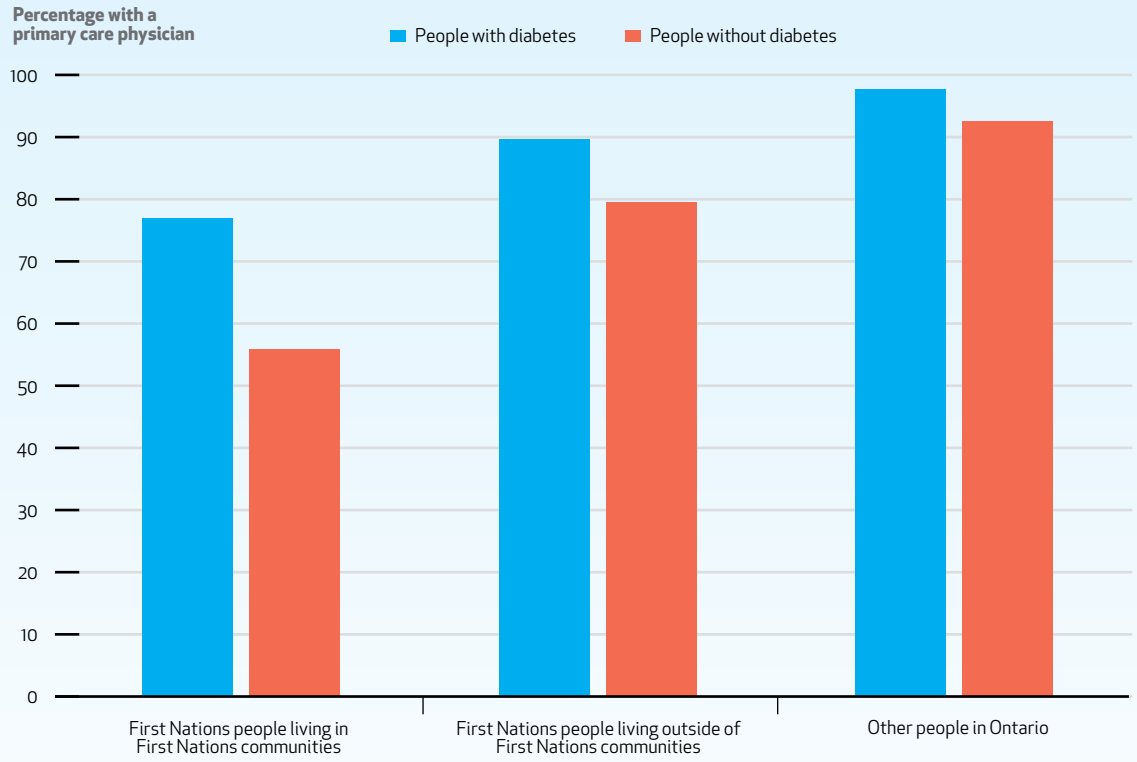


EXHIBIT 7.2 Percentage of people who had a comprehensive primary care physician, among First Nations people living in and outside of First Nations communities and other people in Ontario, by presence or absence of diabetes, 2014

Key Findings

- The proportion of individuals with a comprehensive primary care physician was higher among those with diabetes compared to those without diabetes.
- However, the variation was larger among First Nations people compared to other people in Ontario, especially among those living in First Nations communities.
- These trends remained stable between 2010/11 and 2014/15 (data shown in exhibit 7.5 in the chapter appendix).

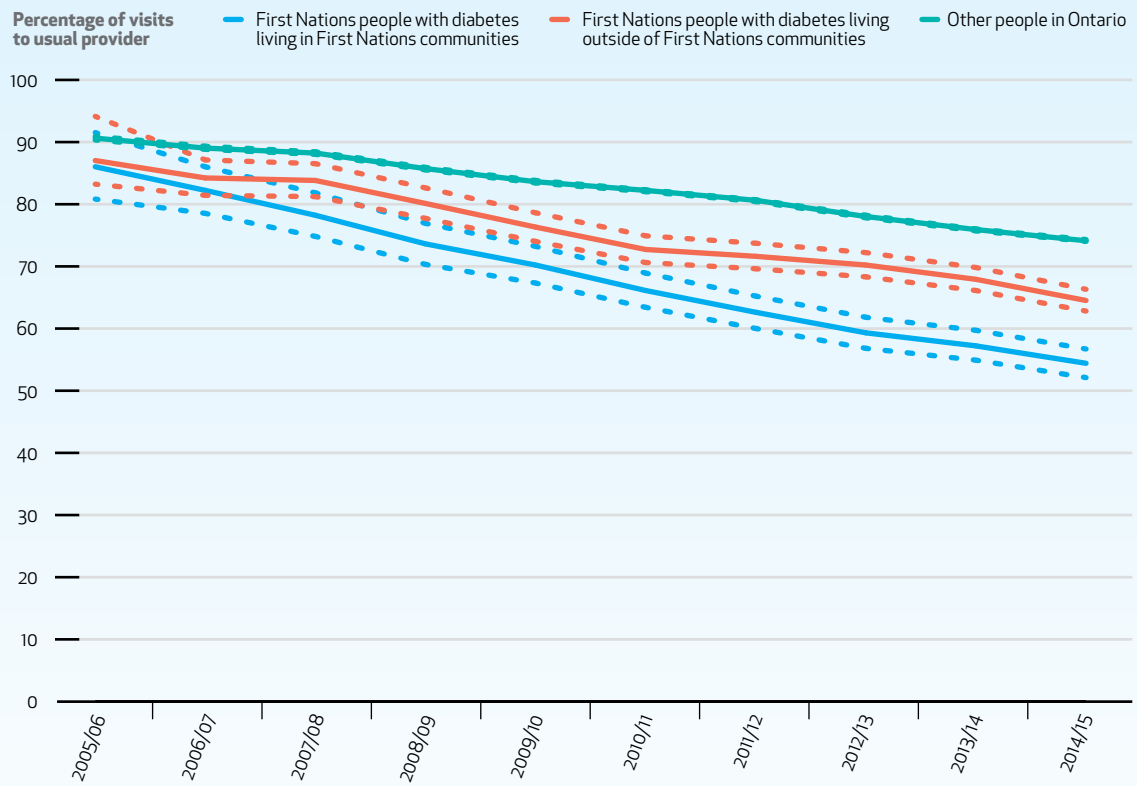


*Defined as having an HbA1c level of <7%.
Error bars represent 95% confidence intervals.

EXHIBIT 7.3 Age- and sex-adjusted percentage of visits to their usual provider by people with diabetes* who had at least 3 primary care visits in the previous 24 months, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2005/06 to 2014/15

Key Findings

- Between 2005/06 and 2014/15, continuity of care declined for everyone in Ontario with diabetes; however, the decrease was more evident among First Nations people.
- In 2014/15, among people with diabetes who had at least 3 primary care visits in the previous 24 months, 61.2% of visits by First Nations people and 74.1% of visits by other people in Ontario were with their usual provider.
- In 2014/15, among First Nations people who had at least 3 primary care visits in the previous 24 months, 64.5% of visits by those living outside of First Nations communities and 54.4% of visits by those living in First Nation communities were with their usual provider.

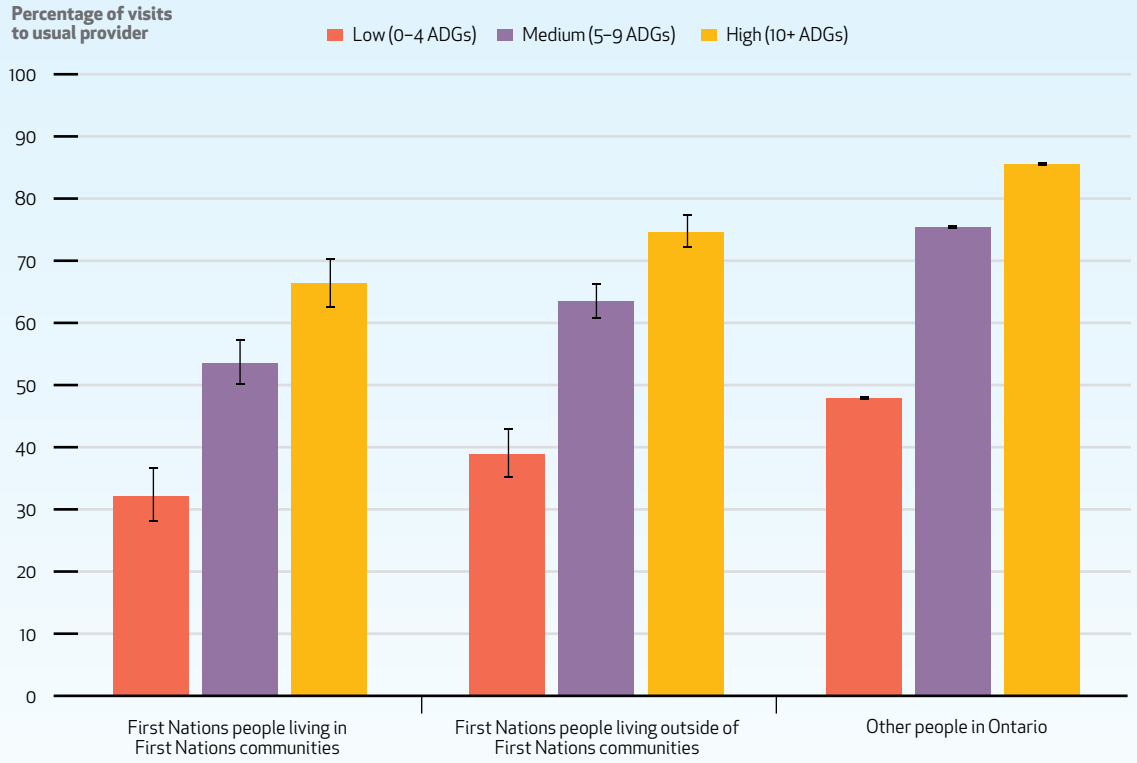


Dashed lines represent 95% confidence intervals.
*Includes only patients enrolled in a primary care model.

EXHIBIT 7.4 Age- and sex-adjusted percentage of visits to their usual provider by people with diabetes* who had at least 3 primary care visits in the previous 24 months, among First Nations people living in and outside of First Nations communities and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- Among people with diabetes in 2014/15, continuity of care increased with increasing level of comorbidity.
- For all levels of comorbidity, First Nations people living in and outside of First Nations communities had lower rates of continuity of care than other people in Ontario.

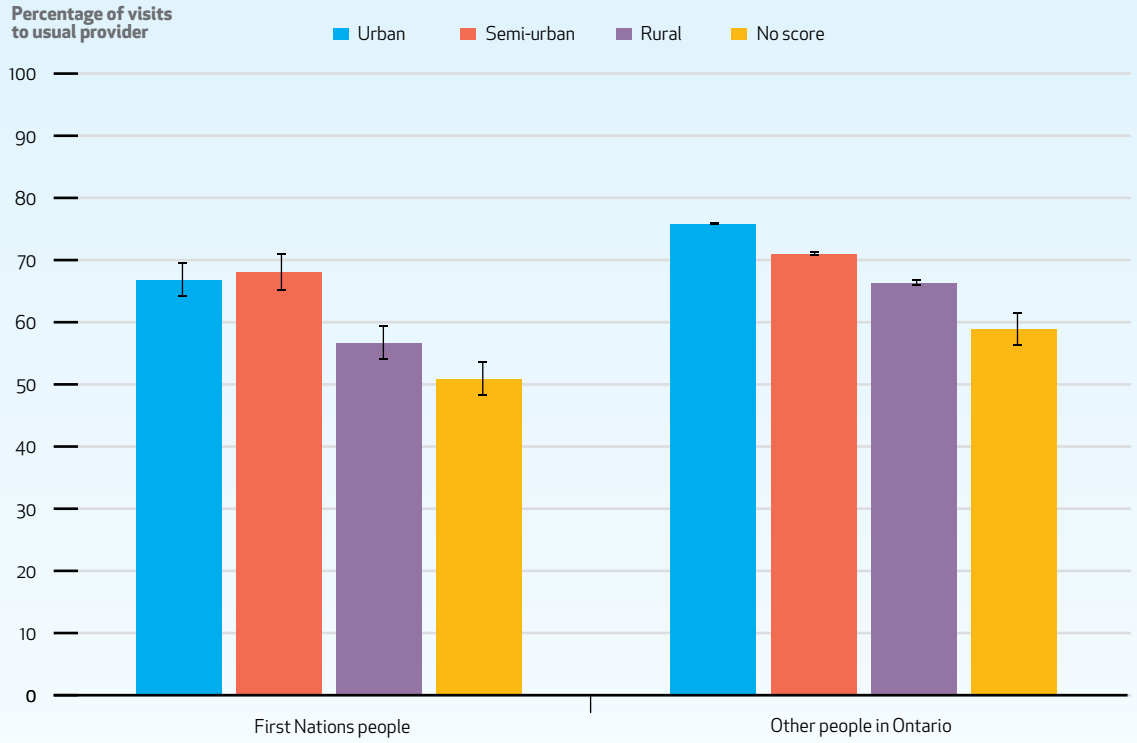


*Includes only patients enrolled in a primary care model.
Error bars represent 95% confidence intervals.

EXHIBIT 7.5 Age- and sex-adjusted percentage of visits to their usual provider by people with diabetes* who had at least 3 primary care visits in the previous 24 months, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- The rate of continuity of care was lowest in rural areas. In 2014/15, 56.6% of visits by First Nations people in rural Ontario were with their usual provider compared with 66.3% of visits by other people in rural Ontario.

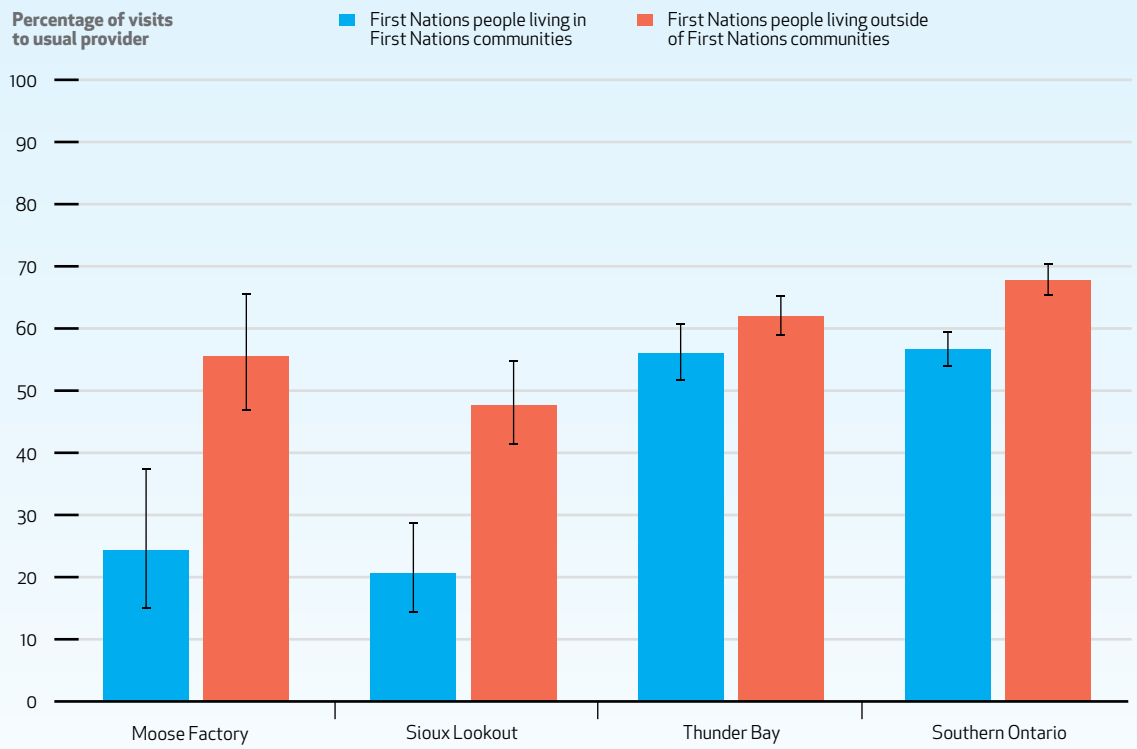


*Includes only patients enrolled in a primary care model.
Error bars represent 95% confidence intervals.

EXHIBIT 7.6 Age- and sex-adjusted percentage of visits to their usual provider by people with diabetes* who had at least 3 primary care visits in the previous 24 months, among First Nations people living in and outside of First Nations communities in Ontario, by Health Canada zone, 2014/15

Key Findings

- In 2014/15, the rate of continuity of care was highest among First Nations people with diabetes living in the Southern Ontario and Thunder Bay zones, where, respectively, 63.4% and 60.0% of primary care visits in the previous 24 months were with their usual provider.
- The difference in the rate of continuity of care was greater among First Nations people living outside of First Nations communities compared to those living in the communities, especially in the Moose Factory (55.6% vs. 24.3%) and Sioux Lookout (47.7% vs. 20.6%) zones.

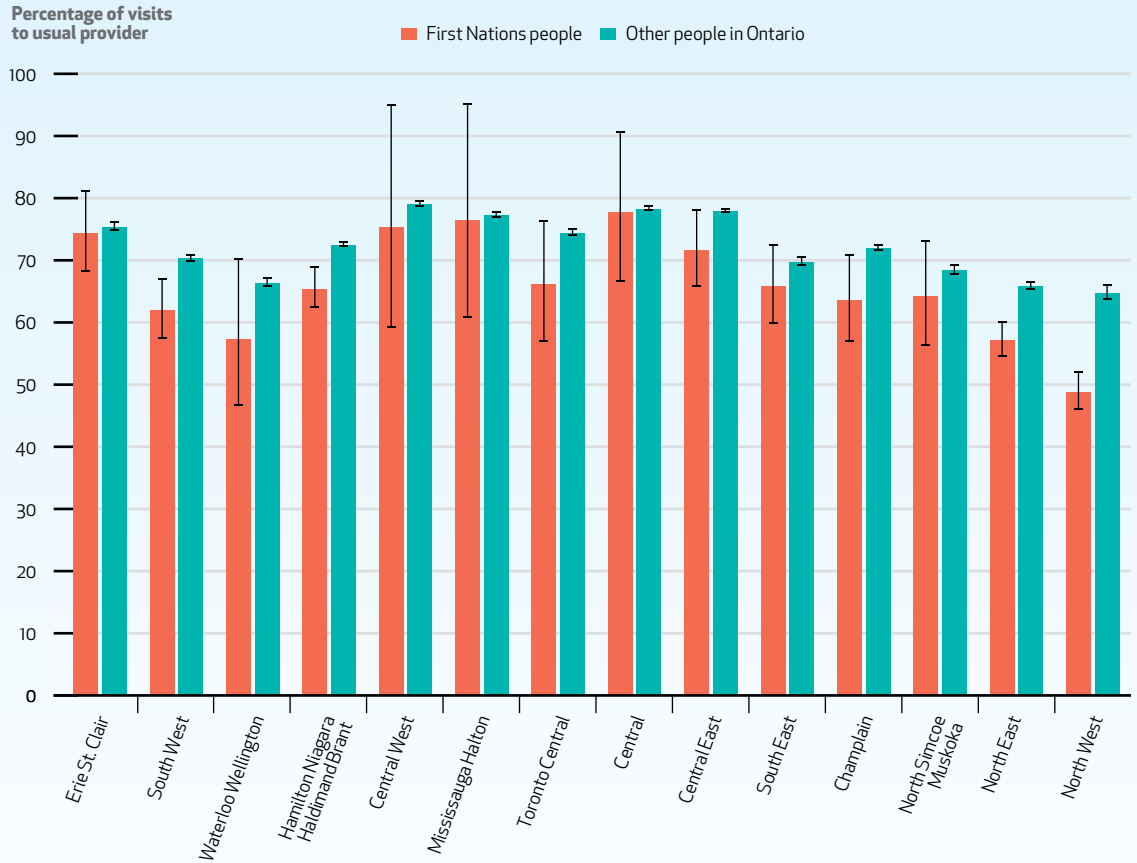


*Includes only patients enrolled in a primary care model.
Error bars represent 95% confidence intervals.

EXHIBIT 7.7 Age- and sex-adjusted percentage of visits to their usual provider by people with diabetes* who had at least 3 primary care visits in the previous 24 months, among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- In 2014/15, the lowest rates of continuity of care among First Nations people and other people in Ontario were found in the North East LHIN (respectively, 57.1% and 65.8%) and the North West LHIN (respectively, 48.8% and 64.7%).

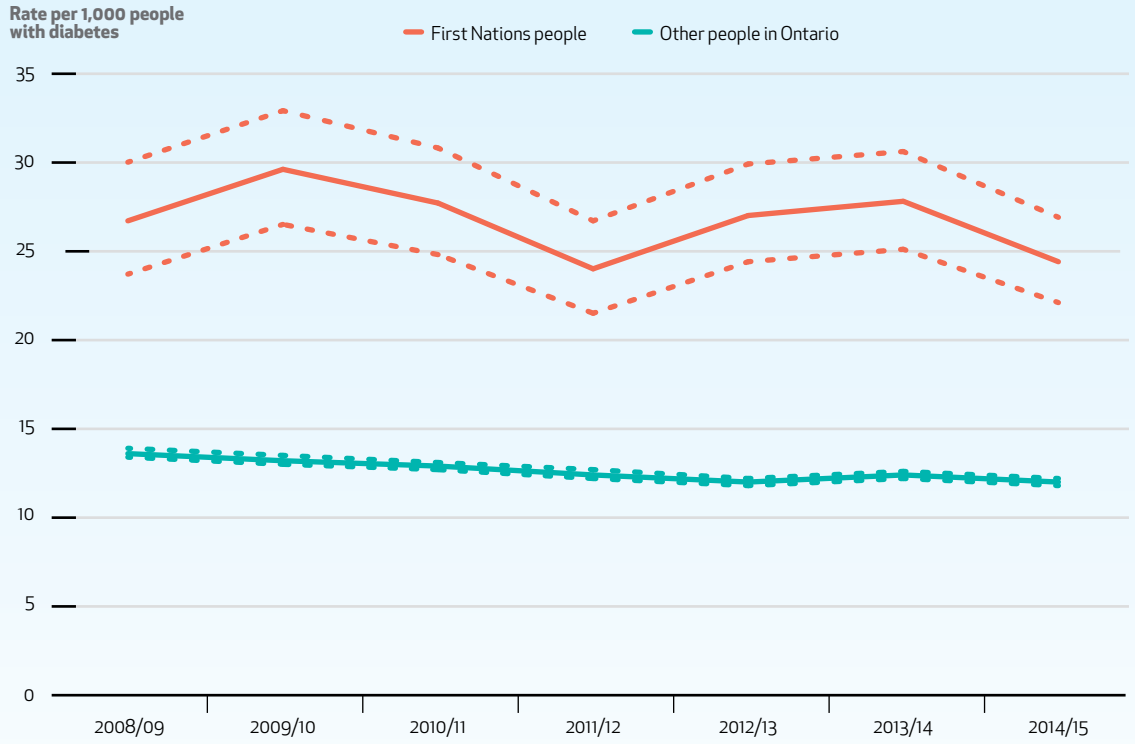


*Includes only patients enrolled in a primary care model.
Error bars represent 95% confidence intervals.

EXHIBIT 7.8 Age- and sex-adjusted number of hospital admissions for ambulatory care–sensitive conditions in the previous 12 months per 1,000 people with diabetes aged 75 years or younger, among First Nations people and other people in Ontario, 2008/09 to 2014/15

Key Findings

- The rate of hospital admissions for ambulatory care–sensitive conditions decreased slightly among both First Nations people and other people in Ontario between 2008/09 and 2014/15.
- Among individuals with diabetes, the rate of hospital admissions for ambulatory care–sensitive conditions was twice as high among First Nations people compared with other people in Ontario (24.4 vs. 12.0 per 1,000 people in 2014/15).

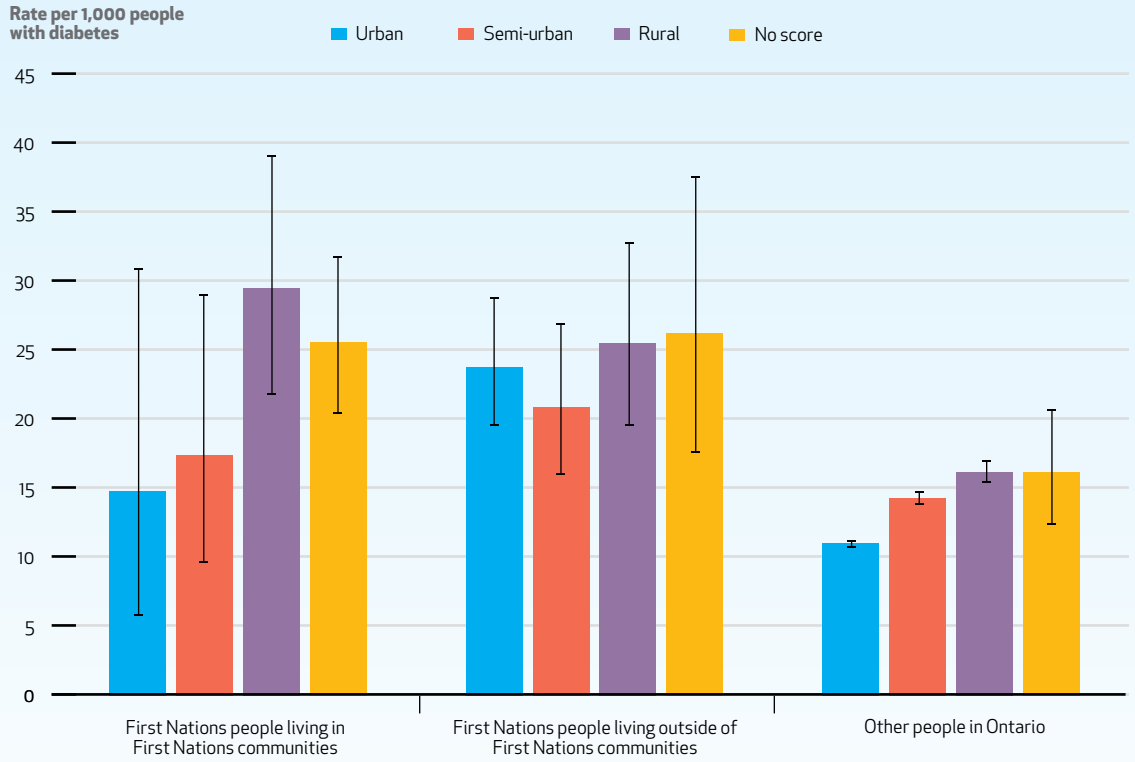


Dashed lines represent 95% confidence intervals.

EXHIBIT 7.9 Age- and sex-adjusted number of hospital admissions for ambulatory care–sensitive conditions in the previous 12 months per 1,000 people with diabetes aged 75 years or younger, among First Nations people living in and outside of First Nations communities and other people in Ontario, by level of rurality, 2014

Key Findings

- Taking confidence intervals into account, rates of hospital admission for ambulatory care–sensitive conditions were similar across urban, semi-urban and rural areas for First Nations people, especially those living outside of First Nations communities.
- In contrast, among other people in Ontario with diabetes, the rate of hospital admissions for ambulatory care–sensitive conditions was lowest in urban areas (11.0 per 1,000 people with diabetes) and highest in rural areas (16.2 per 1,000 people with diabetes).

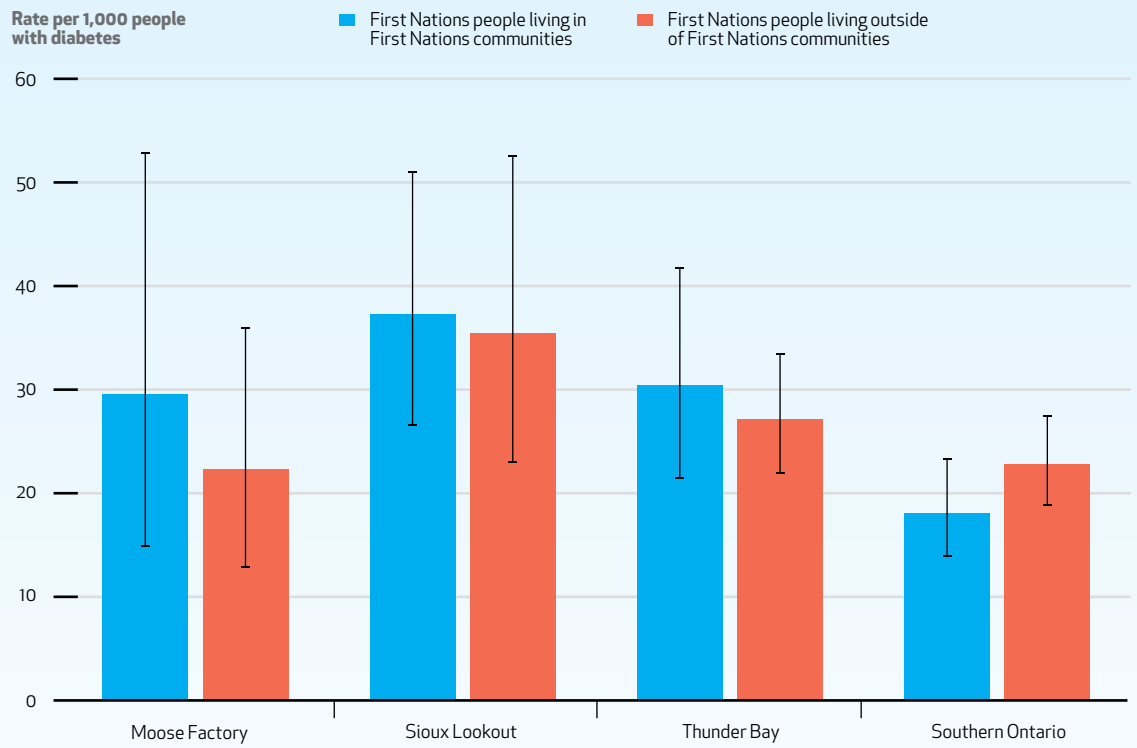


Error bars represent 95% confidence intervals.

EXHIBIT 7.10 Age- and sex-adjusted number of hospital admissions for ambulatory care–sensitive conditions in the previous 12 months per 1,000 people with diabetes aged 75 years or younger, among First Nations people living in and outside of First Nations communities in Ontario, by Health Canada zone, 2014/15

Key Findings

- In 2014/15, hospital admissions for ambulatory care–sensitive conditions were highest among First Nations people living in the Sioux Lookout zone, although these rates were not significantly different from the rates seen in other Health Canada zones.
- There was no significant difference in hospitalizations for ambulatory care–sensitive conditions between First Nations people living in and outside of First Nations communities in any of the Health Canada zones.

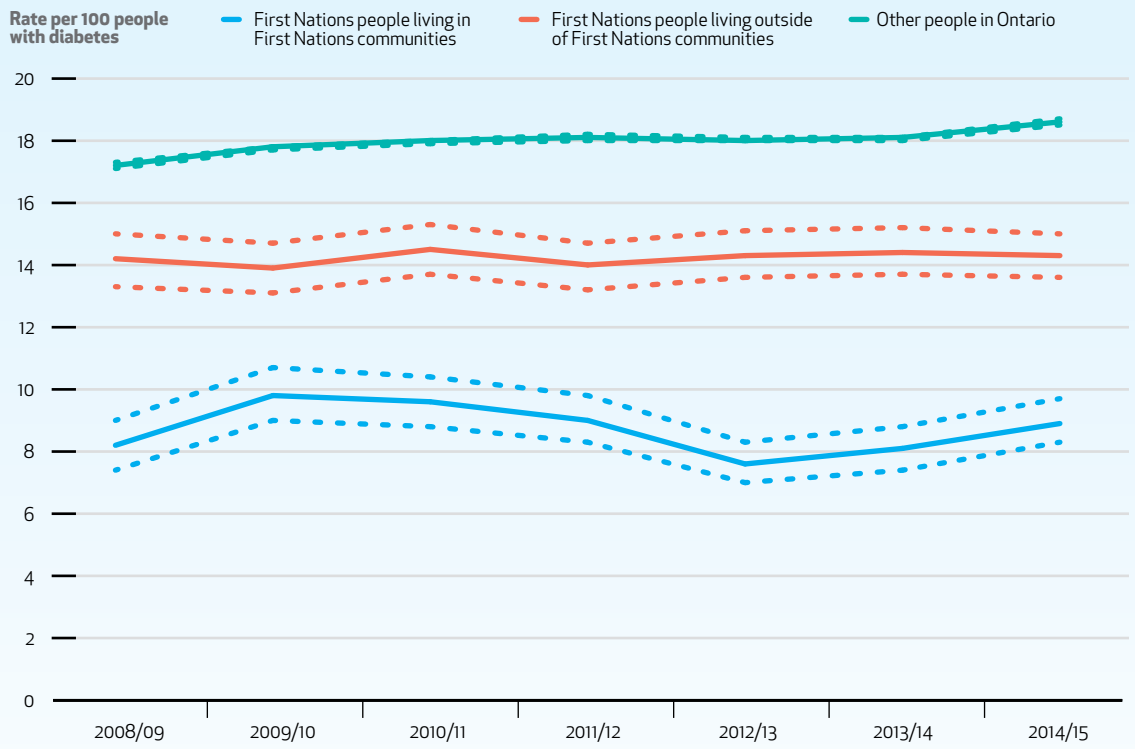


Error bars represent 95% confidence intervals.

EXHIBIT 7.11 Age- and sex-adjusted number of people with at least one visit to a specialist in the previous 12 months per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2008/09 to 2014/15

Key Findings

- For all three cohorts, the proportion of individuals with diabetes visiting specialists remained relatively constant between 2008/09 and 2014/15.
- Specialist visits were higher among other people in Ontario compared to First Nations people in Ontario. In 2014/15, 18.6% of other people in Ontario living with diabetes had at least one visit to a specialist compared to 14.3% of First Nations people living outside of First Nations communities and 8.9% of First Nations people living in First Nations communities.

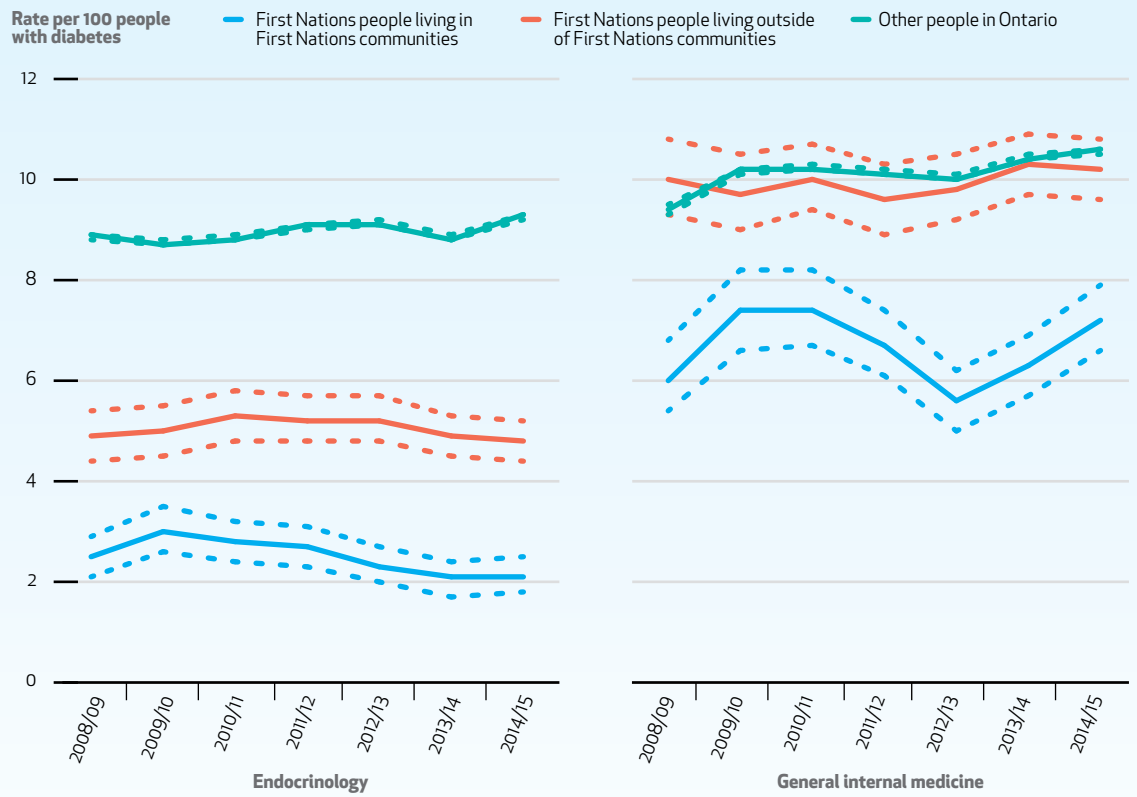


Dashed lines represent 95% confidence intervals.

EXHIBIT 7.12 Age- and sex-adjusted number of people with at least one visit to an endocrinologist or general internal medicine specialist in the previous 12 months per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2008/09 to 2014/15

Key Findings

- Among other people in Ontario, the proportion of individuals with diabetes who visited an endocrinologist remained constant between 2008/09 and 2014/15 at approximately 9%.
- Among First Nations people living in First Nations communities, the proportion of individuals with diabetes who visited an endocrinologist remained relatively stable, ranging from 2.5% in 2008/09 to 2.1% in 2014/15.
- Among First Nations people living outside of First Nations communities, the proportion of individuals with diabetes who visited an endocrinologist remained relatively stable, ranging from 4.9% in 2008/09 to 4.8% in 2014/15.
- In 2014/15, the proportion of individual with diabetes who visited a general internal medicine specialist was similar for First Nations people living outside of First Nations communities and other people in Ontario (10.2% and 10.6%, respectively). These rates remained relatively stable from 2008/09 to 2014/15.
- The proportion of individuals with diabetes who visited a general internal medicine specialist was lowest among First Nations people living outside of First Nations communities. This proportion remained relatively constant, ranging from 6.0% in 2008/09 to 7.2% in 2014/15.

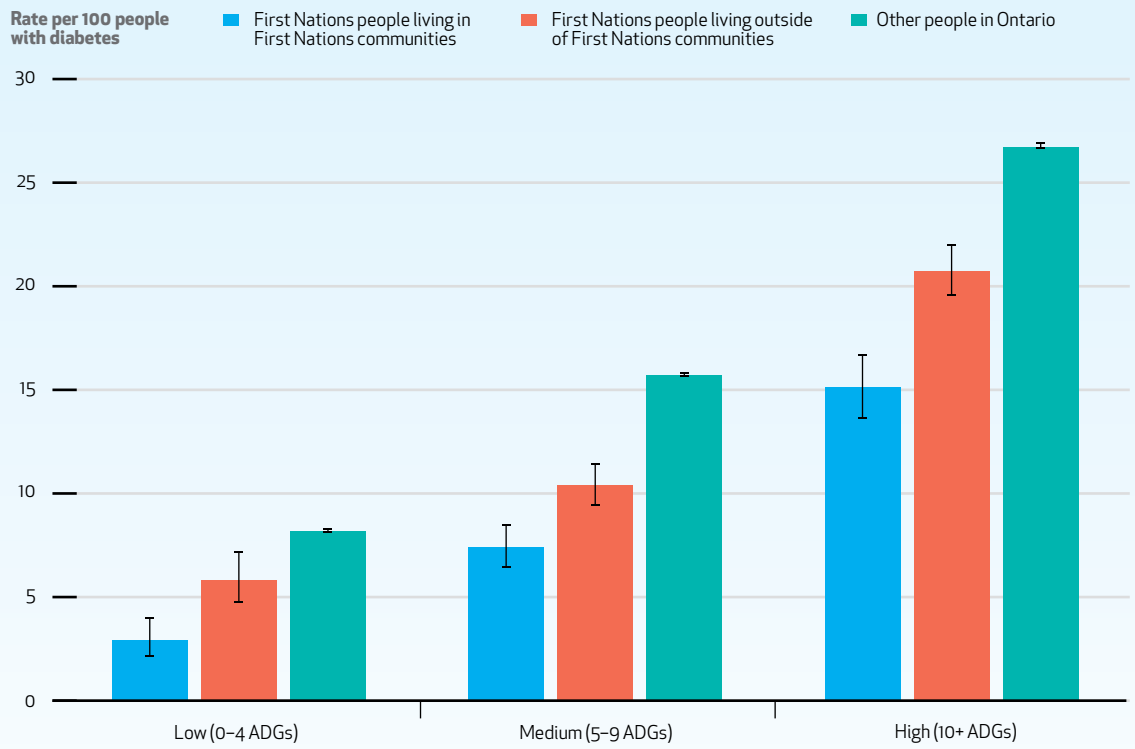


Dashed lines represent 95% confidence intervals.

EXHIBIT 7.13 Age- and sex-adjusted number of people with at least one visit to a specialist in the previous 12 months per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- For all three groups, the rate of visits to specialists per 100 people with diabetes increased with increasing level of comorbid conditions.
- For First Nations people with a low level of comorbidity, the rate of specialist visits was lower among those living in (2.9%) and outside of First Nations communities (5.8%) compared with other people in Ontario (8.2%).
- The variation in the rate of specialist visits increased with increasing number of comorbid conditions. Among those with a medium level of comorbidity, 7.4% of First Nations people living in First Nations communities had seen a specialist, compared to 10.4% of those living outside of First Nations communities and 15.7% of other people in Ontario.
- Among those with diabetes and a high level of comorbidity, 15.1% of First Nations people living in First Nations communities had seen a specialist in the previous 12 months, compared to 20.7% of those living outside of First Nations communities and 26.7% of other people in Ontario.

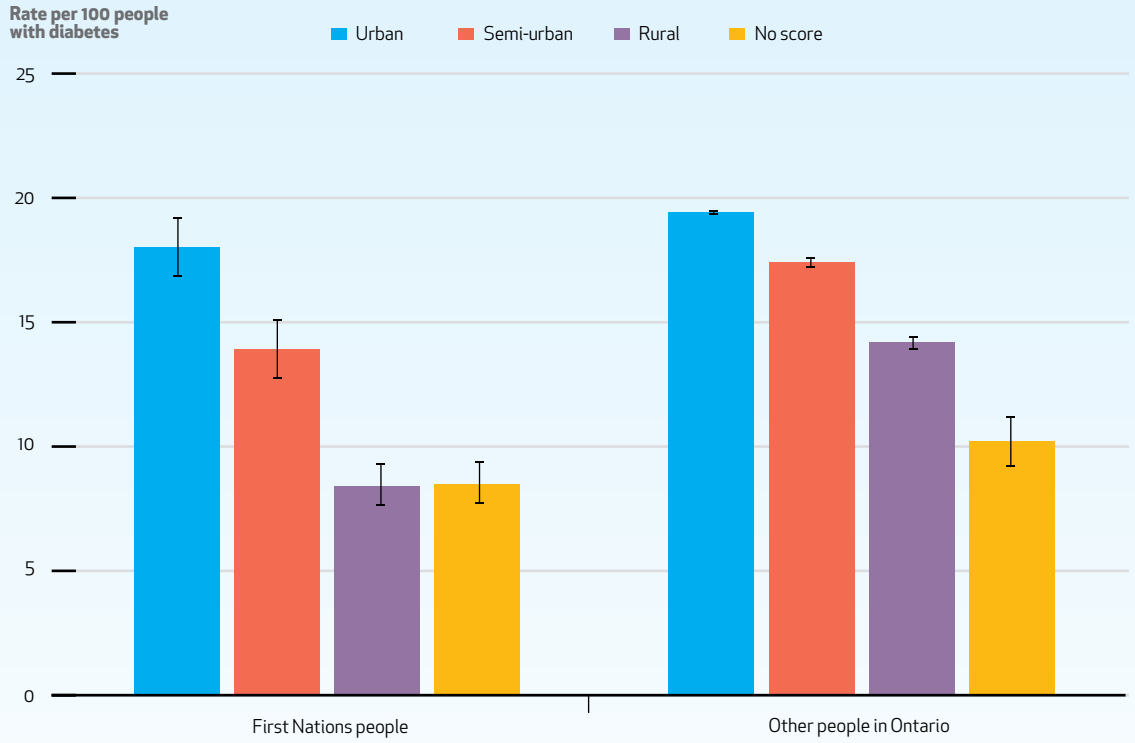


Error bars represent 95% confidence intervals.

EXHIBIT 7.14 Age- and sex-adjusted number of people with at least one visit to a specialist in the previous 12 months per 100 people with diabetes, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- Among both First Nations people and other people in Ontario with diabetes, a greater proportion of those living in urban areas had visits to specialists.
- Among First Nations people with diabetes, 18.0% of urban dwellers had at least one specialist visit in the previous 12 months compared with 8.4% of those living in rural areas in 2014/15.
- Among other people in Ontario with diabetes, 19.4% of urban dwellers had at least one specialist visit in the previous 12 months compared with 14.2% of those living in rural areas in 2014/15.

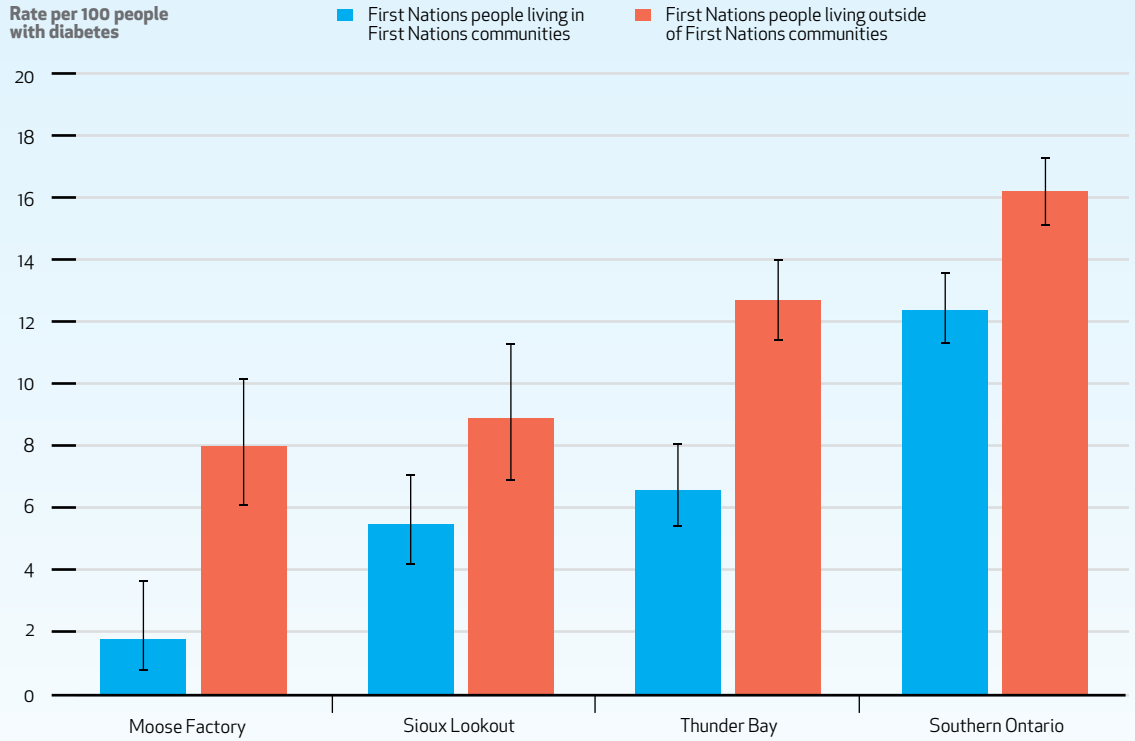


Error bars represent 95% confidence intervals.

EXHIBIT 7.15 Age- and sex-adjusted number of people with at least one visit to a specialist in the previous 12 months per 100 people with diabetes, among First Nations people living in and outside of First Nations communities in Ontario, by Health Canada zone, 2014/15

Key Findings

- In 2014/15, First Nations people living outside of First Nations communities had higher rates of specialist visits that those living in First Nations communities.
- Overall, First Nations people with diabetes living in the Southern Ontario zone had the highest rate of special visits (14.7%) and those in the Moose Factory zone had the lowest (5.4%).

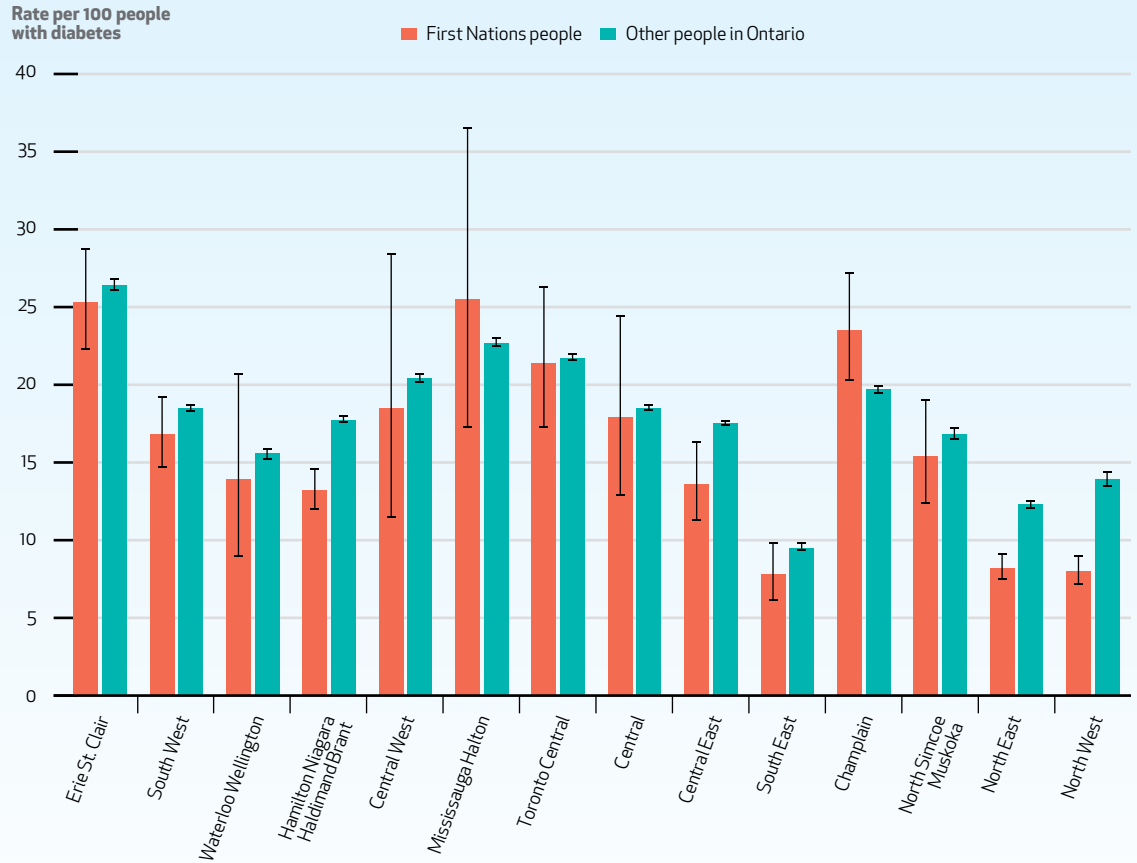


Error bars represent 95% confidence intervals.

EXHIBIT 7.16 Age- and sex-adjusted number of people with at least one visit to a specialist in the previous 12 months per 100 people with diabetes, among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- In 2014/15, the proportion of First Nations people with diabetes who had at least one specialist visit in the previous 12 months was highest in the Mississauga Halton LHIN (25.5%). Among other people in Ontario with diabetes, the proportion who had seen a specialist was highest in the Erie St. Clair LHIN (26.4%).
- Access was lowest in the South East LHIN where only 7.8% of First Nations people and 9.5% of other people had visited a specialist.
- The greatest difference in specialist access was seen in the North West LHIN where the rate for other people in Ontario was 1.7 times that of First Nations people.



Error bars represent 95% confidence intervals.

Discussion

Significant differences in the use of primary care exist between First Nations people and other people in Ontario. According to the 2016 Canadian Community Health Survey, Ontario has greater access to primary care than other provinces, with 9.7% of Ontario residents reporting being without a primary care provider compared to 15.8% across Canada.[12] We found that 93% of Ontarians had a primary care physician, compared to 80% of First Nations people living outside of First Nations communities. Fewer than 60% of First Nations people living in First Nations communities had a primary care physician. National data suggest that Indigenous people across Canada are more likely to not have a primary health care provider.[12]

We found that First Nations people in Ontario with diabetes were less likely to have a primary care physician compared to other people in Ontario with diabetes. As primary care plays an important role in overall health,[2] the fact that 28% of First Nations people in Ontario living with diabetes do not have an assigned comprehensive primary care physician or team is concerning. Patients who are not enrolled in a primary care model have been shown to have poorer quality of diabetes care[13] and lower screening rates.[14] Among those with a comprehensive primary care physician, continuity of care, which is an important part of high-quality care,[6] is lower among First Nations people with diabetes (60%) compared to others in Ontario (74%). In Ontario, the biggest gaps in continuity between First Nations people and other people in Ontario are seen in the North and First Nations people living in First Nations communities have the poorest continuity of care.

When interpreting these results, it is important to consider that we were not able to include data from Community Health Centres (CHCs), Aboriginal Health Access Centres (AHACs), and federally funded nursing stations and health centres, which will result in an underestimate of the proportion of patients who have a regular primary care provider. Data from 2013 showed that CHCs served 569,000 patients and AHACs provided care for 92,600 patients in the province.[15] It is estimated that AHACs and Aboriginal CHCs provide care to 25% of Indigenous populations in Ontario.[16] If the combined use of CHCs and AHACs is higher in the First Nations population than in the general population, the result would be a larger apparent gap in care. Some primary care services delivered through facilities in First Nations communities (i.e., nursing stations and health centres) are based on a nursing-led model of care and supported by the federal government. No billing data are available to measure care delivered in these facilities. First Nations people living in First Nations communities who are seen exclusively by nurses working at these facilities will have no physician visits and appear to have no primary care, when in fact they may be accessing regular primary care at these sites. This will be more relevant in the Sioux Lookout and Moose Factory zones and may partially explain the apparent gaps in care for First Nations people living in First Nations communities in these areas.

Given the limitations associated with measuring primary care utilization, we also analyzed hospitalizations for ambulatory care–sensitive conditions (ACSCs), a measure that has been accepted as an indicator of primary health care performance.[17] Overall, we found that First Nations people with diabetes in Ontario had significantly higher rates of hospital admissions for ACSCs compared to other people in Ontario; this disproportionate trend has also been documented among First Nations people in Alberta[18] and Manitoba.[19] Lavoie et al. found that First Nations communities in Manitoba with better access to primary health care at the community level (i.e., nursing stations) had lower rates of avoidable hospitalizations for ACSCs, whereas communities with limited access to primary health care services within the community had higher hospital admission rates.[20] In Ontario, the Moose Factory Health Canada zone has nursing stations in most communities, whereas the Sioux Lookout zone has a limited number of communities with access to a nursing station. Rates of hospitalization for ACSCs in the two zones are similar, suggesting that access to nursing stations does not make up for a lack in access to a primary care physician.

First Nations people in Ontario are also less likely to receive specialty care for their diabetes, especially if they live in First Nations communities. It is important to note the role of geography here: Utilization of

specialists was much lower among those living in rural areas for all Ontarians, though the gap is much larger for First Nations people. In addition, the gap in access to speciality care between First Nations people and other people in Ontario grows with increasing comorbidity. Access to endocrinologists is especially low for First Nations people. Again, geography is likely an issue here as endocrinologists are predominantly located in large, urban centres in Southern Ontario. This gap in access to speciality care has been reported in other studies of diabetes in First Nations populations,[18] as well as in studies of other chronic conditions.[19,21,22]

It is important to highlight the continuing impact of colonization as a key barrier to health care access[23]; the 2018 Diabetes Canada Clinical Practice Guidelines specifically acknowledge the legacy of colonization and its ongoing effects on Indigenous health.[24] Because of this, First Nations people may be sensitive to power imbalances in their interactions with health care service providers,[25] and miscommunication is a large barrier to care.[26] Engagement in diabetes care is influenced by both personal and community experiences with health care providers and exposure to culturally unsafe care[27]; this is also seen in accessing care for other chronic diseases.[28] Access can be improved through the implementation of models of care that recognize Indigenous knowledge systems.[25,29] Canadian guidelines embrace the *Educating for Equity* framework,[30] guiding providers to address social and cultural barriers in their clinical interactions with patients.[24]

Limitations

As noted above, we were unable to capture primary care delivered in nursing stations, Aboriginal Health Access Centres and Community Health Centres; this will result in an underestimate of the proportion of patients who have a regular primary care provider.

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Appendix

EXHIBIT 7.1A Models of primary care in Ontario*

Indicator	Enhanced Fee-for-Service		Capitation		Family Health Team
	Family Health Group	Comprehensive Care Model	Family Health Network	Family Health Organization	
Year introduced	2003	2005	2002	2007	2005
Minimum group size	3 physicians	1 physician	3 physicians	3 physicians	3 physicians
Interprofessional team members	Limited	No	Limited	Limited	Yes

EXHIBIT 7.2A Inclusion and exclusion criteria for hospital admissions for ambulatory care–sensitive conditions

Inclusion Criteria

- Hospital admissions with ICD-10 code(s) for:
  - Asthma: codes beginning with J45
  - COPD: J41, J42, J43, J44, J47
  - CHF: I500, J81 (excluding cases with cardiac procedures and cases that were not coded as abandoned upon onset)
  - Diabetes: E10.1, E10.6, E10.7, E10.9, E11.0, E11.1, E11.6, E11.7, E11.9, E13.0, E13.1, E13.6, E13.7, E13.9, E14.0, E14.1, E14.6, E14.7, E14.9
- All discharges from acute care hospitals

Exclusion Criteria

- In-hospital complications (DXTYPE M and 2)
- Admissions with the following CCI codes: 1HB53, 1HB54, 1HB55, 1HD53, 1HD54, 1HD55, 1HZ53, 1HZ55, 1HZ85, 1IJ50, 1IJ76
- Cases where death occurred before discharge

* Adapted from Hutchison B, Glazier R. Ontario's primary care reforms have transformed the local care landscape, but a plan is needed for ongoing improvement. *Health Aff (Millwood)*. 2013; 32(4):695–703.

EXHIBIT 7.3A Percentage of people with a comprehensive primary care physician, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2005/06 to 2014/15

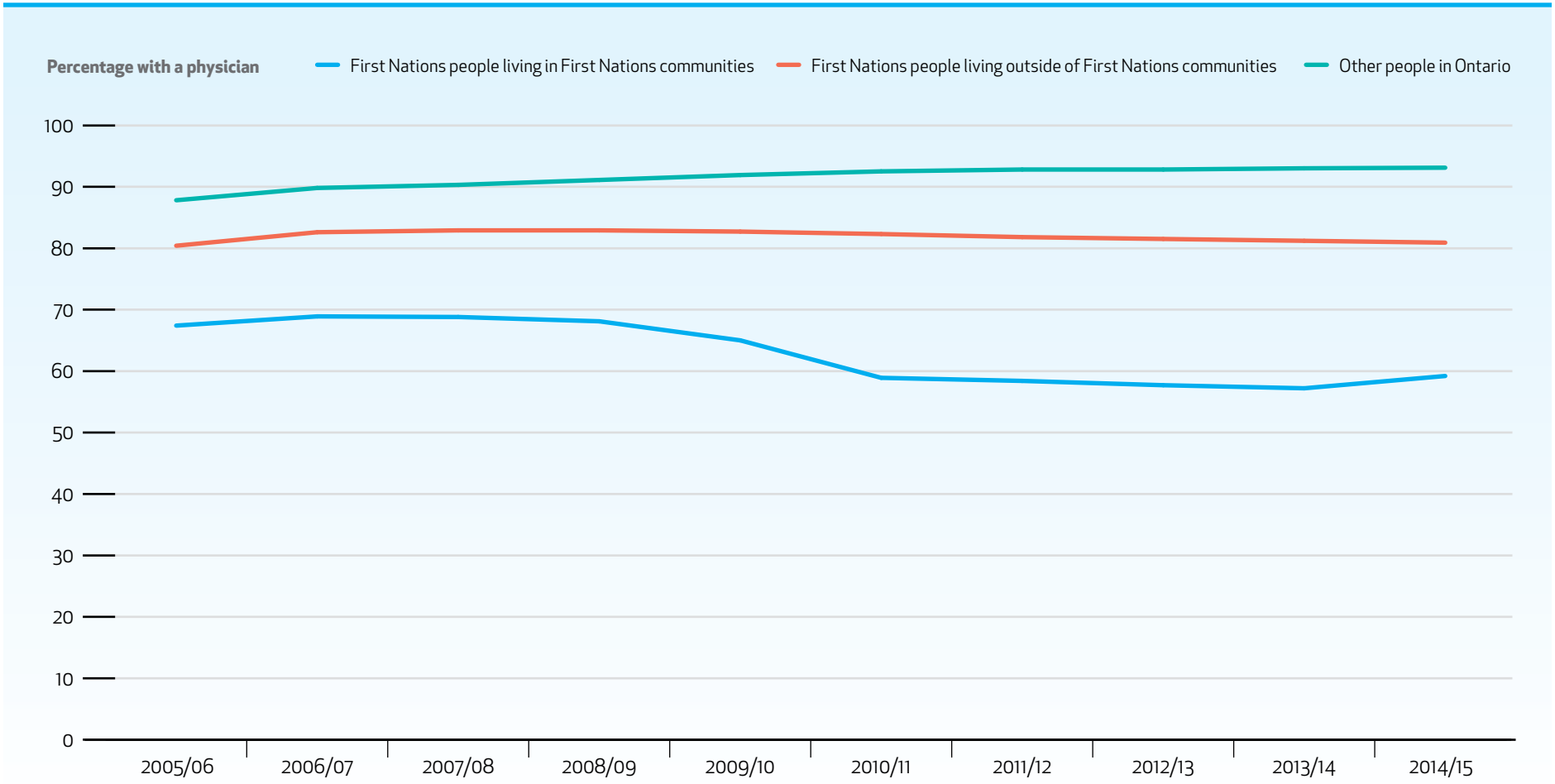


EXHIBIT 7.4A Percentage of people rostered to, or whose comprehensive primary care physician belonged to, a primary care enrolment model, among those living in and outside of First Nations communities and other people in Ontario, 2005/06 to 2014/15

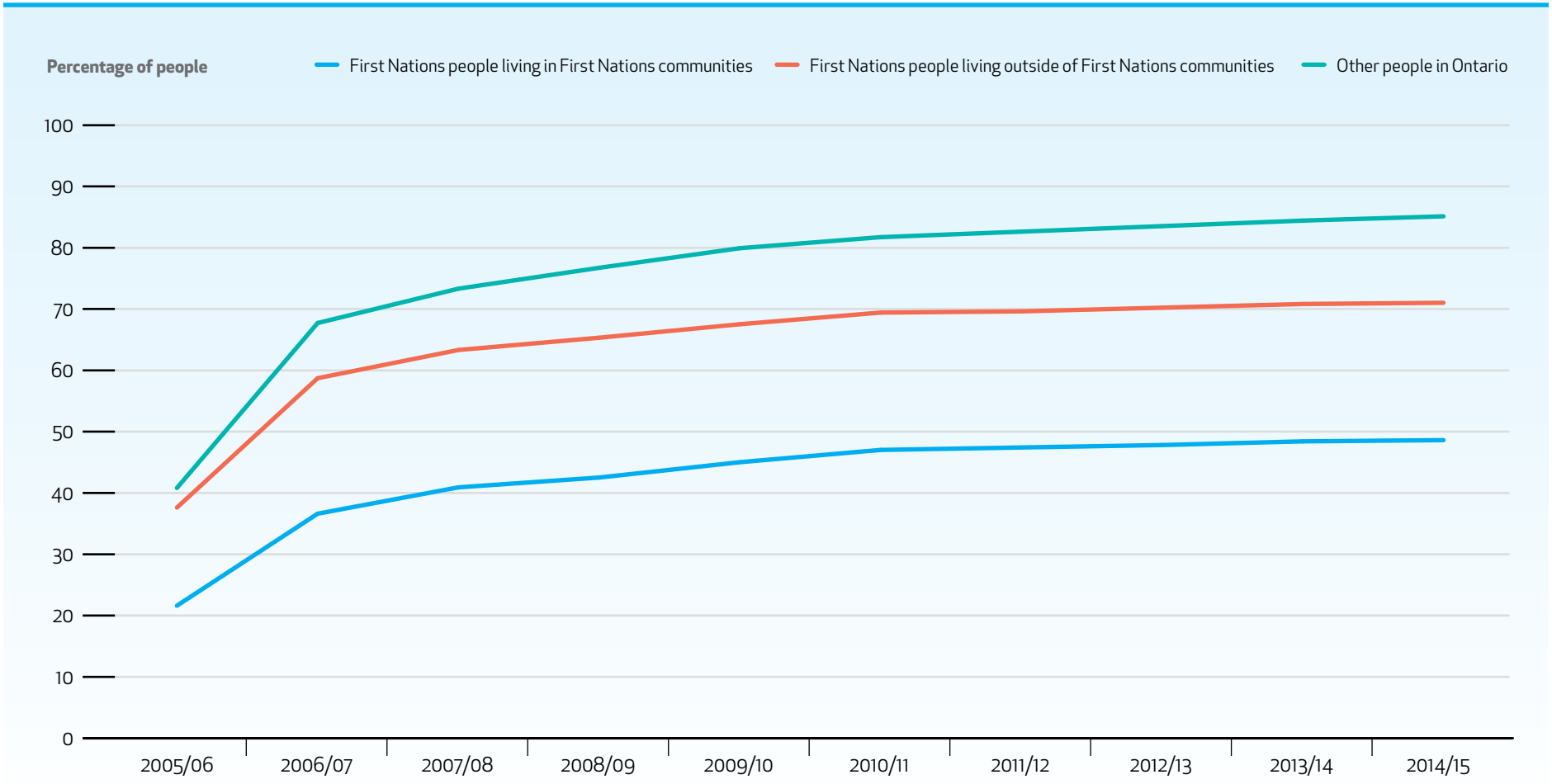


EXHIBIT 7.5A Percentage of people rostered to a primary care enrolment model, among First Nations people living in and outside of First Nations communities and other people in Ontario, by type of model, 2014/15

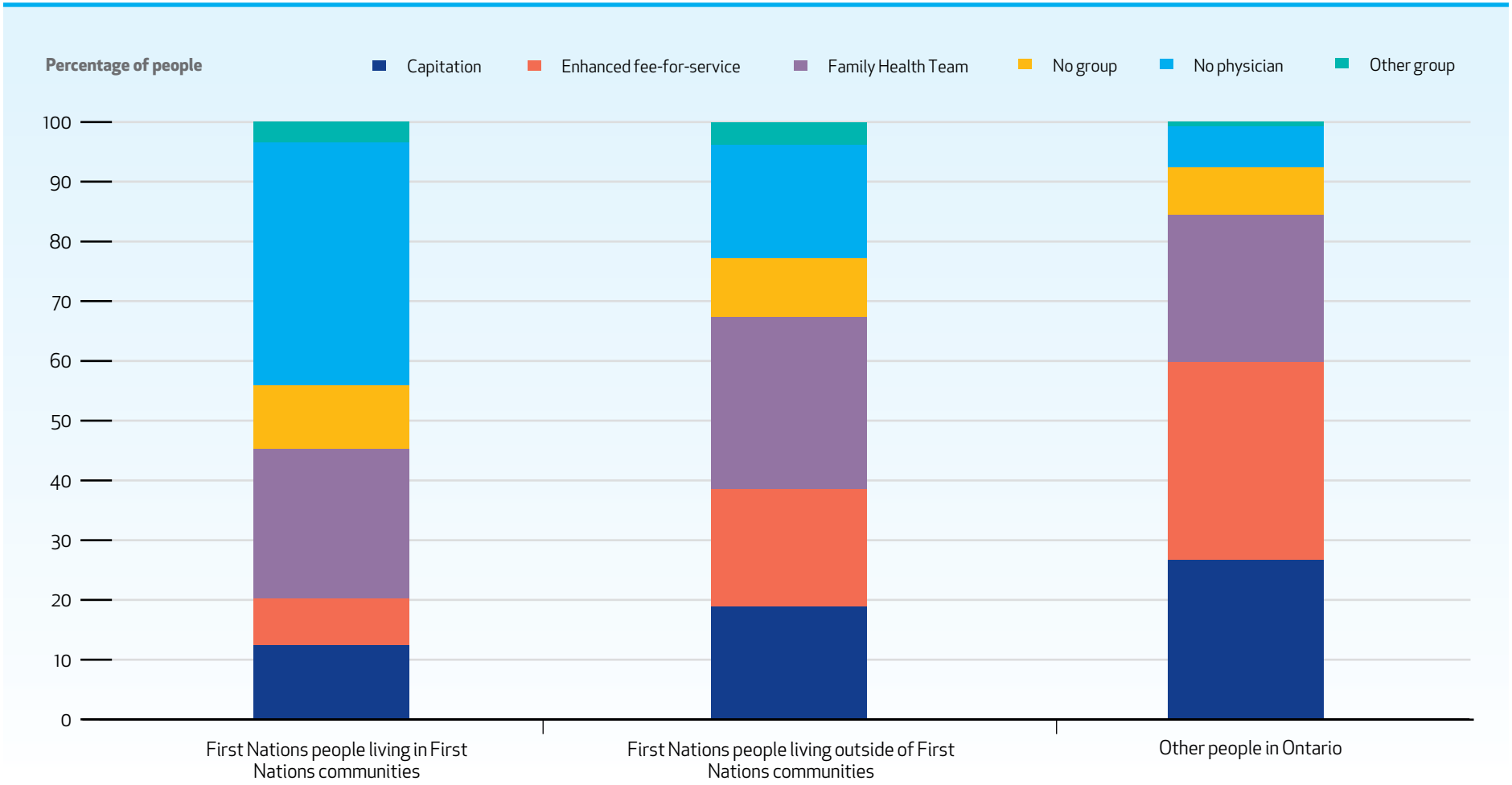
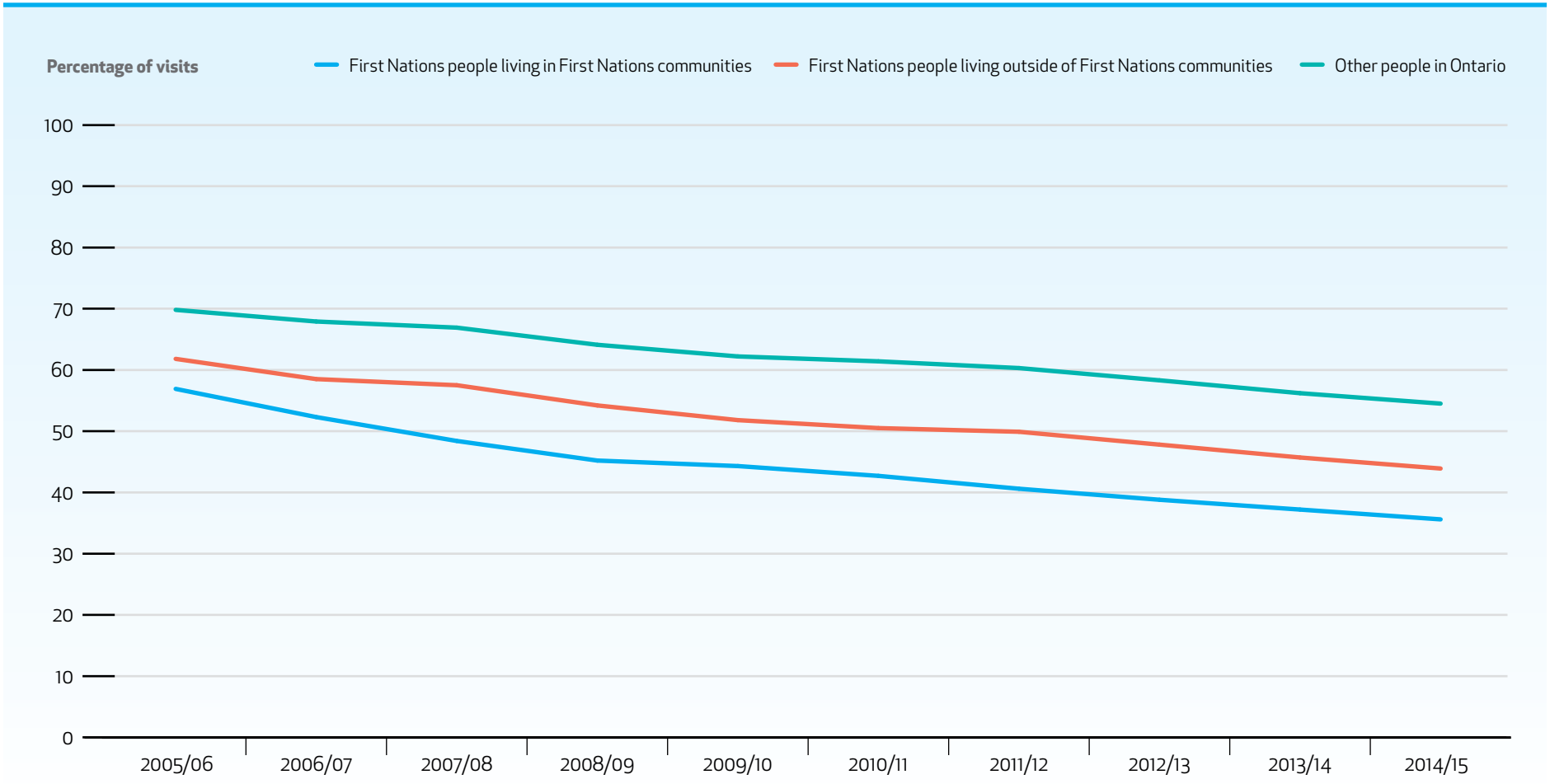


EXHIBIT 7.6A Percentage of visits to their usual provider by people* who had a least 3 primary care visits in the previous 24 months, among First Nations people in and outside of First Nations communities and other people in Ontario, 2005/06 to 2014/15



* Includes only patients enrolled in a primary care model.

8 Acute Complications of Diabetes

Inside

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Overview

Diabetes is associated with a number of complications that can lead to hospital admission. Severe elevations in blood glucose levels (hyperglycemia) can lead to acute and potentially life-threatening emergencies that require immediate medical intervention. In addition, patients who use insulin or other medications are at risk for developing low blood sugar levels (hypoglycemia) and severe episodes may lead to a loss of consciousness. In many cases, hospitalization for these acute complications can be avoided through early recognition and patient education have been shown to reduce rates of these types of admissions.[1-4]

This chapter presents age- and sex-adjusted rates of emergency department (ED) visits and hospitalizations for acute complications of diabetes (hypo- and hyperglycemia) for both First Nations people and other people in Ontario living with diabetes. Overall rates are presented as well as rates stratified by level of comorbidity, rurality and a comparison of First Nations people living in and outside of First Nations communities within Health Canada zones.

Methods

To look at ED visits related to acute complications of diabetes, we used the National Ambulatory Care Reporting System, which includes records of all ED visits in Ontario. Acute complication visits were defined as ED visits that were urgent (defined as a Canadian Triage and Acuity Scale score of 1 to 3), unplanned and had a main diagnosis code related to hypo- or hyperglycemia (see chapter appendix). To capture hospitalizations related to acute complications of diabetes, we used the Discharge Abstract Database to abstract all unique episodes of care with main diagnosis codes related to hypo- or hyperglycemia (see chapter appendix). Only data from 2002/03 onward are presented.

Results

Over time, the rate of ED visits for acute complications of diabetes has been declining in both First Nations and other populations in Ontario. However, First Nations people have had a consistently higher rate of ED visits than other people in Ontario (exhibit 8.1). Among both First Nations people and other people in Ontario, the highest rates of ED visits were seen among those with a high level of comorbidity (exhibit 8.2); this was a consistent trend between 2002/03 and 2014/15.

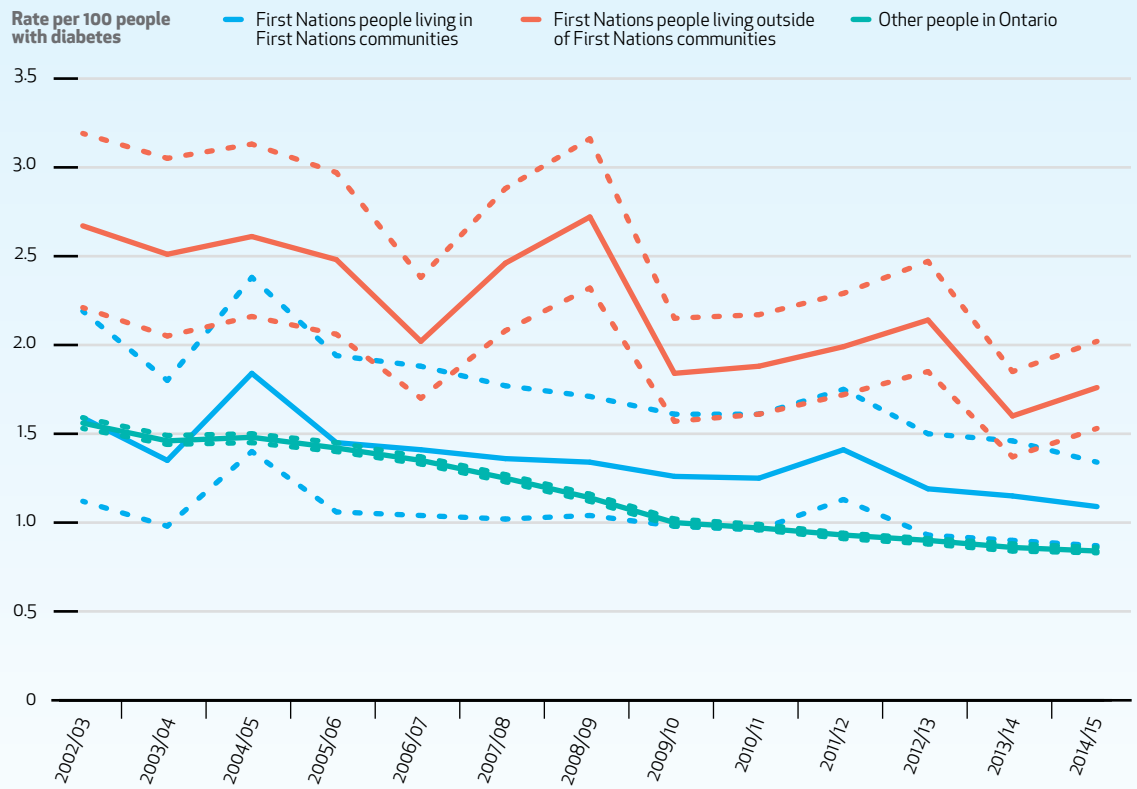
Among First Nations people in Ontario, there is no difference in ED visits for acute diabetes complications between those living in urban versus rural areas (exhibit 8.3). Those living outside of First Nations communities in the Sioux Lookout and South Ontario Health Canada zones had higher ED visit rates compared to those living in First Nations communities (exhibit 8.4).

First Nations people have a higher rate of hospitalizations for acute complications of diabetes compared to other people in Ontario; the rates of hospitalizations among those living in and outside of First Nations communities are similar (exhibit 8.5). For both First Nations people and other people in Ontario, rates of hospitalization for acute complications of diabetes have declined. Among both First Nations people and other people in Ontario, the highest rates of hospitalizations are seen among those with high levels of comorbidity (exhibit 8.6). There is no difference in hospitalizations for acute diabetes complications between First Nations and other people in Ontario people based on level of rurality (exhibit 8.7) or between those living in and outside of First Nations communities based on Health Canada zone (exhibit 8.8).

EXHIBIT 8.1 Age- and sex-adjusted number of people with at least one emergency department visit for hypo- or hyperglycemia per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2002/03 to 2014/15

Key Findings

- In 2014/15, the number of people with at least one visit to the ED per 100 people with diabetes was highest among First Nations people living outside of First Nations communities (1.8) compared to those living in First Nations communities (1.1) and to other people in Ontario (0.8).
- The number of people with at least one visit to the ED for hypo- and hyperglycemia per 100 people with diabetes declined among First Nations people and other people in Ontario between 2002/03 and 2014/15.

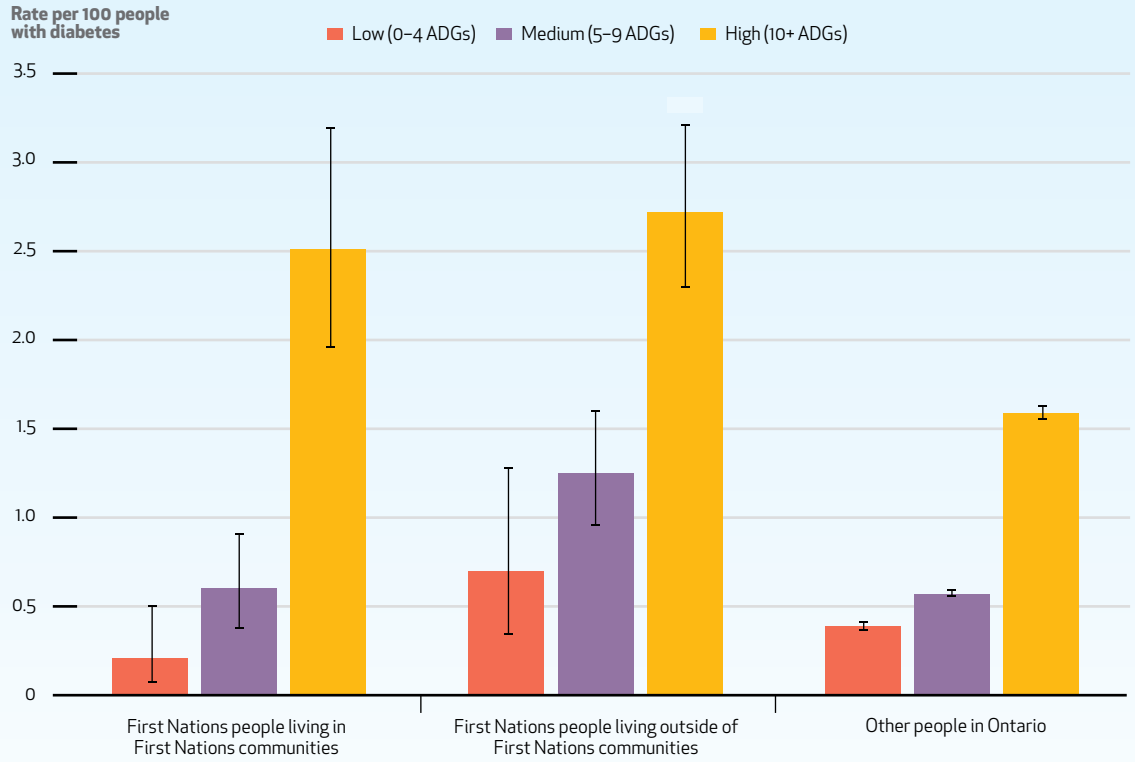


Dashed lines represent 95% confidence intervals.

EXHIBIT 8.2 Age- and sex-adjusted number of people with at least one emergency department visit for hypo- or hyperglycemia per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- For both First Nations people and other people in Ontario, the highest number of people with at least one ED visit for hypo- or hyperglycemia per 100 people with diabetes were seen among those with a high level of comorbidity (10+ ADGs).
- Among those with diabetes and a high level of comorbidity, a significantly greater number of First Nations people living in and outside of First Nations communities visited the ED for hypo- or hyperglycemia compared with other people in Ontario (respectively, 2.5, 2.7 and 1.6 per 100 people with diabetes).



Error bars represent 95% confidence intervals.

EXHIBIT 8.3 Age- and sex-adjusted number of people with at least one emergency department visit for hypo- or hyperglycemia per 100 people with diabetes, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- Among First Nations people with diabetes, there was no significant difference in the rate of individuals visiting the emergency department for hypo- or hyperglycemia among people living in urban, semi-urban and rural areas (respectively, 1.5, 1.9 and 1.5 per 100 people with diabetes).
- Among other people in Ontario with diabetes, the rate of individuals visiting the emergency department for hypo- or hyperglycemia was higher in rural and semi-urban areas than in urban areas (respectively, 1.2, 1.1 and 0.8 per 100 people with diabetes).

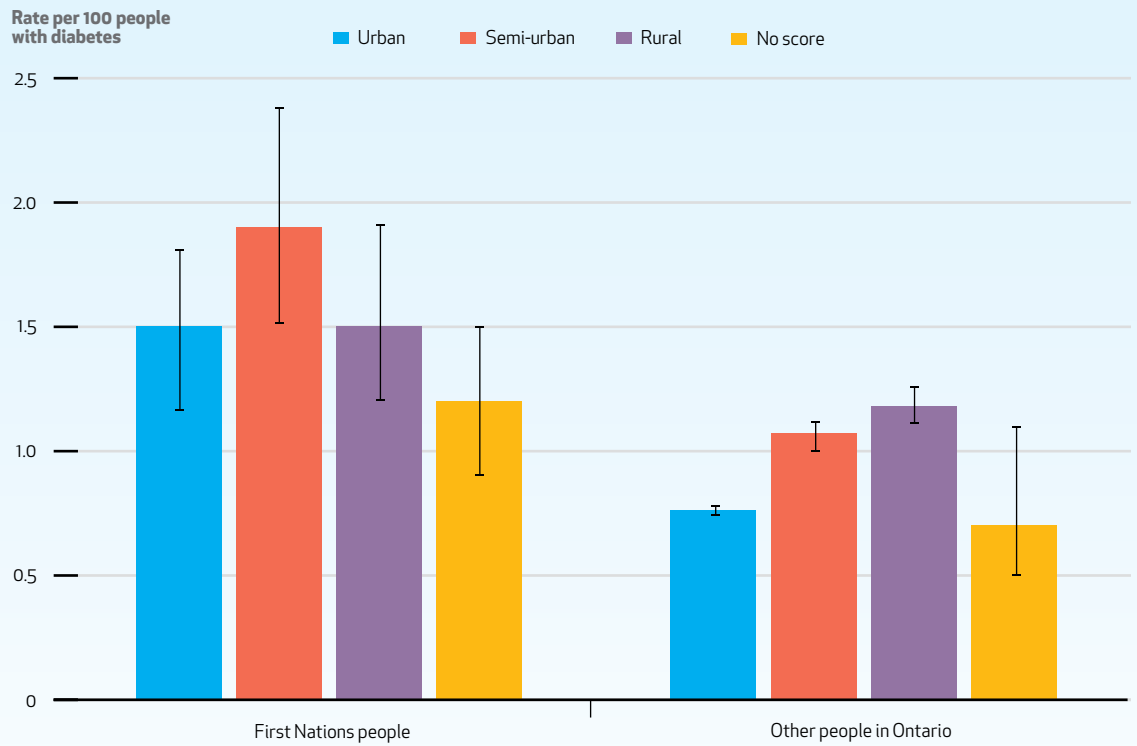
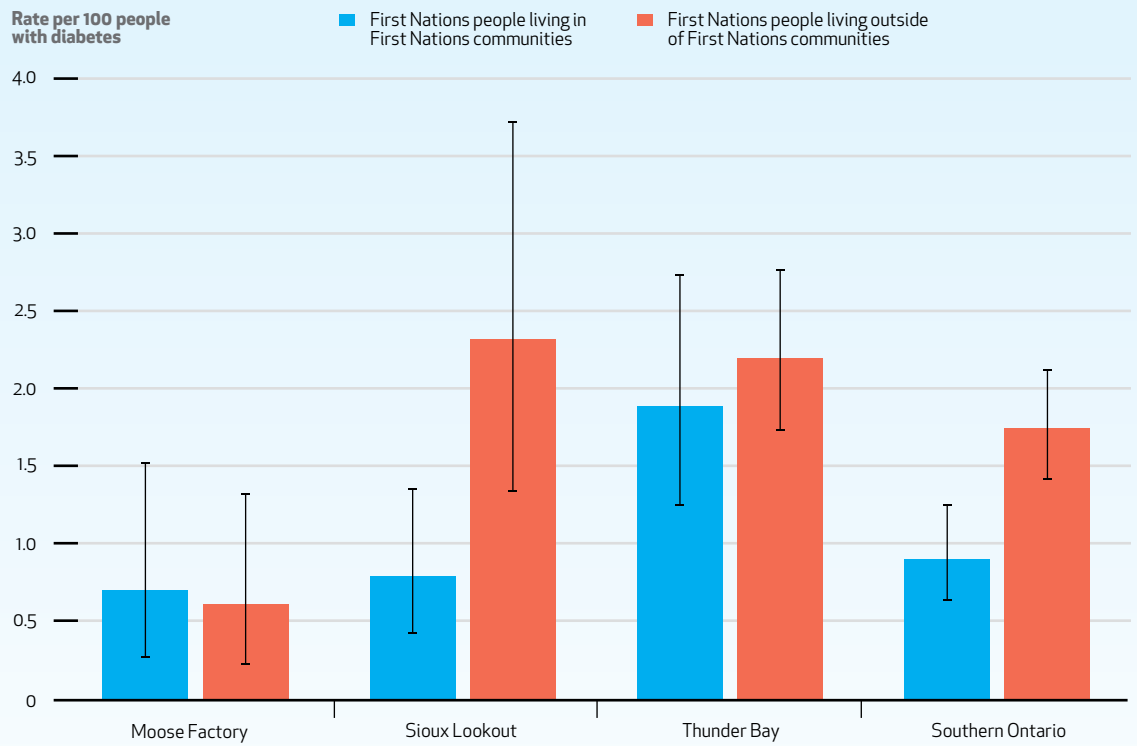


EXHIBIT 8.4 Age- and sex-adjusted number of people with at least one emergency department visit for hypo- or hyperglycemia per 100 people with diabetes, among First Nations people living in and outside of First Nations communities in Ontario, by Health Canada zone, 2014/15

Key Findings

- In the Sioux Lookout and Southern Ontario zones, First Nations people living outside of First Nations communities had higher rates of emergency department visits compared with those living in First Nations communities.
- Low rates of emergency department visits in remote First Nations communities may reflect barriers in access to hospitals rather than differences in hypo- or hyperglycemia severity.

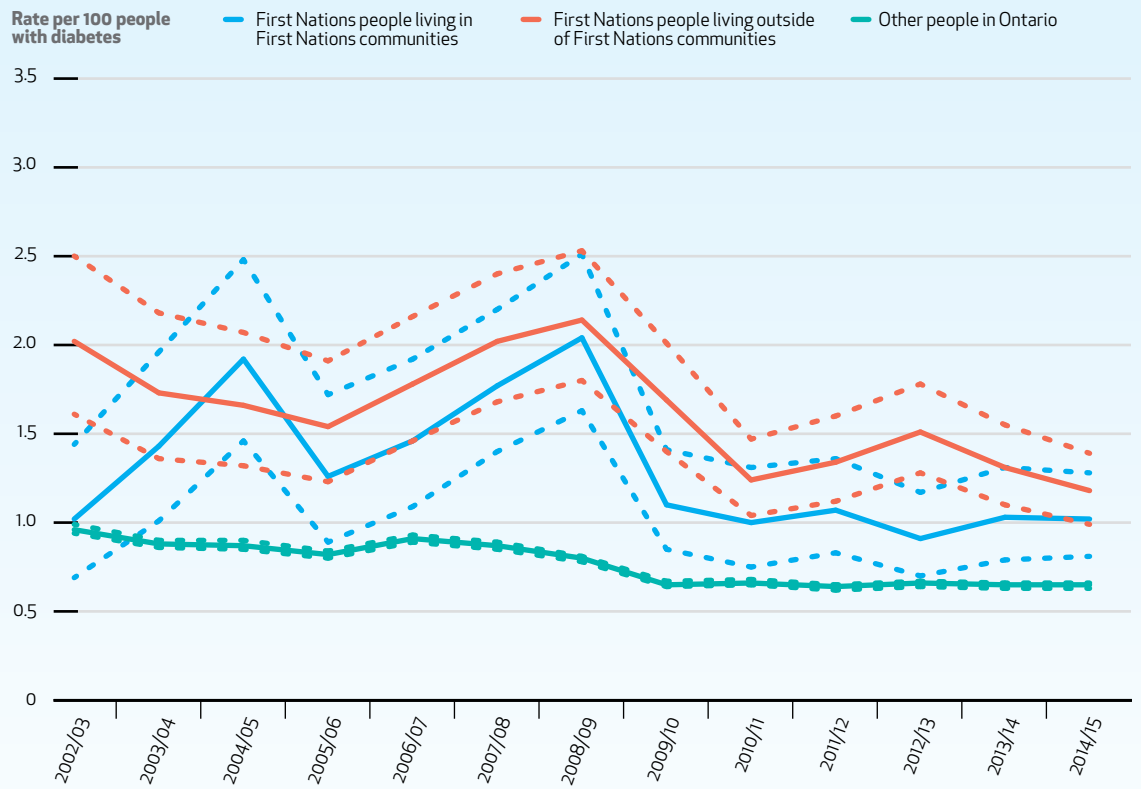


Error bars represent 95% confidence intervals.

EXHIBIT 8.5 Age- and sex-adjusted number of people with at least one hospitalization for hypo- or hyperglycemia per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2002/03 to 2014/15

Key Findings

- In 2014/15, the number of individuals hospitalized for hypo- or hyperglycemia was similar for those living in and outside of First Nations communities (1.02 and 1.18 per 100 people with diabetes, respectively). The rate of hospitalization for hypo- or hyperglycemia for First Nations people was higher compared with other people in Ontario (0.65 per 100 people with diabetes in 2014/15).
- The rate of hospitalizations for hypo- or hyperglycemia decreased among both First Nations people and other people in Ontario between 2002/03 and 2014/15.

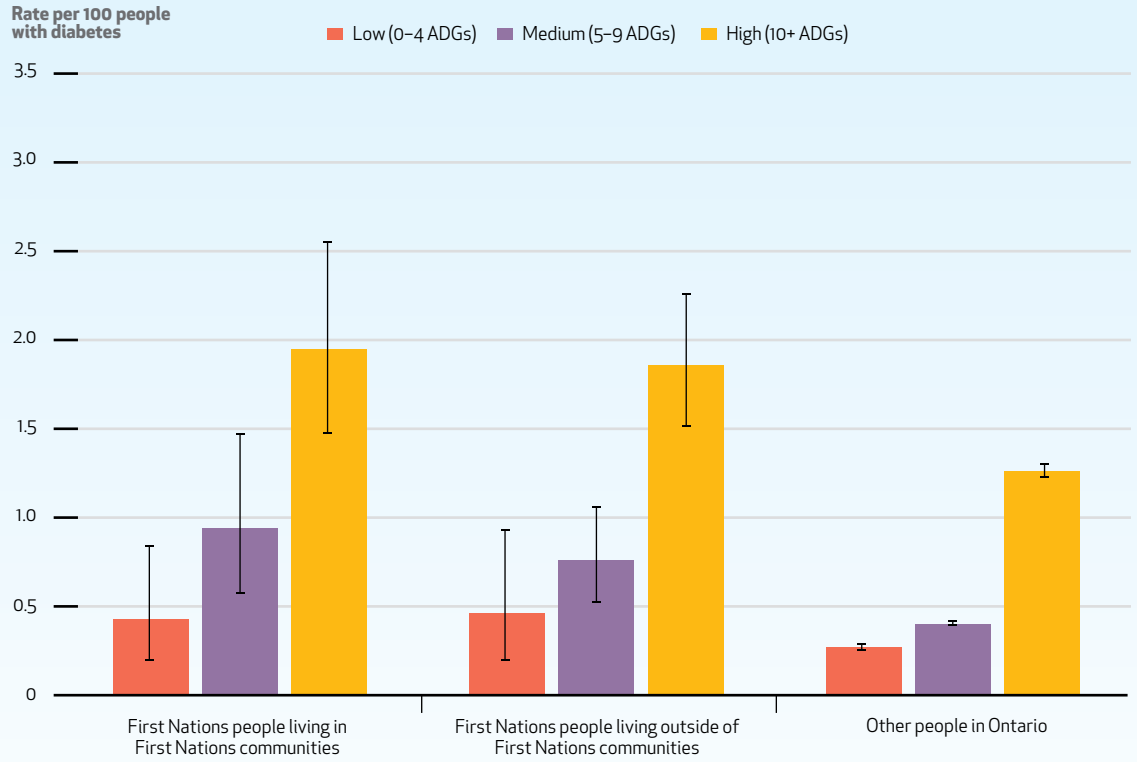


Dashed lines represent 95% confidence intervals.

EXHIBIT 8.6 Age- and sex-adjusted number of people with at least one hospitalization for hypo- or hyperglycemia per 100 people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- For both First Nations people and other people in Ontario with diabetes, the rate of hospitalization for hypo- or hyperglycemia in 2014/15 was highest among those with a high level of comorbidity (10+ ADGs).
- First Nations people living in and outside of First Nations communities had significantly higher numbers of individuals with high comorbidity when hospitalized for hypo- or hyperglycemia compared to other people in Ontario (1.95, 1.86 and 1.26 per 100 patients with diabetes, respectively).

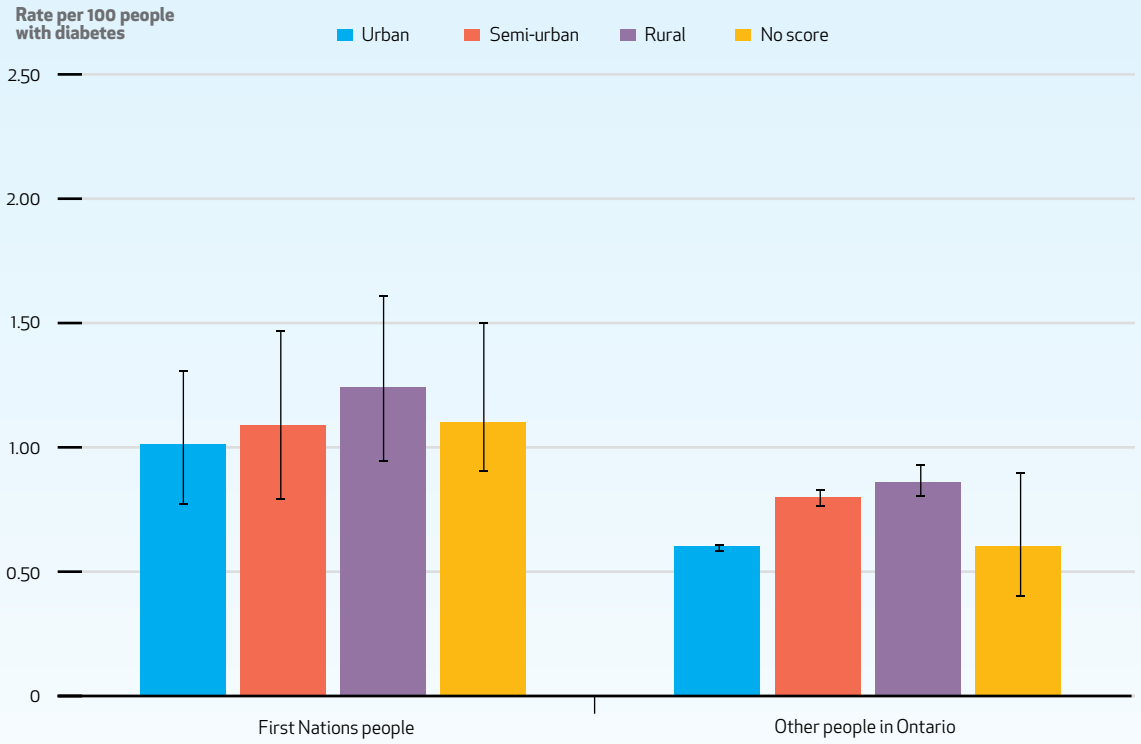


Error bars represent 95% confidence intervals.

EXHIBIT 8.7 Age- and sex-adjusted number of people with at least one hospitalization for hypo- or hyperglycemia per 100 people with diabetes, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- Among First Nations people with diabetes, there was no significant difference in the rate of individuals hospitalized for hypo- or hyperglycemia living in urban, semi-urban and rural areas (respectively, 1.0, 1.1 and 1.2 per 100 diabetic patients).
- Among other people in Ontario with diabetes, the rate of individuals in rural and semi-rural areas hospitalized for hypo- or hyperglycemia was significantly higher compared to those living in urban areas (respectively, 0.9, 0.8 and 0.6 per 100 individuals with diabetes).

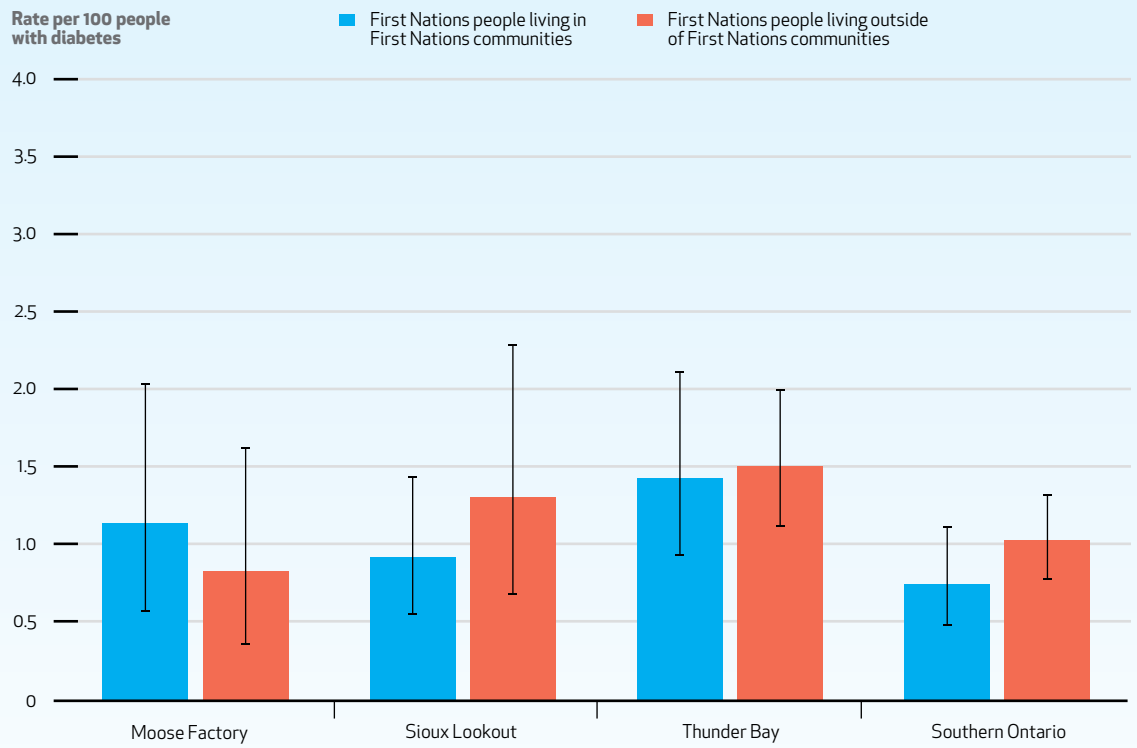


Error bars represent 95% confidence intervals.

EXHIBIT 8.8 Age- and sex-adjusted number of people with at least one hospitalization for hypo- or hyperglycemia per 100 people with diabetes, among First Nations people living in and outside of First Nations communities in Ontario, by Health Canada zone, 2014/15

Key Findings

- In 2014/15, hospitalization rates for hypo- or hyperglycemia were similar across Health Canada zones and among First Nations people living in and outside of First Nations communities.



Error bars represent 95% confidence intervals.

Discussion

Overall, there has been a decline in the rates of ED visits and hospitalizations for acute diabetes complications over time among First Nations people living in and outside of First Nations communities and among other people in Ontario, a study result that is similar to findings in other provinces.[5] First Nations people in Ontario have higher rates of ED visits and hospitalizations for hypo- and hyperglycemia than other people in Ontario.

First Nations people living outside of First Nations communities have higher rates of ED visits and hospitalizations compared to those living in First Nations communities. Though the majority of hypo- and hyperglycemic events can be self-managed by patients outside of the acute care setting.[3,4] this difference may be partially due to access to emergency department and hospital facilities. A recent qualitative study of health care experiences of Indigenous people with type 2 diabetes found that visits to clinics outside of their First Nation communities were considered a considerable challenge, not only because of geographic isolation, but also because the shortage of physicians in First Nations communities significantly jeopardized continuity of care.[6] Interestingly, we found no significant difference in the rates of ED visits or hospitalizations by level of rurality among First Nations people; among other people in Ontario, we observed higher rates of ED visits and hospitalizations among those living in semi-urban and rural areas. This may be due to the fact that a large proportion (50%) of First Nations people live in isolated communities in Northern Ontario and may have limited or no access to these facilities. They may be treated at a facility not administered by the provincial government, such as a nursing station funded by Health Canada's First Nations and Inuit Health Branch[7] or at an Aboriginal Health Access Centre funded by the Ontario Ministry of Health and Long-Term Care.

There are markedly higher rates of ED visits and hospitalizations in patients with high degrees of comorbidity. This may reflect a higher risk of hypo- or hyperglycemia in these sicker patients. However, the ED visit or hospitalization may have been the result of one of the comorbid conditions; without the comorbid condition, the hypo- or hyperglycemic episode may have been managed at home.

Limitations

In addition to the limitations described in the Methods section, it is important to note that we are only able to capture hypo- or hyperglycemia events that resulted in a visit to the ED or admission to hospital. The vast majority of hypo- and hyperglycemic complications are self-managed by patients outside of the hospital setting.[3,4] Thus, these data do not reflect the true magnitude of hypo- and hyperglycemic complications experienced by patients. This may particularly affect populations where travel time to an emergency department may be prohibitive to seeking care.

In addition, hospitalizations and, to a lesser extent, ED visits, often occur because of an exacerbation of some other comorbid condition (e.g., cognitive problems, concurrent renal insufficiency) rather than the hypo- or hyperglycemic condition itself. If the concurrent issue were not present, the patient likely would not have ended up in the ED or hospital but would have managed the diabetic complication on their own.

Finally, because of the requirement to suppress small cell sizes, we were unable to meaningfully compare rates of ED visits and hospitalizations for acute complications by Local Health Integration Network.

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Appendix

EXHIBIT 8.1A ICD-10 diagnostic codes for hypo- and hyperglycemia

Indicator	ICD-10 code
Hypo- or hyperglycemia	E100, E101, E1063, E110, E111, E1163, E130, E131, E1363, E140, E141, E1463, E15, E160, E161, E162, R73, T383, Y423

ICD: International Classification of Diseases

9 Diabetes and Cardiac Disease

Inside

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Overview

Diabetes is a major independent risk factor for cardiovascular diseases (CVD) and its complications, such as myocardial infarction (heart attack) and heart failure.[1,2] Compared with people without diabetes, those with diabetes develop CVD 15 years earlier and their prognosis after a cardiovascular event is poorer, resulting in premature morbidity and mortality.[3-6] People with diabetes also have high rates of other cardiovascular risk factors, such as hypertension, high cholesterol and obesity, which further increase their CVD risk.[1,7,8] Combined with the increasing prevalence of diabetes among both First Nations people and other people in Ontario and Canada, the risk and impact of CVD in this population underscores the importance of cardiac risk factor and disease management in these patients[9] (see chapter 5). In addition to behavioural modification such as exercise and smoking cessation, better outcomes can be achieved with risk factor control through medical therapies such as revascularization of diseased heart vessels; medications for diabetes, hypertension and high cholesterol; and early physician follow-up after hospital discharge for a cardiovascular event.[10-12]

This chapter presents age- and sex-adjusted rates of hospitalization and death due specifically to major cardiac disease events (these include myocardial infarction, unstable angina and heart failure; stroke is presented in chapter 10) for both First Nations people and other people in Ontario who were 20 to 105 years of age and living with diabetes. Indicators of cardiac disease management are also reported, including revascularization procedures, medications for primary and secondary prevention (i.e., prevention of a first and subsequent event, respectively), and post-hospitalization care. Overall rates are presented, and where sample size permits, rates are stratified by sex, age and First Nations communities within Health Canada zones.

Methods

To examine hospitalizations for cardiac disease and for revascularization procedures (percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG) surgery), we used the Canadian Institute for Health Information's Discharge Abstract Database, which includes information from the discharge abstracts of all acute care hospitals in Ontario. Diagnostic and procedure codes used are provided in exhibit 9.1A in the chapter appendix. We identified all admissions with a main diagnosis of each indicator, counting a maximum of one admission or procedure per individual per year. Deaths due to ischemic heart disease were identified from the Office of the Registrar General – Vital Statistics database using codes 410–414 and I20–I25 from the International Classification of Diseases, 9th and 10th Revisions (ICD-9 and ICD-10).

For information about medications prescribed, we used the Ontario Drug Benefit (ODB) database, which contains information about claims covered by and made to the ODB program for eligible patients, primarily those 65 years of age and older, living in long-term care facilities or receiving social assistance. Because statins to lower cholesterol and angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin II receptor blockers (ARBs) for blood pressure control are recommended for a large proportion of individuals with diabetes, the proportion of individuals with at least one prescription claim for these medications in the first 100 days of each 12-month period are reported among all individuals aged 65 and older.[11,13] For beta-blockers and antiplatelets, recommended for cardio-protection among secondary prevention patients, prescription rates were defined as having a prescription claim for these medications in the 90 days after a myocardial infarction related hospital discharge.[11,14] Visits to a primary care physician within 7 days and 30 days after a hospital discharge for a myocardial infarction or heart failure, respectively, as recommended by clinical practice guidelines, were captured from the Ontario Health Insurance Plan physician claims database.[15,16]

Where data allowed, age- and sex-adjusted rates for each indicator were calculated for each 12-month period from April 1, 1996, to March 31, 2016 (the method is described in chapter 2). Additionally, time to a first major cardiac event (hospitalization for myocardial infarction, unstable angina or heart failure, or death due to ischemic heart disease) was

examined among individuals newly diagnosed with diabetes between April 1, 2007, and March 31, 2016, who had no history of myocardial infarction, heart failure, percutaneous coronary intervention, CABG surgery or stroke prior to their diagnosis. Individuals were followed to the earliest of their first event, death or March 31, 2017. Sex-stratified time to a cardiac event was determined using a cause-specific hazard model adjusted for age and year of diabetes diagnosis and accounting for death as a competing risk. Directly adjusted cumulative incidence is reported.

Results

Among people with diabetes, incidence rates for all major cardiac events were higher among First Nations people compared with other people in Ontario (exhibits 9.1 and 9.3). Between 1996/97 and 2015/16, incidence rates declined in all four Health Canada zones (exhibit 9.2) and across all age groups, with the greatest declines in the older age groups; other people in Ontario experienced similar declines (exhibit 9.4).

Among those newly diagnosed with diabetes, the incidence of a major cardiac event at 10 years was higher for First Nations men and women (exhibit 9.5). Revascularization rates increased among First Nations men and women while remaining relatively stable for other men and women in Ontario (exhibit 9.6).

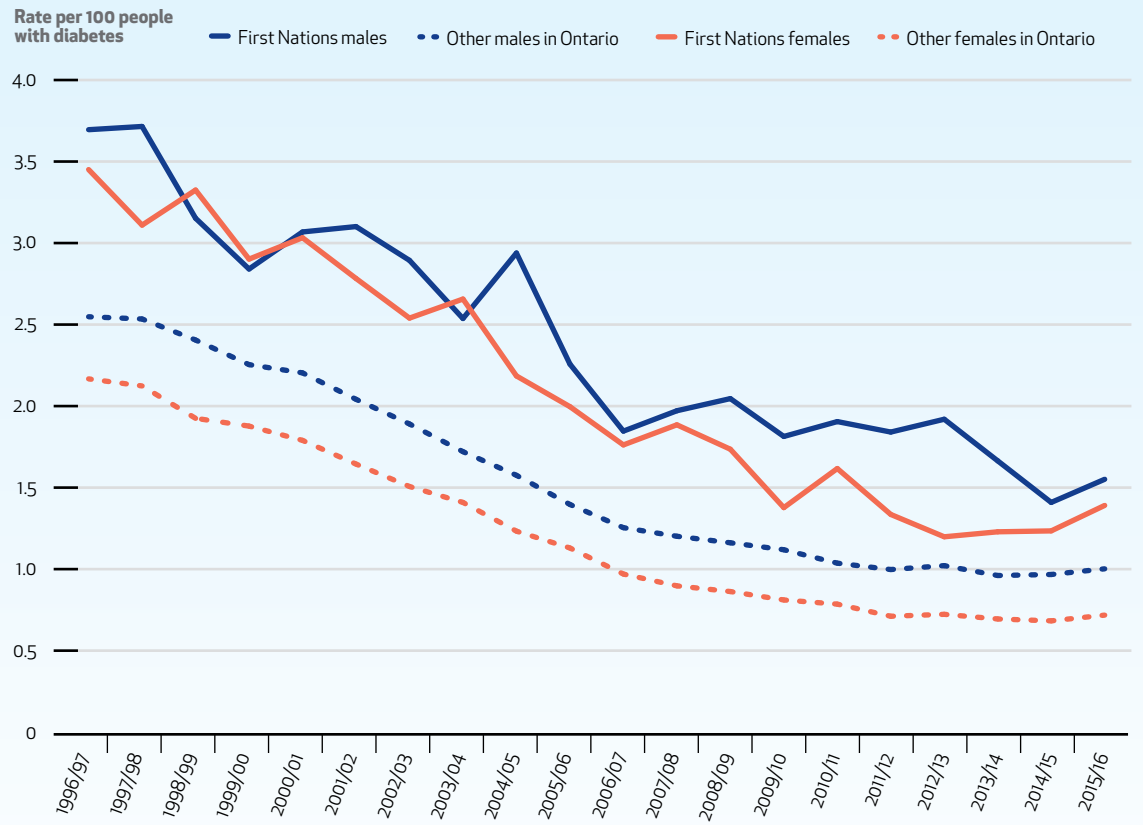
In 2015/16, the proportion of older adults with diabetes who had a prescription claim for statins was similar for First Nations people and other people in Ontario (exhibit 9.7), as was the proportion who had a prescription claim for antiplatelets within 90 days after a hospitalization for myocardial infarction (exhibit 9.9). Compared to other people in Ontario, a higher proportion of First Nations people had a prescription claim for ACEIs or ARBs, and a lower proportion had a prescription claim for beta-blockers within 90 days after a hospitalization for myocardial infarction.

Compared with other people in Ontario, a smaller proportion of First Nations people with diabetes visited a primary care physician after a hospitalization for heart failure or myocardial infarction (exhibit 9.8). Thirty-day and one-year mortality rates after hospitalization for a major cardiac event were similar for First Nations people and other people in Ontario with diabetes (exhibit 9.10).

EXHIBIT 9.1 Incidence of major cardiac events per 100 people with diabetes, among First Nations people and other people in Ontario, by sex, 1996/97 to 2015/16

Key Findings

- Between 1996/97 and 2015/16, incidence rates for major cardiac events among people with diabetes declined 2- to 3-fold among both First Nations people and other people in Ontario.
- In 2015/16, First Nations men and women with diabetes had significantly higher incidence rates for major cardiac events compared to other men and women with diabetes in Ontario: respectively, 1.6 vs.1.0 for men and 1.4 vs. 0.7 for women, per 100 people with diabetes.
- The decline in incidence rates for cardiac events was greater among First Nations people than other people in Ontario (average -0.12 vs. -0.09 per 100 patients per year, respectively) such that the absolute difference in rates narrowed from 1.2 to 0.6 per 100 people with diabetes between 1996/97 and 2015/16.

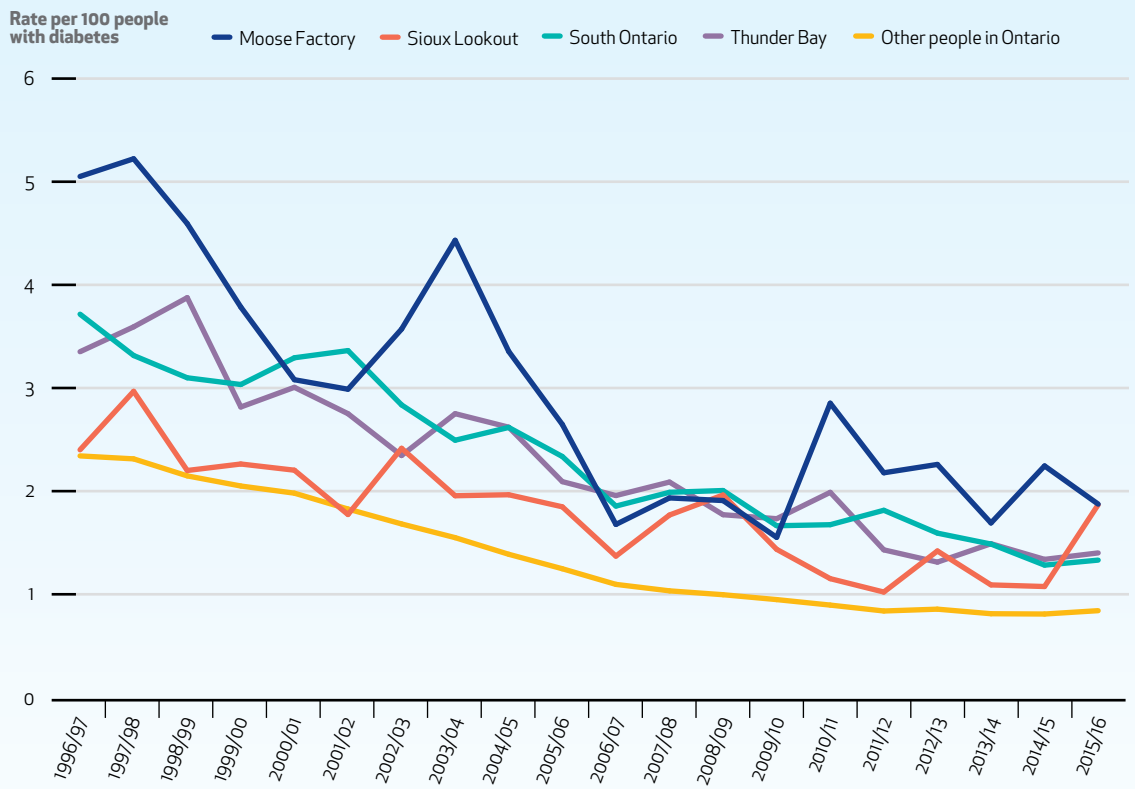


*Includes hospitalization for myocardial infarction, unstable angina or heart failure, or death from ischemic heart disease.

EXHIBIT 9.2 Incidence of major cardiac events* per 100 people with diabetes, among First Nations people and other people in Ontario, by Health Canada zone, 1996/97 to 2015/16

Key Findings

- The incidence of major cardiac events among people with diabetes declined significantly between 1996/97 and 2015/16 in all Health Canada zones, ranging from an average decrease of 0.07 per 100 people per year in the Sioux Lookout zone to 0.16 per 100 people per year in the Moose Factory zone.
- Between 1996/97 and 2015/16, the highest incidence rates of cardiac events were observed in the Moose Factory zone, although by 2015/16, rates were similar across all zones.

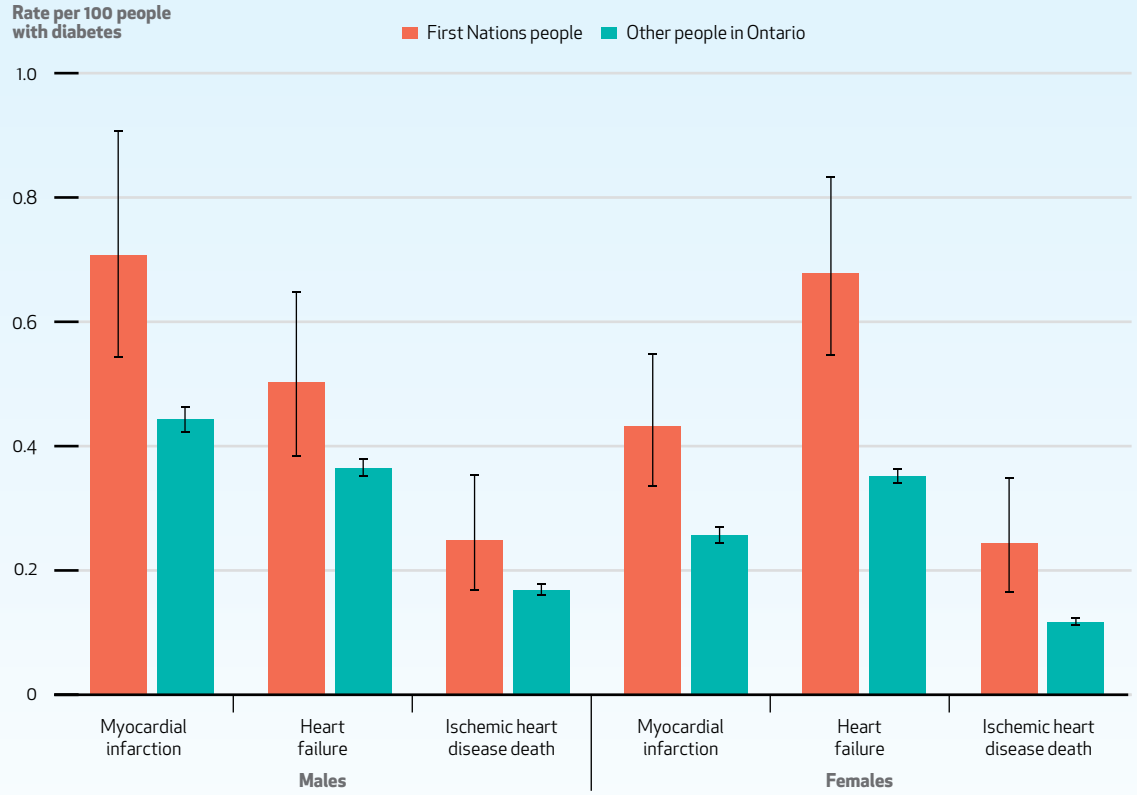


* Includes hospitalization for myocardial infarction, unstable angina or heart failure, or death due to ischemic heart disease.

EXHIBIT 9.3 Incidence of major cardiac events for people with diabetes, among First Nations people and other people in Ontario, by sex and type of cardiac event, 2015/16

Key Findings

- Among people with diabetes, incidence rates for all individual major cardiac events were higher for First Nations people than for other people in Ontario.
- For men, myocardial infarction was the leading cause of hospitalization among the major cardiac events; for women, heart failure was the leading cause.

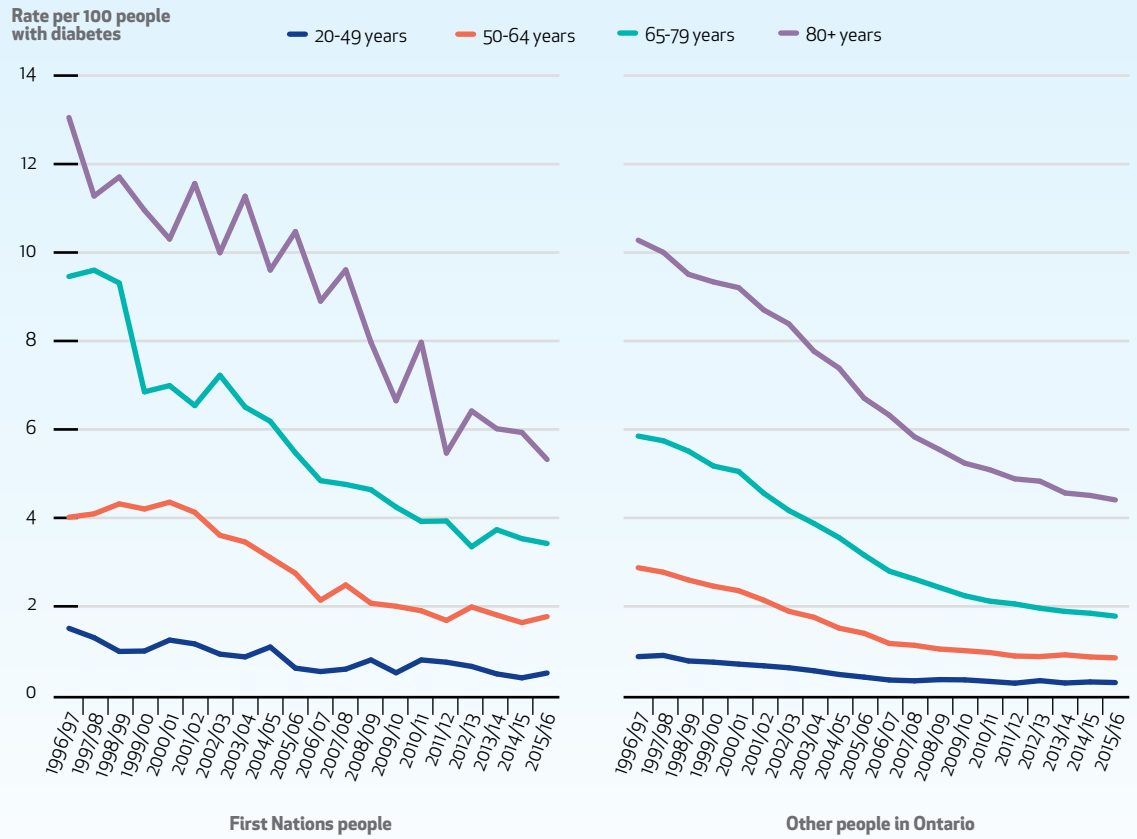


Error bars represent 95% confidence intervals.

EXHIBIT 9.4 Incidence of major cardiac events* in people with diabetes, among First Nations people and other people in Ontario, by age group, 1996/97 to 2015/16

Key Findings

- Among First Nations people with diabetes, the incidence of major cardiac events between 1996/97 and 2015/16 was higher among the older age groups, with a rate of 5.4 per 100 people aged 80 years and older compared with 0.5 per 100 people aged 20–49 years in 2015/16.
- The incidence of major cardiac events among First Nations people with diabetes declined across all age groups, with the greatest declines in the older age groups. Between 1996/97 and 2015/16, there was an average annual decrease of 0.05 per 100 people among 20- to 49-year-olds compared with 0.4 per 100 people among those aged 80 and older.
- For all age groups, similar declines in major cardiac event rates between First Nations people and other people in Ontario were observed between 1996/97 and 2015/16.

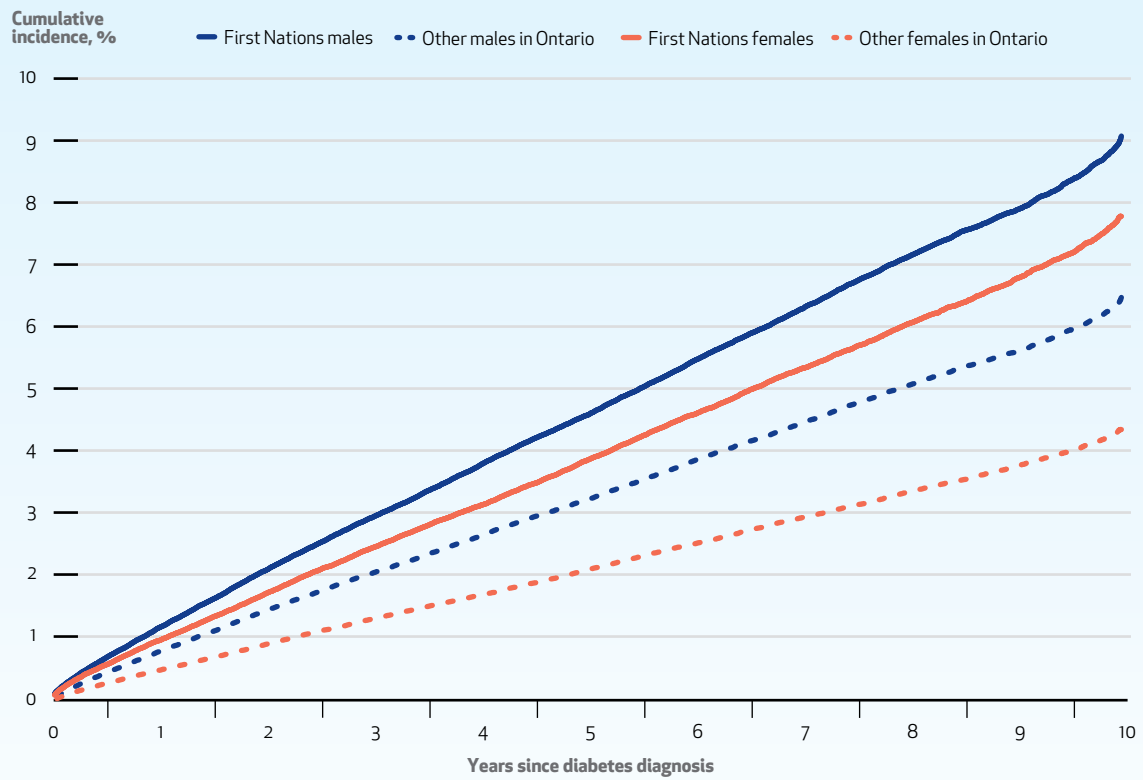


*Includes hospitalization for myocardial infarction, unstable angina or heart failure, or death due to ischemic heart disease.

EXHIBIT 9.5 Age-adjusted time to first major cardiac event* for men and women newly diagnosed with diabetes, among First Nations people and other people in Ontario, 2007/08 to 2015/16**

Key Findings

- The age-adjusted, 10-year cumulative incidence of major cardiac events among First Nations men and women newly diagnosed with diabetes was 9.1% and 7.8%, respectively, compared with 6.5% and 4.4% for other men and women in Ontario.
- First Nations people newly diagnosed with diabetes were more likely to experience a first major cardiac event earlier after diagnosis than other people in Ontario with diabetes.

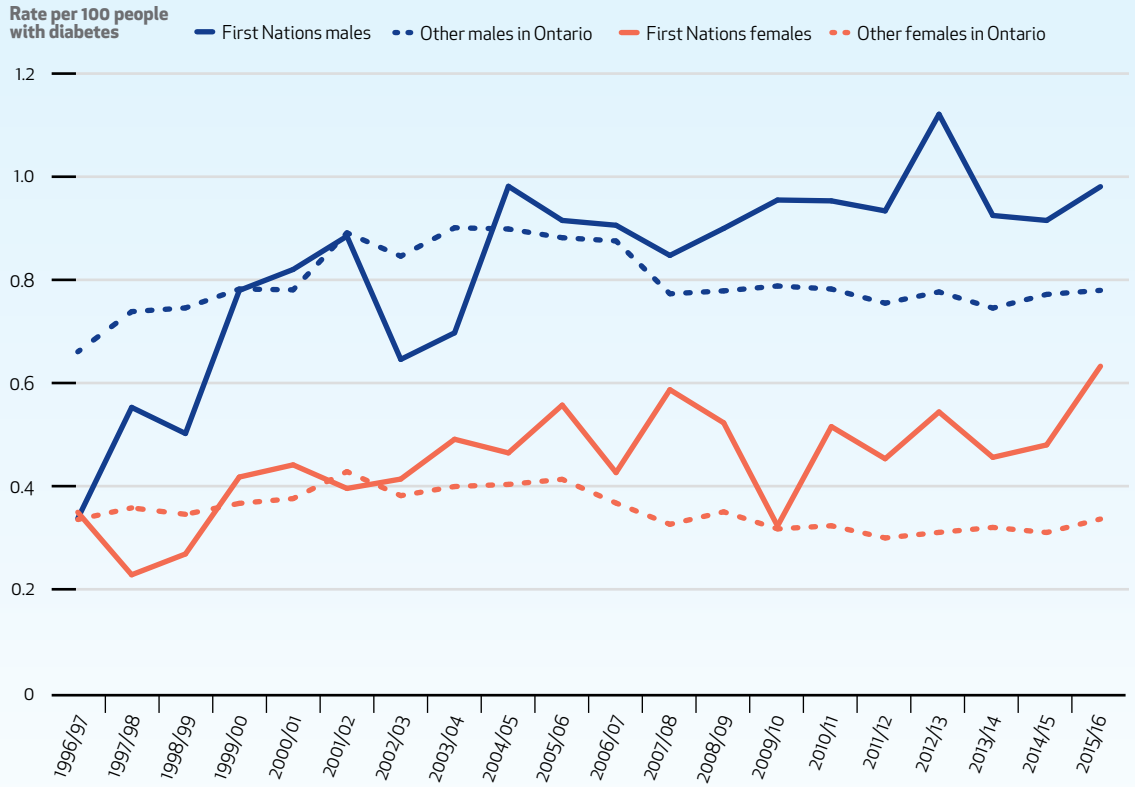


*Includes hospitalization for myocardial infarction, unstable angina or heart failure, or death due to ischemic heart disease.
**Deaths due to ischemic heart disease available to December 31, 2015. Maximum date of follow-up was March 31, 2017.

EXHIBIT 9.6 Incidence of revascularization* per 100 men and women with diabetes, among First Nations people and other people in Ontario, 1996/97 to 2015/16

Key Findings

- Between 1996/97 and 2015/16, the revascularization rate increased among First Nations men and women with diabetes and remained relatively stable among other men and women in Ontario with diabetes.
- In 2015, revascularization rates were higher among First Nations people with diabetes compared with other people in Ontario (respectively, 1.0 and 0.8 per 100 men and 0.6 and 0.3 per 100 women).
- Among both First Nations people and other people in Ontario with diabetes, rates of revascularization were higher for men than for women.



*Includes percutaneous coronary intervention and coronary artery bypass graft.

EXHIBIT 9.7 Percentage of people with diabetes aged 65 years and older with a claim for prescribed statins or angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers (ACEIs/ARBs) in the first 100 days of each year, among First Nations people and other people in Ontario, 2000/01 to 2015/16

Key Findings

- Between 2000/01 and 2015/16, the proportion of older adults with diabetes who had prescription claims for statins or ACEIs/ARBs increased, stabilizing at approximately 63% in 2011/12 for statins and at 65%–70% in 2007/08 for ACEIs/ARBs.
- In 2015, the proportion of older adults with diabetes who had a prescription claim for statins was not significantly different among First Nations people and other people in Ontario (63.4% vs. 63.7%). A higher proportion of First Nations people with diabetes had a prescription claim for ACEIs/ARBs compared with other people in Ontario (68.4% vs. 63.0%).

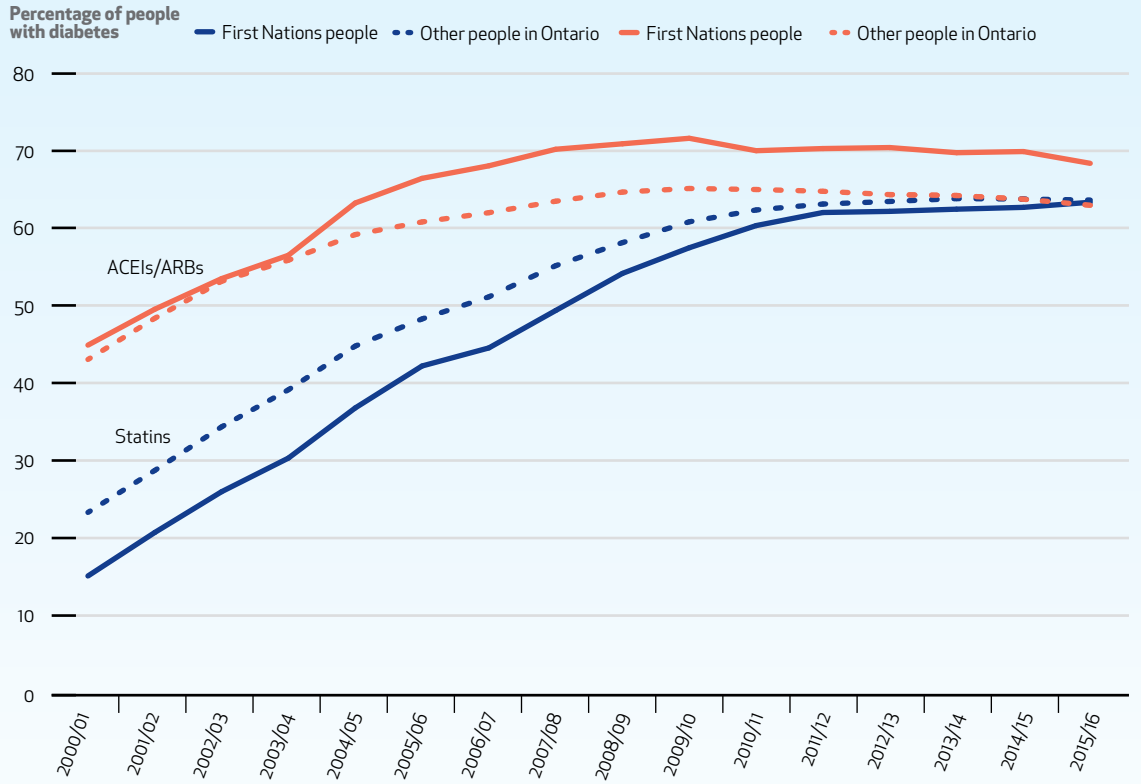


EXHIBIT 9.8 Percentage of people with diabetes who visited a primary care physician after discharge from hospital for heart failure or myocardial infarction, among First Nations people and other people in Ontario, 1996/97 to 2015/16

Key Findings

- A smaller proportion of First Nations people with diabetes visited a primary care physician after a hospitalization for heart failure or myocardial infarction compared with other people in Ontario with diabetes.
- Amng First Nations people with diabetes between 1996/97 and 2015/16, the average rate of early visits to a primary care physician after a heart failure–related hospitalization declined by 0.9 per 100 patients per year; after a myocardial infarction–related hospitalization, the rate declined by 1.7 per 100 patients per year.

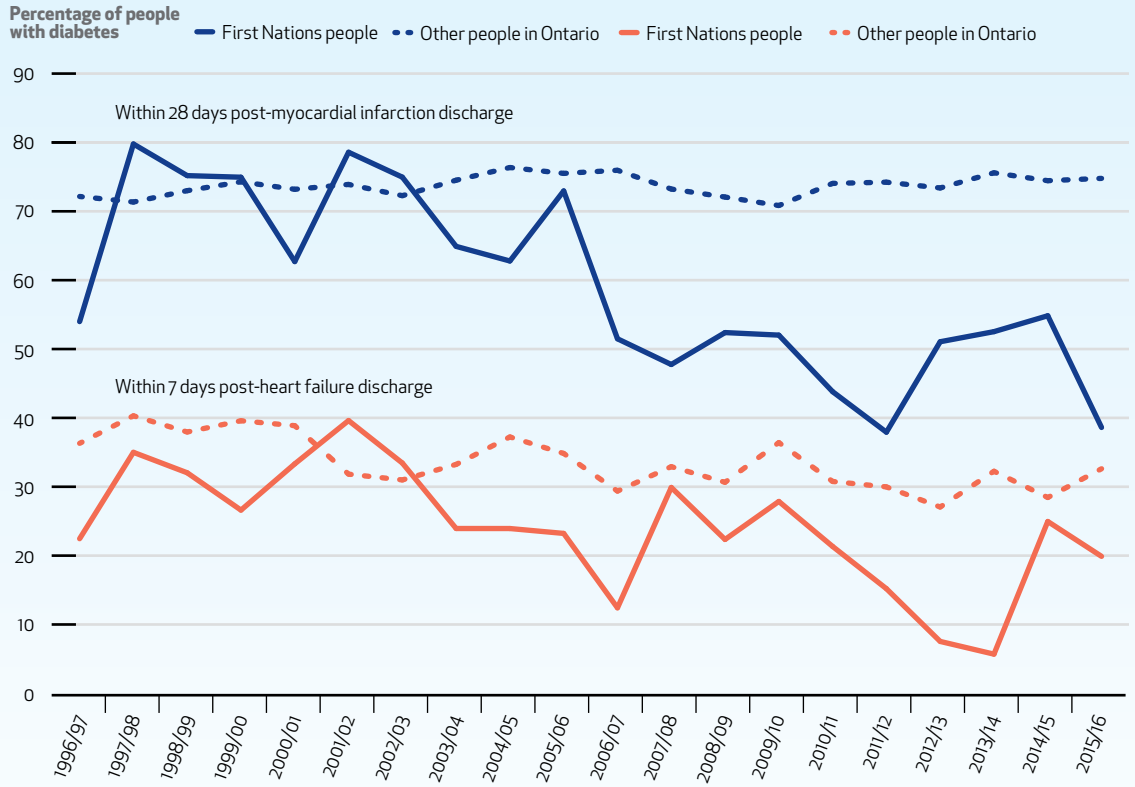


EXHIBIT 9.9 Percentage of people with diabetes aged 65 years and older with a prescription claim for beta-blockers or antiplatelets within 90 days after discharge from hospital for myocardial infarction, among First Nations people and other people in Ontario, 2002/03 to 2015/16

Key Findings

- Among older adults with diabetes, prescription claim rates for beta-blockers after discharge from hospital for myocardial infarction were consistently lower among First Nations people between 2002/03 and 2015/16. In 2015/16, 60.8% of First Nations people had a prescription claim for beta-blockers within 90 days of hospital discharge compared with 74.6% of other people in Ontario.
- The proportion of older adults with diabetes who had a prescription claim for antiplatelets within 90 days after a hospitalization for myocardial infarction increased almost 2.5-fold between 2003/04 and 2015/16 among both First Nations people and other people in Ontario; in 2015/16, the rates were not significantly different between the two populations (68.7% and 69.3%, respectively).

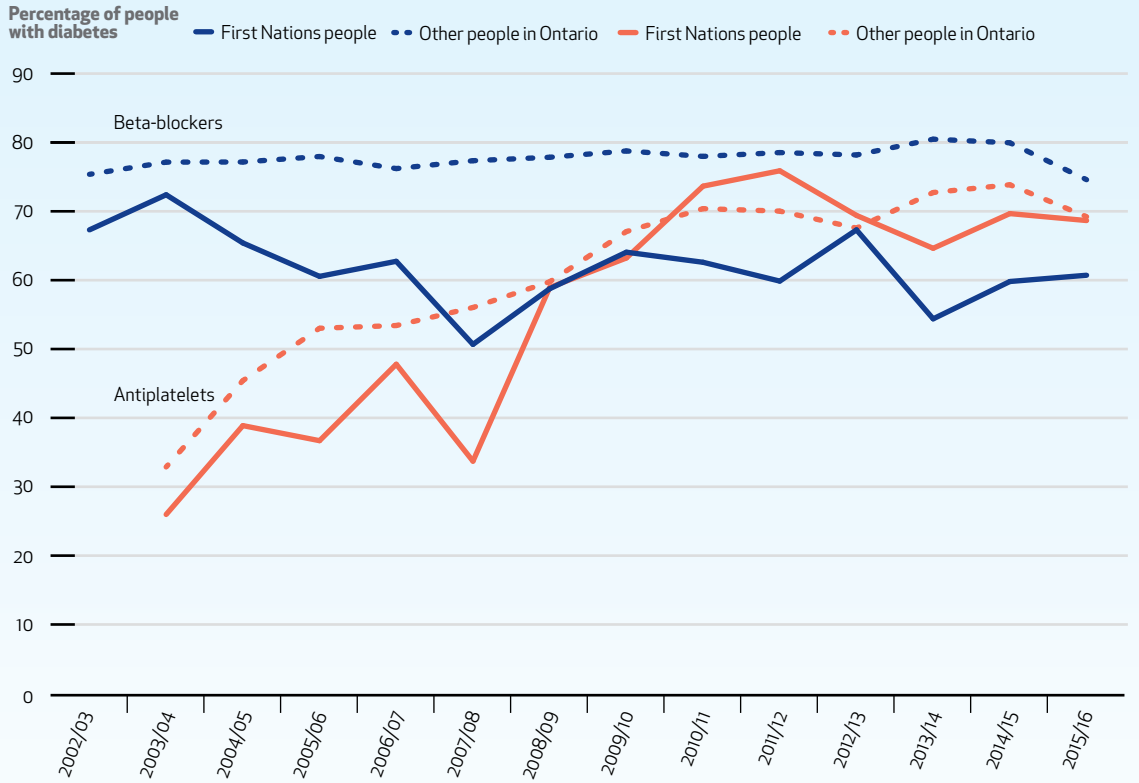
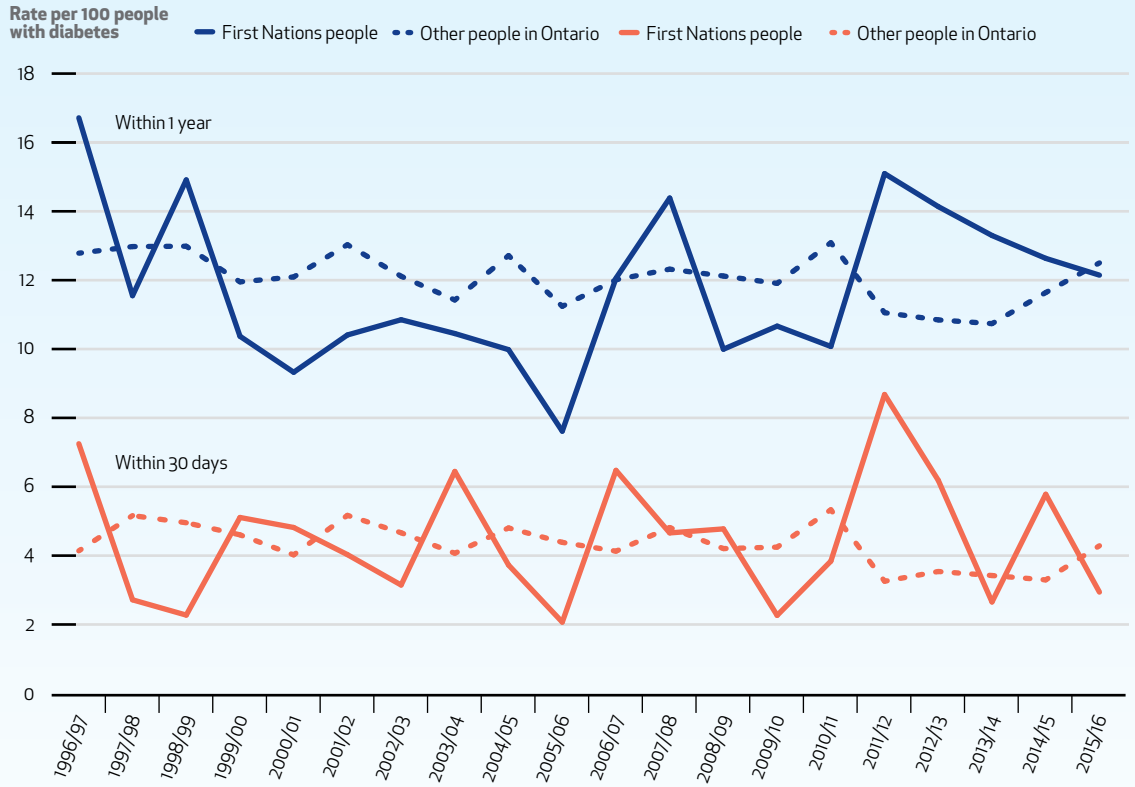


EXHIBIT 9.10 Mortality rate within 30 days and one year after hospital admission for a major cardiac event* in patients with diabetes, among First Nations people and other people in Ontario, 1996/97 to 2015/16

Key Findings

- Between 1996/97 and 2015/16, mortality rates at 30 days and one year after hospital admission for a major cardiac event were stable among both First Nations people and other people in Ontario with diabetes (averaging a combined 4.4 and 12.0 per 100 patients each year, respectively).
- Thirty-day and one-year mortality rates after hospitalization for a major cardiac event were similar for First Nations people with diabetes and other people in Ontario with diabetes.



*Includes myocardial infarction, unstable angina and heart failure.

Discussion

Between 1996/97 and 2016/17, the incidence rate of major cardiac events among people with diabetes declined approximately 60% among both First Nations people and other people in Ontario. These findings were consistent across Health Canada zones and similar to declines in CVD incidence and mortality rates observed in the general population in Ontario, Canada and other developed countries.[17,18] In Ontario, the relative reduction in hospitalizations for various atherosclerotic events between 1994/95 and 2014/15 ranged from 37% for myocardial infarction among men to 87% for unstable angina among women, while mortality due to cardiac disease decreased 56% among men and 58% among women.[18]

Improvements in CVD event rates have largely been attributable to advances in both the prevention and treatment of cardiac risk factors and diseases.[17] Among First Nations people with diabetes, improvements in preventative care and the management of cardiac disease were observed. Specifically, rates of PCI and CABG increased during the study period, with the higher rates in more recent years compared with other people in Ontario with diabetes possibly reflecting the higher incidence of cardiac disease among the First Nations population.

Use of statins, ACEIs/ARBs and antiplatelets (after a hospital discharge for myocardial infarction) also increased substantially between 2000/01 and 2015/16, although rates have stabilized in more recent years. These results may be attributable in part to the increasing support for their cardiovascular benefits among a wide range of patient subgroups, including those with diabetes.[11,19] As more recent years have seen fewer comprehensive primary care physicians practicing in areas with a high proportion of First Nations people, this finding suggests the importance of nurse practitioners in nursing stations, Aboriginal Health Access Centres and Community Health Centres in providing primary health care, including prescribing of medications.[20] Visits to these centres as an alternative to visiting a primary care physician may contribute to the observed declines in primary care visits after hospitalization for myocardial infarction or heart failure, as they are not captured in ICES health administrative databases. Overall, however, the comparable findings in cardiac risk factor and disease management between First Nations and other people in Ontario suggest that First Nations people with diabetes are accessing cardiovascular-related health care similarly.

While the observed improvements in cardiac disease incidence and management are positive, disease rates remain higher among First Nations people, and they experience cardiac events earlier after a diabetes diagnosis compared with other people in Ontario. Additionally, mortality rates after a cardiac event have not changed over time for both populations. With the rising prevalence of diabetes reported in chapter 5, cardiac disease remains an ongoing concern of the First Nations population. Emphasis on early prevention strategies will be one necessary step toward reducing gaps in cardiac disease morbidity and mortality. Future research is also indicated to better understand the roles of nurse practitioners in communities with high proportions of First Nations people in contributing to the advances observed as well as for ongoing progress.

Limitations

In addition to those described in chapter 2, limitations to the results reported in this chapter should be noted. Low absolute counts of major cardiac events among First Nations people limited our ability to report results for many subgroups, such as those living in versus outside of First Nations communities and those living in rural versus urban areas of Ontario. Thus, the application of the results reported in this chapter to these subpopulations requires further examination. Low counts of events also have an effect on the stability of time trends, contributing to the greater year-to-year fluctuations in rates for First Nations people compared with other people in Ontario. In comparing First Nations people to other people in Ontario, we have also not accounted for the presence of cardiac risk factors other than diabetes that may also contribute to differences in cardiac disease incidence and management. Lastly, as prescribed medication information is only available for Ontarians aged 65 years and older, indicators for medication use may not be generalizable to younger age groups.

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Appendix

EXHIBIT 9.1A Diagnostic and procedure codes for cardiac hospitalizations and procedures

Indicator	Codes prior to 2002/03	Codes from 2002/03 onward
	ICD-9	**ICD-10**
Myocardial infarction	410	I21, I22
Unstable angina	411, 413	I20
Heart failure	428	I50
Major cardiac event	410, 411, 413, 428	I20, I21, I22, I50
	CCP	**CCI**
Percutaneous coronary intervention	4802, 4803	1IJ50, 1IJ57GQ, 1IJ54
Coronary artery bypass graft surgery	481	1IJ76

ICD: International Classification of Diseases; CCP: Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures; CCI: Canadian Classification of Health Interventions.

10 Diabetes and Stroke

Inside

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Overview

Stroke is a leading cause of death and disability in Canada and worldwide.[1] Diabetes mellitus is a risk factor for stroke, with previous analyses from Ontario suggesting a three-fold increase in stroke risk for those with diabetes compared to those without.[2,3] Diabetes is also associated with an increased prevalence of other vascular risk factors including hypertension and hyperlipidemia.[4,5]

Stroke best practice recommendations suggest that people with acute stroke or transient ischemic attack (TIA) should undergo urgent brain imaging with computed tomography (CT) or magnetic resonance imaging (MRI), and that selected patients with ischemic stroke should receive thrombolysis with tissue plasminogen activator, with or without endovascular thrombectomy for clot removal.[6] Treatment to prevent a second stroke depends on the underlying cause of stroke, but typically includes antithrombotic, antihypertensive and lipid-lowering therapy.[7] Carotid endarterectomy is recommended for selected patients with severe symptomatic carotid artery stenosis, and stroke rehabilitation is recommended for people with residual neurological deficits.[7,8]

This chapter presents age- and sex-adjusted hospitalization rates for stroke and TIA, processes of care for stroke and TIA (thrombolysis, neuroimaging, carotid revascularization), and outcomes after stroke (discharge destination, case fatality) for both First Nations people and other people in Ontario with diabetes. Overall rates are presented, and, where sample size permits, rates are stratified by age, sex, degree of comorbidity and rurality.

Methods

We linked the diabetes cohort to the Discharge Abstract Database (DAD), an administrative database containing demographic and clinical information about all admissions to acute care hospitals in the province. We used the International Classification of Diseases, 9th revision (ICD-9) and 10th revision, Canada (ICD-10-CA) diagnosis codes recorded in the DAD to determine whether individuals were hospitalized for acute ischemic or hemorrhagic stroke or TIA at any point after their diagnosis of diabetes and between April 1, 1996, and March 31, 2016. If an individual had more than one stroke or TIA hospitalization in any 12-month period (from April 1 to March 31), only the first event was kept for analysis. We excluded the records of individuals whose stroke or TIA diagnosis was flagged as questionable or whose age was younger than 20 years or older than 105 years as of March 31 in the year of their stroke.

We calculated the crude rate of hospitalization for stroke or TIA among First Nations people (living in and outside of First Nations communities) and other people in Ontario and stratified the rate by age group (younger than 30, 30–49, 50–79 and 80 or older) and sex. We also calculated direct age- and sex-adjusted rates and 95% confidence intervals for stroke and TIA hospitalization per 100,000 people with diabetes, using the 2001 Ontario population aged 20 years and older with diabetes as the standard population. Standardized rates were calculated for five 12-month periods (1996/97, 2002/03, 2006/07, 2011/12 and 2015/16) and stratified by location of residence based on the Rurality Index for Ontario and the person's postal code at the time of hospitalization (urban, semi-urban and rural). In addition, rates were stratified by the number of comorbid conditions a person experienced in the 2 years prior to a stroke or TIA hospitalization using the Johns Hopkins Adjusted Clinical Group (ACG) system, a case-mix methodology for aggregating conditions into diagnostic groups that are similar in expected resource use. We categorized the number of conditions into three Aggregated Diagnosis Groups (ADGs): 1–4, 5–9 and 10 or more.

We examined the following outcomes:

- a CT or MRI scan within 24 hours of arrival at hospital;
- thrombolytic (clot-busting) therapy in those with ischemic stroke;
- carotid revascularization (endarterectomy or stenting) within 90 days of admission for ischemic stroke;
- discharge to home, inpatient rehabilitation or long-term care following hospitalization for ischemic or hemorrhagic stroke; and
- mortality at 7 days, 30 days and one year following hospitalization for ischemic or hemorrhagic stroke.

Outcome rates were age- and sex-adjusted to the 2001 Ontario population aged 20 years and older with diabetes. Only the first stroke or TIA event experienced during the 5-year observation period was analyzed.

CT and MRI scanning and thrombolytic treatment rates were based on data aggregated over the period from April 1, 2012, to March 31, 2017. All other outcomes were based on the period from April 1, 2011, to March 31, 2016. We determined whether a patient had received a CT or MRI scan or thrombolysis from the DAD using a special project field that captures process measures specific to stroke and TIA. We determined rates of carotid revascularization using Canadian Classification of Intervention (CCI) codes in the DAD and allowing for 90 days of follow-up to June 30, 2016. From the discharge disposition, we determined rates of discharge to home, rehabilitation or long-term care.

Seven-day, 30-day and one-year mortality rates were based on the period from April 1, 2011, to March 31, 2016, and allowed for follow-up to January 30, 2017. We used the Registered Persons Database (RPDB), a repository of demographic information about all persons in Ontario with a health card number, to determine a person's date of death, if applicable. Diagnoses codes, intervention codes and other information used in the analysis are provided in exhibits 10.1A and 10.2A in the appendix to this chapter.

Results

The rate of hospitalization for stroke or TIA declined from 1996/97 to 2015/16 for both First Nations and other people in Ontario with diabetes (exhibits 10.1 and 10.2). There was no difference in the rate of hospitalization by sex for either First Nations or other people in Ontario (exhibit 10.3). Among First Nations people younger than 65 years, the rate of hospitalization in 2015/16 was significantly higher than for other people (exhibit 10.4). First Nations people with a medium level of comorbidity had a higher rate of hospitalization for stroke or TIA compared to other people at that level (exhibit 10.5). First Nations people living in urban areas had a significantly higher rate of hospitalization than other urban dwellers in Ontario (exhibit 10.6).

The rate of neuroimaging within 24 hours of presentation to hospital was comparable among First Nations and other people in Ontario, and thrombolysis treatment for ischemic stroke was provided significantly less frequently to First Nations people compared to other people in Ontario (exhibit 10.7). Neuroimaging rates were similarly high for First Nations and other people in Ontario across residence settings (exhibit 10.8).

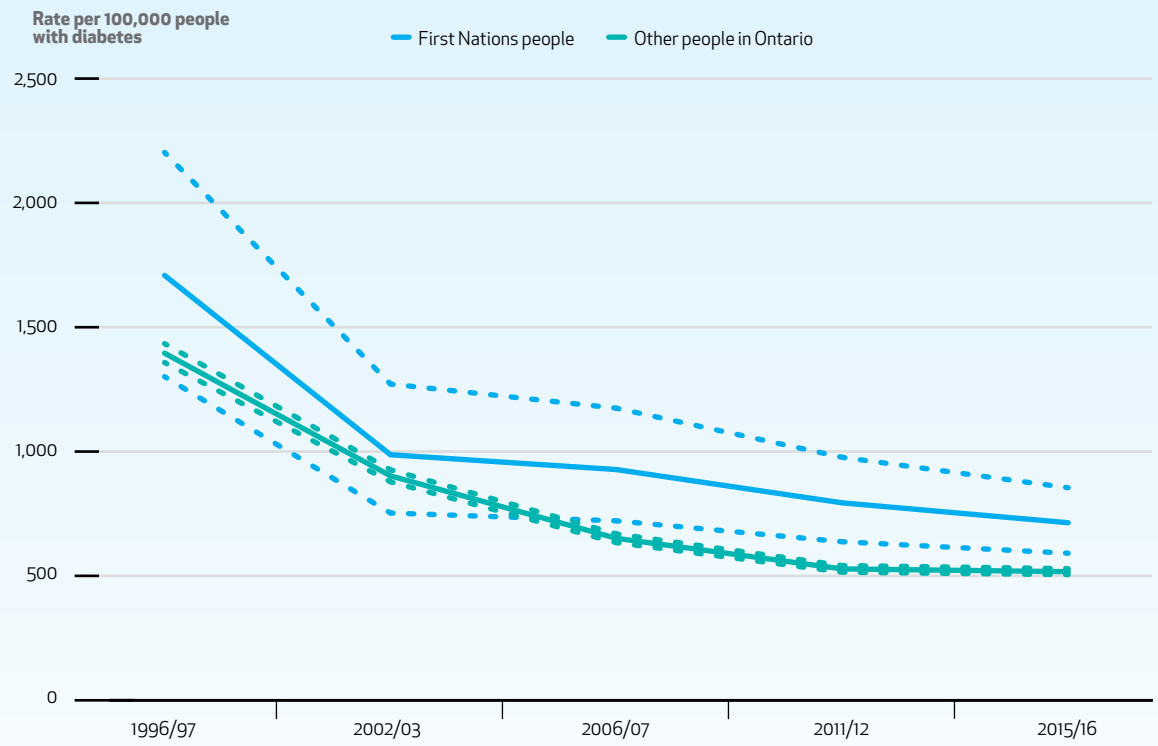
After discharge from hospital, First Nations and other people in Ontario had similar rates of relocation to home, rehabilitation and long-term care settings (exhibit 10.9). Approximately one-third of First Nations and other people in Ontario were discharged to rehabilitation care following the acute phase of treatment (respectively, 31.8% and 34.8%).

Age and sex-adjusted mortality point estimates measured at intervals of 7 days, 30 days and one year following admission to hospital were consistently higher for First Nations people compared to other people in Ontario, although the differences were not statistically significant (exhibit 10.11). There were no differences found between First Nations and other people in Ontario in one-year crude or adjusted mortality rates when stratified by sex (exhibit 10.12), age group (exhibit 10.13) or place of residence (exhibit 10.14).

EXHIBIT 10.1 Age- and sex-adjusted rate of hospitalization for acute stroke or transient ischemic attack per 100,000 people with diabetes, among First Nations people and other people in Ontario, 1996/97 to 2015/16

Key Findings

- Between 1996/97 and 2015/16, stroke and TIA hospitalization rates per 100,000 individuals with diabetes declined from 1,708 to 714 among First Nations people and from 1,395 to 517 among other people in Ontario.
- The rate of decline was less pronounced among First Nations people after 2002/03. From 2006/07 onward, stroke and TIA hospitalization rates were higher among First Nations people compared with other people in Ontario.

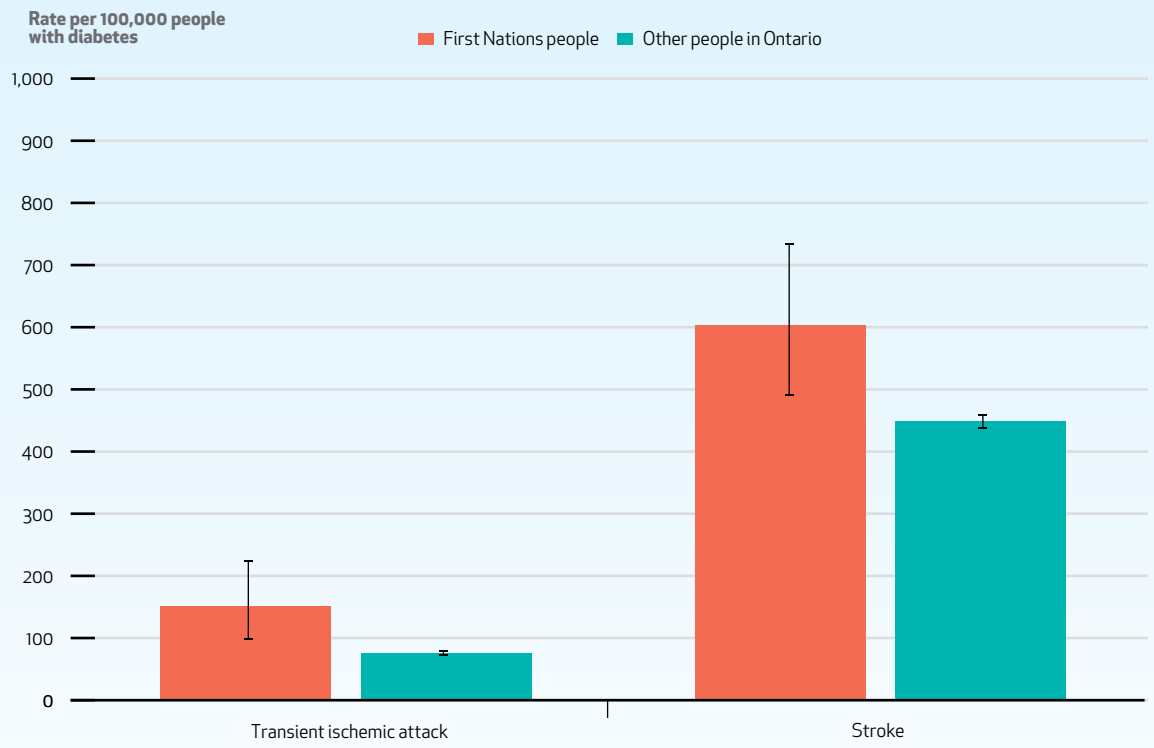


Dashed lines represent 95% confidence intervals.

EXHIBIT 10.2 Age- and sex-adjusted rate of hospitalization for transient ischemic attack or acute stroke per 100,000 people with diabetes, among First Nations people and other people in Ontario, 2015/16

Key Findings

- For individuals with diabetes, the rate of hospitalization for both TIA and stroke was higher among First Nations people than among other people in Ontario in 2015/16.
- The rate of hospitalization for TIA among First Nations people was twice that of other people in Ontario: 151.5 vs. 75.4 per 100,000 people with diabetes.
- The rate of hospitalization for stroke was 602.9 per 100,000 First Nations people and 448.3 per 100,000 other people in Ontario.

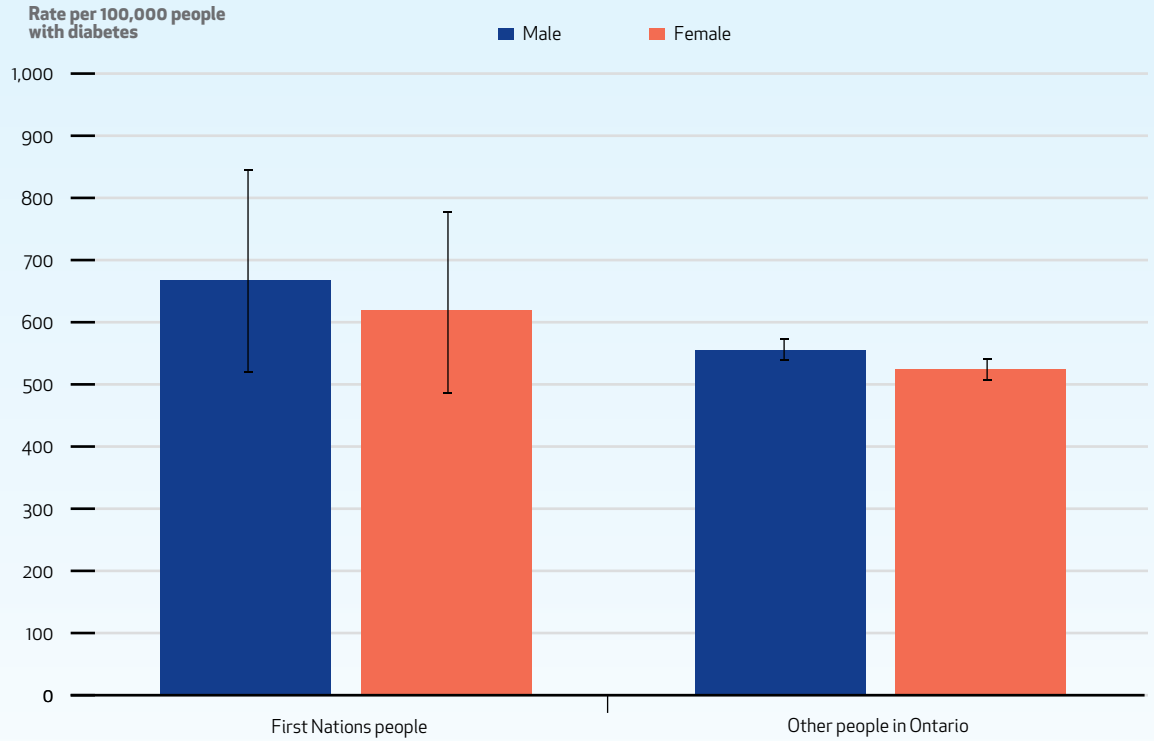


Error bars represent 95% confidence intervals.

EXHIBIT 10.3 Crude rate of hospitalization for acute stroke or transient ischemic attack per 100,000 people with diabetes, among First Nations people and other people in Ontario, by sex, 2015/16

Key Findings

- Crude rates of hospitalization for stroke and TIA were similar for men and women among First Nations people and other people in Ontario in 2015/16.

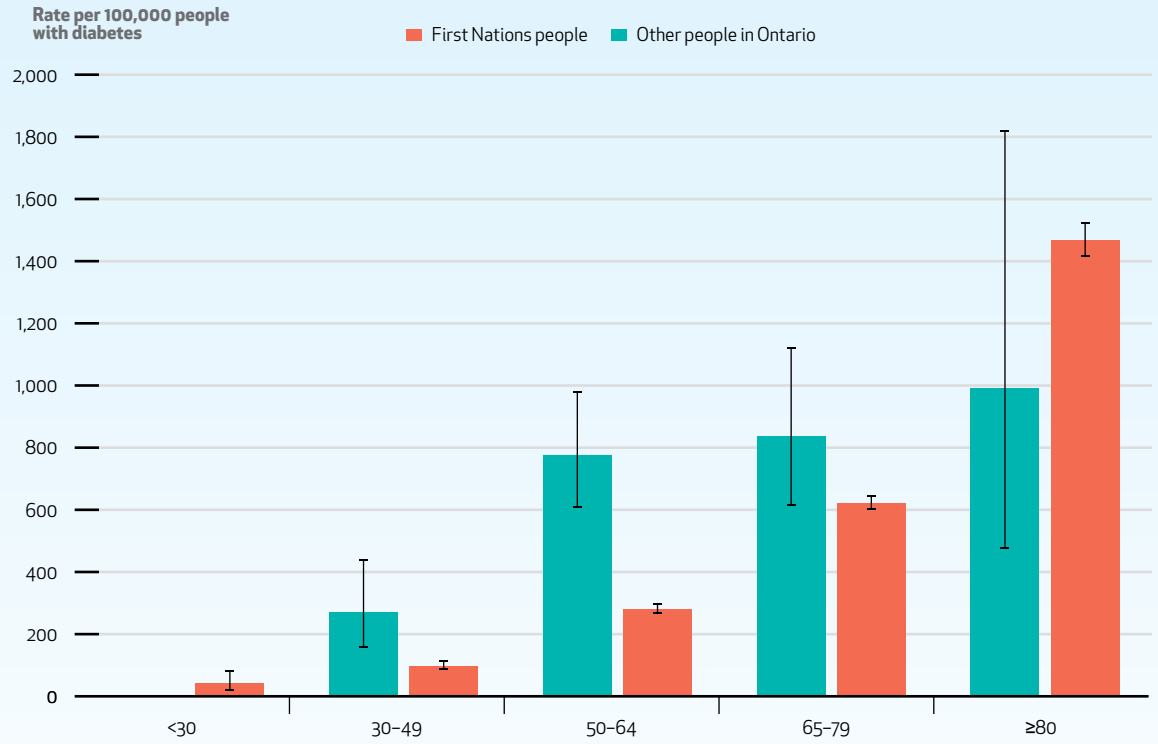


Error bars represent 95% confidence intervals.

EXHIBIT 10.4 Crude rate of hospitalization for acute stroke or transient ischemic attack per 100,000 people with diabetes, among First Nations people and other people in Ontario, by age group, 2015/16

Key Findings

- In 2015/16, the rate of hospitalization for stroke or TIA among individuals aged 30 to 64 years was higher for First Nations people than for other people in Ontario.
- The hospitalization rate of those aged 50-64 years was more than two and a half times greater in First Nations people compared to other people in Ontario (776 vs. 282 per 100,000 people). In those aged 30 to 49, the rate was almost three times greater in First Nations people compared to other people in Ontario (271 vs. 99 per 100,000 people).

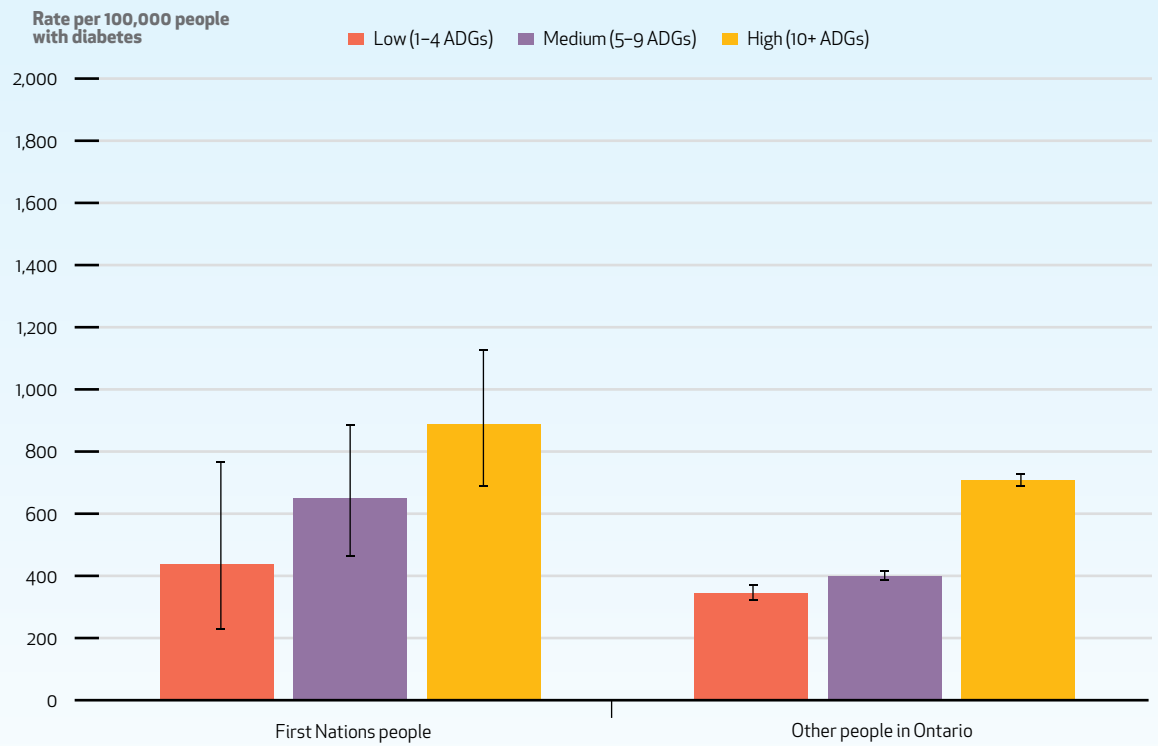


Error bars represent 95% confidence intervals.
* Data suppressed due to small cell sizes for First Nations people 30 years and younger.

EXHIBIT 10.5 Age- and sex-adjusted rate of hospitalization for acute stroke or transient ischemic attack per 100,000 people with diabetes, among First Nations people and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2015/16

Key Findings

- In 2015/16, First Nations people with a medium level of comorbidity had a higher rate of hospitalization for acute stroke or transient ischemic attack than other people in Ontario at that level.

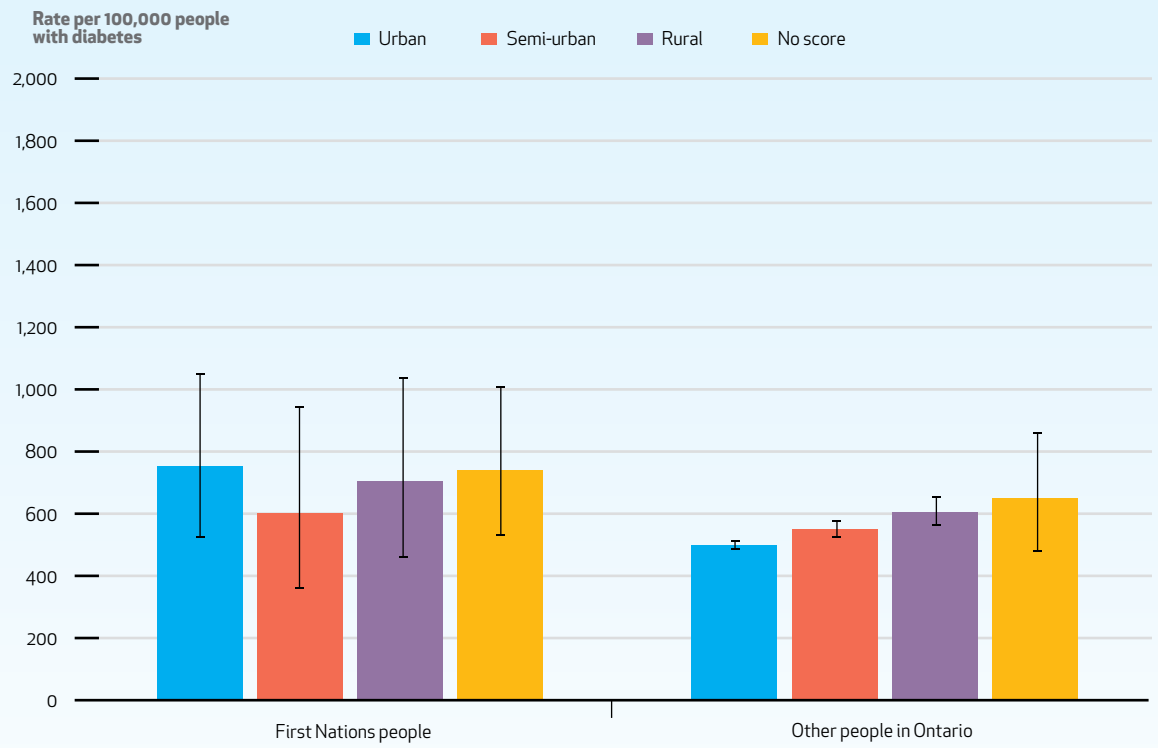


Error bars represent 95% confidence intervals.

EXHIBIT 10.6 Age- and sex-adjusted rate of hospitalization for acute stroke or transient ischemic attack per 100,000 people with diabetes, among First Nations people and other people in Ontario, by level of rurality, 2015/16

Key Findings

- In 2015/16, First Nations people living in urban areas had a higher rate of hospitalization for stroke or TIA compared with other urban-dwelling people in Ontario.

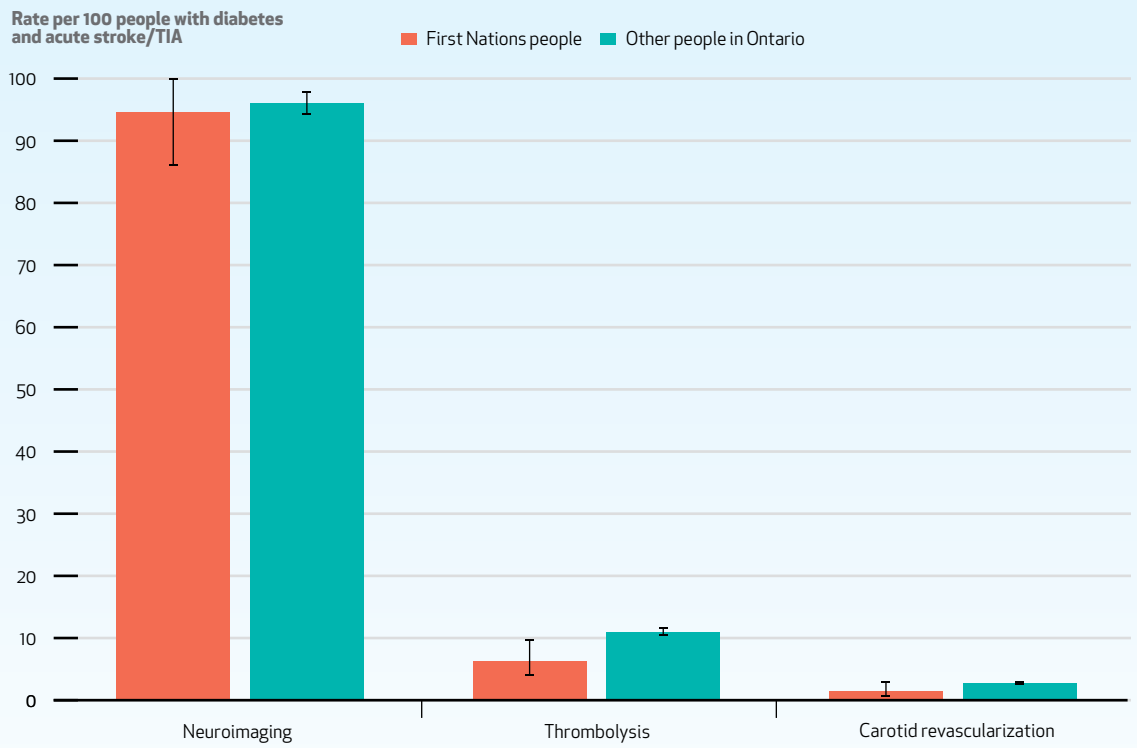


Error bars represent 95% confidence intervals.

EXHIBIT 10.7 Age- and sex-adjusted rates of neuroimaging, thrombolysis and carotid revascularization procedures per 100 people with diabetes and an acute stroke or transient ischemic attack event,* among First Nations people and other people in Ontario, in the 5-year period from 2012/13 to 2016/17

Key Findings

- Neuroimaging rates within 24 hours of presentation to hospital were similar for First Nations people and other people in Ontario with acute stroke or TIA (94.6% vs. 96.0%).
- Thrombolysis was provided less frequently to First Nations people compared to other people in Ontario with ischemic stroke (6.3% vs. 11.0%).
- Carotid revascularization was performed less frequently in First Nations people compared to other people in Ontario with ischemic stroke (1.4% vs. 2.7%).

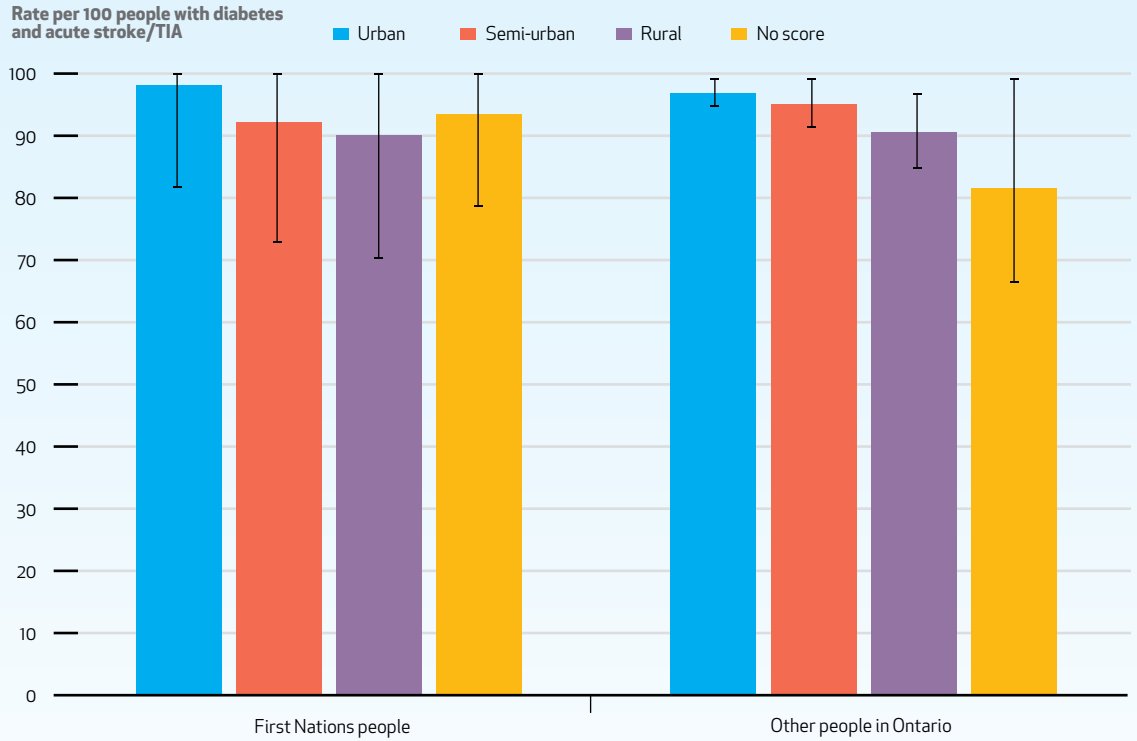


Error bars represent 95% confidence intervals.
*Neuroimaging rates (including computed tomography and magnetic resonance imaging of the brain) were calculated for those with acute stroke or TIA between April 1, 2012, and March 31, 2017.
Thrombolysis rates were calculated for those with ischemic stroke between April 1, 2012, and March 31, 2017.
Carotid revascularization rates were calculated for those with ischemic stroke between April 1, 2011, and March 31, 2016, and allowing for 90 days of follow-up.

EXHIBIT 10.8 Age- and sex-adjusted rate of neuroimaging per 100 people with diabetes and an acute stroke or transient ischemic attack event, among First Nations people and other people in Ontario, by level of rurality, in the 5-year period from 2012/13 to 2016/17

Key Findings

- Regardless of residence setting, the rate of neuroimaging within 24 hours of acute stroke or transient ischemic attack was more than 90% for both First Nations people and other people in Ontario with diabetes.

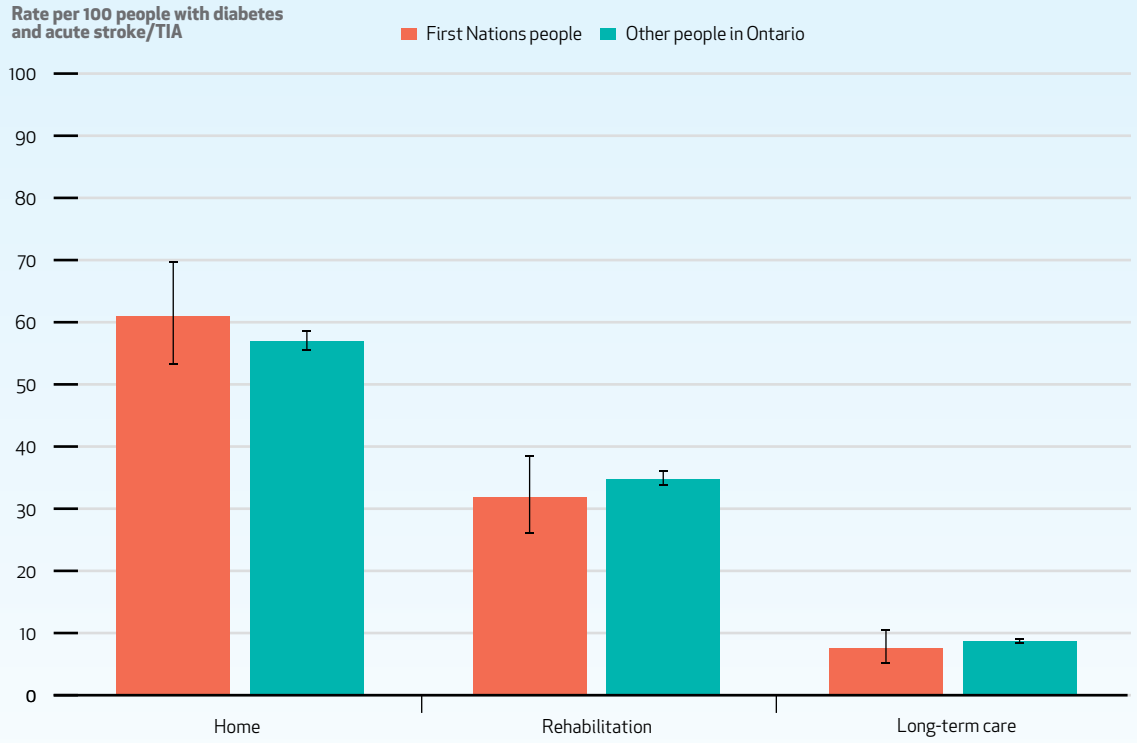


Error bars represent 95% confidence intervals.

EXHIBIT 10.9 Age- and sex-adjusted rate of discharge per 100 people with diabetes and an acute stroke or transient ischemic attack event,* among First Nations people and other people in Ontario, by discharge destination, in the 5-year period from 2011/12 to 2015/16

Key Findings

- Among individuals with diabetes, the rates of discharge to home, rehabilitation or long-term care following stroke were similar for First Nations people and other people in Ontario.

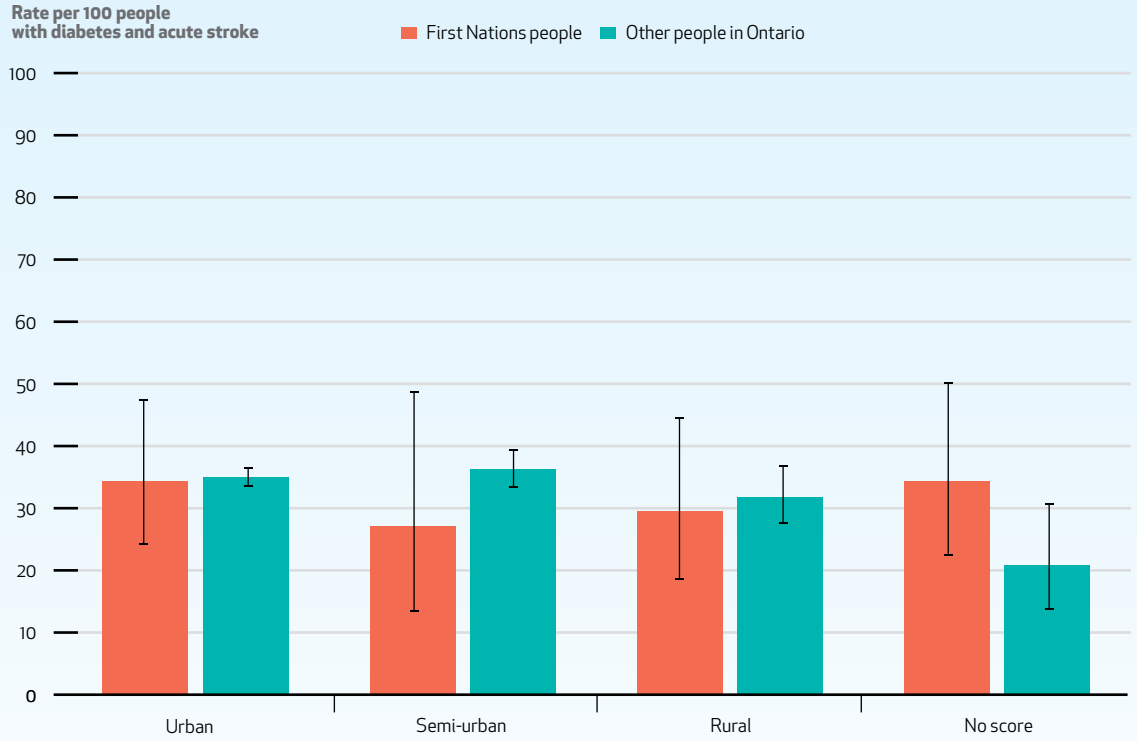


Error bars represent 95% confidence intervals.
*Discharge to rehabilitation is among those who had an acute stroke and does not include TIA.

EXHIBIT 10.10 Age- and sex-adjusted rate of discharge to rehabilitation care per 100 people with diabetes and acute stroke, among First Nations people and other people in Ontario, by level of rurality, in the 5-year period from 2011/12 to 2015/16

Key Findings

- The rate of discharge to inpatient rehabilitation facilities was similar for First Nations people and other people in Ontario regardless of their area of residence.

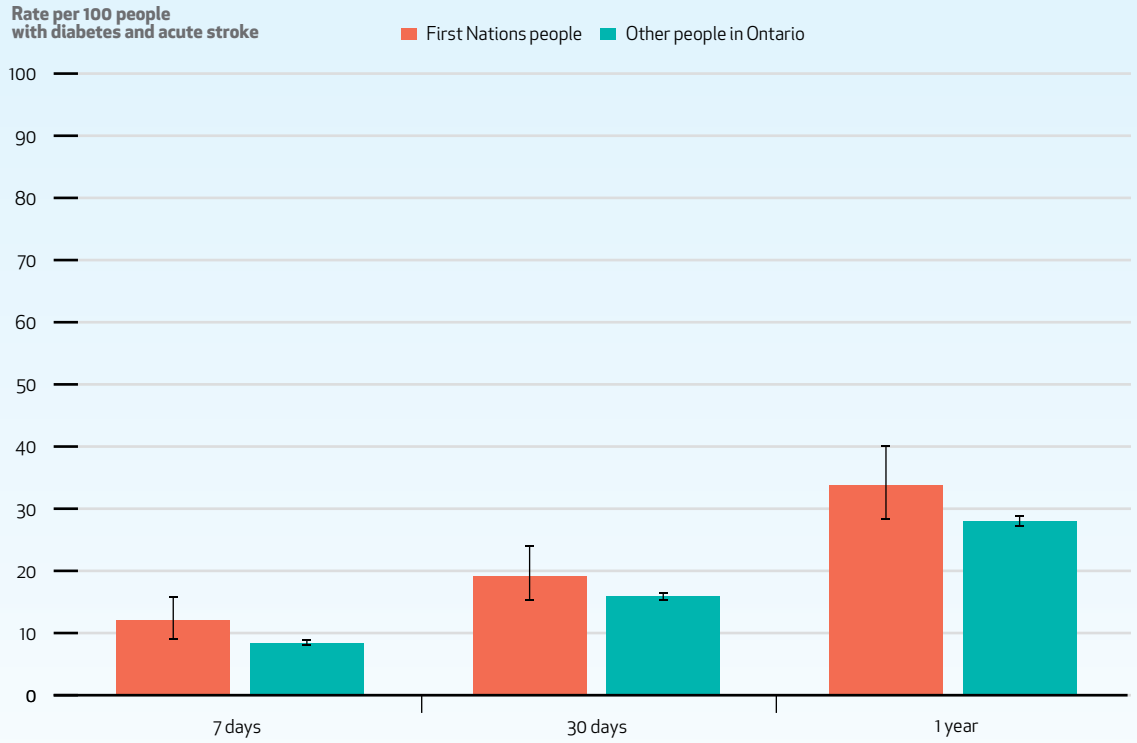


Error bars represent 95% confidence intervals.

EXHIBIT 10.11 Age- and sex-adjusted mortality rate at 7 days, 30 days and one year per 100 people with diabetes and acute stroke, among First Nations people and other people in Ontario, in the 5-year period from 2011/12 to 2015/16 (with follow-up to 2016/17)

Key Findings

- Estimates for the age- and sex-adjusted mortality rate following acute stroke were higher for First Nations people than for other people in Ontario at 7 days (12% vs. 8.4%), 30 days (19.2% vs. 15.9%) and one year (33.8% vs. 28.0%), although the confidence intervals overlapped.

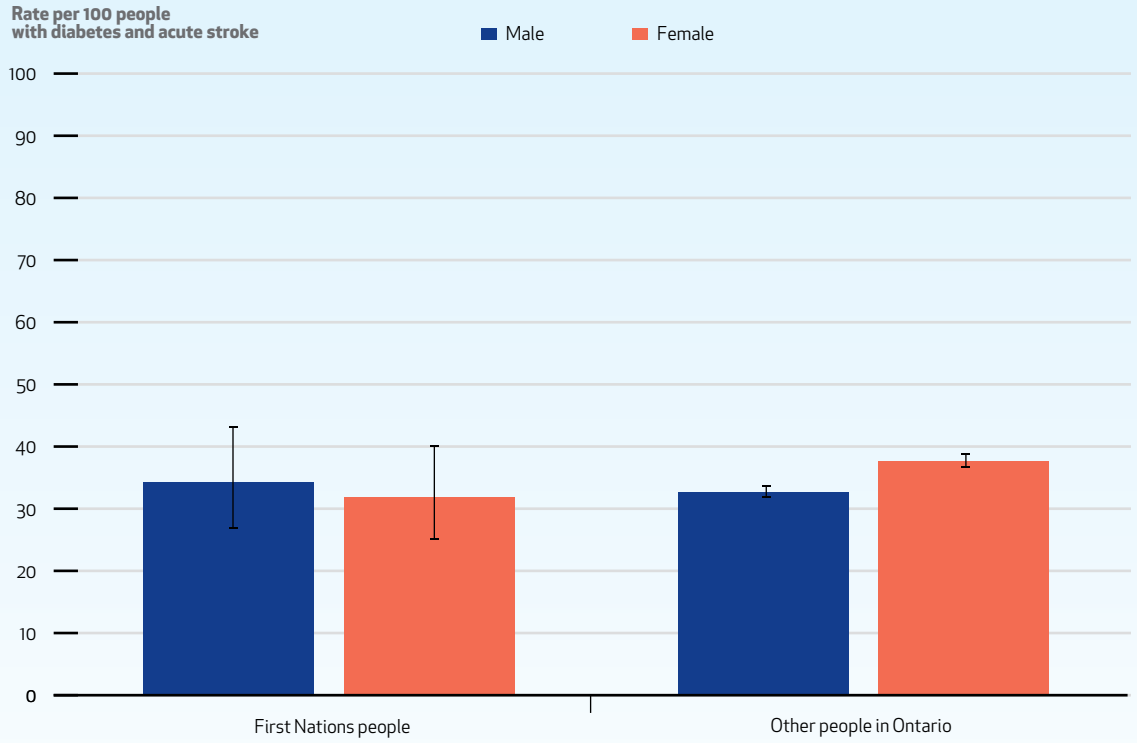


Error bars represent 95% confidence intervals.

EXHIBIT 10.12 Crude mortality rate at one year per 100 people with diabetes and acute stroke, among First Nations people and other people in Ontario, by sex, in the 5-year period from 2011/12 to 2015/16 (with follow-up to 2016/17)

Key Findings

- Among individuals with diabetes and acute stroke, the crude one-year mortality rate was similar for First Nations men and women. Among other people in Ontario, the rate was higher for women than men.

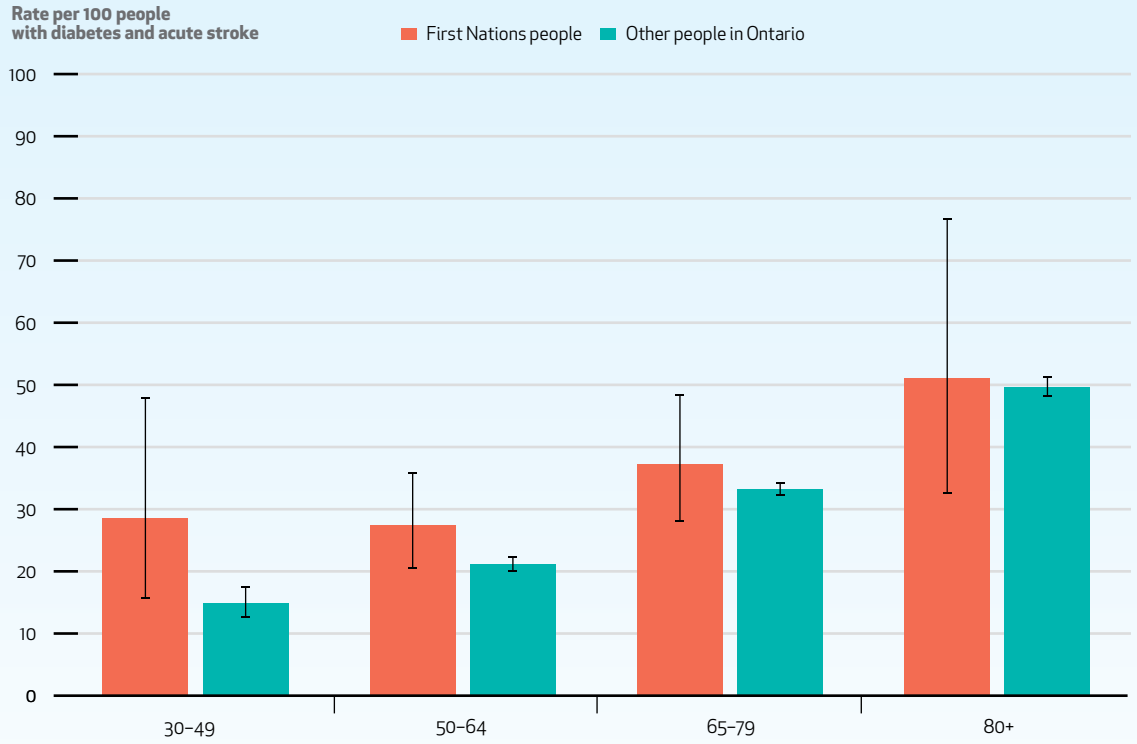


Error bars represent 95% confidence intervals.

EXHIBIT 10.13 Crude mortality rate at one year per 100 people with diabetes and acute stroke, among First Nations people and other people in Ontario, by age group, in the 5-year period from 2011/12 to 2015/16 (with follow-up to 2016/17)

Key Findings

- Estimates for one-year post-stroke mortality rates among First Nations people were higher than for other people in Ontario among those aged 30–49 (28.6% vs. 14.9%) and 50–64 (27.4% vs. 21.1%), although the confidence intervals for these estimates overlapped.
- Among those aged 65 and older, the mortality rate at one-year post-stroke was similar for First Nations people and other people in Ontario.

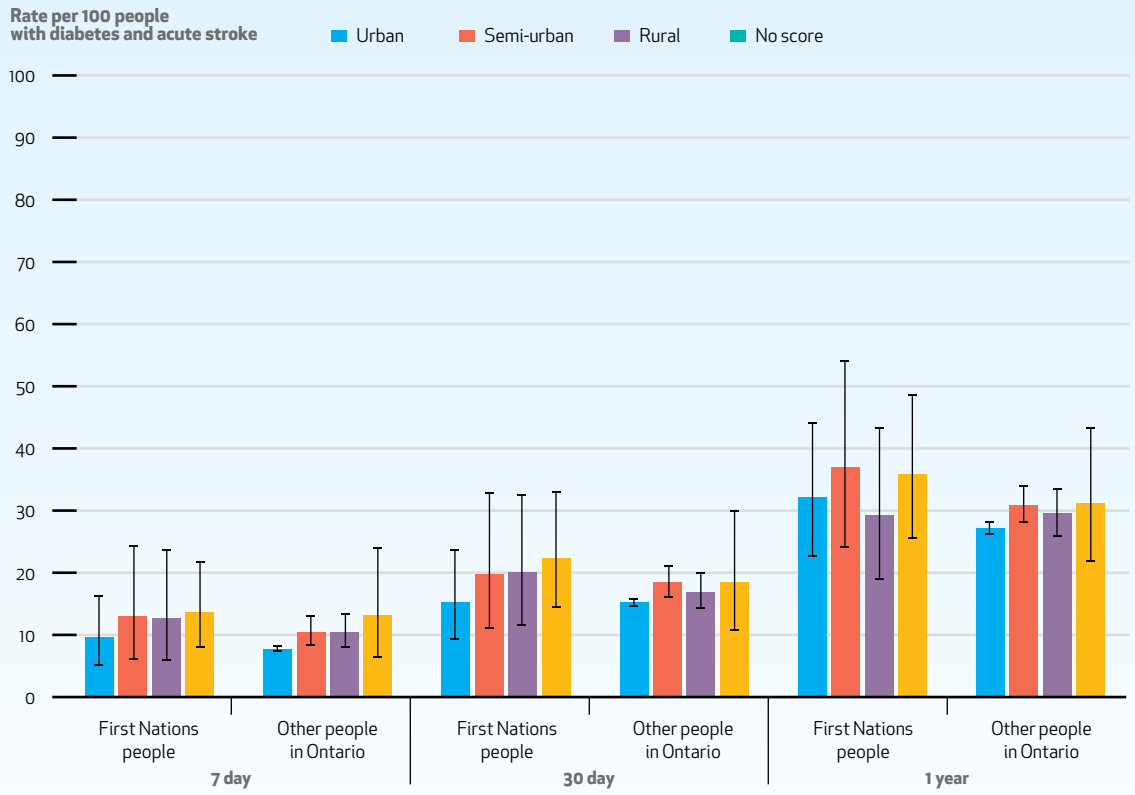


Error bars represent 95% confidence intervals.
*Data for the age group < 30 years were suppressed due to small numbers.

EXHIBIT 10.14 Age- and sex-adjusted mortality rate at 7 days, 30 days and one year per 100 people with diabetes and acute stroke, among First Nations people and other people in Ontario, by level of rurality, in the 5-year period from 2011/12 to 2015/16 (with follow-up to 2016/17)

Key Findings

- Among individuals with diabetes, mortality following an acute stroke was similar for First Nations people and other people in Ontario in all settings (urban, semi-urban and rural).

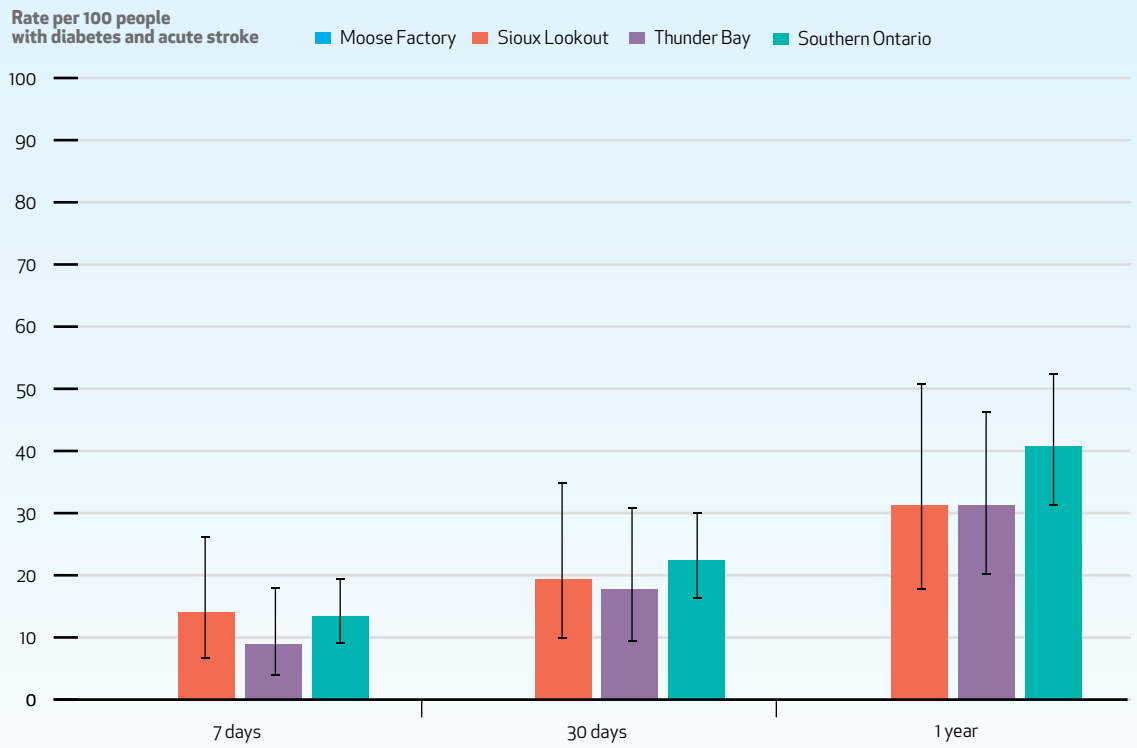


Error represent 95% confidence intervals.

EXHIBIT 10.15 Age- and sex-adjusted mortality rate at 7 days, 30 days and one year per 100 people with diabetes and acute stroke, among First Nations people, by Health Canada zone, in the 5-year period from 2011/12 to 2015/16 (with follow-up to 2016/17)

Key Findings

- Among First Nations people with diabetes, mortality rates at 7 days, 30 days and one year following stroke were similar for all Health Canada zones.



Error bars represent 95% confidence intervals.
*Data for Moose Factory were suppressed due to small numbers.

Discussion

In this population-based study of people with diabetes in Ontario, we found that hospitalization rates for stroke or TIA declined between 1996 and 2015, but that this decline was less marked among First Nations people compared with other people. After 2006, hospitalization rates for stroke and TIA were higher for First Nations people than for other people in Ontario, and this was mainly driven by elevated hospitalization rates among First Nations people younger than 65 years. Compared to other people in Ontario with acute stroke, First Nations people had similar use of brain imaging and inpatient rehabilitation but were less likely to be treated with thrombolysis or carotid revascularization. There was a trend toward higher one-year mortality after stroke among First Nations people compared to other people in Ontario.

Stroke incidence has been declining over the past few decades in most industrialized countries, including Canada, and this is generally attributed to improvements in the management of risk factors such as hypertension, diabetes and atrial fibrillation.[9,10] Our observed higher incidence of stroke and/or TIA among First Nations people compared to other people in Ontario suggests that targeted stroke prevention strategies, including the identification and modification of stroke risk factors, may be needed for First Nations groups with diabetes. The finding that stroke incidence in the younger age groups was particularly high for First Nations people suggests an urgent need to identify and address the causes of stroke in these younger adults, who may also have unique rehabilitation and reintegration needs after stroke.[11,12]

In individuals with suspected acute stroke, rapid neuroimaging with computed tomography or magnetic resonance imaging is recommended to confirm the diagnosis and to determine whether the stroke is ischemic or hemorrhagic,[13] and it is reassuring that almost all First Nations people and other people in Ontario underwent neuroimaging within 24 hours of presentation to hospital. However, First Nations people with ischemic stroke were less likely than other people in Ontario to receive thrombolysis, which can improve outcomes after stroke, and carotid revascularization, which can reduce the risk of recurrent stroke in selected patients. Our data sources do not allow us to determine the reasons for these differences, and further research is needed to understand whether the lower observed rates among First Nations people are due to appropriate patient selection based on presentation and clinical factors, lack of access to treatment, patient preferences or other factors.

Inpatient rehabilitation is recommended for people with stroke and residual functional deficits who are able to participate in a rehabilitation program.[8] In Ontario, overall rates of discharge to inpatient rehabilitation after acute stroke were similar for First Nations people and other people. However, our data sources did not include information on functional status after stroke, and further work is needed to determine whether rates of discharge to rehabilitation are appropriate based on the level of disability in each group.

Although the confidence intervals for estimates of age- and sex-adjusted mortality after stroke overlapped for First Nations people and other people in Ontario, the point estimates for overall mortality were consistently higher among First Nations people, a distinction that appears to be mainly driven by increased post-stroke mortality in those younger than 65 years among First Nations compared to other people in Ontario. This apparent higher mortality in younger First Nations people, combined with the higher observed incidence of stroke in this group, suggests the existence of a particularly vulnerable subgroup of young people with diabetes who are susceptible to both incident stroke and reduced survival after stroke. Targeted strategies are needed to understand and mitigate post-stroke mortality in this subgroup.

Limitations

Limitations of this report include lack of information on other quality indicators of stroke care delivery, such as the use of vascular imaging, mechanical thrombectomy and stroke unit care, and the use of medications for the secondary prevention of stroke. The lack of detailed clinical data in our available data

sources did not permit an analysis of the underlying reasons behind the observed lower rates of thrombolysis and carotid revascularization in First Nations people. The data sources also did not include information on stroke severity, which is the strongest predictor of mortality post-stroke, or on important stroke outcomes such as functional status and quality of life. Finally, the relatively small sample size may have provided inadequate power to detect differences in outcomes among some subgroups of patients.

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Appendix

EXHIBIT 10.1A Diagnostic codes for acute stroke and transient ischemic attack hospitalizations

Diagnosis	ICD-9 Code (prior to 2002/03)	ICD-10-CA Code (2002/03 and later)
Acute ischemic stroke	362.3, 434, 436	I63 (excluding I63.6), I64, H34.1
Acute hemorrhagic stroke	430, 431	I60, I61
Transient ischemic attack	435	G45 (excluding G45.4), H34.0

EXHIBIT 10.2A Codes for diagnostic and therapeutic interventions

Procedure	Variable or Code
Computed tomography/magnetic resonance imaging scan	Discharge Abstract Database or National Ambulatory Care Reporting System special project field 340 where SCAN = 'Y' or 'P' (yes or prior) (from 2012/13)
Thrombolysis	Discharge Abstract Database or National Ambulatory Care Reporting System special project field 340 where THROMBOLYSIS = 'Y' (from 2012/13)
Carotid revascularization (endarterectomy and stenting)	CCI codes: 1JE50, 1JE57, 1JE87
	Physician billing code: R792

ICD: International Classification of Diseases.

11 Diabetes and Peripheral Vascular Disease

Inside

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Overview

Peripheral vascular disease (PVD) is an important vascular complication of diabetes.[1] The risk of PVD is two to four times higher among people with diabetes.[2] While PVD is frequently undiagnosed and undertreated,[3,4] there are a range of therapies for this complication. Typically, this involves addressing the identified risk factors (i.e., smoking, poor diet, high cholesterol level, uncontrolled glucose level).[5] PVD is diagnosed through diagnostic imaging, including angiography. Revascularization procedures (including angioplasty, endarterectomy and bypass) aim to restore circulation to the legs. The most severe complication of PVD is gangrene, which occurs in tissue in the foot or leg as a result of inadequate blood supply. This complication requires amputation. Up to 80% of all lower-extremity amputations in Canada are in patients with diabetes.[6]

This chapter presents age- and sex-adjusted rates of angiogram procedures, revascularization procedures and amputation among both First Nations people and other people in Ontario living with diabetes. Overall rates are presented, as well as rates stratified by level of comorbidity and rurality and rates comparing First Nations people living in and outside of First Nations communities by Health Canada zone, where possible.

Methods

Angiography and revascularization rates were calculated for each 12-month period between April 1, 2002, and March 31, 2015; amputation rates were calculated for each 12-month period between April 1, 1995, and March 31, 2015. The numerator for the rate was the number of individuals in the yearly cohort (defined in chapter 2) who received a particular procedure (such as amputation) in that 12-month period.

Minor amputations are those involving the foot or toe; major amputations are defined as amputations of the ankle or above or below the knee. We excluded any amputations for tumours, fractures, trauma, frostbite or burns. Specific inclusion and exclusion codes are defined in exhibit 11.1A in the chapter appendix.

Results

Angiography rates were similar for First Nations people and other people in Ontario (exhibit 11.1), while revascularization rates were slightly higher for First Nations people (exhibit 11.2).

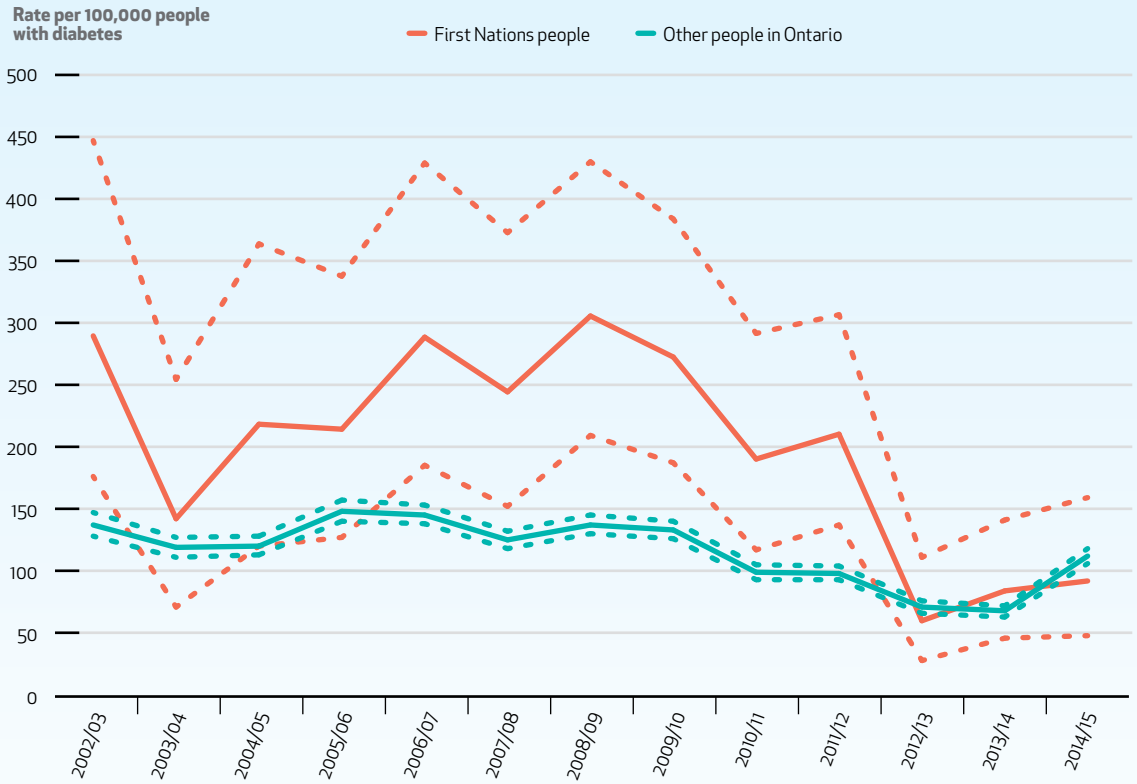
Amputation rates were higher among First Nations people compared with other people in Ontario (exhibits 11.3 and 11.4). Amputation rates were highest among those with high levels of comorbid disease (exhibit 11.5). (Amputation rates for First Nations people living in and outside of First Nations communities are presented in exhibit 11.2A in the chapter appendix.)

While other people living in urban areas of Ontario had significantly lower rates of amputation than those living in semi-urban or rural areas, there does not appear to be a difference in amputation rates among First Nations people based on rurality (exhibit 11.6).

EXHIBIT 11.1 Age- and sex-adjusted rate of angiography for people with diabetes, among First Nations people and other people in Ontario, 2002/03 to 2014/15

Key Findings

- Between 2002/03 and 2014/15, the angiography rate per 100,000 people with diabetes decreased significantly from 290 to 93 among First Nations people. Among other people in Ontario, the rate decreased slightly from 138 to 113.

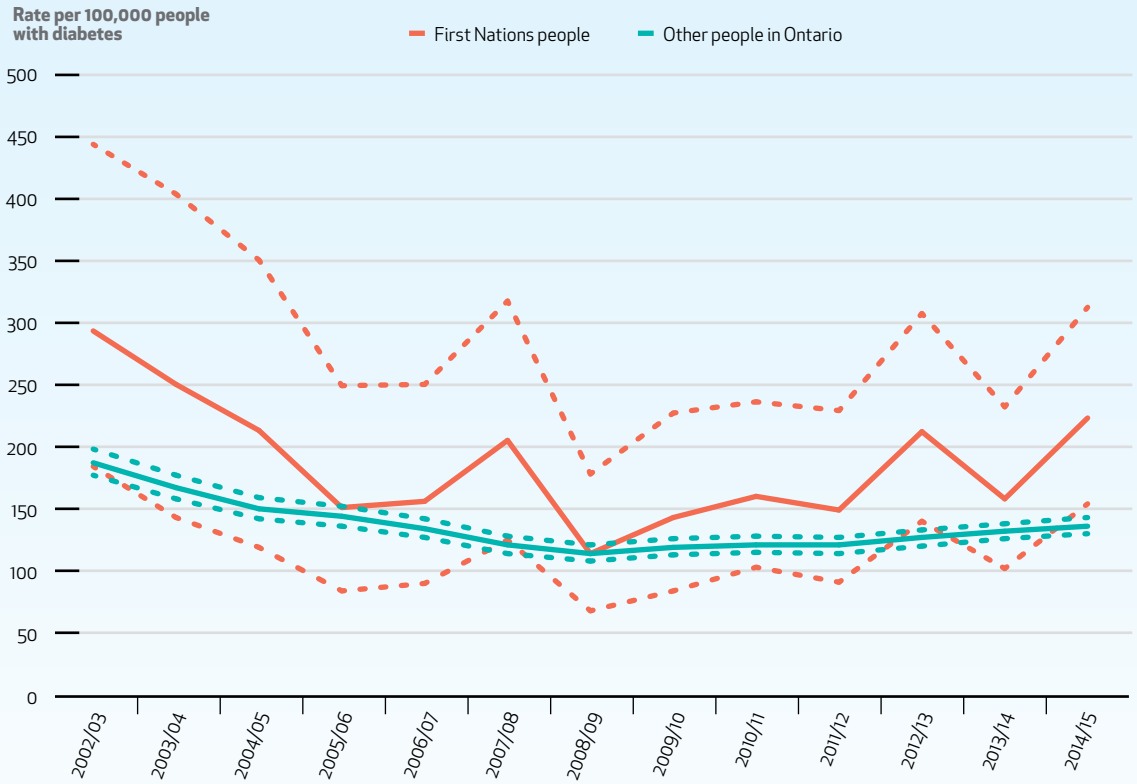


Dashed lines represent 95% confidence intervals.

EXHIBIT 11.2 Age- and sex-adjusted rate of revascularization procedures for people with diabetes, among First Nations people and other people in Ontario, 2002/03 to 2014/15

Key Findings

- In 2014/15, the rate of revascularization procedures was higher among First Nations people compared to other people in Ontario (respectively, 224 vs. 137 per 100,000 people with diabetes).
- Between 2002/03 and 2014/15, the revascularization rate per 100,000 people with diabetes dropped from 294 to 224 among First Nations people and from 188 to 137 among other people in Ontario.

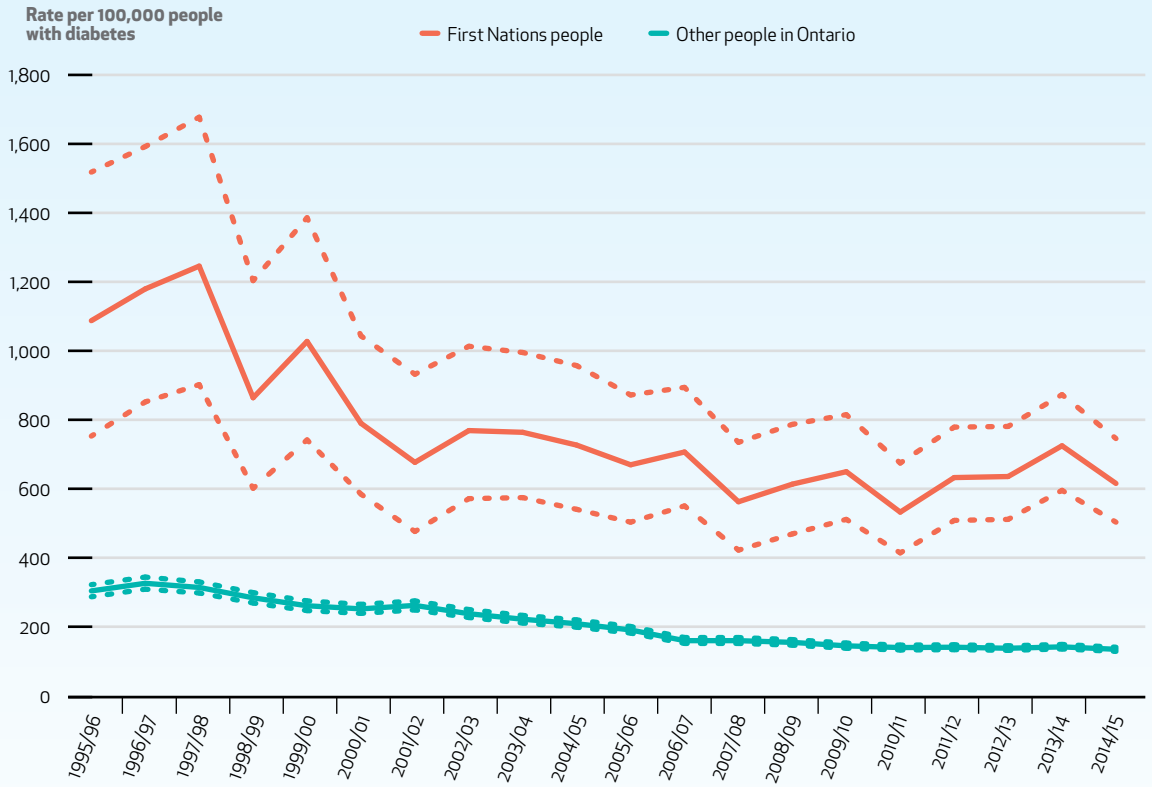


Dashed lines represent 95% confidence intervals.

EXHIBIT 11.3 Age- and sex-adjusted rate of all amputations (major and minor) for people with diabetes, among First Nations people and other people in Ontario, 1995/96 to 2014/15

Key Findings

- Between 1995/96 and 2014/15, the rate of all amputations was higher among First Nations people compared to other people in Ontario. In 2014/15, the amputation rate per 100,000 patients with diabetes was 617 among First Nations people and 137 among other people in Ontario.
- Between 2001/02 and 2014/15, the amputation rate per 100,000 patients with diabetes decreased from 1,088 to 617 among First Nations people and from 264 to 137 among other people in Ontario.

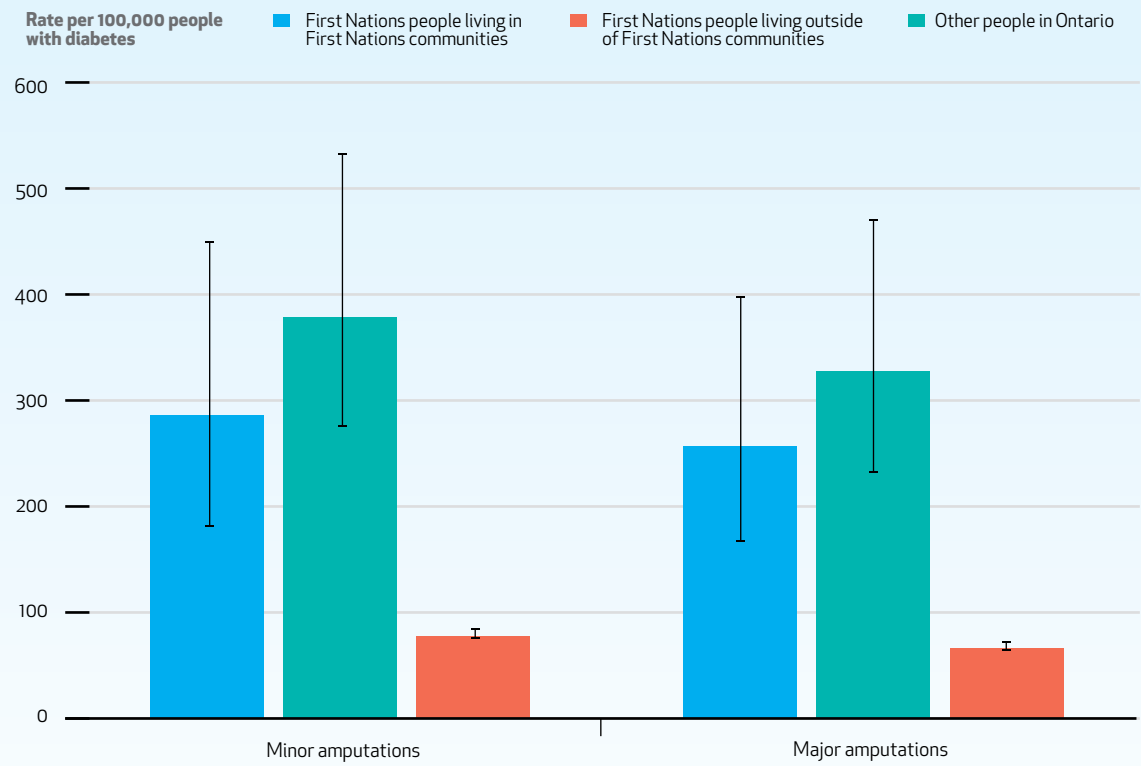


Dashed lines represent 95% confidence intervals.

EXHIBIT 11.4 Age- and sex-adjusted rate of major and minor amputations for people with diabetes, among First Nations people living in and outside of First Nations communities and other people in Ontario, 2014/15

Key Findings

- In 2014/15, the rate of minor amputations per 100,000 individuals with diabetes was similar for First Nations people living in and outside of First Nations communities (respectively, 294 and 388); among other people in Ontario, the rate was lower (80).
- The rate of major amputations per 100,000 individuals with diabetes was similar for First Nations people living in and outside of First Nations communities (respectively, 264 and 336) and lower among other people in Ontario (68).

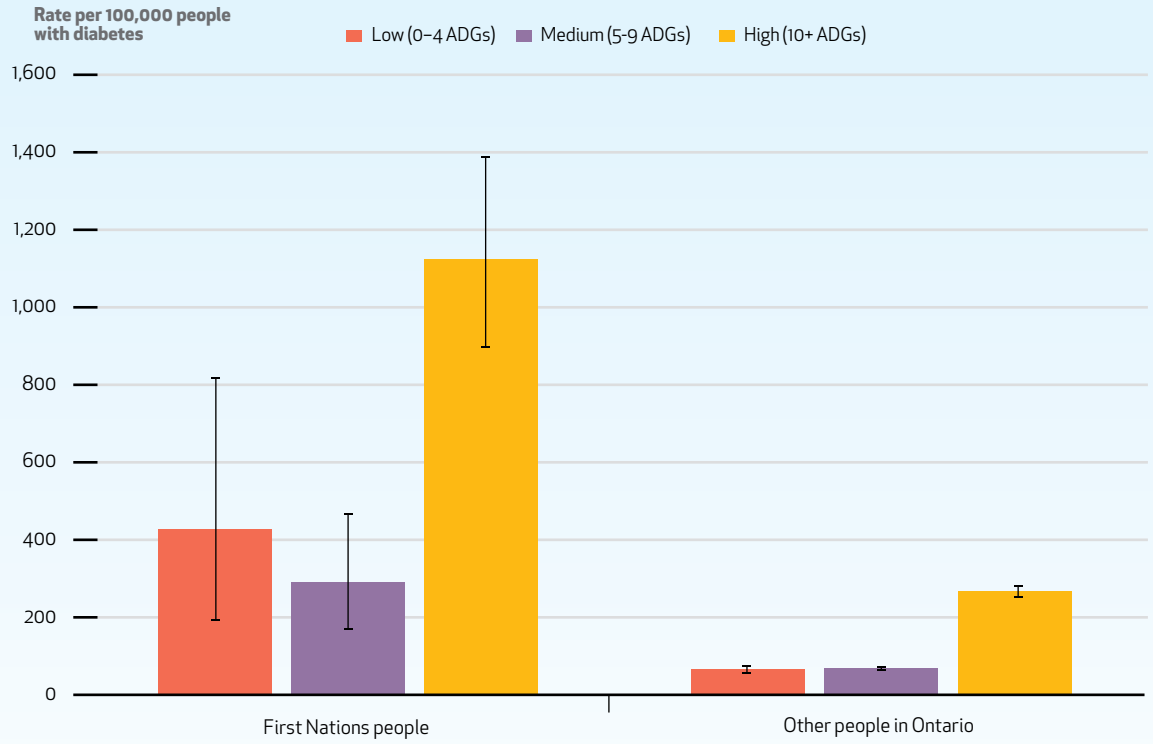


Error bars represent 95% confidence intervals.

EXHIBIT 11.5 Age- and sex-adjusted rate of all amputations (major and minor) for people with diabetes, among First Nations people and other people in Ontario, by level of comorbidity as measured by Aggregated Diagnosis Group, 2014/15

Key Findings

- Among both First Nations people and other people in Ontario, individuals with high levels of comorbidity (10+ ADGs) had the highest amputation rates.
- Among those with a high level of comorbidity, the amputation rate among First Nations people was more than four times that of other people in Ontario.

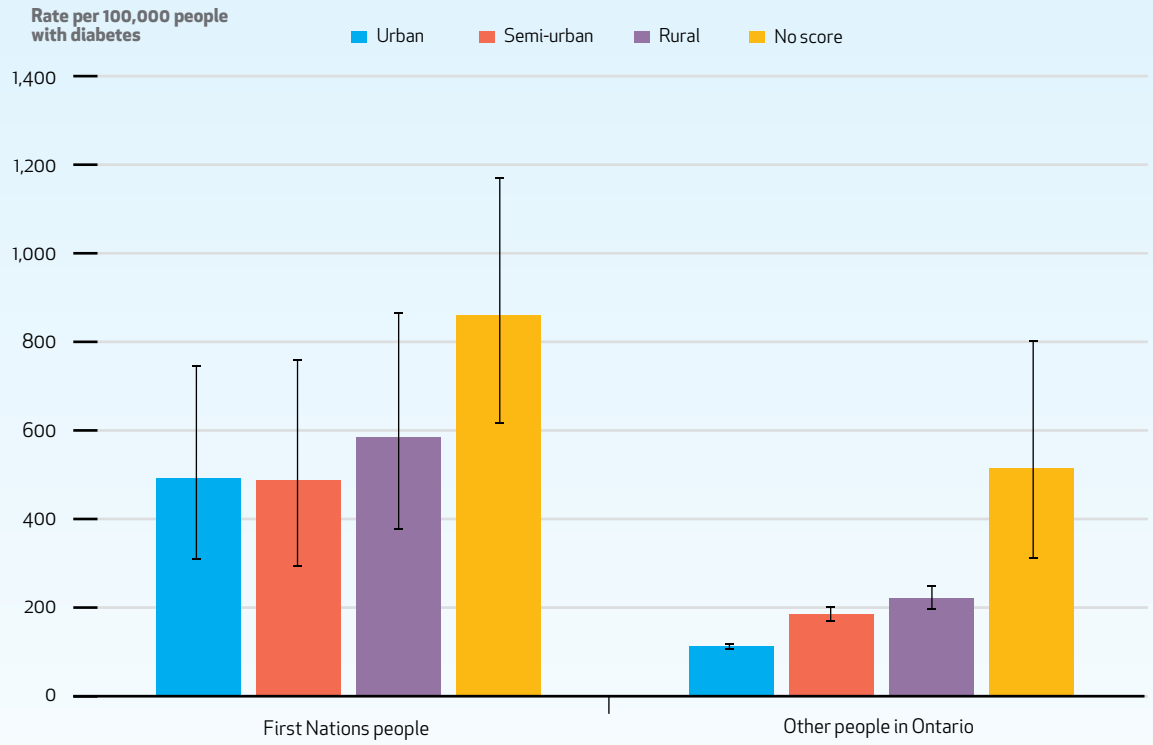


Error bars represent 95% confidence intervals.

EXHIBIT 11.6 Age- and sex-adjusted rate of all amputations (major and minor) for people with diabetes, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- Among First Nations people with diabetes, amputation rates increased with increasing level of rurality. In 2014/15, the rate of amputation per 100,000 people with diabetes was 584 in rural areas compared to 493 in urban areas and 487 in semi-urban areas.
- Among other people in Ontario with diabetes, amputation rates were significantly lower in urban areas. In 2014/15, the rate of amputation per 100,000 people with diabetes was 113 in urban areas, 185 in semi-urban areas and 222 in rural areas.



Error bars represent 95% confidence intervals.

Discussion

The rate of angiography to diagnose peripheral vascular disease is similar between First Nations people and other people in Ontario, despite PVD being a procedure requiring specialized tertiary care services only available in large urban centres. Decreases over time in the use of angiography may represent the gradual uptake of alternative imaging techniques, such as CT angiography or MR angiography. Likewise, revascularization procedures to improve blood flow are performed at a similar rate for First Nations people and other people in Ontario. However, the rate of amputation among First Nations people living in First Nations communities is 5 times higher than the rate for other people in Ontario; among First Nations people living outside of First Nations communities, the rate is 3.8 times higher. These findings highlight the markedly higher rates of limb-threatening PVD among First Nations people. By comparison, in Alberta, rates of lower-leg amputation for First Nations people living with diabetes have been reported to be three times the rates for other people in Alberta.[7] Among First Nations people living in First Nations communities across Canada, circulation and lower-limb problems, along with infections and amputations, have been reported as common effects of diabetes.[8]

For both First Nations people and other people in Ontario, amputation rates are significantly higher among those with a high number of comorbid conditions; however, the rate among First Nations people is four times that of other people in Ontario. Importantly, unlike physicians, the province's podiatrists and chiropodists (who play an important part in the provision of foot care and prevention of amputations) are not covered under OHIP. However, some First Nations communities may have community-level foot care services, which contributes to the slightly lower risk of amputation among First Nations people living in First Nations communities.

Limitations

Using administrative data, we were only able to identify angiography as a diagnostic test for PVD. Other diagnostic tests, such as ultrasound, CT or MRI could not be identified as diagnostic tests for PVD from the available data. In addition, we could only identify major surgical procedures for PVD: revascularization and amputation. Less severe manifestations of PVD, such as symptoms of impaired circulation, foot ulcers, or arterial blockages not suitable for intervention could not be measured using administrative data. Therefore, we were unable to examine differences between populations in these other important outcomes.

The use of administrative data to identify procedures for PVD has not been fully validated. While we excluded amputations due to tumours, fractures, trauma, frostbite or burns, we cannot always identify the indication for the procedure from these data. In addition, the data on diagnostic testing or surgical procedures will undercount procedures for Ontarians living in the northwest of the province, where specialist services may be referred to Winnipeg. As a result, we may have underestimated the rates of amputations and bypass among those living in this area, which is relevant due to the large population of First Nations people living in the northwest.

Finally, to comply with the minimum cell size requirement in ICES' cell size suppression policy, we were unable to meaningfully compare rates of angiography and revascularization between First Nations people living in and outside of First Nations communities and rates of amputation by Local Health Integration Network or Health Canada zone.

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Appendix

EXHIBIT 11.1A Procedure and intervention codes for angiography, revascularization and major and minor amputations, with excluded ICD codes

Inclusions	CCP	CCI
Angiography*		3KG10VX
Revascularization*		1KG76, 1KA76MZ, 1KE76MZ, 1KG50, 1KG57, 1KT76MZ
Minor amputation	96.11, 96.12	1WE93, 1WI93, 1WJ93, 1WK93, 1WL93, 1WM93, 1WN93
Major amputation	96.13, 96.14, 96.15	1VC93, 1VG93, 1VQ93, 1WA93
Exclusions	**ICD-9**	**ICD-10**
Malignant bone tumor, lower extremity	170.7, 170.8	C402, C403
Malignant connective/soft tissue tumor, lower extremity	171.3	C492
Benign bone tumor, lower extremity	213.7, 213.8	D162, D163
Benign connective/soft tissue tumor, lower extremity	215.3	D212
Fractures and trauma	820–829, 835–838, 843–845, 895–897, 904, 928, 956	S72–S79, S82–S89, S92–S99, T02–T09, T12, T132–T139, T142–T149
Frostbite	991.2, 991.3	T346–T349, T350, T351, T355–T357
Burn	945, 946	T24, T25

*Procedure codes for angiography and revascularization procedures are shown only for 2002 onward, as they are based on the *International Classification of Diseases, 10th Revision* (ICD-10).
CCP: Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures; CCI: Canadian Classification of Health Interventions; ICD: International Classification of Diseases.

EXHIBIT 11.2A Age- and sex-adjusted rate of amputations (minor and major) per 100,000 individuals with diabetes, among First Nations people living in and outside of First Nations communities in Ontario, 2001/02 to 2014/15

Year	First Nations people living in First Nations communities*	First Nations people living outside of First Nations communities*
2001/02	488 (257–841)	827 (532–1,227)
2002/03	569 (331–913)	919 (635–1,287)
2003/04	653 (391–1,023)	825 (583–1,133)
2004/05	407 (226–675)	988 (686–1,376)
2005/06	684 (435–1,025)	659 (448–935)
2006/07	541 (331–833)	836 (618–1,107)
2007/08	363 (200–607)	705 (502–961)
2008/09	518 (319–795)	683 (490–926)
2009/10	381 (241–572)	841 (631–1,100)
2010/11	380 (239–574)	637 (468–848)
2011/12	666 (475–908)	608 (450–802)
2012/13	594 (414–825)	666 (503–865)
2013/14	603 (425–831)	812 (636–1,021)
2014/15	526 (376–751)	674 (521–859)

*Values in parentheses represent the 95% confidence interval.

12 Diabetes and Eye Disease

Inside

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Overview

Diabetic retinopathy is the most common complication of diabetes and the leading cause of blindness and vision impairment among working-age adults.[1-3] Diabetic retinopathy is a progressive disorder; of the approximately 3 million Canadians with diabetes, more than 60% will develop the condition.[4-8] At advanced stages, diabetic retinopathy leads to severe vision loss, which has profound effects on people's lives.[9]

Prevention of advanced retinopathy can be achieved through regular eye examinations, which lead to early retinopathy detection and timely interventions to decrease the risk of progressing to irreversible vision impairment and blindness. These examinations can be provided by ophthalmologists or optometrists, either in person or via telemedicine.

At advanced stages, specific ocular interventions are required to prevent further vision loss. In particular, diabetes can cause damage to retinal blood vessels, leading to leakage of fluid and swelling of the central portion of the retina responsible for fine vision, a condition termed diabetic macular edema. At this stage, leakage is inhibited via injection of medications into the eye (usually vascular endothelial growth factor inhibitors or steroids); laser photocoagulation is another form of treatment. Diabetes also causes closure of small blood vessels and the resulting ischemia leads to the growth of abnormal pathologic blood vessels, termed proliferative diabetic retinopathy, which can cause severe vision loss by inducing bleeding in the eye or by retinal detachment. This stage is treated with laser photocoagulation and vitrectomy (a type of eye surgery). Although these treatments can be vision saving, they indicate a failure of preventive efforts and are often associated with poor vision outcomes.

This chapter presents data on access to eye examinations and the need for interventional therapies for vision-threatening stages of diabetic retinopathy.

Methods

To evaluate access to eye examinations, we used the Ontario Health Insurance Plan physician claims database, which captures information on visits to eye care providers (including ophthalmologists, optometrists, comprehensive primary care physicians and telemedicine care) and all procedural care for diabetic retinopathy (see exhibit 12.1A in the chapter appendix). Because recommendations for screening eye examinations apply to all age groups and both sexes, the primary analyses of eye examinations were not adjusted for age and sex. To evaluate retinopathy outcomes, we identified procedures used to treat advanced, vision-threatening disease stages. These included intravitreal medication injections, laser retinal photocoagulation and vitrectomy surgery. The analyses of outcomes were adjusted for age and sex. We also evaluated a number of covariates, including age, sex, rurality and living in or outside of a First Nations community.

The primary analysis included cohorts of First Nations and other people with prevalent diabetes. In a secondary analysis, we also evaluated the time to first interventional treatment for diabetic retinopathy among people with incident diabetes diagnosed between 1995/96 and 2014/15.

Results

During the study period, the use of eye examinations was suboptimal among both First Nations people and other people with diabetes, with only about half the population receiving an examination in the previous year and only two-thirds in the previous 2 years (exhibits 12.1.1 and 12.1.2). Further, First Nations people with diabetes were less likely than other people with diabetes to receive an eye examination. Encouragingly, the proportion of First Nations people with diabetes who received an eye examination during the previous year increased from 43% to 50% between 2005/06 and 2014/15, mirroring a similar increase among other people with diabetes.

Eye examination rates were similar for First Nations people with diabetes regardless of whether they lived in or outside of a First Nations community

(exhibit 12.2). In both populations, younger people were less likely to undergo eye examinations than their older counterparts (exhibit 12.8). Up to the age of 80 years, the proportion of people with diabetes receiving eye examinations increased with age. Beyond 80 years of age, the proportion dropped significantly in both populations.

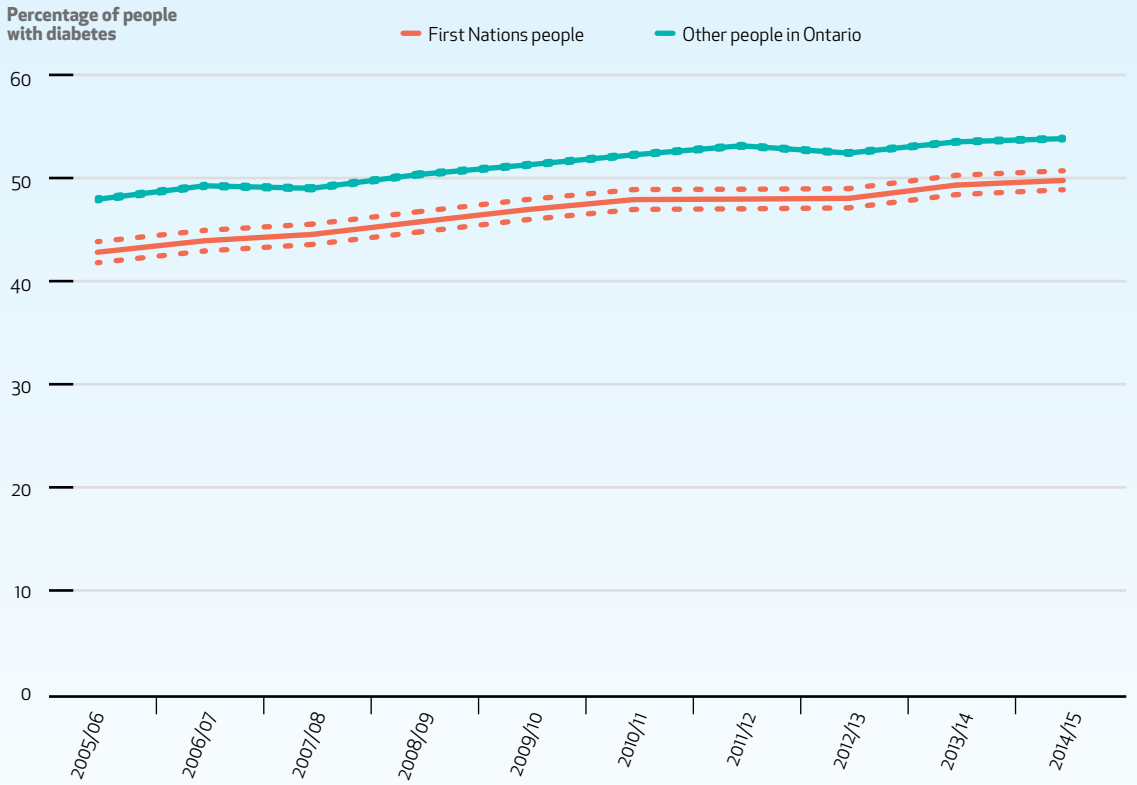
First Nations people with diabetes were more likely to develop advanced diabetic retinopathy requiring treatment, particularly in later study years (exhibit 12.3.1). There were no significant differences in treatment rates for diabetic retinopathy among First Nations people stratified by place of residence (living in versus outside a First Nations community; exhibit 12.4). The differences between First Nations people and other people in Ontario in the proportion requiring therapy for diabetic retinopathy was especially prominent among younger people (exhibit 12.9). For example, in the 30- to 49-year age group, 1.8% of First Nations people required treatment in 2014/15, compared to 0.9% of other people.

In the analysis of time from diabetes diagnosis to first diabetic retinopathy treatment, the rate of progression to severe diabetic retinopathy requiring therapy was approximately 20% higher among First Nations people than among other people in Ontario (hazard ratio: 1.19; 95% confidence interval: 1.02–1.38; exhibit 12.6). Overall, approximately 4% of First Nations people with diabetes required therapy for diabetic retinopathy within 10 years of diagnosis.

EXHIBIT 12.1.1 Percentage of people with diabetes receiving an eye examination, among First Nations people and other people in Ontario, 2005/06 to 2014/15*

Key Findings

- First Nations people with diabetes were less likely than other people with diabetes to receive an eye examination in the years examined.
- The proportion of First Nations people with diabetes who received an eye examination increased from 43% to 50% between 2005/06 and 2014/15.
- There was suboptimal use of screening examinations among both First Nations people and other people with diabetes.

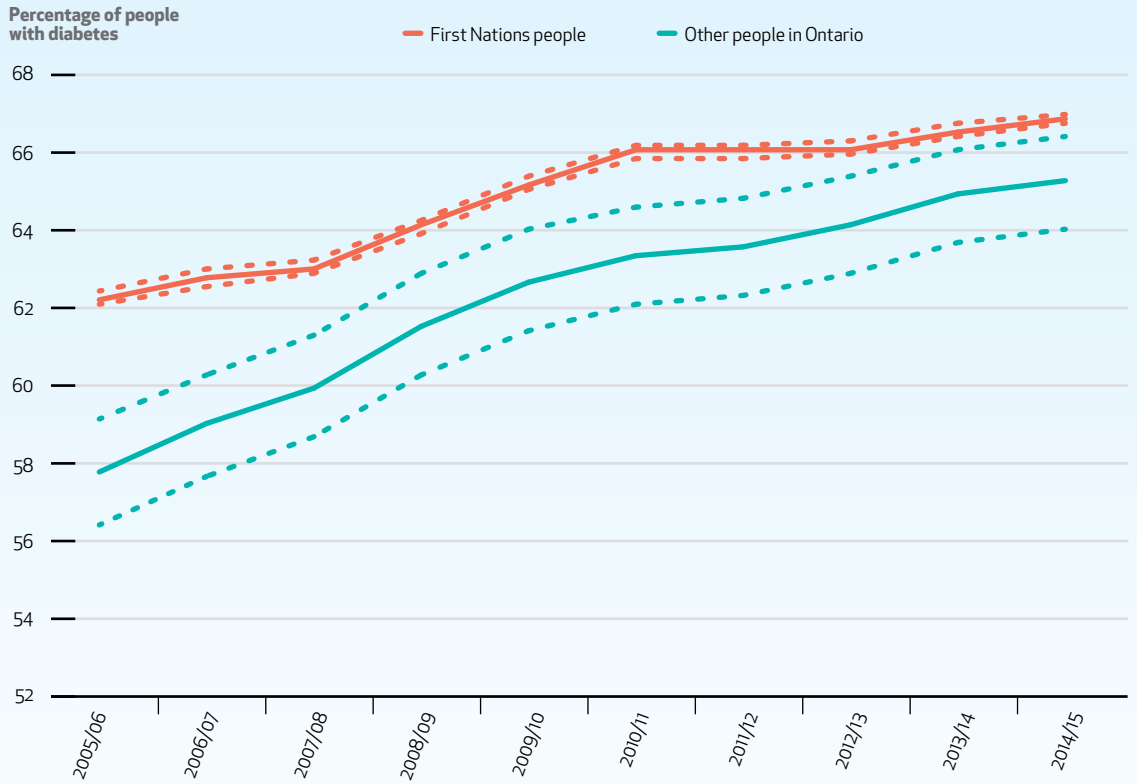


Dashed lines represent 95% confidence intervals.
*Because OHIP funding of eye examinations changed in 2004, the baseline year was set at 2005/06 to provide data consistency.

EXHIBIT 12.1.2 Percentage of people with diabetes receiving an eye examination in the previous 24 months, among First Nations people and other people in Ontario, 2005/06 to 2014/15*

Key Findings

- Among people with diabetes in Ontario, First Nations people were less likely than other people to receive an eye examination in the previous 24 months.
- The difference in eye examination rates between First Nations people and other people in Ontario with diabetes decreased over the study period.
- Eye examination rates among people with diabetes were suboptimal for both First Nations people and other people in Ontario.

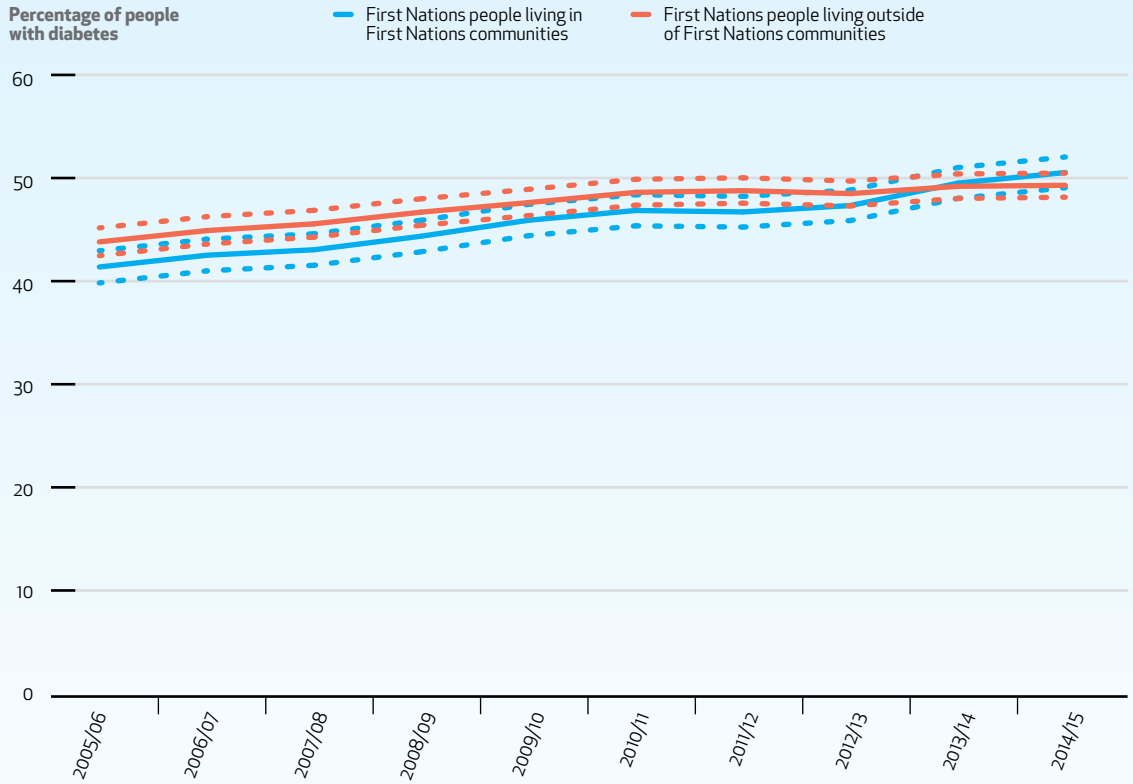


Dashed lines represent 95% confidence intervals.
*Because OHIP funding of eye examinations changed in 2004, the baseline year was set at 2005/06 to provide data consistency.

EXHIBIT 12.2 Percentage of people with diabetes receiving an eye examination, among First Nations people living in and outside of First Nations communities in Ontario, 2005/06 to 2014/15*

Key Findings

- Among First Nations people with diabetes, living in or outside of a First Nations community did not exert a major influence on receiving an eye examination. This may be due in part to the provision of eye examinations by optometrists, who are more widely dispersed across Ontario than ophthalmologists.

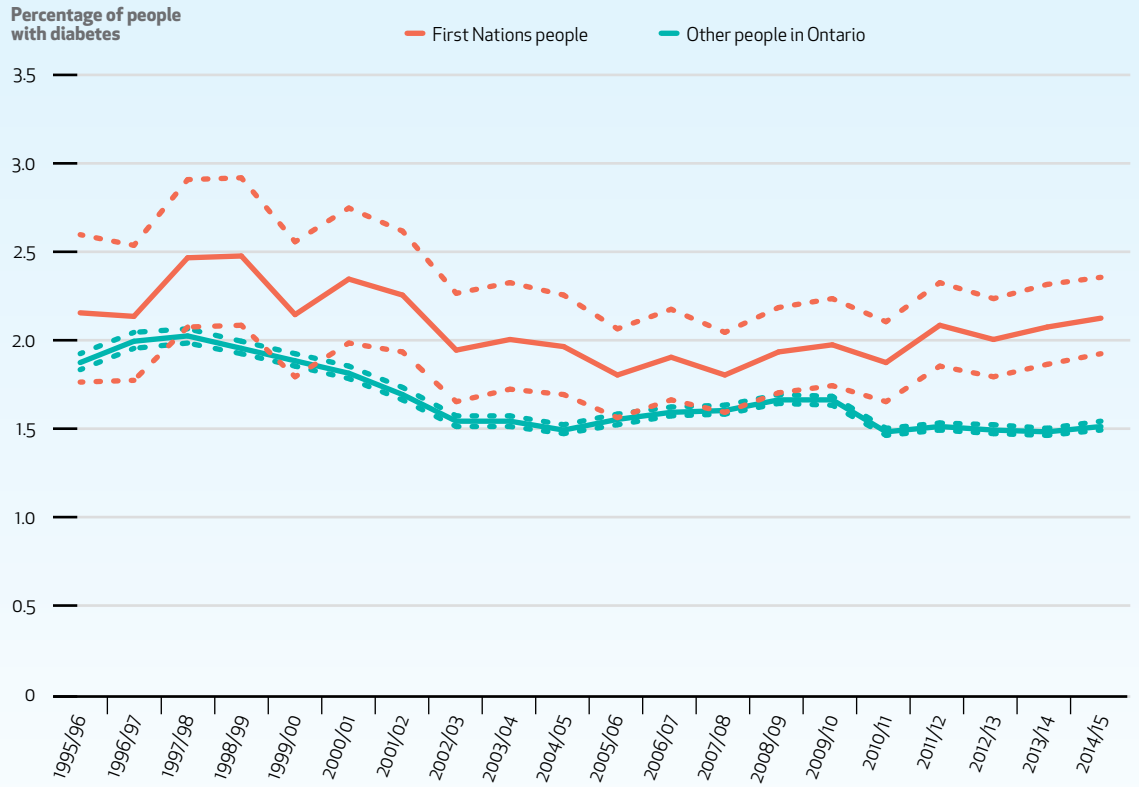


Dashed lines represent 95% confidence intervals.
*Because OHIP funding of eye examinations changed in 2004, the baseline year was set at 2005/06 to provide data consistency.

EXHIBIT 12.3.1 Age and sex-adjusted percentage of people with diabetes receiving any treatment for diabetic retinopathy, among First Nations people and other people in Ontario, 1995/96 to 2014/15

Key Findings

- First Nations people with diabetes were more likely than other people in Ontario to undergo treatment for advanced diabetic retinopathy requiring treatment.

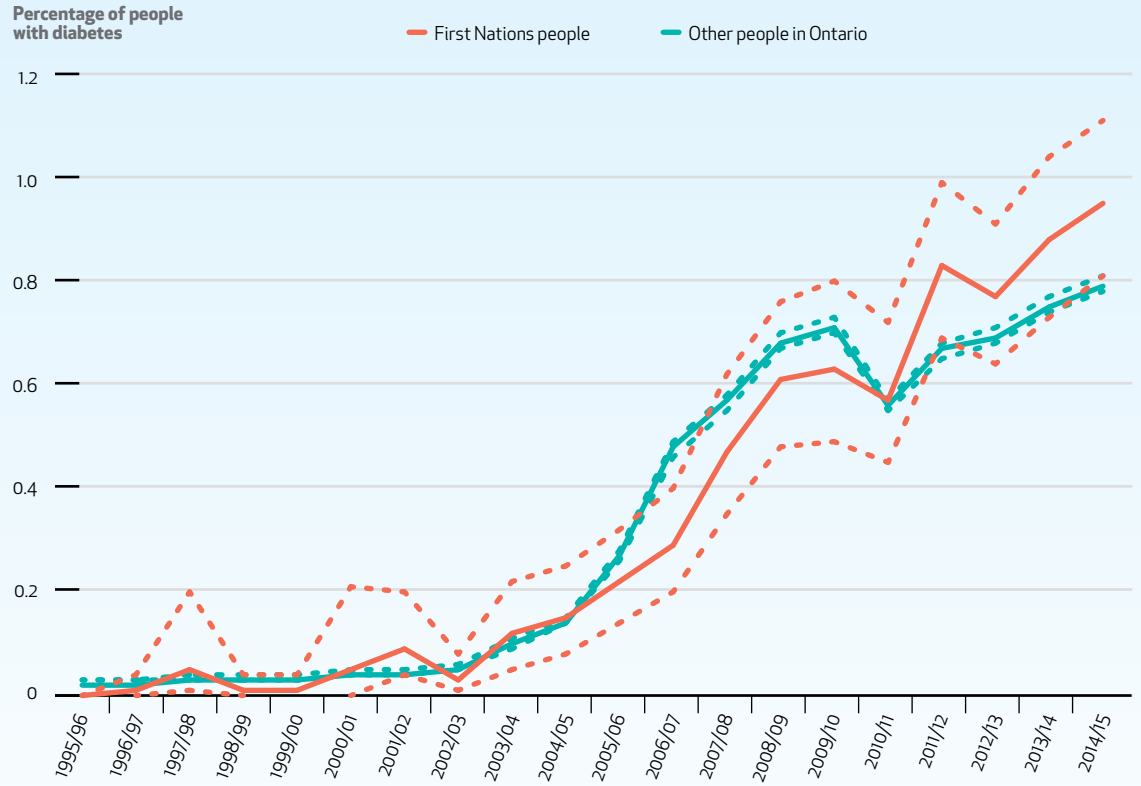


Dashed lines represent 95% confidence intervals.

EXHIBIT 12.3.2 Age and sex-adjusted percentage of people with diabetes receiving intravitreal injection for treatment of diabetic retinopathy, among First Nations people and other people in Ontario, 1995/96 to 2014/15

Key Findings

- The use of intravitreal injection of medications for diabetic retinopathy rose significantly among both First Nations people and other people in Ontario between 1995/96 and 2014/15.

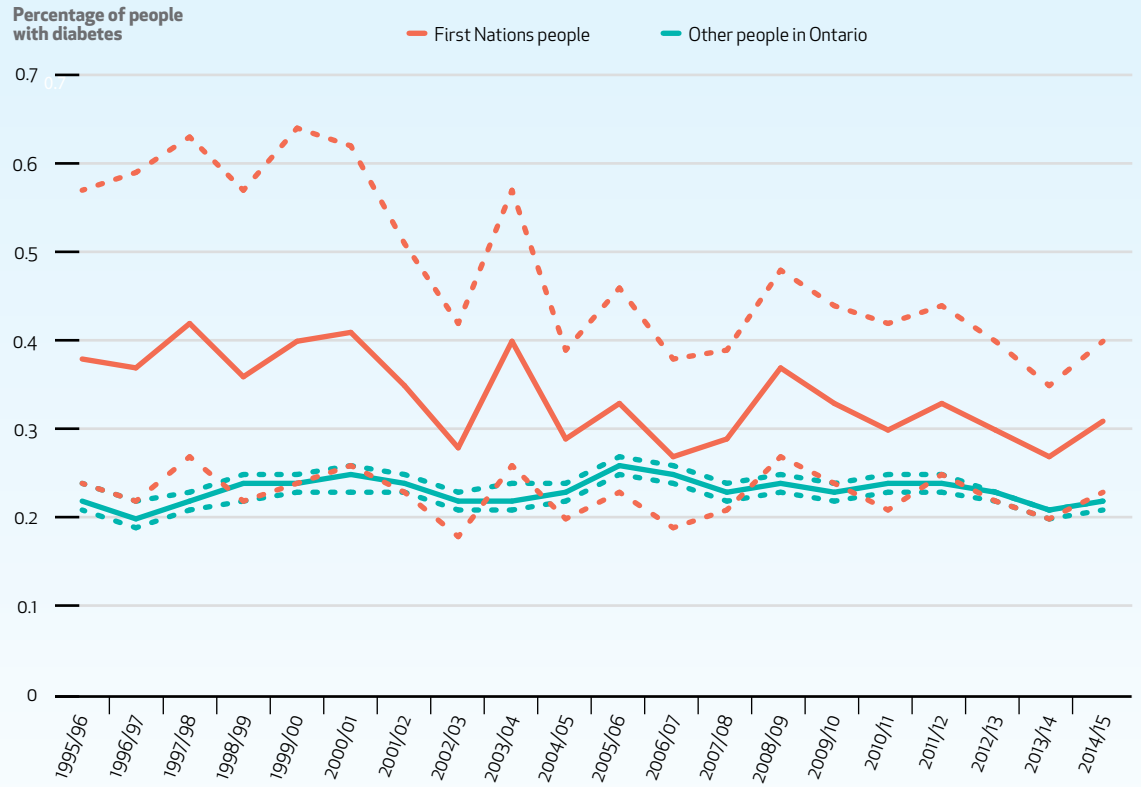


Dashed lines represent 95% confidence intervals.

EXHIBIT 12.3.3 Age and sex-adjusted percentage of people with diabetes undergoing vitrectomy for treatment of diabetic retinopathy, among First Nations people and other people in Ontario, 1995/96 to 2014/15

Key Findings

- Between 1995/96 and 2014/15, First Nations people with diabetes were more likely than other people in Ontario to undergo vitrectomy for advanced diabetic retinopathy.

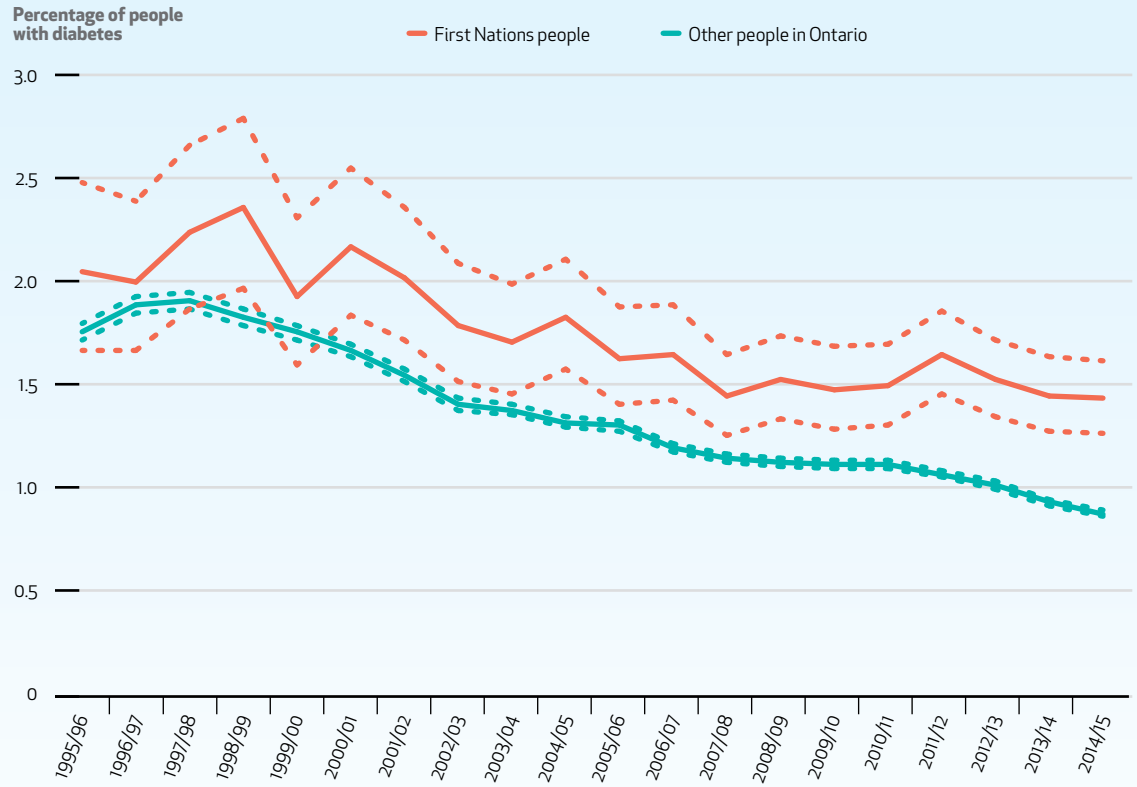


Dashed lines represent 95% confidence intervals.

EXHIBIT 12.3.4 Age and sex-adjusted percentage of people with diabetes receiving laser retinal photocoagulation, among First Nations people and other people in Ontario, 1995/96 to 2014/15

Key Findings

- Between 1995/96 and 2014/15, First Nations people with diabetes were more likely than other people in Ontario to undergo laser photocoagulation treatment for advanced diabetic retinopathy.

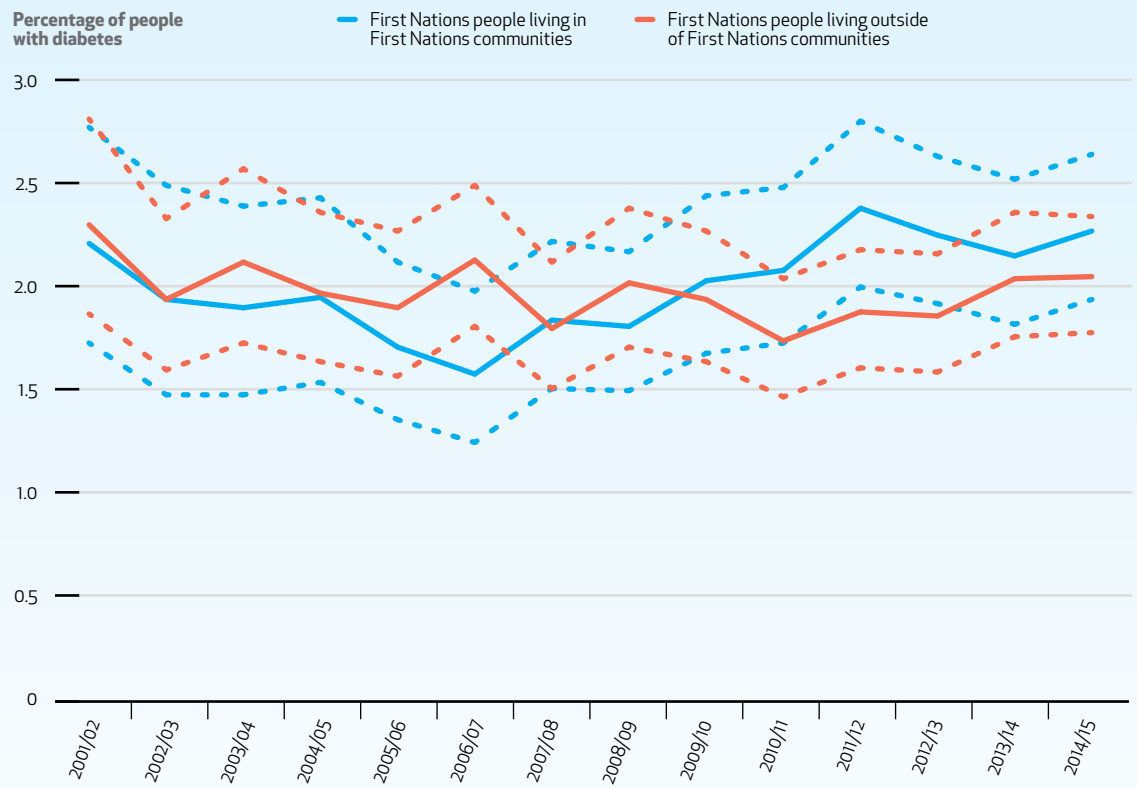


Dashed lines represent 95% confidence intervals.

EXHIBIT 12.4 Percentage of people with diabetes receiving any treatment for diabetic retinopathy, among First Nations people living in and outside of First Nations communities in Ontario, 2001/02 to 2014/15

Key Findings

- Among First Nations people with diabetes, living in versus outside of a First Nations community did not exert a major influence on the rate of treatment for advanced diabetic retinopathy.

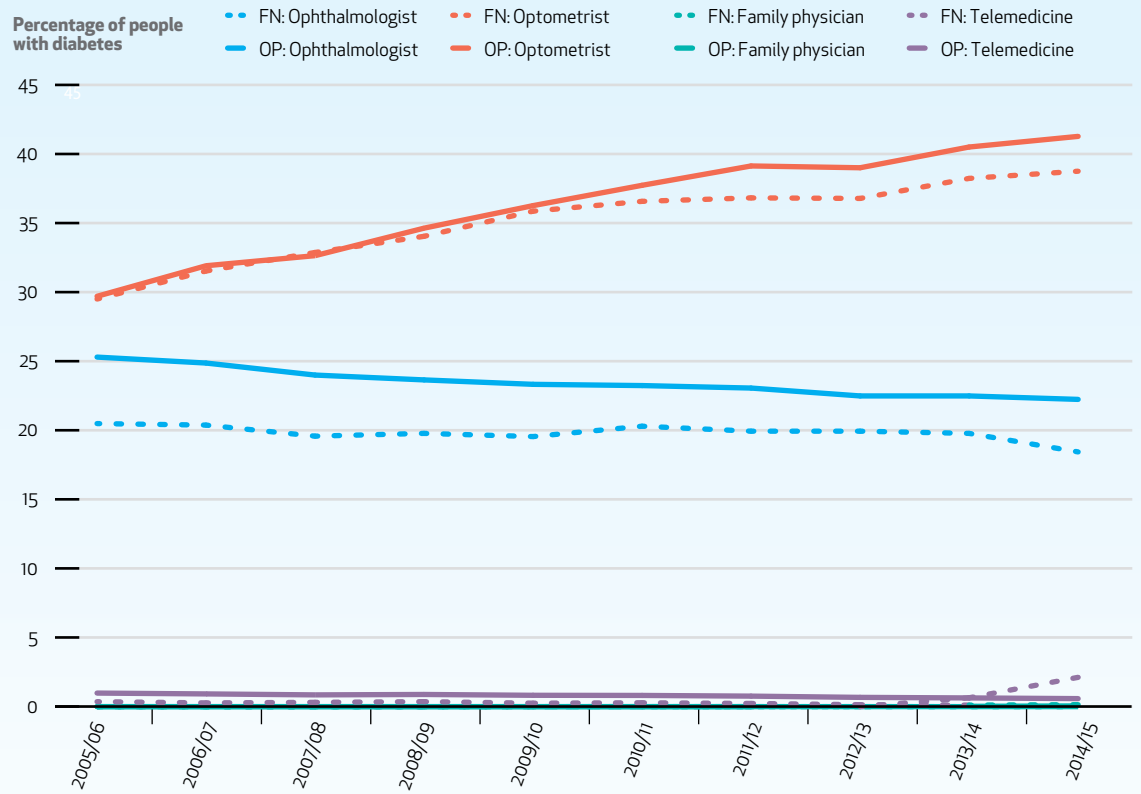


Dashed lines represent 95% confidence intervals.

EXHIBIT 12.5 Percentage of people with diabetes receiving an eye examination, among First Nations people and other people in Ontario, by provider type, 2005/06 to 2014/15*

Key Findings

- Ophthalmologists and optometrists play important roles in delivering eye care for First Nations people with diabetes.
- Optometrists provided an increasing proportion of eye examinations for both First Nations people with diabetes and other people with diabetes.
- Between 2005/06 and 2014/15, telemedicine was used for a larger proportion of eye examinations among First Nations people with diabetes than among other people with diabetes. However, telemedicine was used for only a small fraction of eye examinations in either group (2.1% of examinations for First Nations people and 0.1% of examinations for other people in Ontario in 2014/15).

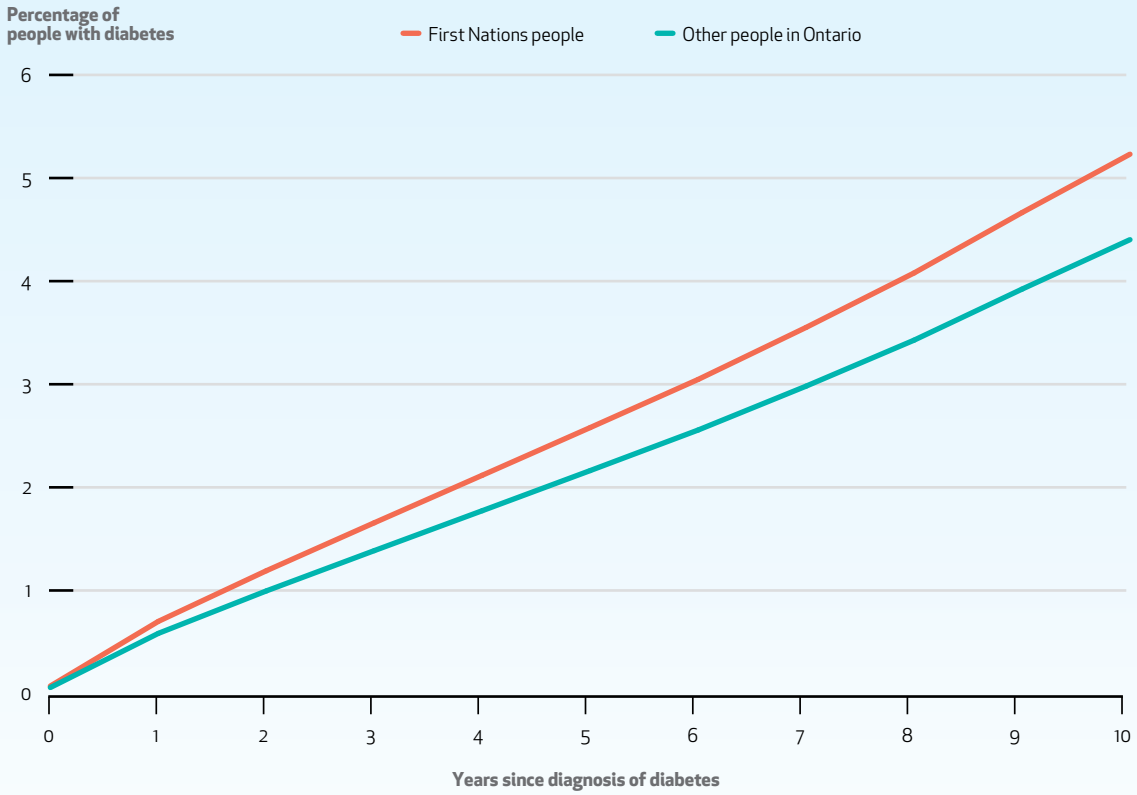


FN: First Nations people; OP: Other people in Ontario.
*Because OHIP funding of eye examinations changed in 2004, the baseline year was set at 2005/06 to provide data consistency.

EXHIBIT 12.6 Age- and sex-adjusted percentage of people with diabetes requiring treatment for diabetic retinopathy,* among First Nations people and other people in Ontario, by time since diabetes diagnosis, 1995/96 to 2014/15

Key Findings

- The rate of progression to advanced stages of diabetic retinopathy requiring therapy was approximately 20% higher among First Nations people with diabetes compared with other people with diabetes (hazard ratio: 1.19; 95% confidence interval: 1.02 to 1.38).
- Approximately 4% of First Nations people with diabetes received therapy for diabetic retinopathy within 10 years of being diagnosed.

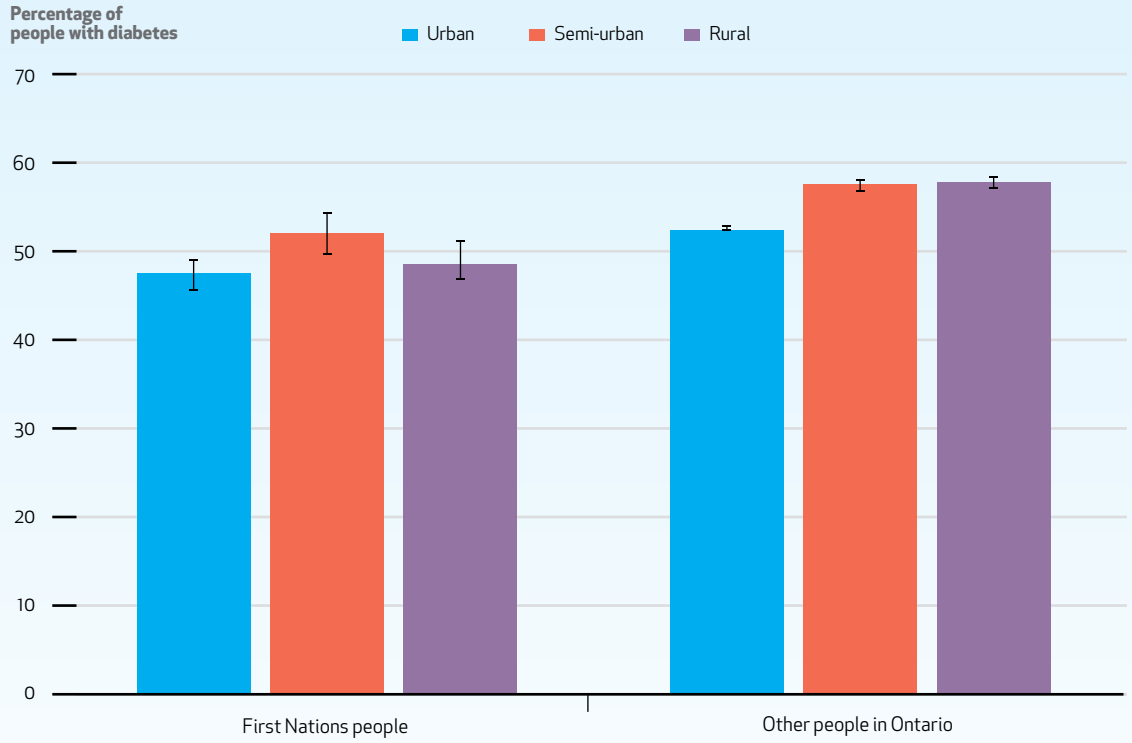


*Includes intravitreal injection procedure, laser photocoagulation and vitrectomy.

EXHIBIT 12.7 Percentage of people with diabetes receiving an eye examination, among First Nations people and other people in Ontario, by level of rurality, 2014/15

Key Findings

- Regardless of whether they lived in an urban, semi-urban or rural area, a slightly lower proportion of First Nations people with diabetes received an eye examination compared to other people in Ontario with diabetes.

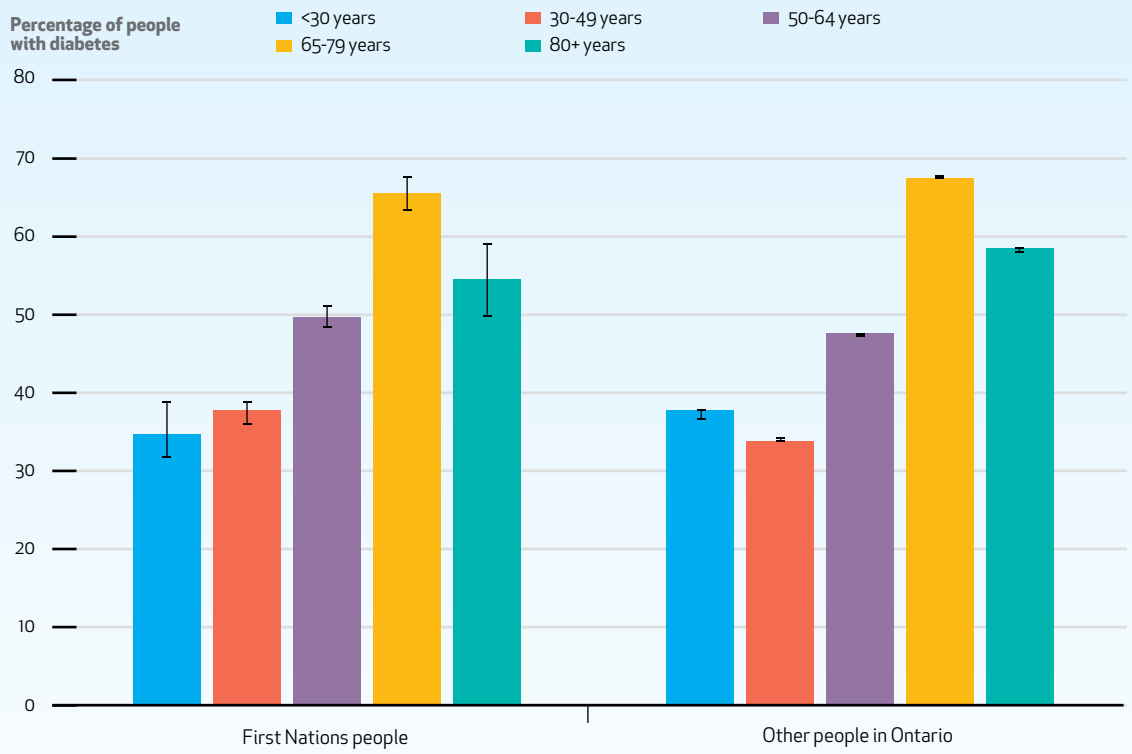


Error bars represent 95% confidence intervals.

EXHIBIT 12.8 Percentage of people with diabetes receiving an eye examination, among First Nations people and other people in Ontario, by age group, 2014/15

Key Findings

- Among both First Nations people and other people in Ontario, those aged 65 to 79 constituted the age group with the largest proportion of individuals receiving an eye examination.
- The proportion of individuals with diabetes who received an eye examination declined in the oldest age group (those aged 80 and older) for both First Nations people and other people in Ontario.

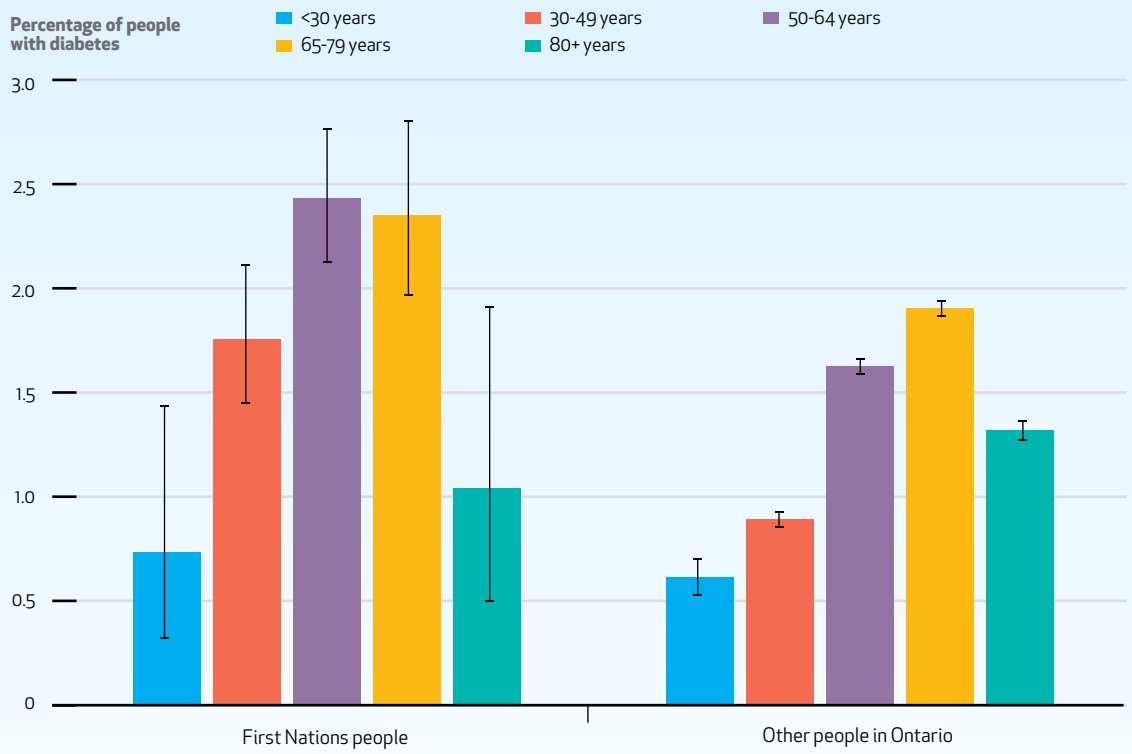


Error bars represent 95% confidence intervals.

EXHIBIT 12.9 Percentage of people with diabetes receiving therapy for diabetic retinopathy, among First Nations people and other people in Ontario, by age group, 2014/15

Key Findings

- Among people aged 30 to 64 with diabetes, the proportion requiring therapy for diabetic retinopathy was higher for First Nations people than for other people in Ontario in 2014/15.
- The proportion of people receiving treatment for diabetic retinopathy declined after age 79 for both First Nations people and other people in Ontario.



Error bars represent 95% confidence intervals.

Discussion

We found that access to and uptake of preventative eye examinations by people with diabetes was suboptimal for all and least optimal for First Nations people in Ontario. Even when the screening interval was liberally set at the upper limit of guideline recommendations, only two-thirds of either group received eye exams. These findings are consistent with other population-based studies.[7,10-13] While all people diagnosed with diabetes in Ontario have yearly eye exams covered through the Ontario Health Insurance Plan (OHIP), obstacles to screening, both among all Ontarians and specifically among First Nations people, have persisted over time.

Similar to other studies,[11,14-18] our study found that First Nations people in Ontario with diabetes were more likely to require interventions for advanced stages of diabetic retinopathy and to progress to advanced stages of retinopathy at a faster rate than other people in Ontario. This has led to a strikingly higher need for interventional diabetic retinopathy treatment among younger First Nations people with diabetes and underlines the importance of enhanced screening and risk factor control to reduce the onset of diabetic retinopathy.[14]

Limitations

We assumed that visits to care providers for an eye examination would include an examination of the retina to evaluate the presence of diabetic retinopathy. However, it is not possible to determine if a full examination was provided, though given the importance of diabetic retinopathy, it is likely that people with diabetes receive a full examination, including the retina. In addition, our quantification of eye care services was based on fee-for-service claims captured in OHIP and excludes examinations reimbursed solely through private insurance.

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Appendix

EXHIBIT 12.1A Codes used to identify eye examination visits and procedures to treat advanced diabetic retinopathy

Visit/Procedure	Ontario Health Insurance Plan Billing Code
Eye examination visits	A110–A112, A114, A115, A233–A240, A253, K065, K066, U233, U235, U236, V401, V402, V404–V409, V450, V451
Intraocular (intravitreal) injection procedure	E149
Laser photocoagulation	E154
Vitrectomy surgery	E148

13 Diabetes and Kidney Disease

Inside

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Overview

Twenty to fifty percent of people with diabetes in Canada also have chronic kidney disease, which is characterized by a sustained reduction in kidney function.[1,2] Chronic kidney disease affects approximately 2.9 million Canadians, with around 42,000 individuals receiving treatment for end-stage kidney disease (i.e., kidney failure) in 2013.[3,4] Patients with advanced chronic kidney disease have worse outcomes than most cancers, and the early stages of chronic kidney disease are often asymptomatic which is only detected with blood and urine tests. It is a priority to detect kidney disease early and reduce the progression to end-stage kidney disease.[5,6] The prevalence of chronic kidney disease and end-stage kidney disease among First Nations people living with diabetes in Ontario is not well known.

Most patients in the early stages of chronic kidney disease are managed by primary care providers and only referred to a nephrologist when the disease is more advanced.[7,8] It is unknown if the quality of care provided to people with both diabetes and chronic kidney disease is different for First Nations people compared to other people in Ontario.

In this chapter, we describe and compare the prevalence of chronic kidney disease, the prevalence and incidence of end-stage kidney disease, and the quality of chronic kidney disease care received by First Nations people and other people in Ontario with diabetes.

Methods

We identified a cohort of patients with prevalent diabetes who were alive on September 30, 2015. To determine the prevalence and severity of chronic kidney disease, we used the most recent laboratory serum creatinine and urine albumin-to-creatinine ratio (ACR) values in the Ontario Laboratories Information System (OLIS) database in the 36 months prior to September 30, 2015. We used the Chronic Kidney Disease Epidemiology Collaboration equation to calculate the estimated glomerular filtration rate (eGFR) from serum creatinine; the equation includes a variable for black versus other race to account for the finding that black individuals generally have a faster rate of kidney disease progression.[9] Since we had no information on race in our databases, we assumed all patients to be other than black in the equation, as less than 5% of the Ontario population is black.[10] Based on these eGFR and urine ACR values, we used the chronic kidney disease classification presented in the KDIGO clinical practice guidelines.[8] We also identified patients based on eGFR staging alone, since urine ACR testing is not administered as routinely as serum creatinine testing.

We defined end-stage kidney disease as patients receiving chronic dialysis or a kidney transplant in the Canadian Organ Replacement Register database (CORR). To assess the prevalence of end-stage kidney disease, we identified people with a treatment date in the CORR database in the 27 years prior to September 30, 2015. For patients receiving chronic dialysis, we identified the most recent dialysis modality as either in-centre hemodialysis, home hemodialysis or peritoneal dialysis. Among individuals receiving in-centre hemodialysis, we measured great-circle distance in kilometres from their home residence to their dialysis facility using postal codes.

To measure the incidence of end-stage kidney disease, we restricted the analysis to individuals with a diabetes diagnosis date between April 1, 2002, and March 31, 2014. We identified the incidence of end-stage kidney disease by following individuals from the date of their diabetes diagnosis to initiation of chronic dialysis, a kidney transplant, death or end of follow-up.

To assess the quality of care provided to patients with diabetes and chronic kidney disease (restricted to patients without end-stage kidney disease), we used consensus-based quality indicators for early-stage chronic kidney disease care, including receipt of recommended kidney function tests, use of appropriate prescription medications and referral to a nephrologist when clinically indicated.[11,12] (Indicator definitions are shown in exhibit 13.1A in the chapter appendix.)

Appropriate medication use was only assessed in a population of those 65 years of age and older, given the availability of prescription medication in the Ontario Drug Benefit database. Specialist referrals are not captured in our data sources, so nephrologist

visits were used as a proxy (as identified through the ICES Physician Database and the Ontario Health Insurance Plan database).

All measures were described for both First Nations people and other people in Ontario. We used direct standardization based on the other Ontario population to estimate age- and sex-adjusted prevalence estimates for the First Nations population. Kaplan-Meier survival curves were generated to estimate the probability of end-stage kidney disease during follow-up.

Results

Prevalence of chronic kidney disease and end-stage kidney disease

Among patients with diabetes, the age- and sex-adjusted prevalence of chronic kidney disease was higher for First Nations people compared with other people in Ontario (exhibit 13.1). According to the international scale for risk of adverse kidney disease–related outcomes, the age- and sex-adjusted proportion for 'very high risk' was higher for First Nations people than for other people in Ontario (exhibit 13.2).

Among people with diabetes, the age- and sex-adjusted prevalence of end-stage kidney disease was higher for First Nations people compared with other people in Ontario. First Nations people were also more likely to be receiving chronic dialysis to treat end-stage kidney disease compared with other people in Ontario (exhibit 13.3).

First Nations people with diabetes receiving in-centre hemodialysis had a greater distance to travel to receive dialysis than other people in Ontario (exhibit 13.4). Among patients with diabetes receiving chronic dialysis, the age- and sex-adjusted proportion receiving in-centre hemodialysis as opposed to home dialysis was higher in First Nations people compared with other people in Ontario (exhibit 13.5).

Incidence of end-stage kidney disease

The incidence of end-stage kidney disease following diabetes onset was higher for First Nations people compared with others (exhibit 13.6). The median age of end-stage kidney disease onset was 52 years for First Nations people and 60 years for other people in Ontario.

Quality of early-stage kidney care

See exhibit 13.7 for the proportion of people with diabetes meeting quality of early-stage kidney care indicators. A similar proportion of First Nations people with diabetes and an initial eGFR < 60 mL/min/1.73m^2 received a repeat serum creatinine test compared to other people in Ontario, but a lower proportion received a follow-up ACR test within 6 months. Among patients with diabetes and chronic kidney disease, a lower proportion of First Nations people received regular kidney function monitoring than other people in Ontario.

Most patients with diabetes and chronic kidney disease were not prescribed a nonsteroidal anti-inflammatory drug for longer than 2 weeks. The majority for both groups was also being prescribed either an angiotensin-converting enzyme (ACE) inhibitor or an angiotensin II receptor blocker (ARB), and most were not taking both concurrently. After ACE inhibitor or ARB therapy initiation, serum potassium monitoring within the following 7 to 30 days was completed for 17.4% of First Nations people and 13.2% of other people in Ontario.

EXHIBIT 13.1 Prevalence of chronic kidney disease* for individuals with diabetes,** among First Nations people and other people in Ontario, by Health Canada zone, on September 30, 2015

Key Findings

- Among patients with diabetes and at least one serum creatinine value or evidence of receiving chronic dialysis, the age- and sex-adjusted prevalence of chronic kidney disease (eGFR <60 mL/min/1.73 m^2 and/or receipt of chronic dialysis) was higher among First Nations people (22.5%) compared to other people in Ontario (18.9%).
- The prevalence of chronic kidney disease among individuals with diabetes ranged from 18.1% in the Moose Factory zone to 27.0% in the Sioux Lookout zone.

Health Canada Zone	First Nations People N = 15,699		Other People N = 1,110,900
	Crude prevalence n (%)	Age- and sex-adjusted prevalence %	Prevalence n (%)
Overall	2,476 (15.8)	22.5	209,933 (18.9)
Moose Factory	115 (13.0)	18.1	—
Sioux Lookout	348 (20.5)	27.0	—
Thunder Bay	529 (14.5)	19.4	—
Southern Ontario	1,330 (16.2)	22.6	—
Missing or out of province	154 (12.0)	19.2	—

* Based on the estimated glomerular filtration rate (eGFR) and/or receipt of chronic dialysis.
** Restricted to individuals with a serum creatinine value or evidence of receiving chronic dialysis.

EXHIBIT 13.2 Prevalence of chronic kidney disease for individuals with diabetes,* among First Nations people and other people in Ontario, by level of risk for adverse outcomes,** on September 30, 2015

Key Findings

- The age- and sex-adjusted proportion of people considered to be at very high risk for chronic kidney disease–related adverse outcomes was higher among First Nations people than among other people in Ontario (10.8% vs. 6.5%).

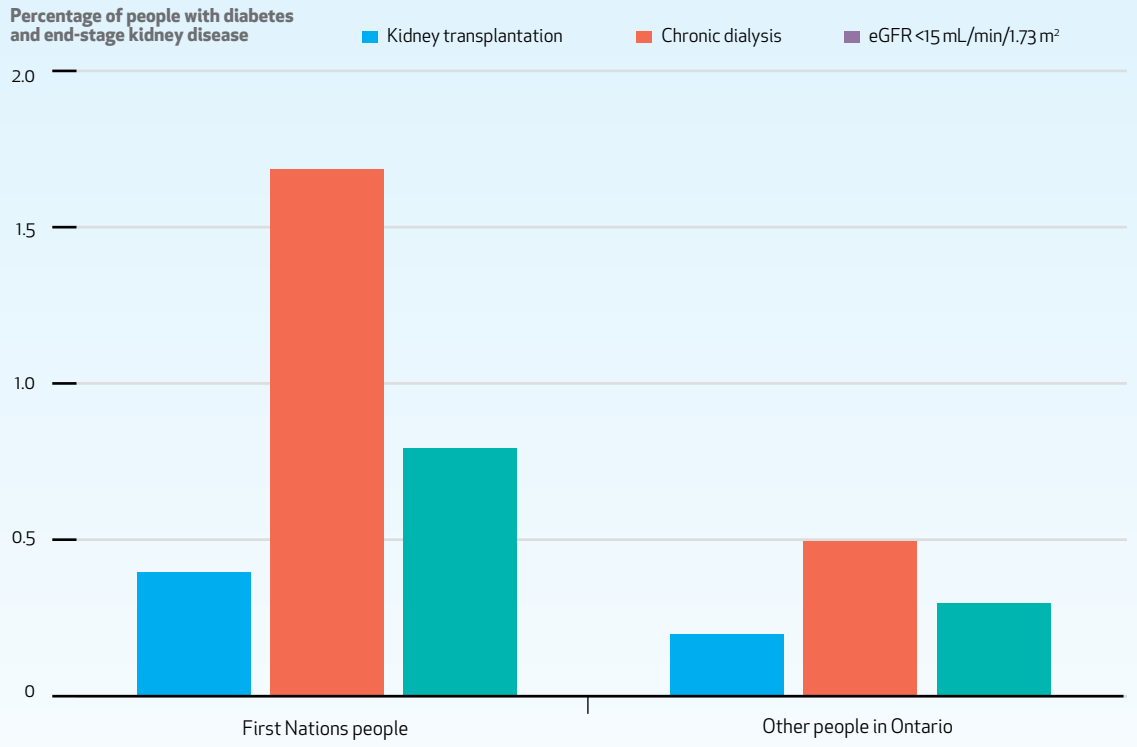
Risk Level	First Nations People N = 10,746		Other People N = 768,569
	Crude prevalence n (%)	Age- and sex-adjusted prevalence %	Prevalence n (%)
Low	6,191 (57.6)	51.7	490,934 (63.9)
Moderate	2,642 (24.6)	25.3	163,692 (21.3)
High	1,099 (10.2)	12.0	64,250 (8.4)
Very high	814 (7.6)	10.8	49,693 (6.5)

* Restricted to individuals with both serum creatinine and urine albumin-to-creatinine ratio values.
** Based on KDIGO 2012 Clinical Practice Guidelines.[8]
eGFR: estimated glomerular filtration rate; ACR: albumin-to-creatinine ratio.

EXHIBIT 13.3 Age- and sex-adjusted prevalence of end-stage kidney disease for individuals with diabetes, among First Nations people and other people in Ontario, by type of disease treatment, on September 30, 2015

Key Findings

- Overall age- and sex-adjusted prevalence of end-stage kidney disease was 2.9% for First Nations people and 1.0% for other people in Ontario with diabetes.
- The age- and sex-adjusted proportion of individuals with an eGFR <15 mL/min/1.73 m^2 in the absence of chronic dialysis treatment was higher among First Nations people than among other people in Ontario (0.8% vs. 0.3%).
- First Nations people with diabetes were more likely to receive chronic dialysis treatment compared to other people in Ontario with diabetes (1.7% vs. 0.5%).

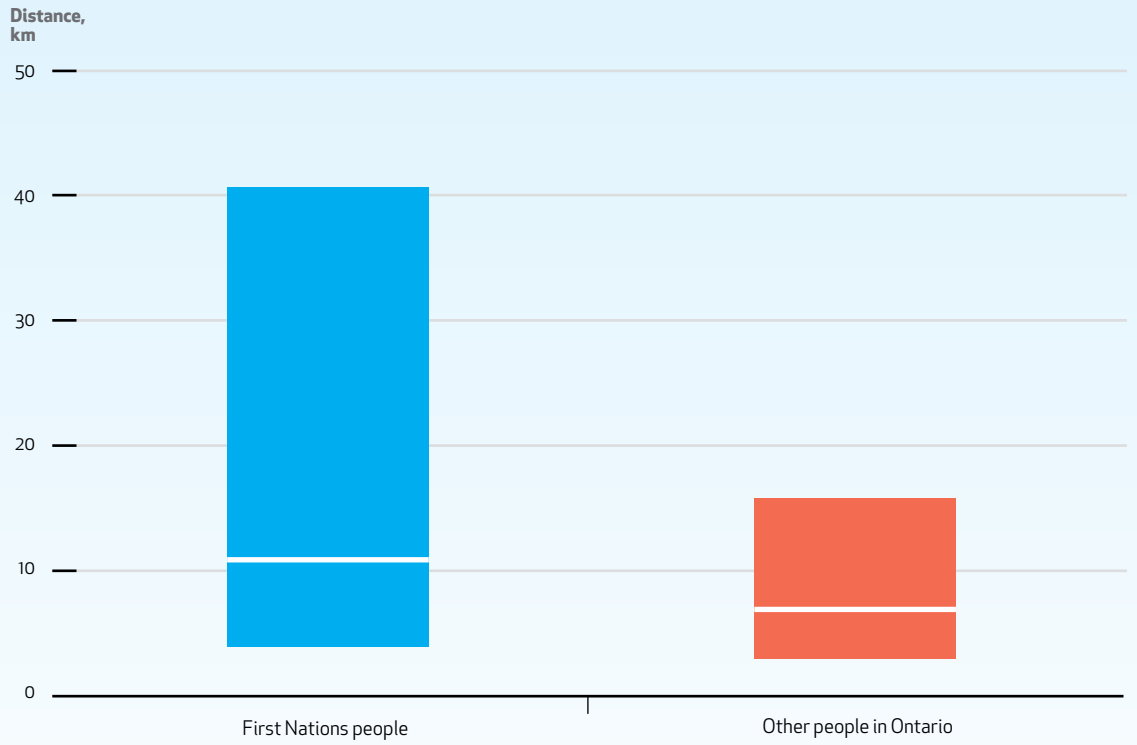


eGFR: estimated glomerular filtration rate.

EXHIBIT 13.4 Median distance travelled to receive in-centre hemodialysis by individuals with diabetes, among First Nations people and other people in Ontario, on September 30, 2015

Key Findings

- First Nations people with diabetes who were receiving in-centre hemodialysis had a greater median distance to travel to receive dialysis treatment than other people in Ontario: 11 km versus 7 km.



The white line within each bar is the median, and the top and bottom of each bar are the 75th and 25th percentiles, respectively.

EXHIBIT 13.5 Age- and sex-adjusted percentage of individuals with diabetes receiving chronic dialysis treatment, among First Nations people and other people in Ontario, by dialysis modality, on September 30, 2015

Key Findings

- Among individuals with diabetes receiving chronic dialysis treatment, the proportion of patients receiving in-centre hemodialysis was higher among First Nations people (87.1%) compared with other people in Ontario (80.0%).

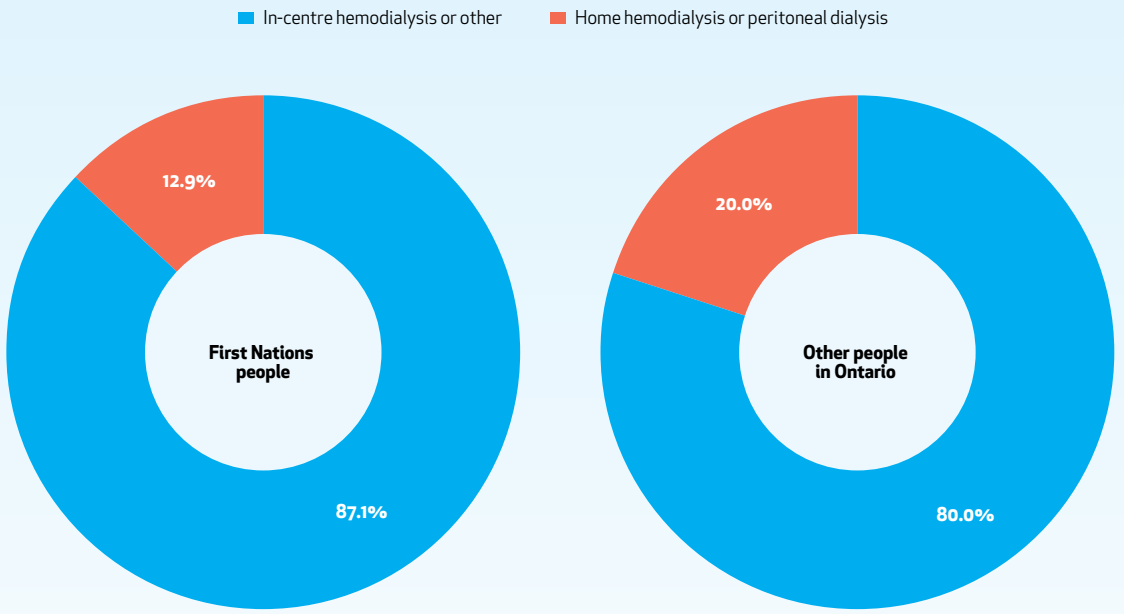


EXHIBIT 13.6 Probability of end-stage kidney disease following diabetes onset for First Nations people and other people in Ontario with a diabetes diagnosis between April 1, 2002, and March 31, 2014

Key Findings

- The rate of progression to end-stage kidney disease following diabetes onset was approximately twice as high among First Nations people with diabetes compared to other people with diabetes (hazard ratio: 2.23; 95% confidence interval: 1.72 to 2.89).
- Approximately 0.9% of First Nations people with diabetes received treatment for end-stage kidney disease within 10 years of being diagnosed with diabetes.

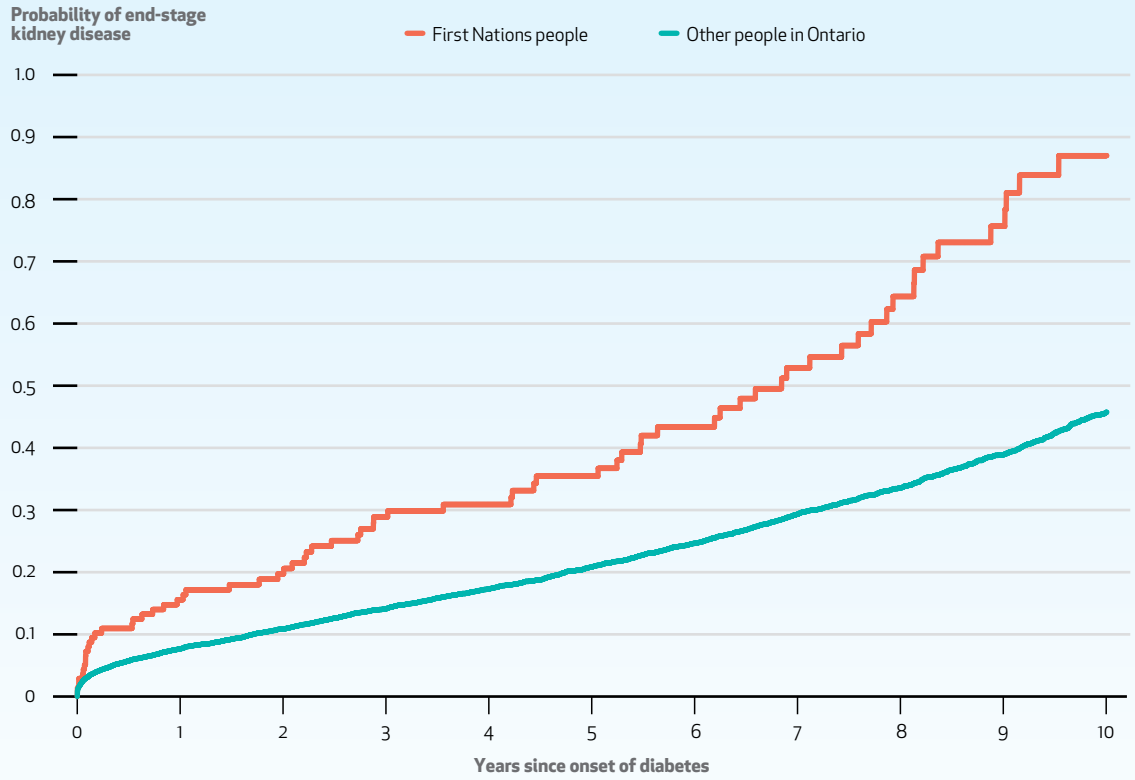
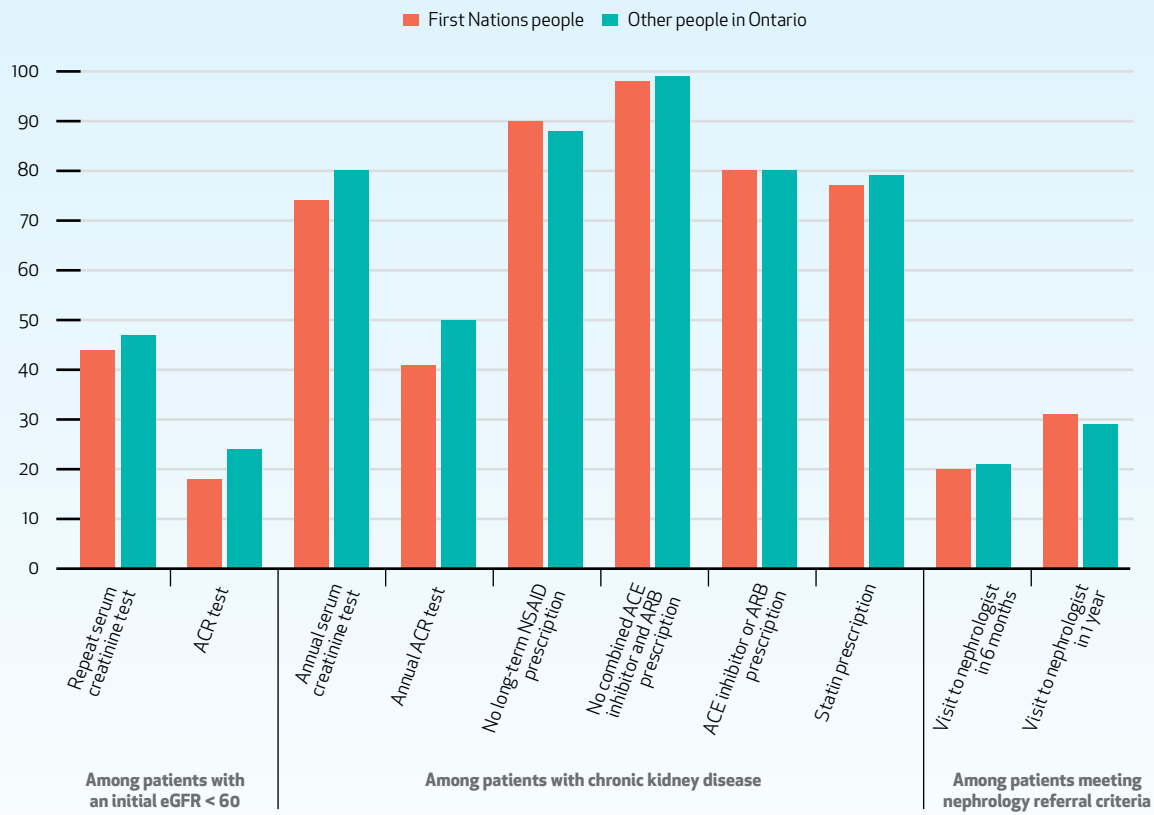


EXHIBIT 13.7 Percentage of individuals with diabetes* who met quality of care indicators for chronic kidney disease, among First Nations people and other people in Ontario, by patient status and type of indicator, on September 30, 2015

Key Findings

- Among individuals with diabetes and an initial eGFR <60 mL/min/1.73m^2, the proportion that received a follow-up ACR test within 6 months was lower for First Nations people (18.1%) than for people in Ontario (23.8%).
- Among individuals with diabetes and chronic kidney disease, a lower proportion of First Nations people received regular monitoring of kidney function compared with other people in Ontario (73.8% vs. 79.8% for serum creatinine monitoring, and 41.1% vs. 50.0% for ACR monitoring).
- Both First Nations people and other people in Ontario with diabetes were generally receiving the recommended medications for their kidney disease.
- Referral to a nephrologist when indicated was low for both populations.



*Excludes individuals with end-stage kidney disease.
ACR: albumin-to-creatinine ratio; ACEI: angiotensin-converting enzyme inhibitor; ARB: angiotensin II receptor blocker; eGFR: estimated glomerular filtration rate; NSAID: nonsteroidal anti-inflammatory drug.

Discussion

Access to nephrology care is similar for First Nations people and other people in Ontario and is low for both groups.

First Nations people have more severe chronic kidney disease (i.e., end-stage kidney disease) than other people in Ontario, and they are more likely to receive in-centre hemodialysis than home dialysis. First Nations people have a longer average distance to travel to receive in-centre hemodialysis than other people in Ontario. First Nations people are also younger, on average, when they develop end-stage kidney disease. These findings are consistent with studies in other provinces.[13,14]

In regard to quality of care, both First Nations people and other people in Ontario with diabetes are generally receiving recommended medications for their kidney disease. Furthermore, individuals in both groups are equally likely to visit a nephrologist when indicated; however, visit rates are low for both groups. Compared to other people in Ontario, First Nations people are less likely to receive serum creatinine and urine albumin tests to confirm the presence of kidney disease, and those with chronic kidney disease are less likely to receive regular monitoring with urine albumin.

Limitations

We used laboratory values from OLIS to identify the prevalence of chronic kidney disease in this study, so we only captured patients who had laboratory tests done in OLIS. Although the three major community laboratory providers have been contributing their data to OLIS since 2007, hospitals across Ontario started providing their data to OLIS at different times. One concern is that the majority of the hospitals in the North East and North West Local Health Integration Networks did not start contributing their laboratory data to OLIS until 2013 and 2015, respectively. Therefore, we did not capture laboratory tests for First Nations people who resided in these regions and received outpatient laboratory tests at local hospitals. This limitation does not apply to the quality of care indicators presented in exhibit 13.7, as we used OHIP billing codes rather than test values to identify whether or not patients had laboratory tests. However, this method has its own limitations, as laboratory tests done in outpatient clinics at some hospitals may be covered under the hospital's global budget and would not be captured through OHIP billing claims.

Prescription medication information in this study was available only for individuals aged 65 and older who were funded through the Ontario Drug Benefit Program; therefore, the quality of care indicators on medication use presented in exhibit 13.7 are not generalizable to people younger than age 65.

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Appendix

EXHIBIT 13.1A Definitions of quality of care indicators for early-stage chronic kidney disease

Indicator	Numerator	Denominator
Screening for chronic kidney disease	Patients who receive a repeat outpatient serum creatinine test in the following 6 months, based on physician billing codes	Patients in the prevalent diabetes cohort with an initial outpatient eGFR <60 mL/min/1.73 m^2
	Patients who receive an outpatient urine albumin-to-creatinine in the following 6 months, based on physician billing codes	
	Patients who receive a repeat outpatient urine albumin-to creatinine test in the following 6 months, based on physician billing codes	Patients in the prevalent diabetes cohort with an initial outpatient ACR >3 mg/mmol
Monitoring of kidney function	Patients with an outpatient serum creatinine test in the following 18 months, based on physician billing codes	Patients in the prevalent diabetes cohort with 2 eGFR values <60 mL/min/1.73 m^2 separated by at least three months but less than 18 months
	Patients with an outpatient urine albumin-to-creatinine in the 18 months following the date of the second eGFR value, based on physician billing codes	
Use of appropriate medication	Patients who are not prescribed an NSAID for longer than 2 weeks at any time in the 1 year following the date of the second eGFR value	Patients in the prevalent diabetes cohort aged 66 and older with 2 eGFR values <60 mL/min/1.73 m^2 separated by at least 3 months but less than 18 months
	Patients who are not simultaneously receiving both an ACE inhibitor and an ARB at any time in the 1 year following the date of the second eGFR value. This was defined as a prescription for an ARB filled during the continuous use of an ACE inhibitor or an ACE inhibitor filled during the continuous use of an ARB.	
	Patients who are prescribed an ACE inhibitor or ARB at any time in the 1 year following the date of the second eGFR value	
	Patients who are prescribed a statin at any time in the 1 year following the date of the second eGFR value	Patients in the prevalent diabetes cohort aged 66 to 80 with 2 eGFR values <60 mL/min/1.73 m^2 separated by at least 3 months but less than 18 months

Indicator	Numerator	Denominator
Monitoring of ACE inhibitors and ARBs	Patients who receive an outpatient serum creatinine test 7 to 30 days after the initial prescription date, based on physician billing codes	Patients in the prevalent diabetes cohort aged 66 and older with 2 eGFR values <60 mL/min/1.73 m^2 separated by at least 3 months but less than 18 months who receive an initial prescription for an ACE inhibitor or ARB
	Patients who receive an outpatient serum potassium test 7 to 30 days after the initial prescription date, based on physician billing codes	
Appropriate referral to a nephrologist	Patients who have an outpatient visit to a nephrologist (based on physician billing code) in the 6 months from first evidence of meeting one of the referral criteria	Patients in the prevalent diabetes cohort who meet at least one criteria for referral to a nephrologist: • eGFR <30 mL/min/1.73 m^2 • ACR >60 mg/mmol • eGFR <45 mL/min/1.73 m^2 and ACR >30–60 mg/mmol • eGFR <60 mL/min/1.73 m^2 and at least 5 mL/ min/1.73 m^2 decline within 6 months
	Patients who have an outpatient visit to a nephrologist (based on physician billing code) in the 1 year from first evidence of meeting one of the referral criteria	

ACE: angiotensin-converting enzyme; ARB: angiotensin receptor blocker; eGFR: estimated glomerular filtration rate; NSAID: non-steroidal anti-inflammatory drug;

Sources:
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14 Diabetes and Pregnancy

Inside

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Overview

Diabetes during pregnancy, either pre-existing or gestational diabetes, is a major contributor to maternal and perinatal adverse events. In Canada, the number of women affected by diabetes during pregnancy has increased over time, and associated with this is an increase in the risk of adverse outcomes, including hypertension, preeclampsia, labour induction, cesarean delivery and neonatal morbidity.[1,2] The prevalence of diabetes among First Nations women is two to five times greater than that of the general Canadian population.[3-5]

At the provincial level in Canada, a handful of population-based studies have assessed and compared the prevalence of diabetes during pregnancy and, to a lesser extent, associated maternal and perinatal outcomes, among First Nations and non-First Nations women. In Manitoba, a study of deliveries between 1985 and 2004 reported a prevalence of gestational diabetes among First Nations women that was three times greater than that for non-First Nations women; the study also documented an increase in gestational diabetes prevalence over time, but did not examine pregnancy outcomes.[6] In Ontario, a study comparing deliveries between First Nations women living in First Nations communities and other women in Ontario between 2002 and 2010 reported that First Nations women had a higher prevalence of diabetes in pregnancy, less pregnancy care and higher rates of adverse outcomes.[7] In Alberta, a 2014 study documented a higher prevalence of pre-existing diabetes and gestational diabetes and higher rates of adverse pregnancy outcomes among First Nations women compared to other women.[8] However, the prevalence of diabetes during pregnancy among First Nations women in Alberta was stable over time (from 2002 to 2009).[8] In Quebec, a recent study of births from 1996 to 2010 reported a higher prevalence of pre-existing diabetes and gestational diabetes in First Nations women and an increased risk of perinatal death in women with pre-existing diabetes, largely in First Nations women, but not in women with gestational diabetes.[9]

In this chapter, we describe and compare the prevalence of diabetes, maternal and infant outcomes, and service utilization between First Nations women and other women in Ontario during pregnancy.

Methods

We included all hospital deliveries for women who were 13–50 years old in Ontario between April 1, 2002, and March 31, 2015. We used the MOMBABY2016 data set, which includes all inpatient admission records from the Discharge Abstract Database for mothers and their newborns. Details included maternal and infant characteristics, labour and delivery events, and diagnoses and procedures.

Pre-existing diabetes is defined as a diagnosis of diabetes in the Ontario Diabetes Database at any point before delivery. This algorithm does not distinguish between type 1 and type 2 diabetes. Gestational diabetes is defined as the presence of one or more diagnostic codes for diabetes from hospital discharge abstract records or two or more OHIP billings with a diagnosis of diabetes (OHIP code 250) in the last 120 days of pregnancy, in the absence of pre-existing diabetes (adapted from Booth et al.[10]).

For First Nations and other women in Ontario, we present rates of pre-existing diabetes and gestational diabetes, preeclampsia, induction of labor, obstructed labor, cesarean delivery, preterm birth, baby large for gestational age, congenital anomalies, stillbirth and use of health services (visits to an internal medicine specialist, endocrinologist, ophthalmologist, optometrist, obstetrician/gynecologist or primary care physician). When appropriate, rates of outcomes for women without diabetes are presented.

Prevalence and maternal and infant outcomes were age-adjusted to 2002. Baseline characteristics were captured at the time of delivery. Each delivery was counted separately. The frequency of maternal outcomes was expressed using rates per 100 or per 1,000 deliveries and their 95% confidence intervals; for infant outcomes, rates were expressed per 100 or 1,000 births. Data are presented for 2-, 4- or 5-year intervals for outcomes of interest. The Cochran-Armitage Trend Test was used to assess temporal trends from 2002/03 to 2014/15.

Results

The cohort consisted of 1,671,337 deliveries occurring in Ontario between 2002 and 2014 by 1,065,950 women. Of the deliveries, 31,417 were by First Nations women (2%) and 1,639,920 by other women (98%). The mean age at delivery was 25.2 years (± 6.0) for First Nations women and 30.1 years (± 5.5) for other women.

The prevalence of pre-existing diabetes and gestational diabetes was higher for First Nations pregnant women than other women in each of the years studied (exhibit 14.1). From 2002/03 to 2014/15, the rate of gestational diabetes increased among all women, while the rate of pre-existing diabetes stayed the same among First Nations women and increased among other women.

Maternal outcomes are shown in exhibits 14.2 to 14.5. Rates of preeclampsia and labour induction were higher in First Nations women than other women, regardless of diabetes status. The differences were greater among those with diabetes than those without. Rates of obstructed labour were similar between First Nations women and other women with diabetes. Among women with no diabetes, rates of obstructed labour were lower in First Nations women compared to other women. Rates of cesarean deliveries were similar for First Nations women and other women with no diabetes. For women with diabetes, First Nations women have a higher rate of cesarean deliveries compared to other women.

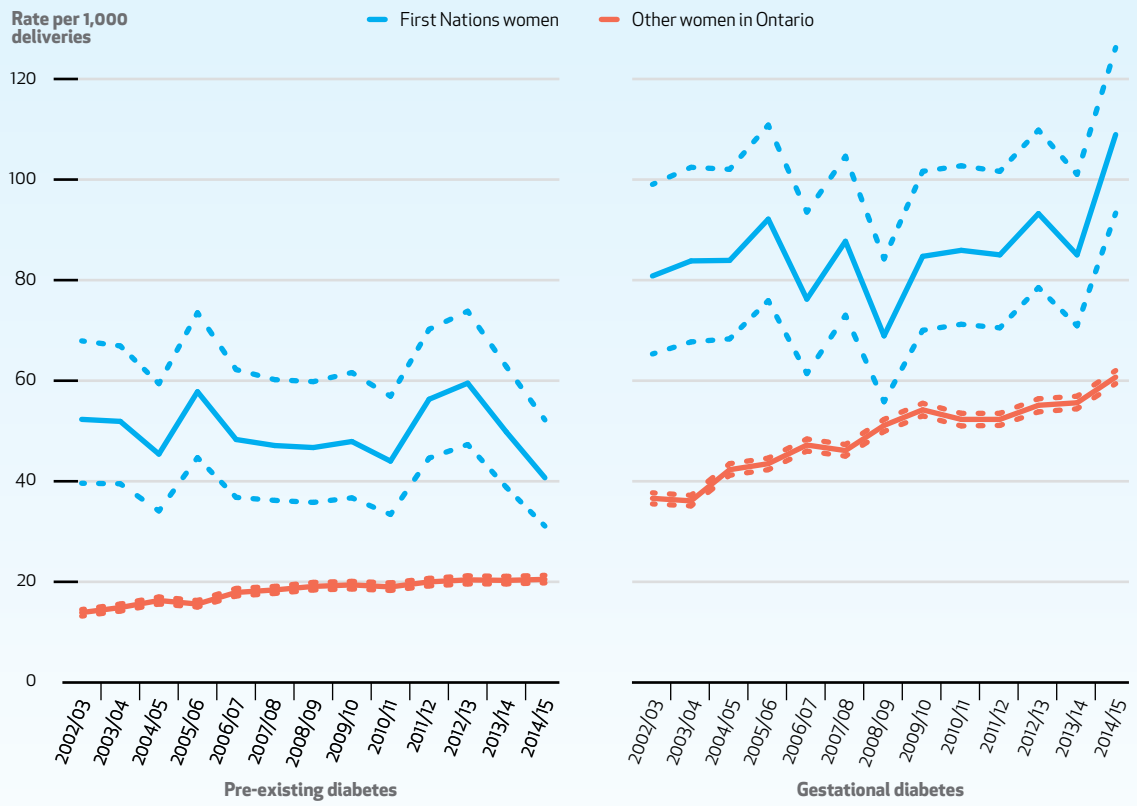
Neonatal outcomes are shown in exhibits 14.6 to 14.9. First Nations women had similar rates of preterm birth compared to other women, regardless of diabetes status. Rates of large-for-gestational-age births were higher among First Nations women than other women; the gap was greater among those with diabetes (half of First Nations women with diabetes had large-for-gestational-age infants). First Nations women with pre-existing diabetes had a higher rate of congenital anomalies compared to other women. Stillbirth rates were higher in First Nations women compared to other women regardless of diabetes status. Stillbirth rates for both groups were highest among those with pre-existing diabetes.

Exhibits 14.10 to 14.13 present health services utilization data. While the majority of women, independent of diabetes status, were seen by a primary care provider at least once during pregnancy, the rate was significantly lower in First Nations women with no diabetes or with gestational diabetes. Most women with pre-existing diabetes or gestational diabetes had seen an obstetrician-gynecologist, but the proportion was significantly lower in First Nations women compared to other women in Ontario, as was the proportion of women with diabetes who were seen by an internal medicine or endocrinology specialist. Among women with pre-existing diabetes, there was no difference between First Nations women and other women in visits to ophthalmologists or optometrists; however, only 15% of women with pre-existing diabetes saw an ophthalmologist or optometrist during pregnancy.

EXHIBIT 14.1 Age-adjusted prevalence of pre-existing or gestational diabetes per 1,000 deliveries, among First Nations women and other women in Ontario, 2002/03 to 2014/15

Key Findings

- Pre-existing diabetes was more prevalent for First Nations women than for other women in Ontario (respectively, 52.3 vs. 13.9 per 1,000 deliveries in 2002/03 and 40.7 vs. 20.5 per 1,000 deliveries in 2014/15).
- From 2002/03 to 2014/15, the prevalence of pre-existing diabetes remained similar among First Nations women ($p = 0.65$) and increased among other women in Ontario ($p < 0.001$).
- The prevalence of gestational diabetes per 1,000 deliveries was higher for First Nations women than for other women in Ontario (respectively, 80.8 vs. 36.6 in 2002/03 and 108.9 vs. 60.7 in 2014/15).
- From 2002/03 to 2014/15, the prevalence of gestational diabetes increased among First Nations women ($p = 0.003$) and other women in Ontario ($p < 0.001$).

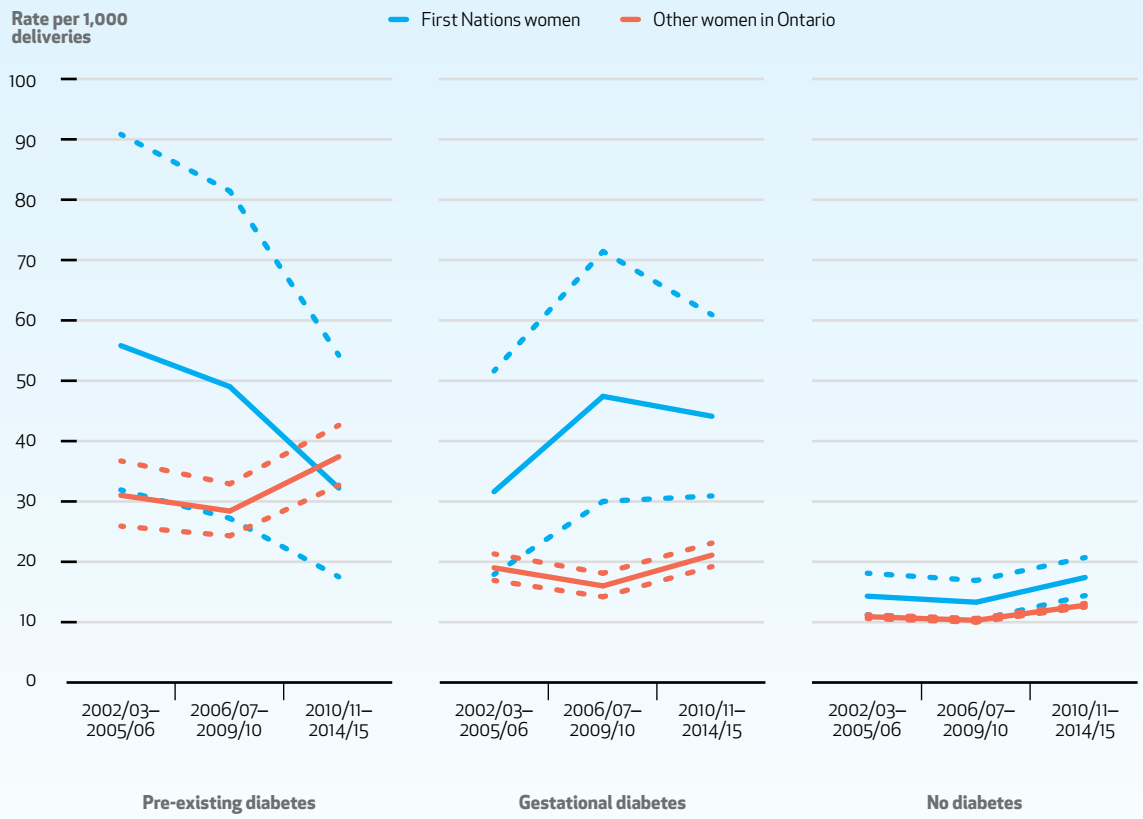


Dashed lines represent 95% confidence intervals.

EXHIBIT 14.2 Age-adjusted rate of preeclampsia per 1,000 deliveries, among First Nations women and other women in Ontario, by type or absence of maternal diabetes, in 4- or 5-year increments from 2002/03 to 2014/15

Key Findings

- Overall, the rate of preeclampsia was higher among First Nations women than among other women in Ontario. The difference was greater among women with pre-existing and gestational diabetes than among women with no diabetes.
- For women with pre-existing diabetes delivering during 2002/03–2005/06, the rate of preeclampsia was higher among First Nations women than other women in Ontario (55.8 vs. 31.0 per 1,000 deliveries). During 2010/11–2014/15, the rate was similar among First Nations women and other women in Ontario (32.2 vs. 37.4 per 1,000 deliveries).
- For women with gestational diabetes, the rate of preeclampsia was higher among First Nations women than among other women in Ontario (respectively, 31.0 vs. 19.0 per 1,000 deliveries in 2002/03–2005/06 and 44.1 vs. 21.1 in 2010/11–2014/15).

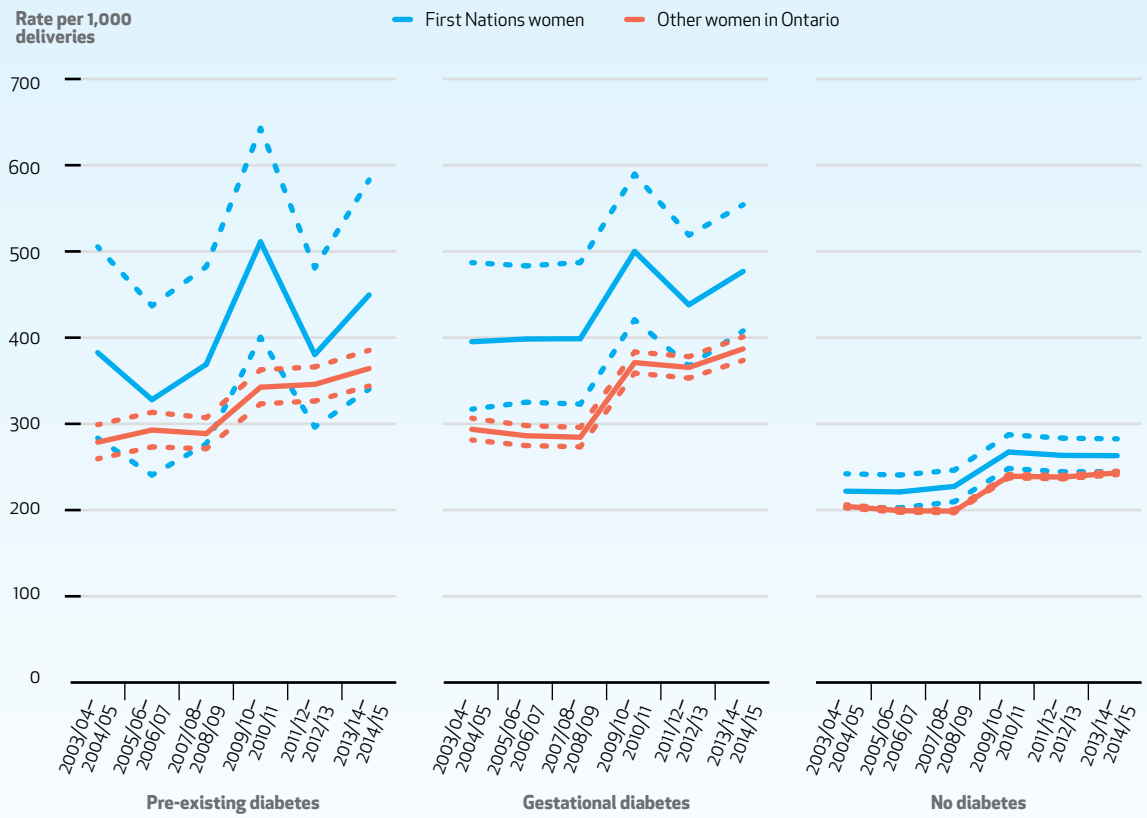


Dashed lines represent 95% confidence intervals.

EXHIBIT 14.3 Age-adjusted number of induced deliveries per 1,000 deliveries, among First Nations women and other women in Ontario, by type or absence of maternal diabetes, in 2-year increments from 2003/04 to 2014/15

Key Findings

- Overall, rates of labour induction were higher among First Nations women than among other women in Ontario. The difference was greater for women with pre-existing or gestational diabetes than for women with no diabetes.
- For women with pre-existing diabetes, the rate of labour induction was higher among First Nations women than in the other population (respectively, 38.3% vs. 27.9% in 2003/04–2004/05 and 44.9% vs. 36.4% in 2013/14–2014/15).
- For women with gestational diabetes, the rate of labour induction was higher among First Nations women than among other women in Ontario (respectively, 39.5% vs. 29.4% in 2003/04–2004/05 and 47.7% vs. 38.7% in 2013/14–2014/15).



Dashed lines represent 95% confidence intervals.

EXHIBIT 14.4 Age-adjusted number of obstructed labours per 1,000 deliveries, among First Nations women and other women in Ontario, by type or absence of maternal diabetes, in 4- or 5-year increments from 2002/03 to 2014/15

Key Findings

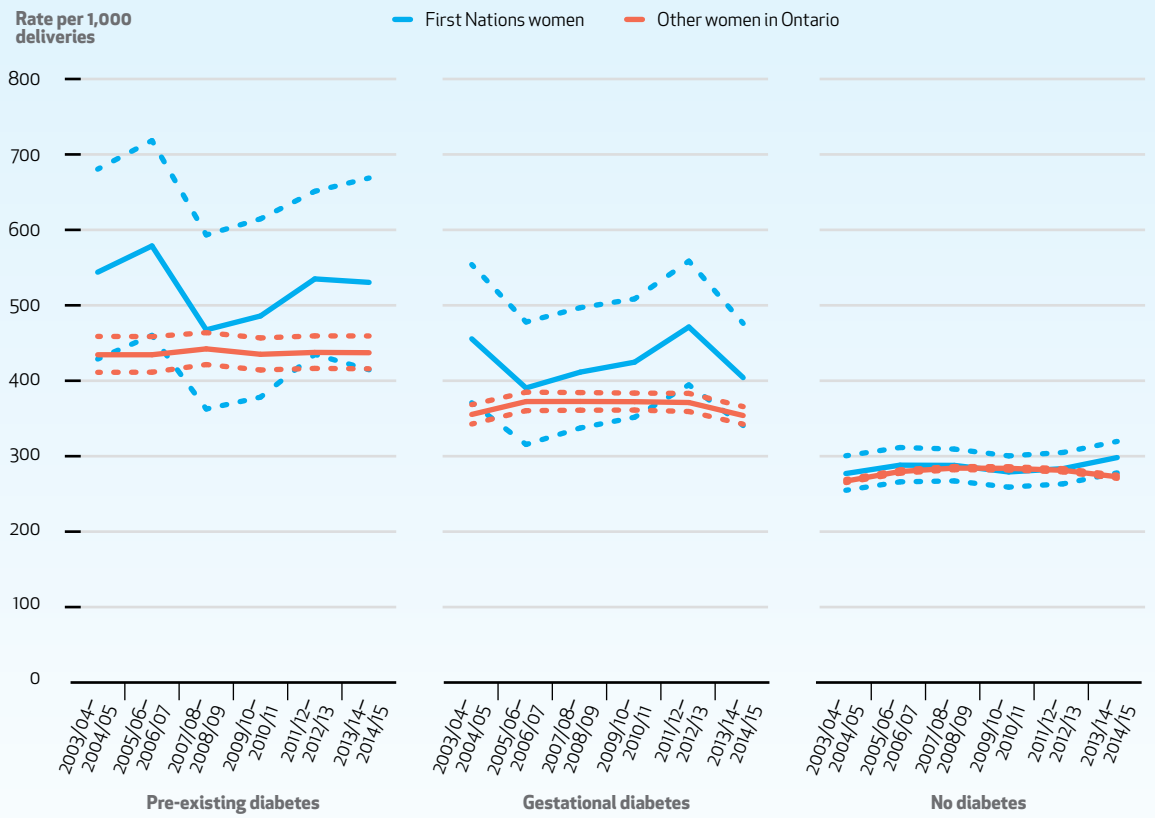
- Although rates of obstructed labour seemed lower among First Nations women compared to other women in Ontario, the overlapping confidence intervals indicate that there was no significant difference between the two populations.
- For women with pre-existing diabetes, the rate of obstructed labour was similar for First Nations women and other women in Ontario (respectively, 35.6 vs. 57.6 per 1,000 deliveries in 2002/05 and 37.4 vs 63.4 in 2010/14)
- For women with gestational diabetes, the rate of obstructed labour was similar for First Nations women and other women in Ontario (respectively, 45.8 vs. 57.6 per 1,000 deliveries in 2002/05 and 55.5 vs. 65.7 in 2010/14).

Dashed lines represent 95% confidence intervals.

EXHIBIT 14.5 Age-adjusted number of cesarean deliveries per 1,000 deliveries, among First Nations women and other women in Ontario, by type or absence of maternal diabetes, in 2-year increments from 2003/04 to 2014/15

Key Findings

- Among women with pre-existing diabetes, First Nations women had a higher rate of cesarean deliveries than other women in Ontario (respectively, 543.7 per 1,000 deliveries vs. 434.3 in 2003/04–2004/05 and 530.2 vs. 437.0 in 2013/14–2014/15).
- Among women with gestational diabetes, First Nations women had a higher rate of cesarean deliveries compared to other women in Ontario (respectively, 455.4 per 1,000 deliveries vs. 355.2 in 2003/04–2004/05 and 404.0 vs. 353.8 in 2013/14–2014/15).

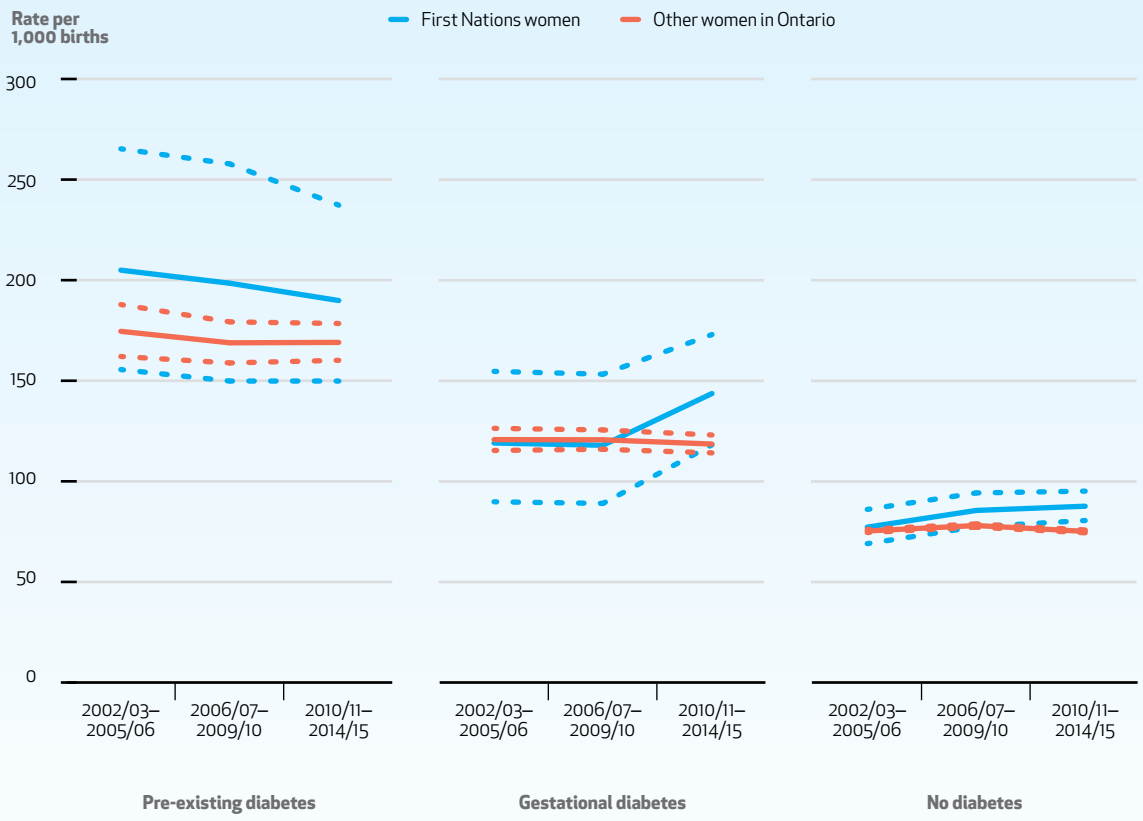


Dashed lines represent 95% confidence intervals.

EXHIBIT 14.6 Age-adjusted number of pre-term deliveries per 1,000 births, among First Nations women and other women in Ontario, by type or absence of maternal diabetes, in 4- or 5-year increments from 2002/03 to 2014/15

Key Findings

- Women with pre-existing or gestational diabetes were at higher risk of preterm delivery compared to women without diabetes.
- Among women with pre-existing diabetes, First Nations women and other women in Ontario had similar rates of preterm deliveries (respectively, 20.5% vs.17.5% in 2002/03–2005/06 and 19.0% vs. 16.9% in 2010/11–2014/15).
- Among women with gestational diabetes, First Nations women and other women in Ontario had similar rates of preterm deliveries (respectively, 11.9% vs. 12.1% in 2002/03–2005/06 and 14.4% vs. 11.9% in 2010/11–2014/15).



Dashed lines represent 95% confidence intervals.

EXHIBIT 14.7 Age-adjusted number of large-for-gestational-age infants per 1,000 births, among First Nations women and other women in Ontario, by type or absence of maternal diabetes, in 2-year increments from 2003/04 to 2014/15

Key Findings

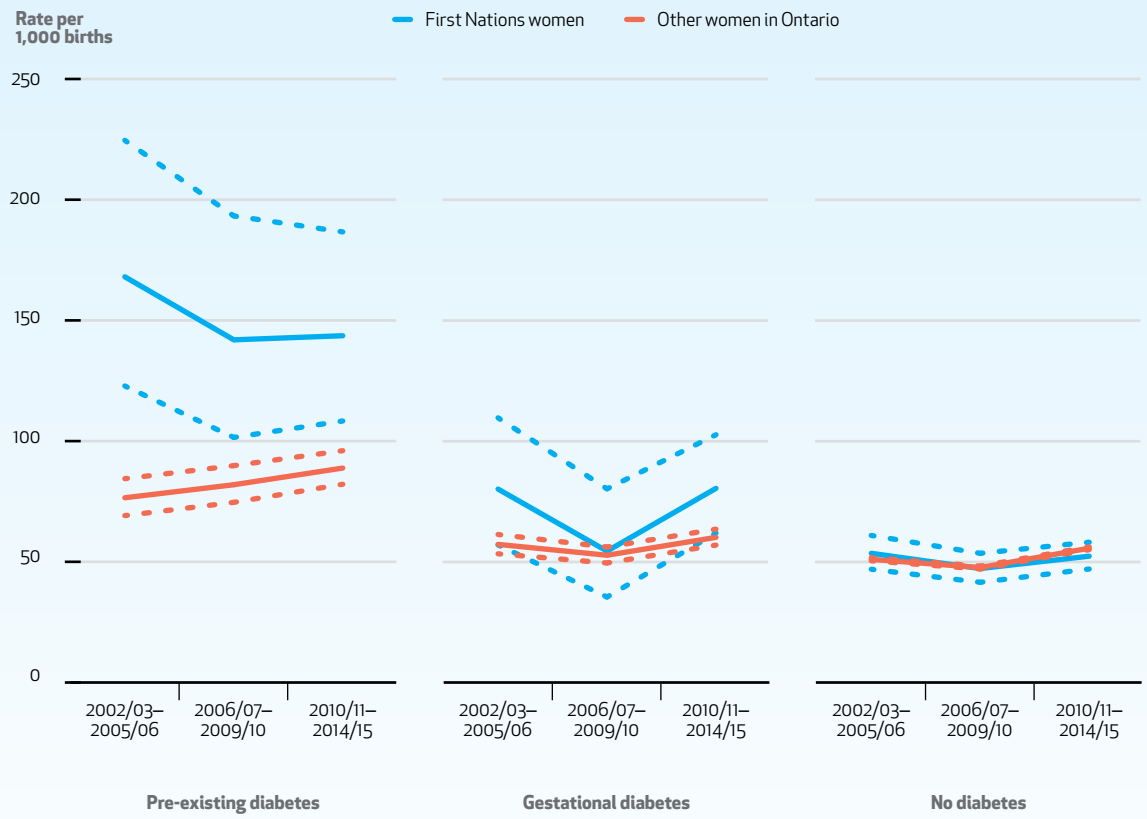
- Overall, rates of large-for-gestational-age (LGA) infants were higher for First Nations women than for other women in Ontario. The difference in rates was greater among women with pre-existing or gestational diabetes than among women with no diabetes.
- Among women with pre-existing diabetes, the rate of LGA births was higher for First Nations women than for other women in Ontario (respectively, 53.0% vs. 26.0% in 2003/04–2004/05 and 47.5% vs. 24.6% in 2013/14–2014/15).
- Among women with gestational diabetes, the rate of LGA births was higher for First Nations women than for other women in Ontario (respectively, 50.6% vs. 16.3% in 2003/04–2004/05 and 47.1% vs. 13.6% in 2013/14–2014/15).

Dashed lines represent 95% confidence intervals.

EXHIBIT 14.8 Age-adjusted prevalence of congenital anomalies per 1,000 births, among First Nations women and other women in Ontario, by type or absence of maternal diabetes, in 4- or 5-year increments from 2002/03 to 2014/15

Key Findings

- For both First Nations women and other women in Ontario, the rate of congenital anomalies was significantly higher among women with pre-existing diabetes compared to women with gestational diabetes or no diabetes.
- For women with pre-existing diabetes, the rate of congenital anomalies at birth was higher for First Nations women than for other women in Ontario (168.0 vs. 76.5 per 1,000 births in 2002/03–2005/06, and 143.6 vs. 88.8 per 1,000 births in 2010/11–2014/15).
- For women with gestational diabetes, the rate of congenital anomalies at birth was higher for First Nations women than for other women in Ontario (80.1 vs. 57.2 per 1,000 births in 2002/03–2005/06, and 80.4 vs. 60.1 per 1,000 births in 2010/11–2014/15).



Dashed lines represent 95% confidence intervals.

EXHIBIT 14.9 Age-adjusted number of stillbirths per 1,000 births, among First Nations women and other women in Ontario, by type of or absence of maternal diabetes, in 4- or 5-year increments from 2002/03 to 2014/15

Key Findings

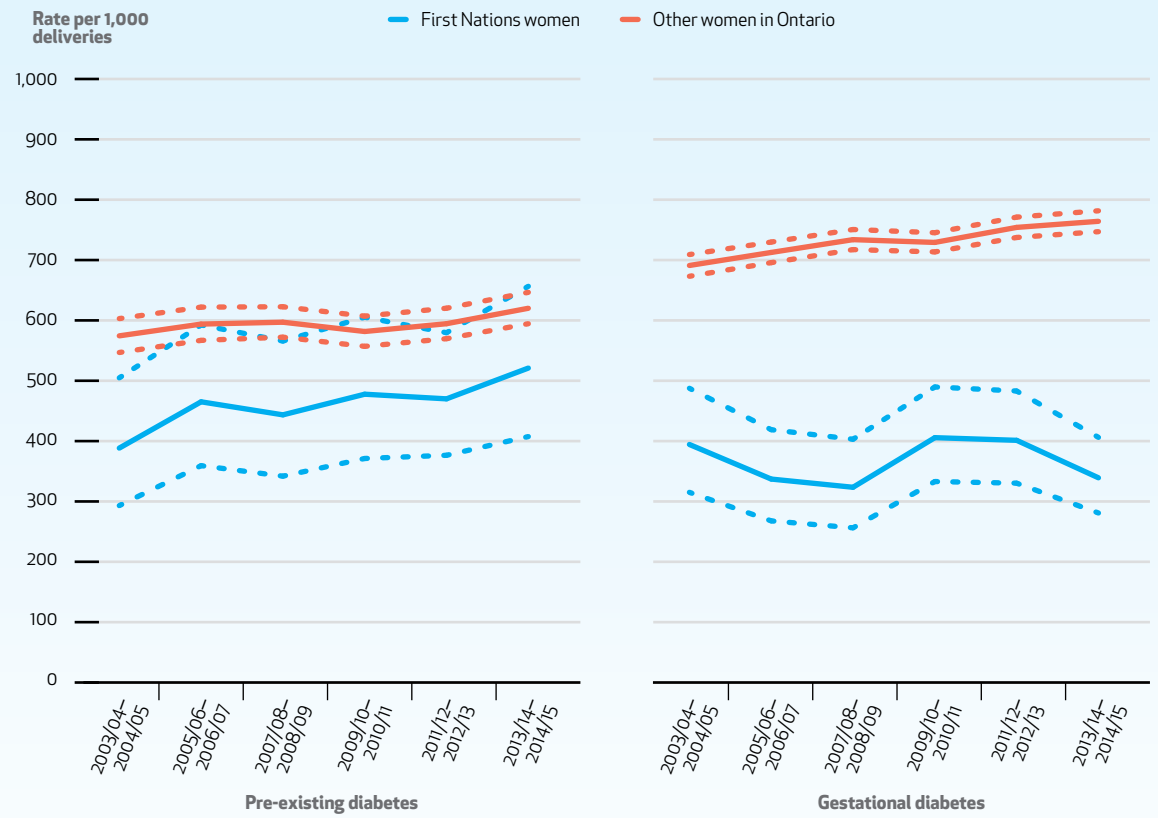
- Overall, the rate of stillbirths was higher among First Nations women compared to other women in Ontario. The difference was greatest for women with pre-existing diabetes.
- For women with pre-existing diabetes, the rate of stillbirths among First Nations women was twice that of other women in Ontario (30.6 vs. 14.0 per 1,000 births) during 2002/03–2005/06; the rate was similar (11.3 vs. 12.3 per 1,000 births) during 2010/11–2014/15.
- For women with gestational diabetes, the rate of stillbirths among First Nations women appears to be higher than that of other women in Ontario during 2002/03–2005/06 (11.0 vs. 5.1 per 1,000 births). During 2010/11–2014/15, the difference was statistically significant (9.9 vs. 3.8 per 1,000 births).

Dashed lines represent 95% confidence intervals.

EXHIBIT 14.10 Age-adjusted number of women with diabetes and at least one visit to an internal medicine specialist or endocrinologist in the 280 days prior to hospital admission for delivery per 1,000 deliveries, among First Nations women and other women in Ontario, by type of diabetes, in 2-year increments from 2003/04 to 2014/15

Key Findings

- First Nations women with pre-existing or gestational diabetes had less access to internal medicine specialists and endocrinologists compared to their counterparts among other women in Ontario. However, some First Nations women may have received specialized care in Manitoba (data not captured in Ontario databases).

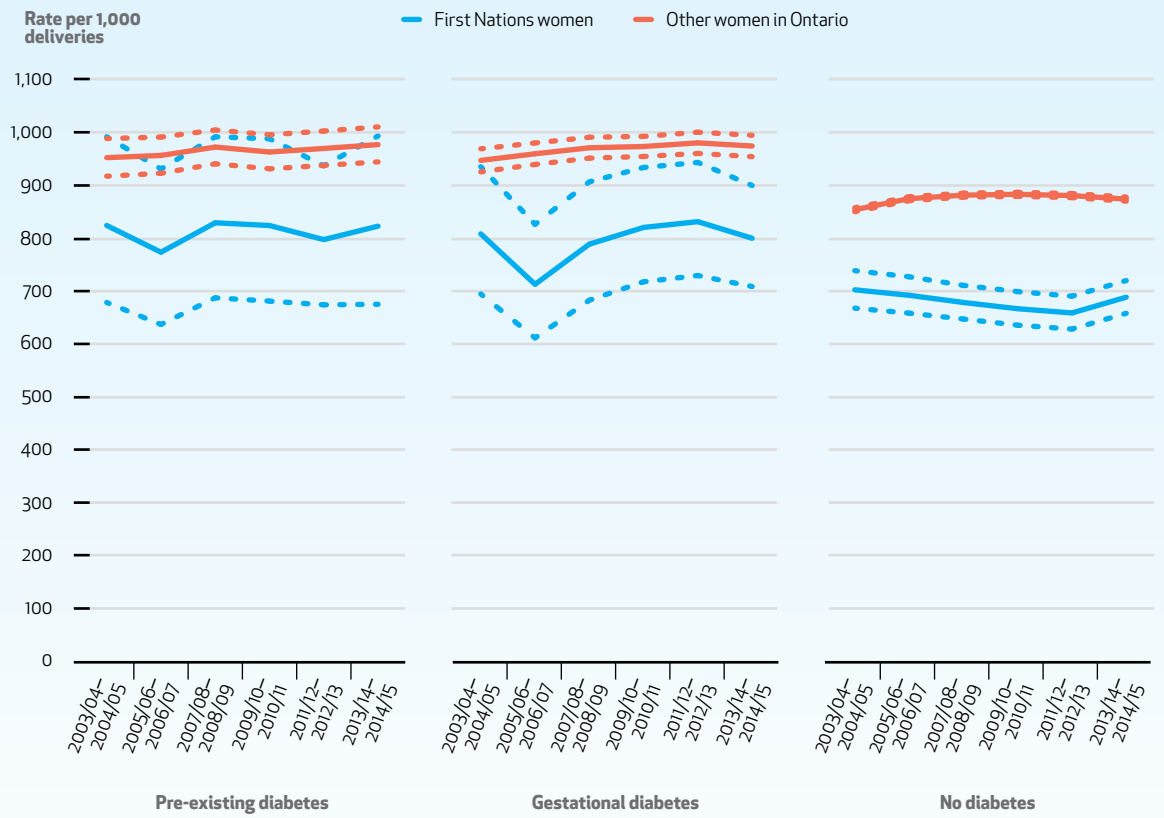


Dashed lines represent 95% confidence intervals.

EXHIBIT 14.11 Age-adjusted number of women with at least one visit to an obstetrician and gynecologist in the 280 days prior to hospital admission for delivery per 1,000 deliveries, among First Nations women and other women in Ontario, by type of and absence of diabetes, in 2-year increments from 2003/04 to 2014/15

Key Findings

- Between 2003/04 and 2014/15, about 85% of First Nations women with pre-existing or gestational diabetes had seen an obstetrician and gynecologist, compared with almost 100% of their counterparts among other women in Ontario.

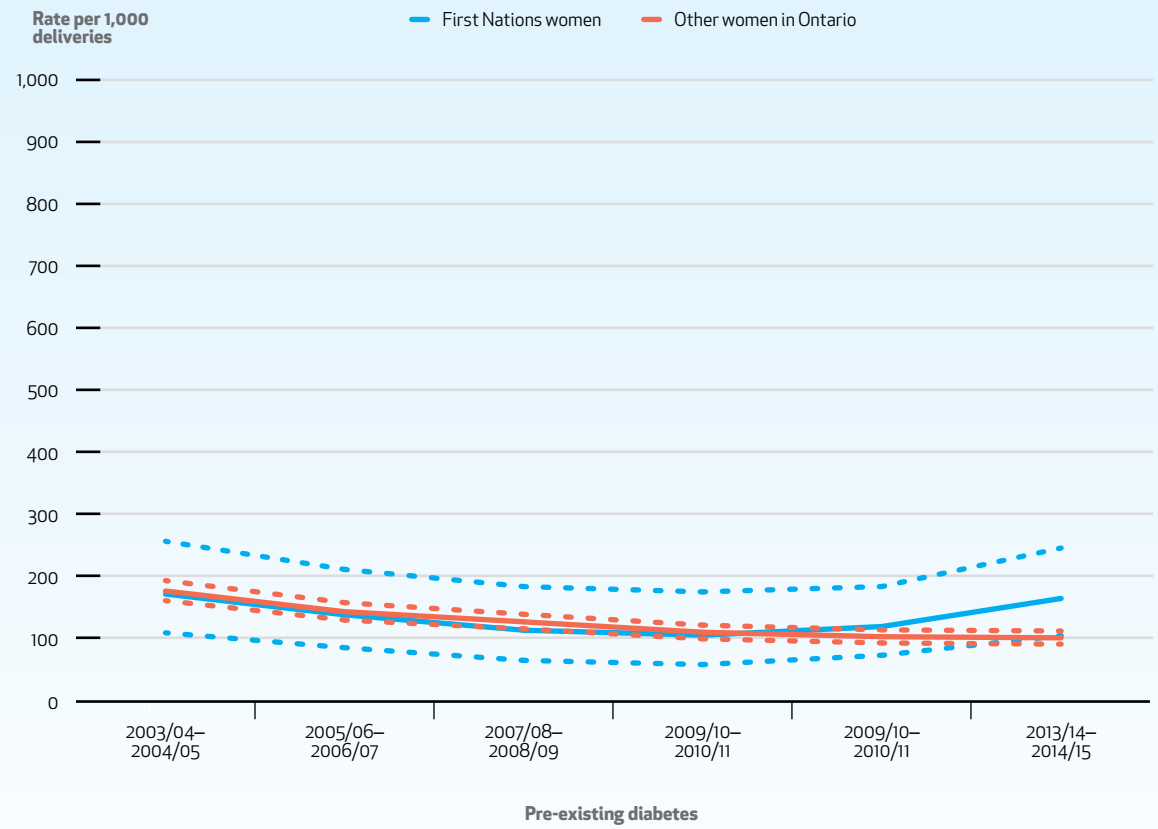


Dashed lines represent 95% confidence intervals.

EXHIBIT 14.12 Age-adjusted number of women with pre-existing diabetes and at least one visit to an ophthalmologist or optometrist in the 280 days prior to hospital admission for delivery per 1,000 deliveries, among First Nations women and other women in Ontario, in 2-year increments from 2003/04 to 2014/15

Key Findings

- Among women with pre-existing diabetes, both First Nations women and other women in Ontario had similar rates of low access to or utilization of ophthalmology or optometry services between 2003/04 and 2014/15.

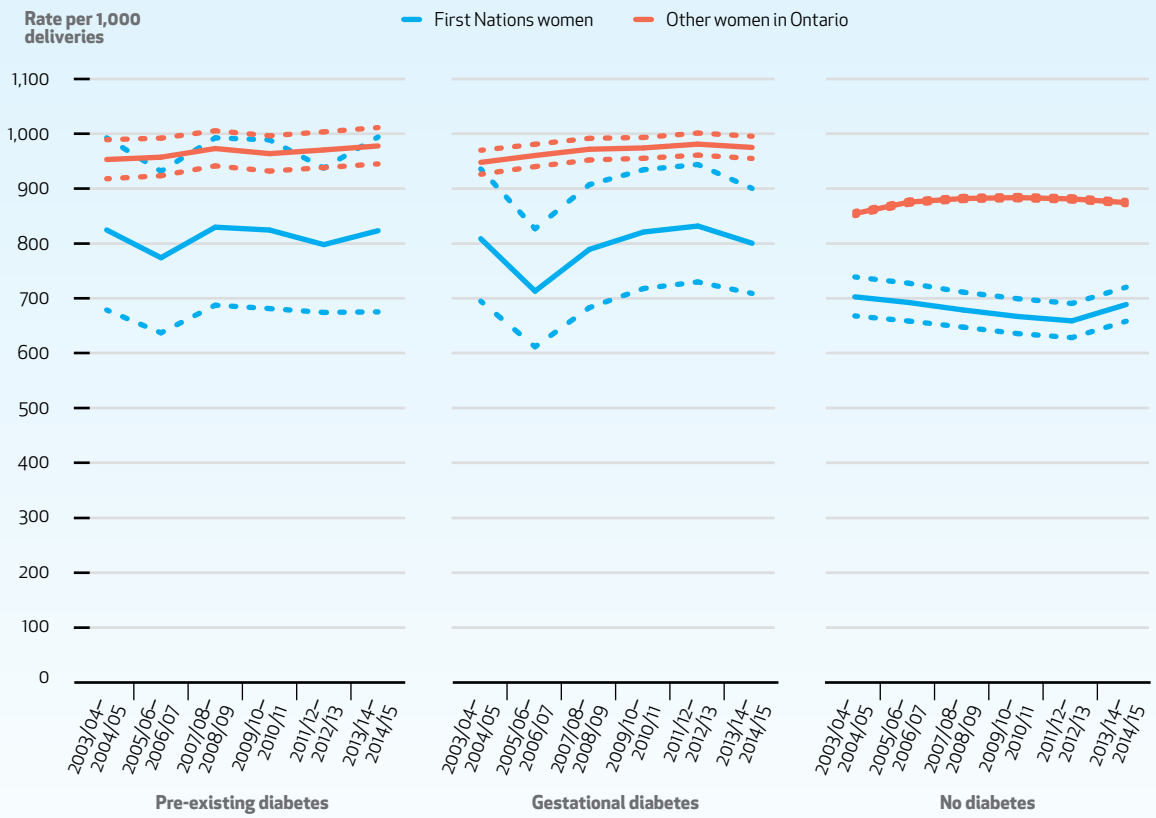


Dashed lines represent 95% confidence intervals.

EXHIBIT 14.13 Age-adjusted number of women with at least one visit to a primary care physician in the 280 days prior to hospital admission for delivery per 1,000 deliveries, among First Nations women and other women in Ontario, by type and absence of diabetes, in 2-year increments from 2003/04 to 2014/15

Key Findings

- Between 2003/04 and 2014/15, approximately 80% of First Nations women were seen by a primary care physician during pregnancy, independent of their diabetes status; the rate was about 100% for other women in Ontario.



Dashed lines represent 95% confidence intervals.

Discussion

Important gaps in data collection continue to exist for First Nations women compared with other women in Ontario. In line with other population-based studies in Canada,[6,7,9,11] our investigation of pregnancy in Ontario indicates that the prevalence of pre-existing diabetes and gestational diabetes is higher among First Nations women.

We compared our study of maternal outcomes for women in Ontario with those in an Alberta study and found the following:

- Preeclampsia rates were higher for First Nations women than for other women in Ontario. The difference was greater among women with pre-existing diabetes and gestational diabetes compared to women with no diabetes; this is supported by a study finding that women with pre-existing diabetes and gestational diabetes are more likely to develop preeclampsia.[2] In Alberta, a lower rate of pregnancy-induced hypertension was reported in First Nations women compared to the other women in that province; no difference was found between the two populations in women with diabetes during pregnancy.[8]

- Rates of labour induction were higher for First Nations women compared to other women in Ontario, especially among those with pre-existing diabetes and gestational diabetes. In Alberta, rates of labour induction were similar between First Nations women and other women, independent of their diabetes status.[8]

- Among women with pre-existing diabetes and gestational diabetes, First Nations women had a higher rate of cesarean deliveries compared to other women in Ontario. In Alberta, lower caesarean rates were reported for First Nations women, independent of their diabetes status.[8]

- Differences in the health of First Nations women in Ontario and Alberta, as well as in access to health care, may explain the differences found in maternal health of First Nations women in the two provinces.[8]

We observed the following perinatal outcomes in our study:

- First Nations women did not appear to be at higher risk for pre-term births compared to other women in Ontario. Previous studies comparing pregnancy outcomes in women with pre-existing or gestational diabetes reported a higher rate of pre-term births among First Nations women living in First Nations communities compared to other women in Ontario.[7,9]

- Although First Nations babies are larger for their gestational age compared to other babies in Ontario,[8,9] we did not find a difference in the rate of obstructed labour for First Nations women and other women in Ontario.

- Women with pre-existing diabetes had a higher rate of congenital anomalies than women with gestational or no diabetes, which is consistent with the literature.[12,13] We found that rates of congenital anomalies were higher among First Nations women, an outcome supported by another study.[8,9] In our study, even First Nations women with gestational diabetes had a greater risk of congenital anomalies compared to other women. It is usually thought that gestational diabetes does not increased the risk for anomalies because the glucose intolerance occurs after organogenesis has finished. This finding suggests there may be a burden of undiagnosed type 2 diabetes among those First Nations women labelled as gestational diabetes, supporting the need for greater screening for type 2 diabetes in First Nations women of reproductive age.

- Rates of stillbirths were higher for First Nations women than for other women in Ontario, regardless of diabetes status; this has also been reported in the literature.[14] The difference was greater among women with pre-existing diabetes, a known risk factor for stillbirths.[9,12,14,15]

With regard to health services access and use, the fact that almost all First Nations women and other women in Ontario, independent of their diabetes status, were seen by a primary care provider during pregnancy is a positive indicator. We found that access to specialized care differed for First Nations women and other women in Ontario, with First Nations women with pre-existing diabetes having

less access to specialized care (internal medicine or endocrinology), a finding supported by another Ontario study.[7] Among pregnant women with pre-existing diabetes, there was no difference between First Nations women and other women in Ontario with regard to the number of consultations with ophthalmologists; however, only about 18% of women in either group visited an ophthalmologist during pregnancy, a very low proportion considering that all women with pre-existing diabetes should be seen by an ophthalmologist before and during pregnancy, as recommended by current guidelines.[16]

Our results confirm disparities in maternal and perinatal outcomes between First Nations women and other women in Ontario. While access to and utilization of health services at the primary care level seem adequate, access to specialized care, especially for women with pre-existing diabetes, needs to improve, as adequate antenatal care and control of sugar levels before and during pregnancy are associated with better pregnancy outcomes.[13]

Limitations

First, women with pre-existing diabetes may have been misclassified as having gestational diabetes due to incomplete capture of such cases by the Ontario Diabetes Database. In addition, the database's algorithm does not distinguish between type 1 and type 2 diabetes. However, compared to other women in Ontario, a much greater proportion of First Nations women with pre-existing diabetes are likely have type 2 diabetes, and this may be driving some of the difference in adverse outcomes. Second, due to the limitations of small sample sizes, we were unable to compare maternal and infant outcomes between First Nations women living in and outside of First Nations communities.

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15 Diabetes in Children

Inside

Authors

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Overview

The prevalence of type 2 diabetes in children is increasing worldwide.[1-3] Using data from a national surveillance study conducted in 2006–2008, the incidence of childhood-onset type 2 diabetes in Canada was estimated at 1.5 per 100,000 per year with the highest incidence in Manitoba; in Ontario, the incidence was 1.7 per 100,000 per year.[4] In the same study, First Nations children in Canada were estimated to have the highest incidence of type 2 diabetes at 23.2 per 100,000 per year. In Manitoba and Northwestern Ontario, 87% of children diagnosed with type 2 diabetes between 2006 and 2011 were of First Nations heritage.[5] First Nations status is known to be associated with the risk of developing type 2 diabetes in the first 30 years of life.[6] In a population-based cohort of all children aged 1–18 years, those with type 2 diabetes developed complications at an earlier age than those with type 1 diabetes.[7] The population-based incidence and outcomes of diabetes among First Nations children in Ontario are not known.

Methods

This chapter reports on outcomes among individuals aged 19 years and younger. Definitions for HbA1c monitoring, emergency department visits and hospitalizations, and eye examinations can be found in chapters 6, 8 and 12, respectively. It is important to note that the algorithm used to identify diabetes in children is slightly different than that for adults. A total of four OHIP claims for diabetes in a 2-year period was used to identify children with diabetes,[8] compared to two claims in 2 years for adults.[9] The algorithm does not distinguish between different types of diabetes.

To remain consistent with the pediatric literature, we have reported prevalence per 100 children per year and incidence per 100,000 children per year. Because of small sample sizes, we were rarely able to present data comparing First Nations children living in and outside of First Nations communities.

Results

Demographic characteristics

Those aged 19 years and younger make up a higher proportion of the First Nations population compared with the population of other people in Ontario; however the difference between the two populations has declined in recent years (exhibit 15.1). A higher percentage of First Nations children live in semi-urban and rural areas compared to other children in Ontario (exhibit 15.2). In 2014/15, the largest proportion (42.2%) of the province's First Nations children lived in the Southern Ontario zone (exhibit 15.3). In that same year, First Nations populations in the North East and North West LHINs had the largest proportions of children (22.3% and 33.3% of the population, respectively) (exhibit 15.4).

Diabetes prevalence and incidence

The crude prevalence of diabetes in First Nations and other children with diabetes from 1995/6 to 2014/15 are shown in exhibit 15.5. In 1995/96, the prevalence of diabetes was similar in the two populations, but it diverged over time and by 2014/15, it was more than 50% higher among First Nations children. Compared to other children in Ontario, the prevalence of diabetes among First Nations children was higher in urban, semi-urban and rural settings in 2014/15 (exhibit 15.6). In the same year, diabetes prevalence among First Nations children was highest in the Moose Factory and Sioux Lookout zones (exhibit 15.7). Between 1995/96 and 2014/15, the incidence of diabetes per 100,000 children increased from 38.4 to 93.6 among First Nations children and from 22.6 to 45.8 among other children in Ontario (exhibit 15.8).

Acute diabetes complications

The proportion of both First Nations children and other children in Ontario with diabetes who had at least one emergency department visit annually for hypo- or hyperglycemia decreased between 2002/03 and 2014/15. In 2014/15, 4.8% of First

Nations children and 8.8% of other children with diabetes had at least one emergency department visit for hypo- or hyperglycemia (exhibit 15.9). From 2002/03 to 2006/07, there was a rapid decrease in the proportion of First Nations children with diabetes who had at least one hospitalization for hypo- or hyperglycemia. After 2006/07, that proportion decreased more slowly and became similar to the proportion of other children in Ontario (exhibit 15.10).

Visits to physician specialists

In 2014/15, 36.6% of First Nations children and 63.5% of other children with diabetes visited a pediatrician or an endocrinologist for diabetes (exhibit 15.11). Among other people in Ontario, utilization of specialists was similar regardless of where people lived; however, for First Nations children there were differences by level of rurality (exhibit 15.12).

Glycemic control and monitoring for retinopathy

In 2014/15, 42.1% of First Nations children and 35.6% of other children in Ontario with prevalent diabetes had at least one HbA1c test result; this likely reflects incompleteness of the OLIS data. In 2014/15, the median HbA1c level was 9.1 (IQR, 6.7–11.3) for First Nations children and 8.3 (IQR, 7.1–9.6) for other children. In 2014/15, 52.3% of First Nations children and 45.1% of other children had an HbA1c level of 8.5% or greater (exhibit 15.13). In 2014, among individuals aged 16 to 17 with diabetes for 5 or more years, 71.4% of First Nations children and 75.5% of other children had at least one eye exam in the previous 2 years (exhibit 15.14).

EXHIBIT 15.1 Percentage of the population aged 0 to 19 years, among First Nations people and other people in Ontario, 1995/96 to 2014/15

Key Findings

- Young people aged 19 years and younger made up a higher proportion of the First Nations population compared with the population of other people in Ontario.
- This difference narrowed in more recent years; in 2014/15, those aged 19 years and younger made up 28.3% of the First Nations population and 21.4% of the population of other people in Ontario, compared to 39.7% and 25.6%, respectively, in 1995/96.

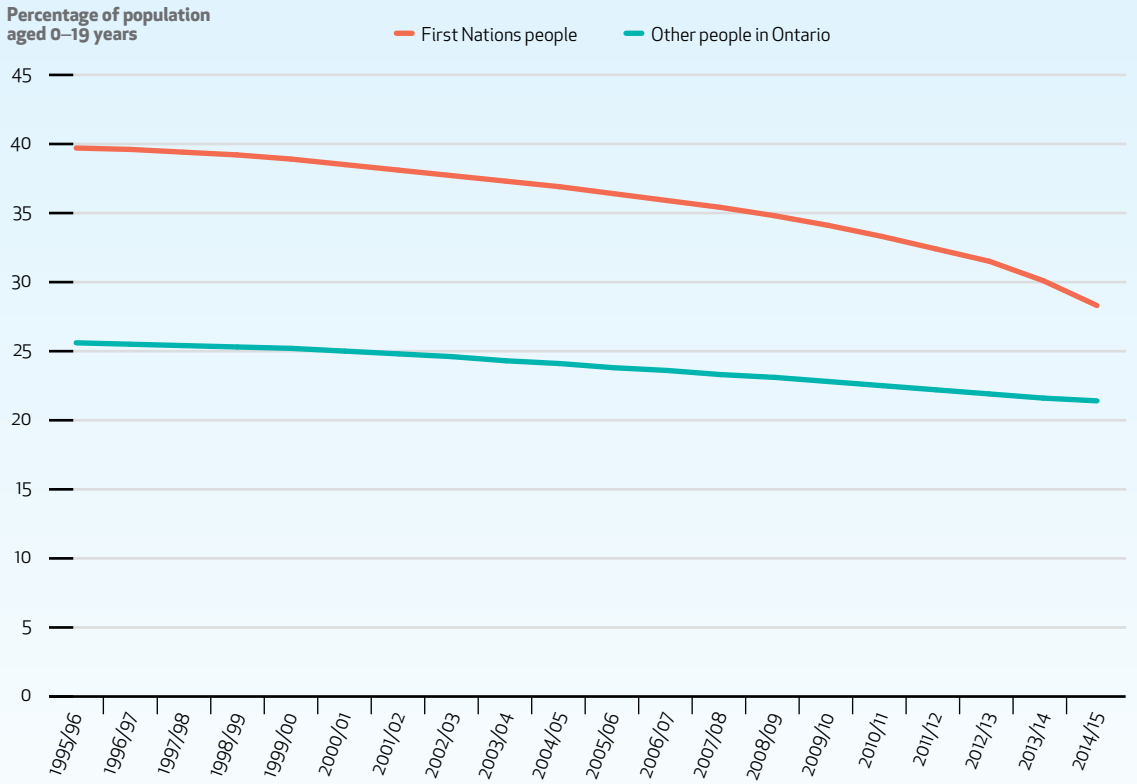


EXHIBIT 15.2 Percentage of children aged 0 to 19 years, among First Nations people and other people in Ontario, by level of rurality 2014/15

Key Findings

- In 2014/15, First Nations children were more equally distributed among urban, semi-urban and rural areas in Ontario (28.6%, 18.0% and 22.4%, respectively) compared to other children, of whom 74.3% lived in urban areas.

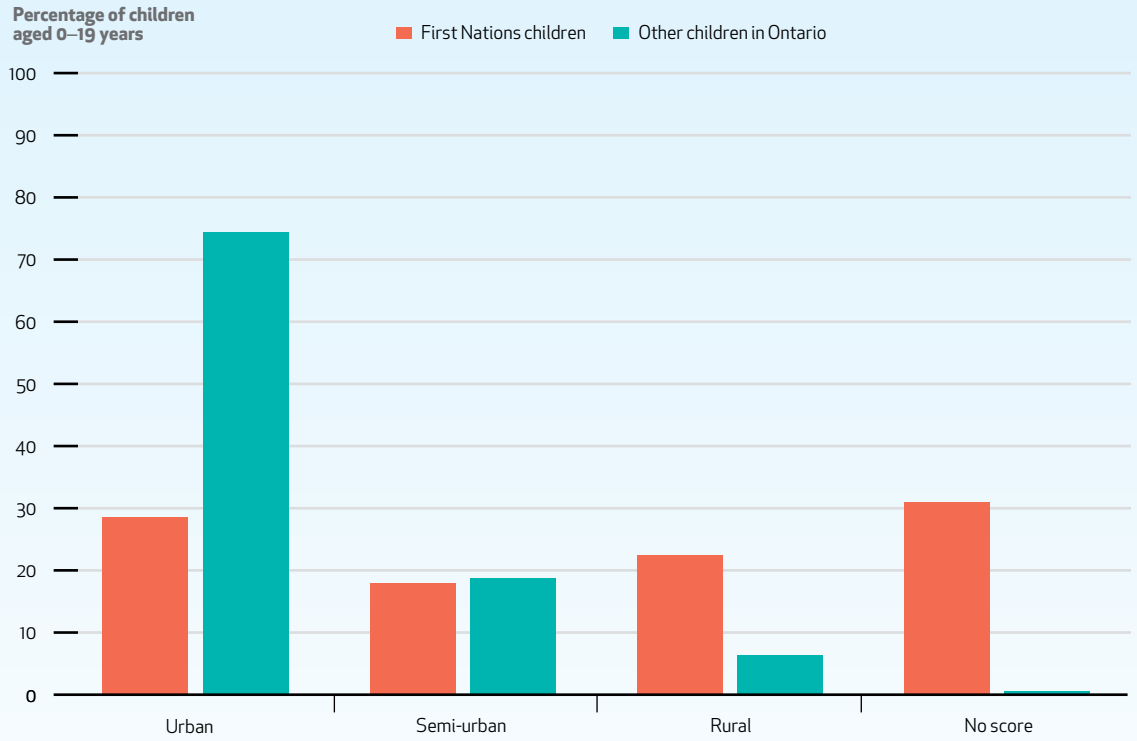


EXHIBIT 15.3 Distribution of the population of First Nations children aged 0 to 19 years among Health Canada zones in Ontario, 2014/15

Key Findings

- In 2014/15, the largest proportion (42.2%) of the province's First Nations children lived in the Southern Ontario zone.

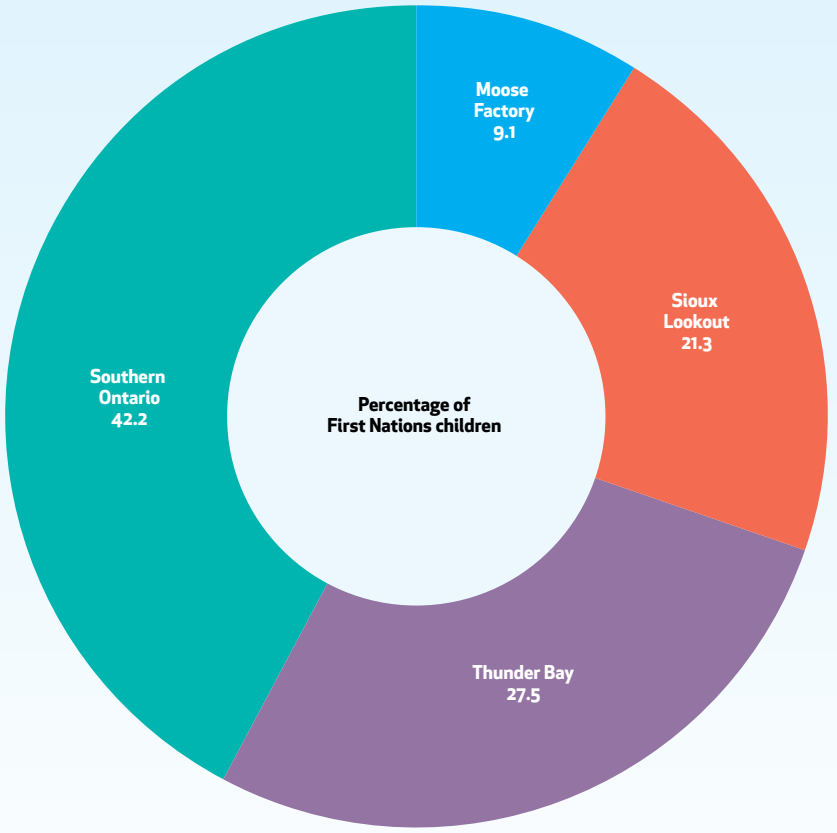


EXHIBIT 15.4 Percentage of children aged 0 to 19 years, among First Nations people and other people in Ontario, by Local Health Integration Network, 2014/15

Key Findings

- In 2014/15, First Nations populations in the North East and North West LHINs had the largest proportion of children (22.3% and 33.3%, respectively). Among other people in Ontario, the Central LHIN had the largest proportion of children (14.0%).

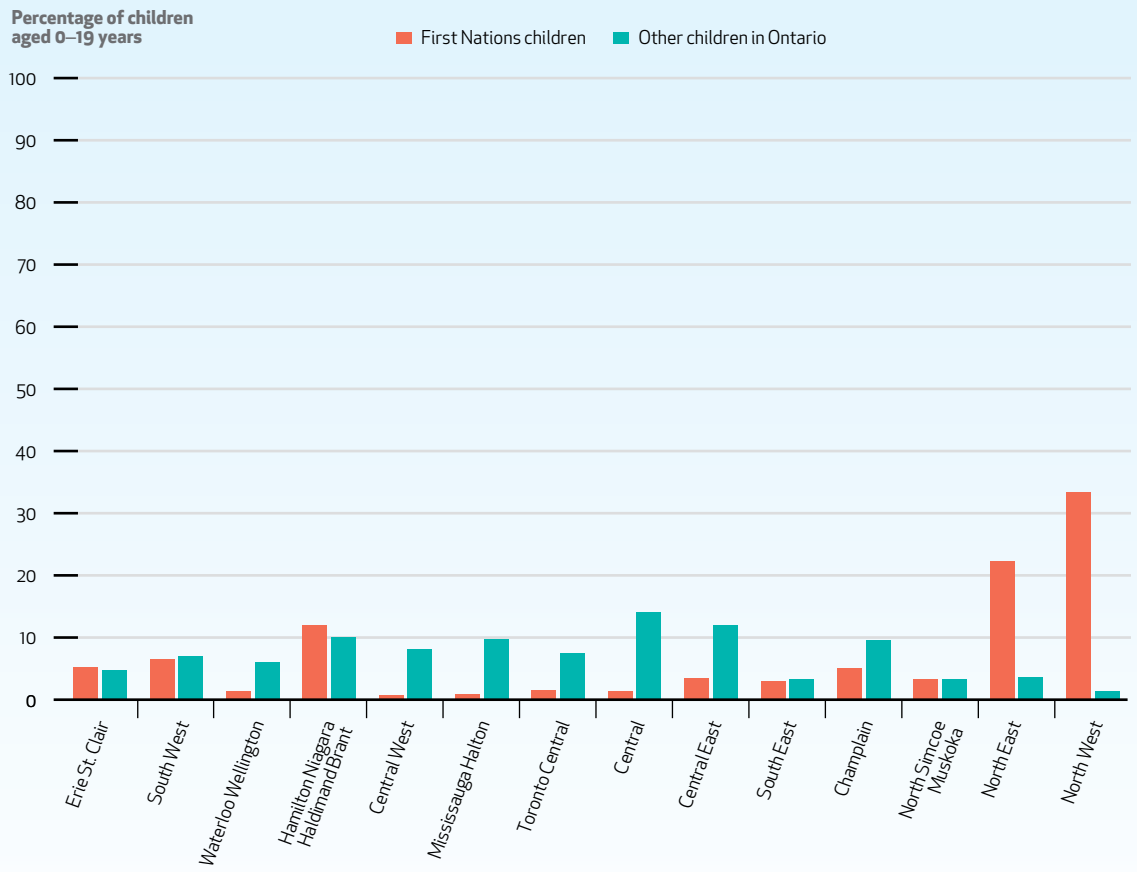
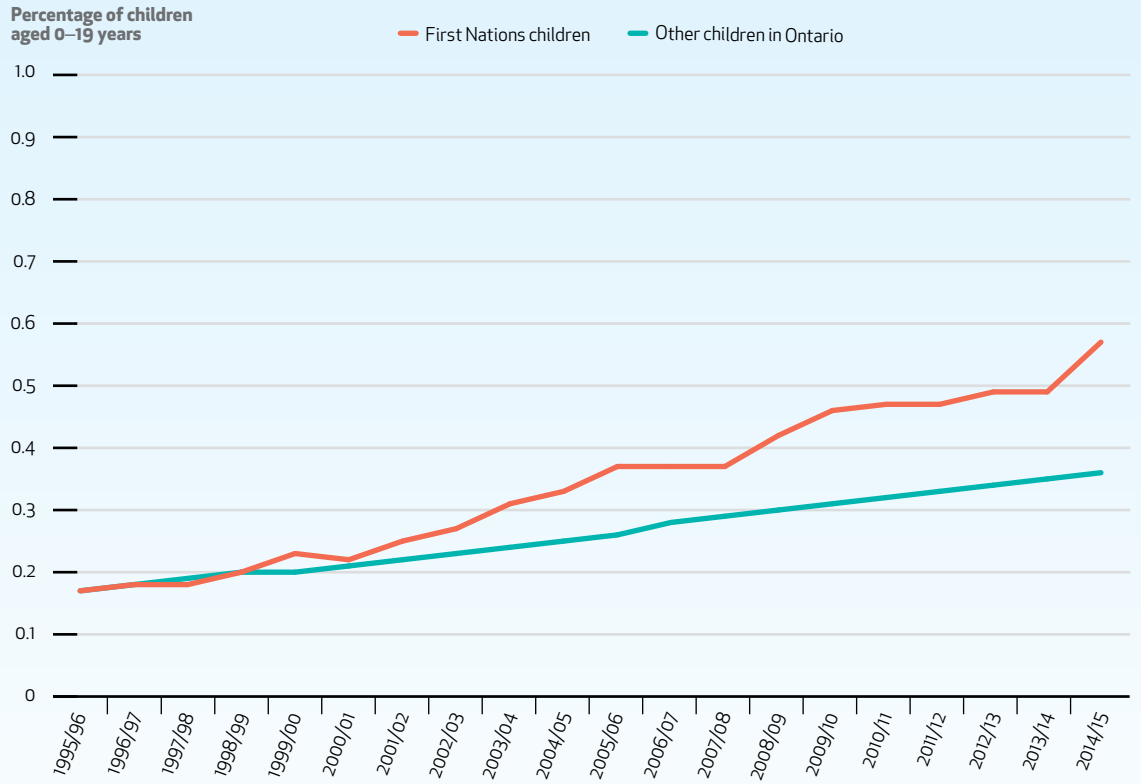


EXHIBIT 15.5 Crude prevalence of diabetes* per 100 children aged 0 to 19 years, among First Nations children and other children in Ontario, 1995/96 to 2014/15

Key Findings

- Between 1995/96 and 2014/15, the prevalence of diabetes increased for both First Nations children and other children in Ontario.
- Between 2000/01 and 2014/15, the prevalence of diabetes increased at a faster rate among First Nations children compared with other children in Ontario.
- Among First Nations children, the prevalence of diabetes per 100 children rose from 0.17 in 1995 to 0.57 in 2014/15.

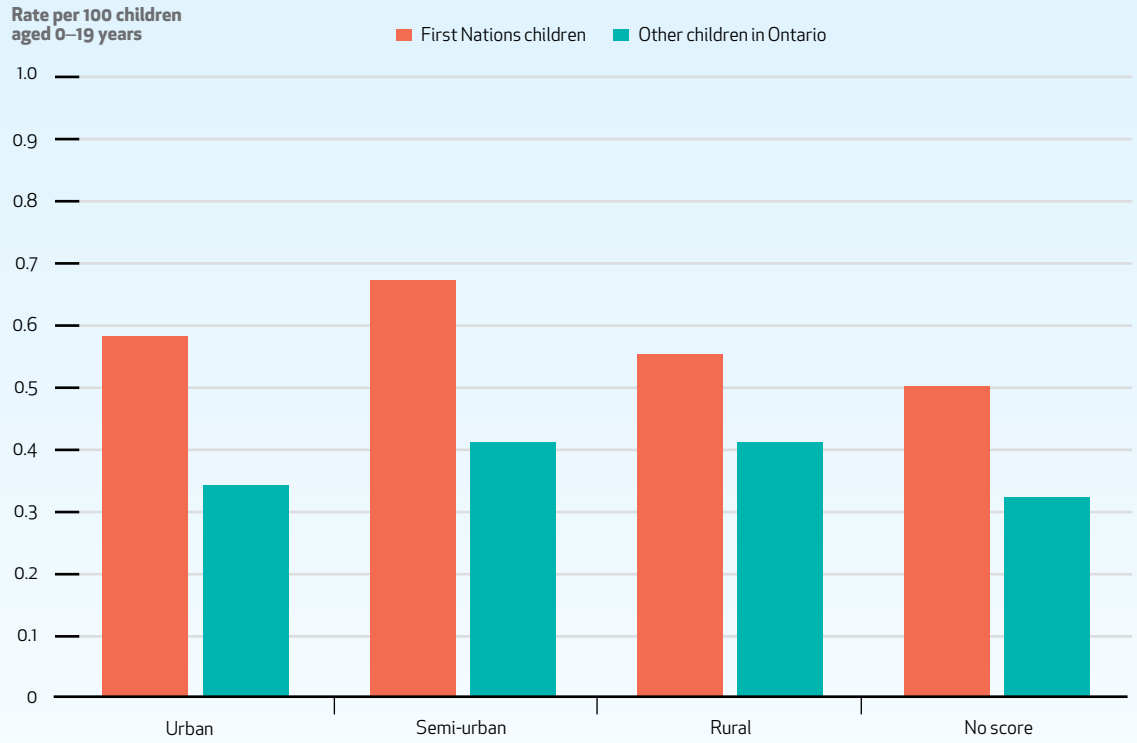


*Includes all types of diabetes.

EXHIBIT 15.6 Crude prevalence of diabetes* among children aged 0 to 19 years, among First Nations children and other children in Ontario, by level of rurality, 2014/15

Key Findings

- In all three settings (urban, semi-urban and rural), the prevalence of diabetes among First Nations children exceeded that of other children in Ontario in 2014/15.
- For First Nations children, diabetes prevalence was greater in semi-urban and urban areas than in rural areas (respectively, 0.67, 0.58 and 0.55 per 100 children). For other children in Ontario, diabetes prevalence was greater in semi-urban and rural areas than in urban areas (respectively, 0.41, 0.41 and 0.34 per 100 children).

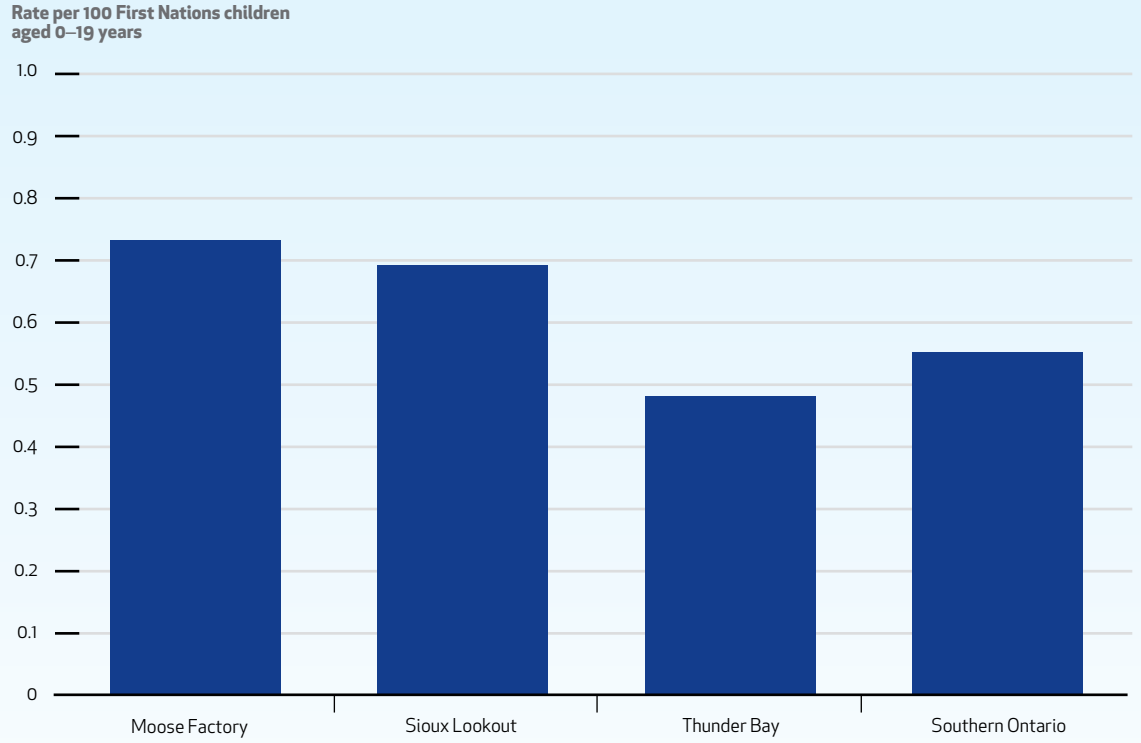


*Includes all types of diabetes.

EXHIBIT 15.7 Crude prevalence of diabetes* among First Nations children aged 0 to 19 years in Ontario, by Health Canada zone, 2014/15

Key Findings

- In 2014/15, diabetes prevalence among First Nations children was highest in the Moose Factory and Sioux Lookout zones (respectively, 0.73 and 0.69 per 100 children).

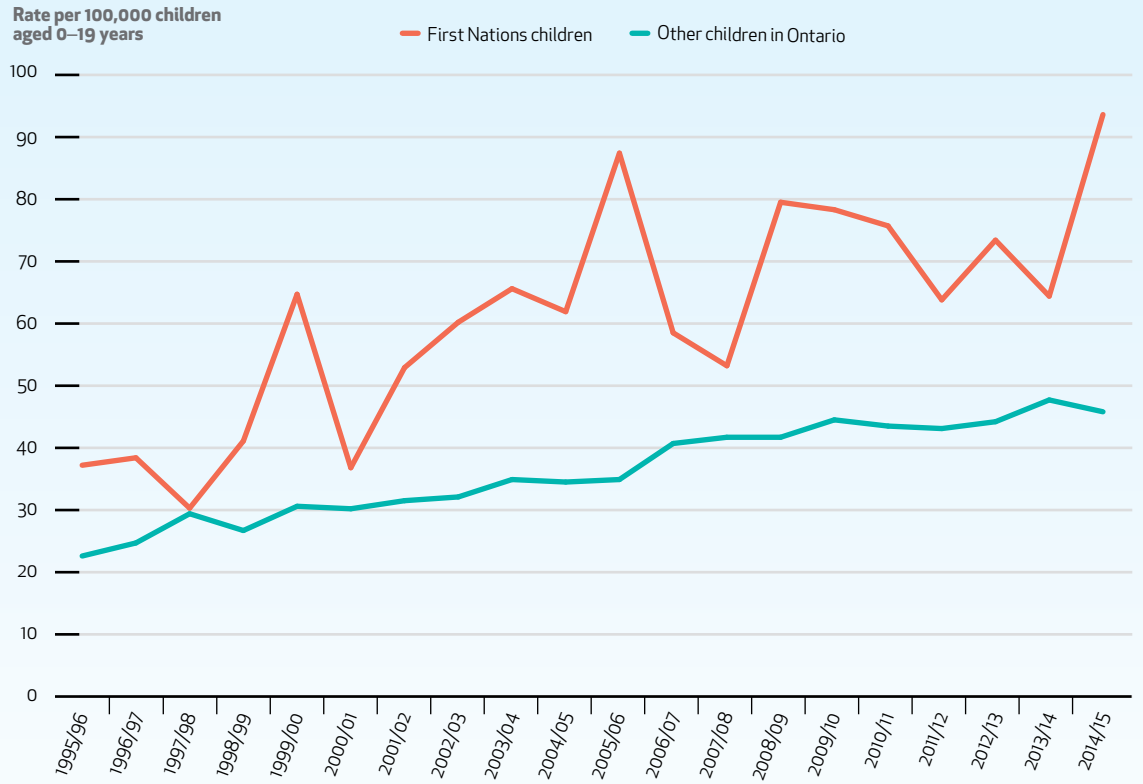


*Includes all types of diabetes.

EXHIBIT 15.8 Crude incidence of diabetes* in individuals aged 0 to 19 years, among First Nations children and other children in Ontario, 1995/96 to 2014/15

Key Findings

- Between 1995/96 and 2014/15, the incidence of diabetes per 100,000 children increased from 38.4 to 93.6 among First Nations children and from 22.6 to 45.8 among other children in Ontario.
- Between 1995/96 and 2014/15, the incidence of diabetes among First Nations children and other children in Ontario increased by 150% and 102%, respectively.
- The fluctuation in the incidence of diabetes among First Nations children is likely a reflection of the relatively small sample size of this group.

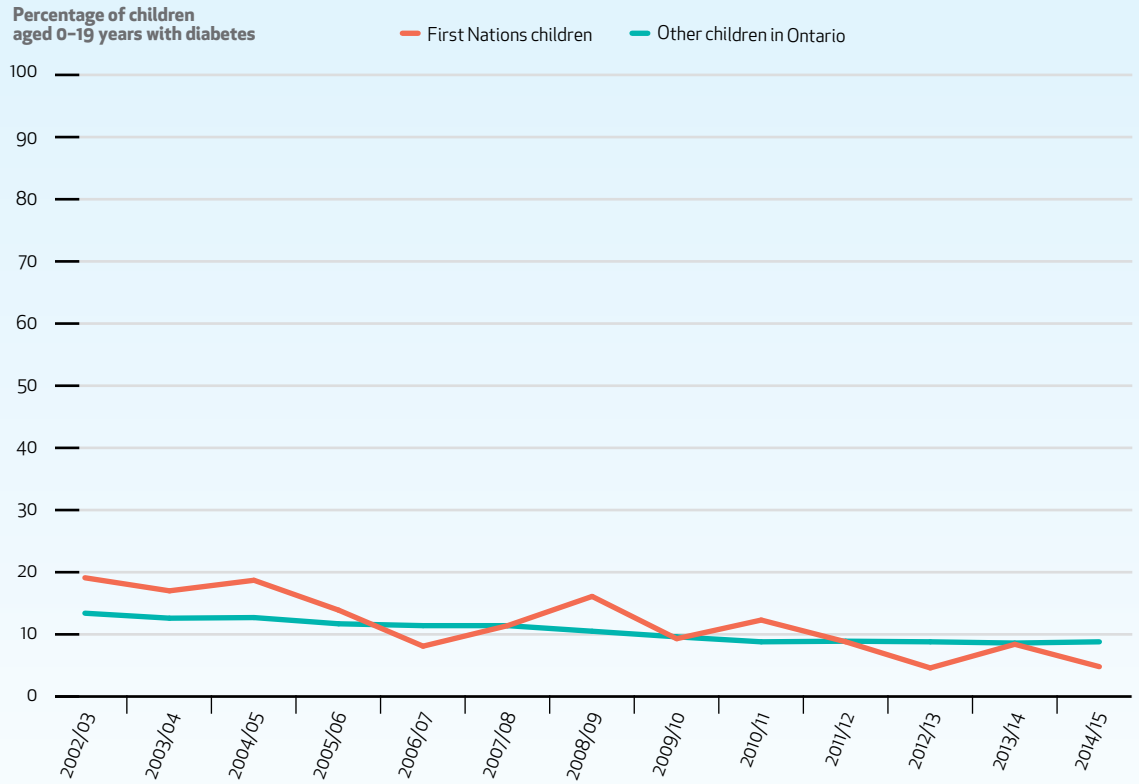


* Includes all types of diabetes.

EXHIBIT 15.9 Percentage of individuals aged 0 to 19 years with diabetes* and at least one emergency department visit for hypo- or hyperglycemia, among First Nations children and other children in Ontario, 2002/03 to 2014/15

Key Findings

- For both First Nations children and other children in Ontario with diabetes, the proportion who had at least one emergency department visit for hypo- or hyperglycemia per year decreased between 2002/03 and 2014/15.
- In 2014/15, 4.8% of First Nations children and 8.8% of other children with diabetes had at least one emergency department visit for hypo- or hyperglycemia.
- The large variation in the annual proportion of First Nations children with an emergency department visit for hypo- or hyperglycemia is likely due to the relatively small sample size.

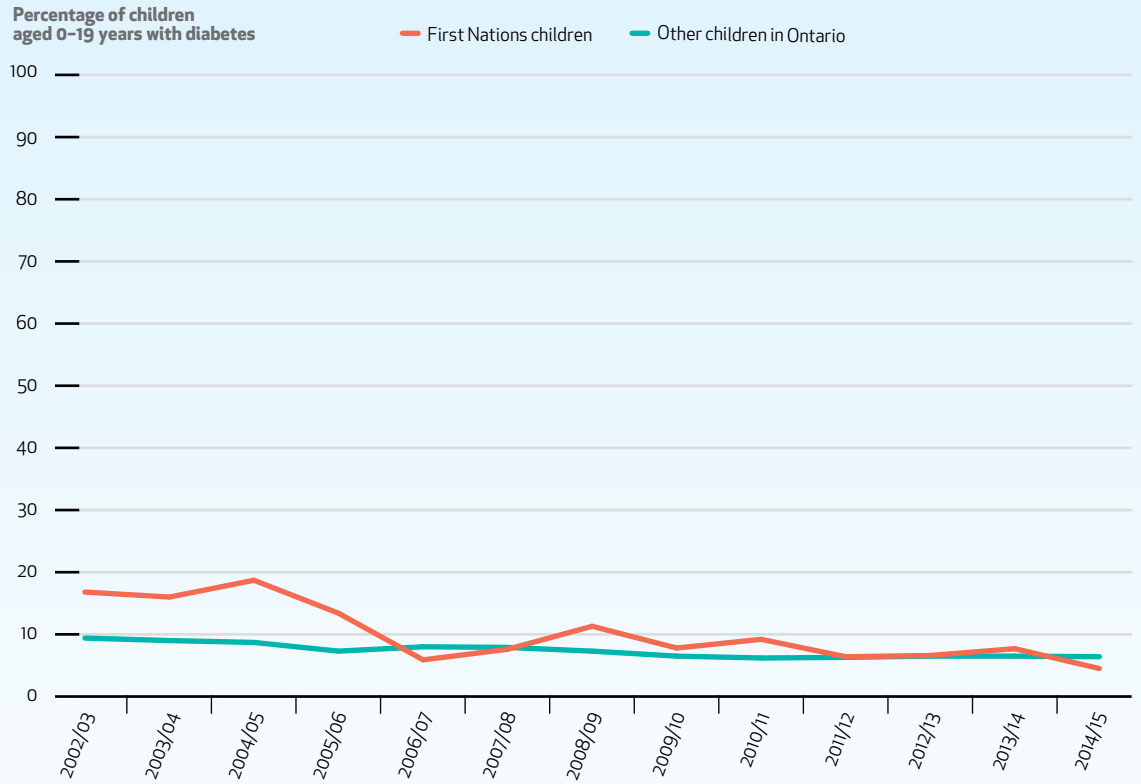


*Includes all types of diabetes.

EXHIBIT 15.10 Percentage of individuals aged 0 to 19 years with diabetes* and at least one hospitalization for hypo- or hyperglycemia, among First Nations children and other children in Ontario, 2002/03 to 2014/15

Key Findings

- Between 2002/03 to 2014/15, the proportion of children with diabetes who had at least one hospitalization for hypo- or hyperglycemia decreased among both First Nations children and other children in Ontario.
- From 2002/03 to 2006/07, there was a rapid decrease in the proportion of First Nations children with diabetes who had at least one hospitalization for hypo- or hyperglycemia. After 2006/07, that proportion decreased more slowly and became similar to that of other children in Ontario.

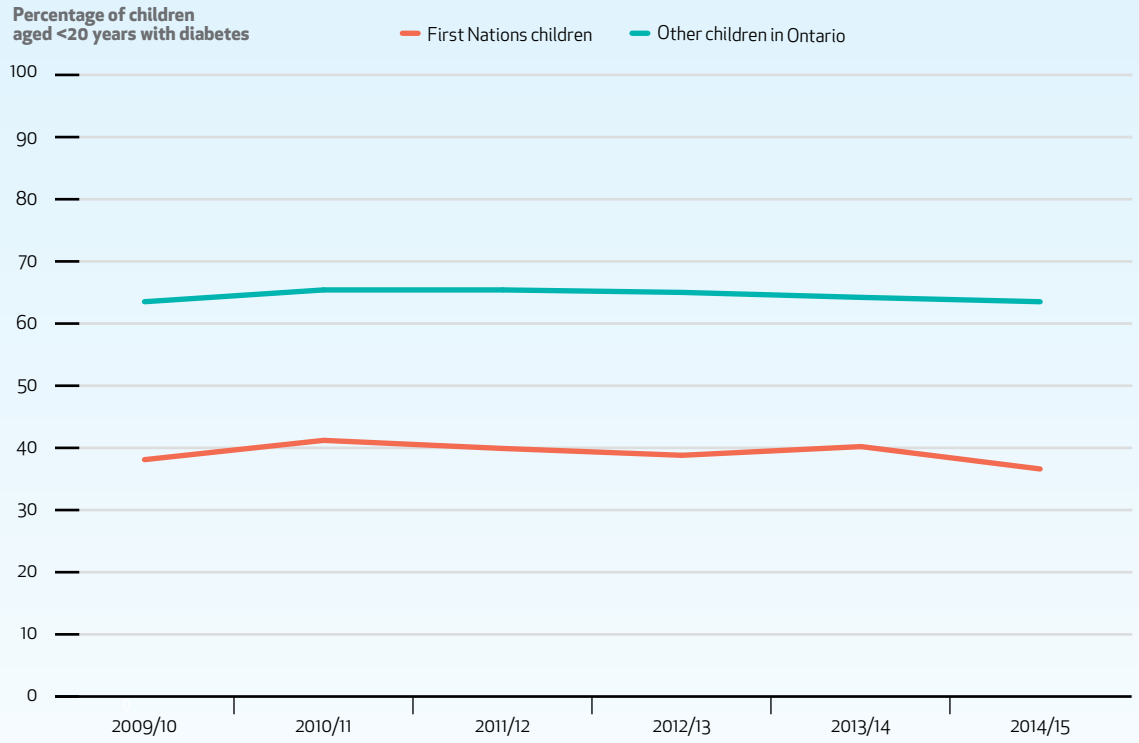


*Includes all types of diabetes.

EXHIBIT 15.11 Percentage of individuals younger than 20 years with diabetes* and at least one visit in the previous 12 months to a pediatrician or endocrinologist for a diagnosis of diabetes, among First Nations children and other children in Ontario, 2009/10 to 2014/15

Key Findings

- In 2014/15, 36.6% of First Nations children and 63.5% of other children visited a pediatrician or an endocrinologist for diabetes.
- Among both First Nations children and other children with diabetes, the proportion who visited a pediatrician or an endocrinologist for diabetes was stable between 2009/10 and 2014/15.

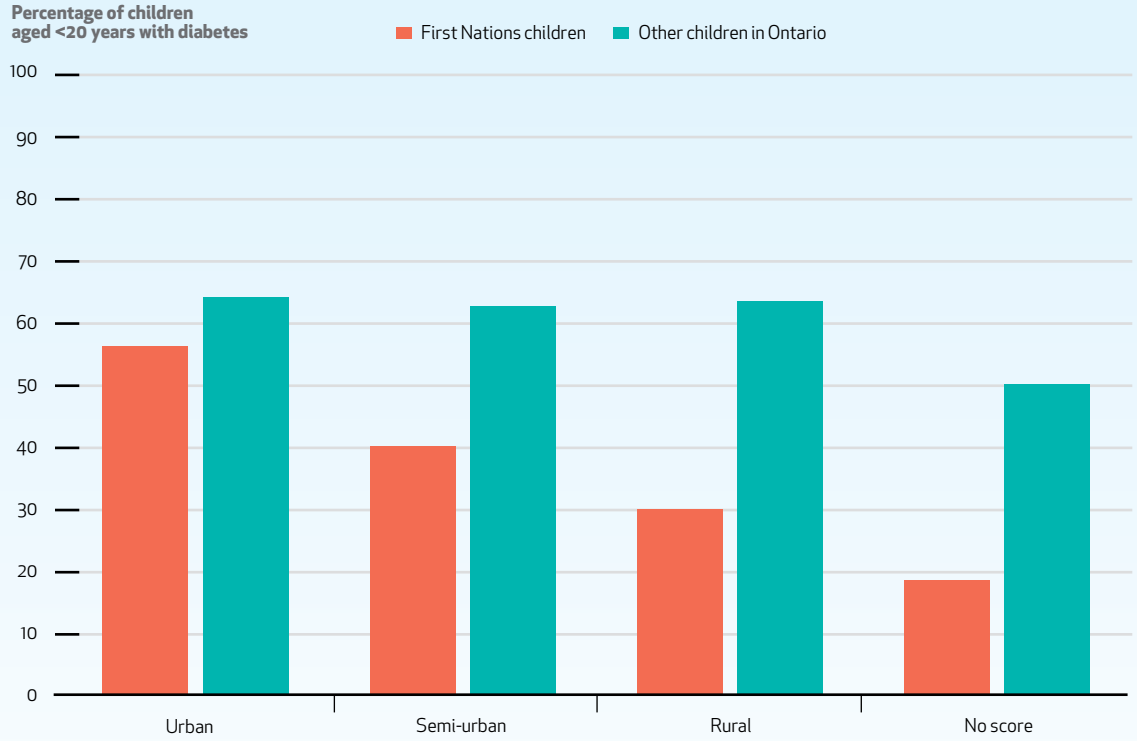


*Includes all types of diabetes.

EXHIBIT 15.12 Percentage of individuals younger than 20 years with diabetes* and at least one visit to a pediatrician or endocrinologist in the previous 12 months for a diagnosis of diabetes, among First Nations children and other children in Ontario, by level of rurality, 2014/15

Key Findings

- Among First Nations children with diabetes, 56.1% of those living in urban areas in 2014/15 had a visit with a pediatrician or endocrinologist for diabetes compared to 29.9% of those living in rural areas.
- Among other children in Ontario, utilization of these specialists was similar regardless of the setting.

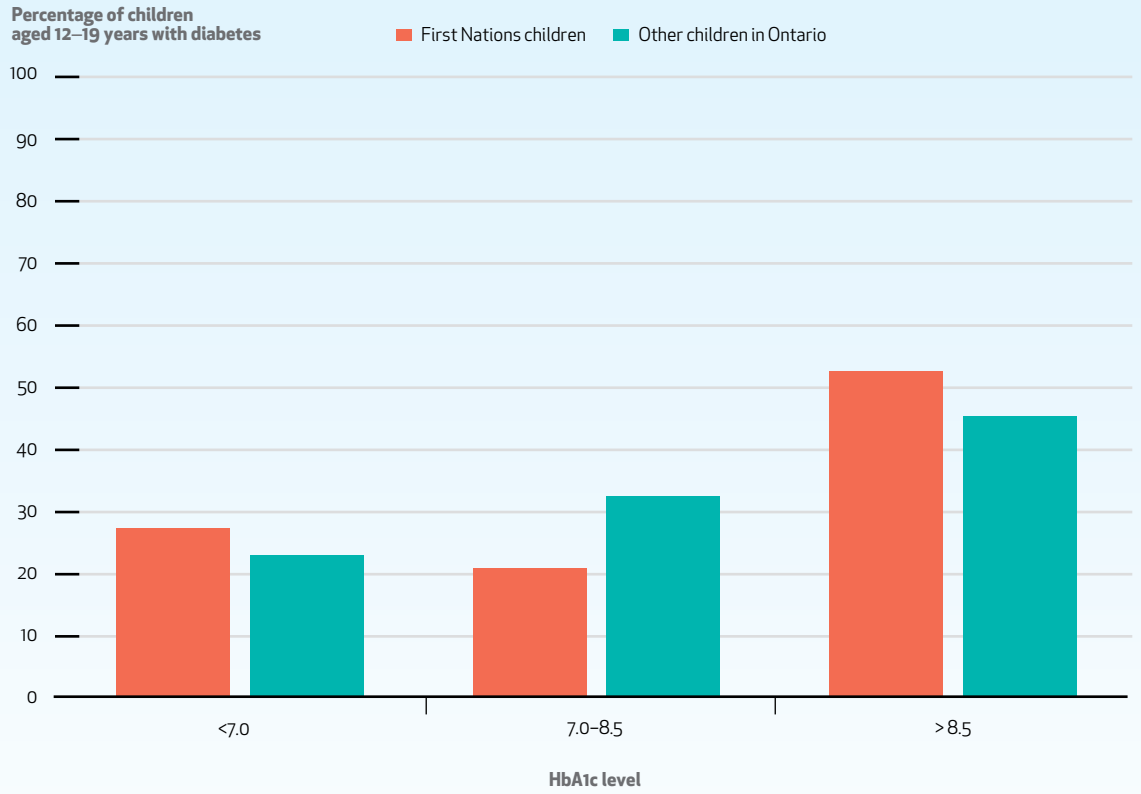


*Includes all types of diabetes.

EXHIBIT 15.13 Percentage of individuals aged 12 to 19 years with diabetes* who had an HbA1c test result in the Ontario Laboratories Information System, among First Nations children and other children in Ontario, by HbA1c level, 2014/15

Key Findings

- In 2014/15, 42.1% of First Nations children and 35.6% of other children with prevalent diabetes had at least one HbA1c test result available in OLIS.
- In 2014/15, the median HbA1c level was 9.1% (IQR, 6.7–11.3) for First Nations children and 8.3% (IQR, 7.1–9.6) for other children.
- In 2014/15, 52.3% of First Nations children and 45.1% of other children had an HbA1c level of 8.5% or greater.

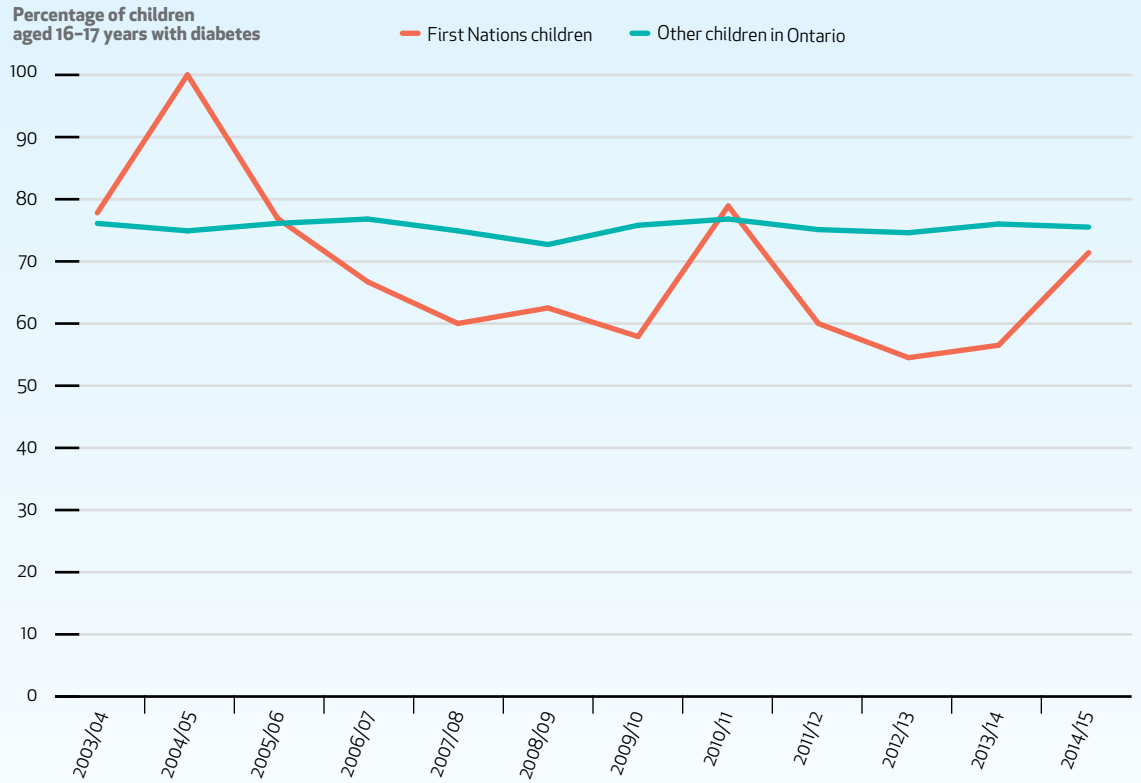


*Includes all types of diabetes.

EXHIBIT 15.14 Percentage of individuals aged 16 to 17 years with diabetes* for 5 or more years who had an eye examination in the previous 24 months, among First Nations children and other children in Ontario, 2003/04 to 2014/15

Key Findings

- In 2014/15, among individuals aged 16 to 17 with diabetes for 5 or more years, 71.4% of First Nations children and 75.5% of other children had at least one eye examination in the previous 2 years.
- Between 2003/04 and 2014/15, there was no change in the proportion of other children in Ontario with diabetes who had an eye examination in the previous 24 months.
- In more recent years, fewer First Nations children with diabetes had an eye examination in the previous 24 months, compared with other children in Ontario.



*Includes all types of diabetes.

Discussion

Individuals aged 19 years and younger continue to make up a higher proportion of the First Nations population compared with Ontario's general population. Compared to other children in Ontario, a higher proportion of First Nations children live outside of urban areas. The largest proportion of First Nations children in Ontario live in southern Ontario and in the North East and North West Local Health Integration Networks.

We found that First Nations children in Ontario are disproportionately affected by diabetes. This is likely driven by an increased incidence of type 2 diabetes, as type 1 diabetes is uncommon in First Nation populations.[7] This is consistent with findings from other studies conducted in Canada and the United States.[2,4,5] First Nations children with diabetes, particularly those living in rural areas, did not receive diabetes care from pediatricians or endocrinologists in accordance with clinical practice guidelines that were relevant during the years from which our data were collected.[10] It is concerning that glycemic control is very poor among First Nations children with diabetes; this puts them at increased risk for diabetes complications.

Limitations

We were unable to determine the type of diabetes from the billing codes in the health administrative data sources because the physician claims data use only three-digit ICD diagnosis codes that do not allow for differentiation by type. Because the ICES data only include claims from physicians and health care facilities in Ontario, we were unable to fully capture out-of-province care; however, we do know that in 2016 the Children's Hospital in Winnipeg, Manitoba, provided pediatric diabetes care to 86 youth who reside in Northwestern Ontario.[11] There are several limitations to the OLIS data, as detailed in chapter 6. A specific limitation of these data for measuring HbA1c in children is that major pediatric hospitals such as The Hospital for Sick Children and the Children's Hospital of Eastern Ontario do not contribute laboratory data to OLIS.

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