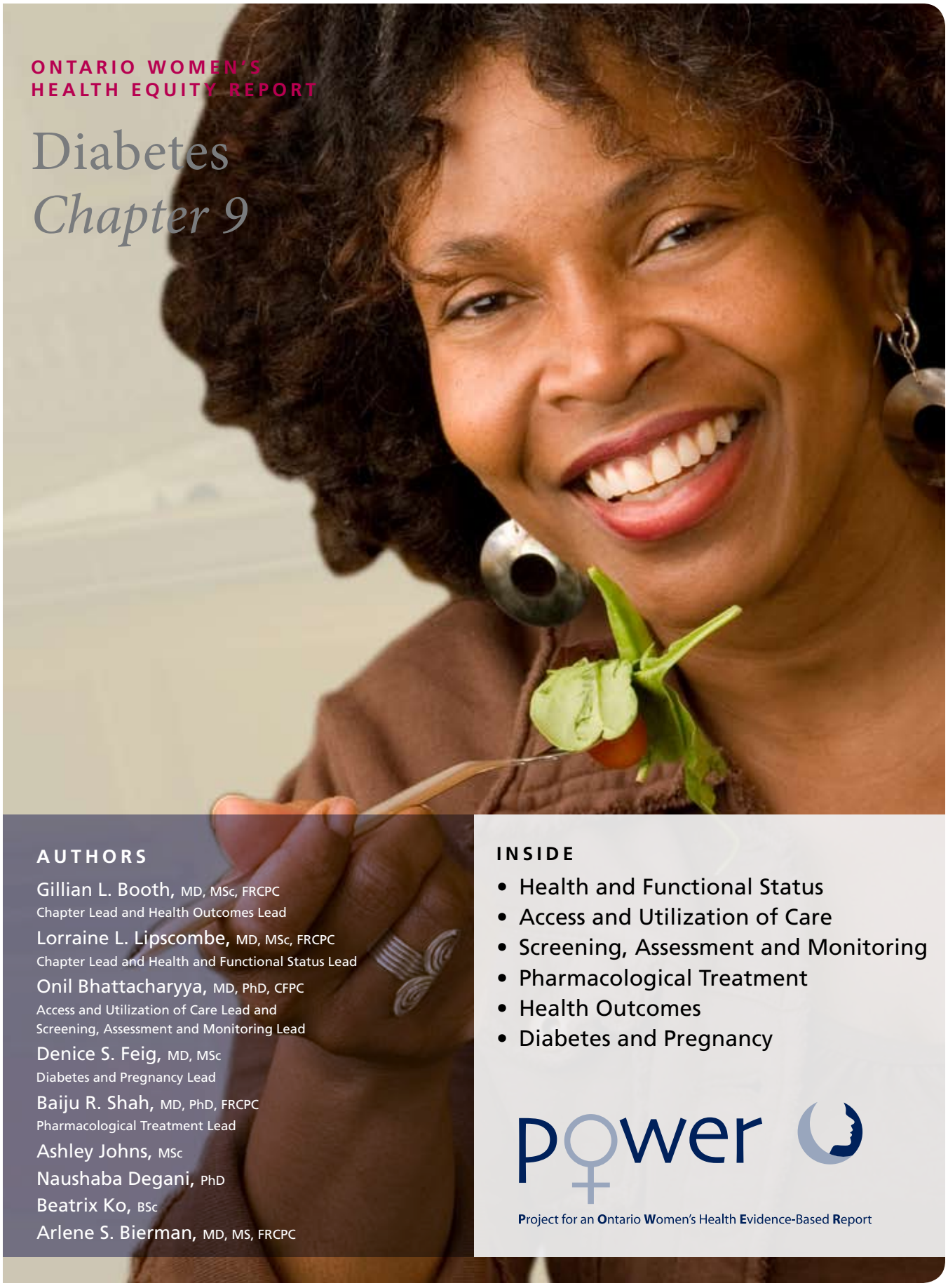

ONTARIO WOMEN'S HEALTH EQUITY REPORT

Diabetes
Chapter 9

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Improving Health and Promoting Health Equity in Ontario

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Executive Summary

ISSUE

In Canada, more than three million Canadians have diabetes and this number is expected to climb significantly over the next decade.

It is predicted that between 2007 and 2017, 1.9 million Canadians will develop diabetes. Recent data from Ontario indicate that the rate of diabetes has increased dramatically over the last decade and has already surpassed the global prevalence predicted by the World Health Organization for 2030. Diabetes is one of the leading causes of blindness, the most common cause of end-stage renal disease in the developed world, and a major cause of cardiovascular complications such as heart attack and stroke. Furthermore, the treatment is complex and costly with the direct health care costs of diabetes ranging from 2.5 to 15 percent of health budgets. The increasing prevalence, associated complications and treatment costs make diabetes one of the most costly and burdensome chronic diseases of our time.

Approximately 10 percent of people with diabetes have type 1 diabetes, which mainly presents in children and young adults and is caused by autoimmune destruction of insulin-producing cells in the pancreas. The increase in diabetes prevalence has largely been attributed to a rise in new cases of type 2 diabetes, which has an older age of onset and results in part from impaired insulin function, primarily due to a combination of behavioural risk factors and genetics. The increase in type 2 diabetes may be partly explained by the rise in risk factors such as obesity, sedentary lifestyle, unhealthy diets and the aging of the population. The increased migration of susceptible populations, accompanied by shifts in lifestyle, have added to the diabetes burden in the developed world. In addition, increased survival among people with diabetes has contributed to increasing prevalence.

Diabetes differentially affects certain populations—in terms of both incidence and complications. For example, low-income populations have a higher risk of developing diabetes and have worse outcomes once they have it. The risk of diabetes is also higher in certain immigrants and ethnic groups, such as those of South Asian, African, Hispanic and Aboriginal descent. Canadians living in rural regions have higher rates of diabetes compared to their urban counterparts. Evidence indicates that rural residents have worse access to care, lower incomes, and are more likely to have some behavioural risk factors that place them at risk for developing diabetes and other chronic conditions. While the prevalence of diabetes remains higher among men than women, recent data suggest that young women (aged 20-49) have seen the greatest relative increase in diabetes prevalence over the last decade. Not only do young women with diabetes have a potentially higher lifetime risk of complications because of an earlier diagnosis, but they may face other health issues such as reproductive problems and complications during pregnancy.

To address the burden of diabetes, Ontario has launched a comprehensive diabetes strategy that builds on internationally accepted best practices and the growing body of evidence supporting the organization of health care around chronic disease management. The strategy includes efforts to prevent diabetes onset; improve access to information and educational materials to promote diabetes self-management; enhance access to comprehensive, team-based care for people with diabetes; and support the optimal management of diabetes in clinical practice through the development of a province-wide diabetes registry.

ABOUT THIS CHAPTER

The chapter has six sections:

A. Health and Functional Status
B. Access and Utilization of Care
C. Screening, Assessment and Monitoring
D. Pharmacological Treatment
E. Health Outcomes
F. Diabetes and Pregnancy

In the first section, the **health and functional status** of Ontario women and men with diabetes is profiled including: prevalence, morbidity (the presence of other chronic conditions or probable depression), activity limitations, self-rated health and health behaviours. The second section includes indicators of **access and utilization of care,** including measures of primary and specialty physician care. In the section on **screening, assessment and monitoring,** clinical and self-monitoring of blood glucose and foot care as well as clinical monitoring of kidney function and eye examination are measured. In the section on **pharmacological treatment,** self-reported use of insulin and oral glucose-lowering medications is measured as well as the use of medications to treat hypertension and cholesterol among adults aged 65 and older with diabetes. The section on diabetes-related **health outcomes** includes measures of diabetes complications including glucose-related emergencies, retinopathy, cardiovascular, cerebrovascular and peripheral vascular disease and kidney damage. Finally, the section on **diabetes and pregnancy** measures indicators of prenatal care, obstetrical complications and fetal complications in women with pregestational diabetes and gestational diabetes compared to women without diabetes.

STUDY

The indicators we report are the result of a rigorous selection process which included an extensive literature review of existing indicators, as well as input and agreement from experts in the field (see Introduction to the POWER Study, chapter 1). The indicators that have been included have been identified through a number of sources including for example: Statistics Canada; Health Canada; the Canadian Diabetes Association; the Association of Public Health Epidemiologists of Ontario; the Institute for Clinical Evaluative Sciences; the National Quality Measures Clearinghouse and the US Department of Health and Human Resources. Many of these indicators are widely used to measure quality of care. We build on these reports by incorporating a gender and equity analysis (see the POWER Study Framework, chapter 2). This is important because women and men have different patterns of disease, disability and mortality. Women and men also have different social contexts and different experiences with health care which, together with differences in biology, contribute to observed gender differences in health. Furthermore, well documented health inequities among women and men associated with sociodemographic factors are such that differences between subgroups of women may be larger than overall differences between women and men.

Data from several sources were used to produce this section. These include: Statistics Canada's 2006 Census; Canadian Community Health Survey (CCHS), 2000/01 (Cycle 1.1), 2005 (Cycle 3.1) and 2007; Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); Ontario Drug Benefit (ODB) database; Ontario Health Insurance Plan (OHIP) database; National Ambulatory Care Reporting System (NACRS); Institute for Clinical Evaluative Sciences (ICES) Physician Database (IPDB) and ICES Mother-Baby (MOMBABY) Linked Database. Indicators that were measured using the CCHS were first stratified by sex and then further stratified by socioeconomic variables including annual household income, educational attainment, age, ethnicity, years

of immigration and Local Health Integration Network (LHIN) and analysed as allowed by sample size. Indicators that were measured using administrative data were first stratified by sex and then by neighbourhood income quintile, age group and LHIN and analysed as allowed by sample size. Age-adjustment was done using indirect standardization and data were standardized to the population with diabetes. A complete list of the indicators in this chapter and their data sources can be found in Appendix 9.2.

KEY FINDINGS

Diabetes is one of the most common conditions in our society.

Nearly one in ten adults in Ontario have been diagnosed with diabetes—however, by age 65, this figure reaches nearly one in four. Diabetes prevalence was higher in men (10.5 percent) than in women (8.4 percent), however, prevalence in women of reproductive age (aged 20-44) was similar to the rate in young men (2.7 percent versus 2.6 percent, respectively) (Exhibit 9A.2). Developing diabetes at an early age can have devastating consequences for both sexes, but in women there are additional implications; we found that diabetes prior to pregnancy is associated with a substantially increased risk of adverse pregnancy outcomes and, if poorly controlled, can cause serious harm to an unborn child.

People with diabetes have worse functional status and self-rated health than those without diabetes.

Having diabetes was associated with worse self-rated health (Exhibit 9A.7), higher rates of comorbidity (two or more additional chronic health conditions) (Exhibit 9A.4) and probable depression (Exhibit 9A.5) and greater limitations in instrumental activities of daily living (IADLs) and activities of daily living (ADLs). Among women and men with diabetes, 56 percent reported having two or more additional chronic health conditions besides diabetes (compared to 28 percent of adults without diabetes), increasing the complexity of care delivery. Among adults with diabetes, there were important gender differences; women had worse health and functional status than men including higher rates of comorbidity (63 percent versus 51 percent, respectively), depression (11.1 percent versus 4.3 percent, respectively) and IADL and/or ADL limitations (49 percent versus 27 percent, respectively). Lower-income groups fared even worse than higher-income groups with respect to their health status (Exhibit 9A.7) and disability (Exhibit 9A.8). They were more likely to report their health as fair or poor (52 percent versus 33 percent, respectively) and among men, they were more likely to have at least two other chronic conditions (66 percent versus 41 percent, respectively). Comorbidity can have a considerable impact on quality of life and complicate diabetes management. For practitioners, competing medical and social issues may detract from diabetes care; for patients, disability and coexisting conditions such as depression and osteoarthritis can impede the ability to make changes in diet or activity levels, to lose weight, to self-manage diabetes and to adhere to medications. These findings have implications for Ontario's chronic disease strategy and underscore the necessity of patient-centred models of chronic disease management that address multiple conditions concurrently.

The ongoing rise in diabetes prevalence creates a significant challenge for those who provide and fund health care.

Diabetes is one of the most commonly encountered conditions in primary practice, accounting for nearly seven million visits to family physicians each year in Ontario alone. Innovation and improvement of diabetes

prevention and management in primary care are critical to addressing this challenge. We found that people with diabetes visited a primary care provider an average of 7.3 times per year. Similar to the overall gender differences reported in The POWER Study Access to Health Care Services chapter, women with diabetes had greater utilization of health services than men. Adults living in lower-income neighbourhoods also had a higher mean number of visits to primary care physicians than adults living in higher-income neighbourhoods (7.7 versus 6.8 visits per year, respectively) (Exhibit 9B.2), yet they suffered more complications from diabetes, suggesting that current models of care are not sufficient to meet their health needs.

Men had higher rates of diabetes complications than women.

This included more cardiovascular disease (CVD); however, the observed gender gap in revascularization procedures exceeded gender differences in the burden of CVD (Exhibit 9E.7)—suggesting a potential underutilization of these procedures in women with diabetes or gender-related differences in the appropriateness of revascularization. Gender differences in hospitalizations for acute myocardial infarction (AMI), congestive heart failure (CHF) (Exhibit 9E.8) and stroke (Exhibit 9E.11) and gender differences in dialysis (Exhibit 9E.17) and laser photocoagulation therapy for diabetic eye disease were greatest in younger age groups and tended to diminish with increasing age—which may reflect differences between men and women in the biology leading to complications or worse control of risk factors in young men. Health care utilization was higher in women with diabetes which could provide women with more opportunities for intervention. Young men and men living in lower-income neighbourhoods (Exhibits 9E.1, 9E.2) were more likely to visit a hospital for emergency management of hyper- or hypoglycemia—a complication that may be avoided through good access to outpatient management and improved self-management.

Another important gender difference was in the rates of amputation and peripheral revascularization (Exhibit 9E.13). Men were more likely than women to undergo minor amputations (109 per 100,000 versus 44 per 100,000, respectively), major amputations (143 per 100,000 versus 72 per 100,000, respectively) or peripheral revascularization (143 per 100,000 versus 77 per 100,000, respectively). These differences persisted across most age groups (Exhibit 9E.14). Men and women may vary with respect to risk factors for peripheral vascular disease, attention to routine foot care or treatment of foot ulcers/infections, or they may have differential exposures to minor trauma—a common precipitating event that can lead to infection and potentially to gangrene and amputation. From our data, self-reported rates of foot examination by a health professional (50 percent of women and 51 percent of men) and performing a self foot examination at least annually (69 percent of women and 67 percent of men) did not vary by gender (Exhibits 9C.3, 9C.4); however, the latter may be an insensitive measure of routine foot care and both measures may be biased due to self-report. Men may be more likely than women to delay seeking care for foot ulcers until they reach a stage where the process is unlikely to be reversed. With fewer primary care visits per year, there are perhaps fewer opportunities for men to receive preventive counselling and management.

Diabetes in pregnancy is associated with higher rates of complications.

Compared to pregnant women without diabetes, pregnant women with pregestational diabetes (diabetes that predates pregnancy) were at one and a half to three times greater risk for serious obstetrical complications, including hypertension (12.5 percent versus 4.4 percent, respectively), preeclampsia (3.9 percent versus 1.2 percent, respectively), and shoulder dystocia (3.2 percent versus 1.7 percent, respectively); and had higher rates of caesarean section (44.5 percent versus 27.4 percent, respectively) (Exhibit 9F.4). Women with

gestational diabetes (diabetes diagnosed in pregnancy) were also at higher risk for complications than women without diabetes. Of great concern, infants of women with pregestational diabetes had nearly twice the rate of fetal complications compared to infants of women without diabetes, including major and minor congenital anomalies (7.7 percent versus 4.8 percent, respectively) and stillbirth/in-hospital mortality (5.2 per 1,000 versus 2.5 per 1,000, respectively) (Exhibit 9F.8)—outcomes that can be prevented through optimal control of glucose and blood pressure at the time of conception and during pregnancy. Infants of younger women with diabetes (aged 20-29) had the highest rates of fetal complications (Exhibit 9F.10), reflecting a need in this group for more targeted pre-pregnancy counselling and better pregnancy care. We also found that a significant percentage of pregnant women with diabetes were not being seen by specialists with experience in intensive diabetes management and the special circumstances of pregnancy, and the rate of specialist use varied across LHINs (Exhibits 9F.1, 9F.2). LHIN variation may partly be due to alternate funding plans (AFPs) where OHIP billing information may be incomplete or due to out of province use of specialists. The prevalence of diabetes in pregnancy is rising in Ontario. Strategies are required to ensure accessibility of specialized services throughout the province and to promote appropriate referral to care.

Income matters when it comes to diabetes prevalence and complications.

Lower-income groups share a disproportionate burden of diabetes and suffer more diabetes complications. In fact, socioeconomic status was a strong and inverse risk factor for virtually all diabetes complications that we studied, including CVD (Exhibit 9E.7) and renal disease. Income-related gradients were steeper in men with respect to hyper- or hypoglycemic emergencies (Exhibit 9E.1), amputations and end-stage renal disease requiring dialysis (Exhibit 9E.16). Coronary revascularization procedures were largely unaffected by neighbourhood income, despite a higher burden of vascular disease in adults living in lower-income neighbourhoods, suggesting a potential underutilization of these procedures in this population. Of note, no significant income-related differences in eye procedures were found.

In Ontario, lower-income groups with diabetes have worse outcomes despite greater use of primary care services suggesting missed opportunities for intervention. Evidence suggests that lower-income groups need more frequent and more intensive interactions with a health care team to achieve improvements in diabetes control. Rates of specialist visits were unaffected by socioeconomic status; however, this may reflect problems accessing these services, given the greater burden of complications among lower-income groups. Moreover, we found that men living in the lowest-income neighbourhoods were more likely to not receive any care (primary or specialist care) within a two-year period than men living in the highest-income neighbourhoods (8.0 percent versus 5.6, respectively) (Exhibit 9B.5), suggesting that they have problems accessing care or a preference for not seeking care as it is currently offered. Changes in services and focused outreach could help to address this problem.

Performance on many measures varied across the province.

We found that where you live in Ontario matters with respect to the risk of diabetes complications. The highest rates of complications were found in northern and rural areas of the province where access to care is more challenging (Exhibits 9E.4, 9E.9, 9E.10, 9E.15, 9E.18). Regional differences in prevalence, population characteristics and risk factors may have also have contributed to these findings. The proportion of people with no primary care physician or specialist visits within a two-year period may be high in some LHINs due to a shortage of doctors in underserviced or differently serviced areas or to variations in access to services due to language,

socioeconomic or cultural barriers to care. As well, LHIN variation may be due to AFPs where OHIP billing may be incomplete or due to out of province use of specialists.

Age is a strong risk factor for diabetes complications.

Therefore, the burden of diabetes complications will likely continue to rise with the aging of the population. This has tremendous implications for the planning and provision of health services including the need for hospital beds, dialysis and cardiac rehabilitation services, among others. Seniors with diabetes already exhibit high rates of use of primary care services and will continue to do so. We found that age was associated with a reduced likelihood of seeing a specialist (endocrinologist, general internist, or geriatrician) among adults with diabetes (Exhibit 9B.3). Older individuals may have mild disease with recent onset and doctors may be less likely to refer older patients either due to patient preference or a more conservative approach to treatment in this group.

Despite growing evidence on best practices for diabetes, gaps in care persist.

We found that rates of foot exams (Exhibit 9C.4) and dental care (Exhibit 9C.5) were suboptimal. Among those with diabetes, rates of dental care in the past 12 months were particularly low for adults aged 65 and older (47 percent), those in the lowest-income group (40 percent) and adults with less than a secondary school education (40 percent). These differences may reflect a decreased propensity to seek care and/or financial barriers to accessing care due to a lack of insurance coverage for these services. We also found that rates of eye examination in the two years following the diagnosis of diabetes were low (58 percent) (Exhibit 9C.2) and this was consistent across all Ontario LHINs. Based on our findings, the likelihood of receiving an eye examination within two years of diagnosis appears to be no higher today than it was a decade ago. However, our data rely solely on fee-for-service claims and do not include reimbursement from private insurance providers, out-of-pocket payment for retinal photography, or telemedicine and mobile eye programs in Northern Ontario—which may have led to an underestimation of the true level of retinal screening in the province and in specific LHINs. It is also not clear whether wait times for eye care services has influenced these rates, or alternatively, whether people with diabetes are not accessing available services. The delisting of general optometry visits from OHIP may have unwittingly impaired access to eye care particularly in areas that are dependent on these services despite the fact that individuals with diabetes are exempted from this policy.

There was good news as well.

A large proportion of seniors with diabetes are receiving therapies proven to reduce the risk of CVD. In fact, we noted a dramatic increase in the use of glucose-lowering medications (Exhibit 9D.1) and the use of medications for CVD risk reduction (Exhibit 9D.2) compared to the late 1990s and early 2000s. Furthermore, there was virtually no variation in medication use among seniors by sex, age, income or LHIN, except where expected (e.g., glucose-lowering medication use increases with age). This implies that when drug costs are universally covered, income has little influence on access to important therapies. Out-of-pocket costs of medications are likely to be substantial in the absence of insurance coverage, thus income-related differences in access to therapies may exist for younger groups with diabetes, but could not be examined in our study.

Finally, our report illustrates the **importance of looking at subgroups of individuals** when evaluating quality of care. Stratification by age, sex, income or other factors allows us to identify specific subgroups of individuals who are more vulnerable which in turn can identify areas for further study or facilitate targeted improvement efforts.

KEY MESSAGES

We took a broad look at the burden of diabetes and quality and outcomes of care for diabetes in the province, focusing on gender, socioeconomic, demographic and regional variations. While much progress has been made in improving quality and outcomes of care for diabetes, much work remains to be done. Our findings point to a number of key areas for intervention and improvement. Inequities in health and functional status associated with gender and socio-economic status were much greater than inequities in the provision of diabetes care, underscoring the need to address the social determinants of health to reduce the burden of diabetes. For many indicators, there was sizable LHIN variation. The Ontario Diabetes Strategy is working to reduce regional variations in diabetes care. The results of our analyses are available for the LHINs to use in their priority setting, planning and quality improvement activities. By implementing interventions at the policy, population health and practice levels and coordinating these interventions for maximum impact, it will be possible to hasten progress. To address regional needs, the Ontario Diabetes Strategy has established 14 Diabetes Regional Coordination Centres, within each LHIN, to provide leadership in integration of diabetes best practices across service providers, and to further strengthen coordination within the system and support improved care across the continuum.

The following five actions can help accelerate progress in reducing the burden of diabetes, improve health outcomes among women and men with diabetes and reduce health inequities related to diabetes. For these actions to be truly successful, gender and socio-economic differences in the burden of diabetes and experiences with care will need to be addressed.

Strategies to halt the diabetes epidemic are critically needed in order to minimize future burden on the health care system caused by diabetes and other obesity-related illnesses.

- Halting the obesity and consequent diabetes epidemics will require a multifaceted approach that promotes positive lifestyle changes at the population level and acknowledges the need to address enabling factors such as access to healthy food and safe, walkable neighbourhoods to promote physical activity. Obesity prevention needs to start in childhood as it is very hard to treat once present. Using anti-smoking campaigns as a model, a strategy that combines social and public policy changes, public awareness campaigns and clinical interventions aimed at promoting physical activity and healthier eating could help curb the ongoing rise in diabetes.
- More intensive diabetes prevention strategies should be targeted towards high-risk populations, including those from lower-income groups, immigrants, Aboriginal communities and women with gestational diabetes. Overcoming socioeconomic and demographic barriers to achieving a healthy lifestyle are likely to require innovative and cross-sectoral approaches. Culturally appropriate programs and services are also needed to enhance levels of physical activity and promote healthier eating patterns in ethnically diverse groups. For women with recent gestational diabetes, the demands of child-rearing in the postpartum period in combination with the balancing of work, family and other commitments pose additional barriers to lifestyle change.

Reduce income-related disparities in diabetes outcomes.

- Focusing efforts upstream through cross-sectoral collaboration can serve to address the root causes of income-related health inequities while reducing the burden of diabetes in the population. A multifaceted

approach would likely be required to tackle the many complex problems which contribute to greater diabetes prevalence and poorer health in these groups.

- Measures to improve the health of low-income groups and other high-risk populations will also have to address barriers to accessing care related to poverty and immigration such as language barriers and high medication costs if health promotion and chronic disease prevention and management programs are to be successful.

Comprehensive, patient-centred, chronic disease management can improve quality and outcomes of care for diabetes.

- Diabetes is a complex chronic disease that requires close follow up by a multidisciplinary diabetes health care team for optimal management. Individuals with diabetes often have multiple chronic conditions making diabetes management more challenging. Therefore, implementation of a comprehensive, coordinated, patient-centred chronic disease prevention and management strategy—one that addresses the needs of at-risk populations—is the key to improving quality and outcomes of care for people with diabetes.

Province-wide, integrated, organized models of care delivery can improve health outcomes and reduce inequities in care.

- We found sizable regional variations in diabetes outcomes likely due in part to differences in human resources and regional capacity, as well as regional differences in practice patterns and the complexity of the population being served. Interventions such as performance measurement and quality improvement in primary care, the regional coordination of care, use of telemedicine, enhancing the availability of diabetes team members and providing training and support for local practitioners are approaches that—when coupled with better patient education and support for healthy lifestyle changes—could reduce regional variations in care. Technological approaches such as telemedicine can improve access to effective care in underserviced communities. Including performance measurement and quality improvement initiatives when these programs are being implemented will provide timely information on what is working.

Improve quality, availability and timeliness of data to assess diabetes outcomes and care delivery in the province.

- While data to assess diabetes care in the province have improved, there is still much to be done to improve the quality, completeness, availability and timeliness of data. Specifically, medication data on people under age 65, laboratory data on screening and monitoring indicators and clinical data (e.g., blood pressure levels or foot examinations) to assess the quality of diabetes management in routine care settings are needed. As well, given the importance of eye examination to detect early changes from retinopathy, data on the frequency of retinopathy screening are also needed.
- Diabetes is primarily managed in the ambulatory care setting through primary care and specialty care. As a result, high quality clinical data are lacking. Better and more comprehensive data collection on management of diabetes in primary care and other ambulatory care settings is needed. Especially needed, is more complete data on care that is provided through AFPs.
- Given the known variation in diabetes prevalence in different ethnic communities as well as issues of access to care in recent immigrant populations, data on diabetes care and outcomes that can be stratified by ethnicity and recency of immigration would allow us to assess disease burden, target interventions, as well as to evaluate access, quality, and outcomes of care in Ontario's diverse communities.

Introduction

The number of people with diabetes has increased dramatically over the last 20 years,[1-3] making it one of the most costly and burdensome chronic diseases of our time.

More than three million Canadians have diabetes and this number is expected to climb significantly over the next decade. It is predicted that between 2007 and 2017, another 1.9 million adults—or about nine out of every 100 adults without diabetes—will develop diabetes. Recent data from Ontario indicate that diabetes prevalence has increased dramatically over the last decade, and have already surpassed the global prevalence predicted by the World Health Organization for 2030.[3, 4] It is one of the leading causes of blindness, the most common cause of end-stage renal disease in the developed world,[5, 6] and a major cause of cardiovascular complications such as heart attack and stroke.[7, 8] Furthermore, the treatment is complex and costly with the direct health care costs of diabetes ranging from 2.5 to 15 percent of health care budgets.[9] Approximately 10 percent of people with diabetes have type 1 diabetes, which mainly presents in children and young adults, and is caused by autoimmune destruction of insulin-producing cells in the pancreas. The increase in diabetes prevalence has largely been attributed to a rise in new cases of type 2 diabetes,[10] which has an older age of onset and results in part from impaired insulin function, primarily due to a combination of behavioural risk factors and genetics. The increase in type 2 diabetes may be explained by the rise in risk factors such as obesity,[11] sedentary lifestyle, unhealthy diets, and the aging of the population.[12-14] The increased migration of susceptible populations, accompanied by shifts in lifestyle, have added to the diabetes burden in the developed world. In addition, increased survival among people with diabetes also contributes to increasing prevalence.[15, 16]

The chapter has six sections:

A. Health and Functional Status
B. Access and Utilization of Care
C. Screening, Assessment and Monitoring
D. Pharmacological Treatment
E. Health Outcomes
F. Diabetes and Pregnancy

Data also suggest that certain populations are at higher risk for diabetes and diabetic complications. For example, low-income populations, in particular women, have a higher risk of developing diabetes[17] and have worse outcomes once they have it.[18] The risk of diabetes is also higher in certain immigrants and ethnic groups, such as those of South Asian, African, Hispanic, and Aboriginal descent.[19-22] Canadians living in rural regions have higher rates of diabetes compared to their urban counterparts. Evidence indicates that rural residents have worse access to care, lower income, and behavioural risk factors that place them at risk for developing the disease.[23]

While the prevalence of diabetes is higher among men than women, recent data suggest that young women (aged 20-49) have seen the greatest increase in diabetes over the last decade.[4] Not only do young women with diabetes have a potentially higher lifetime risk of complications because of an earlier diagnosis, but they may face other health issues such as reproductive problems[24] and complications during pregnancy.[25-30] As more women develop type 2 diabetes during childbearing age,

pregnancies complicated by diabetes are becoming increasingly common.[31] This trend has substantial implications for women, their offspring and the health care system. Pregnant women with pregestational diabetes have higher rates of pregnancy-induced hypertension, preeclampsia, obstructed labour and caesarean section.[25-30, 32] In addition, their infants have higher rates of birth defects, perinatal mortality, shoulder dystocia and jaundice.[25-30] Consequently, women with diabetes and their offspring have longer hospital stays and more neonatal intensive care unit (NICU) admissions, which imposes a greater burden on the health care system. Gestational diabetes, a temporary condition that generally develops later in pregnancy, is less likely to be associated with adverse maternal and fetal outcomes compared to pregestational diabetes. However, women with gestational diabetes are also at greater risk of obstetrical complications compared to the general population and their offspring have higher rates of macrosomia (high birth weight) and shoulder dystocia. Pregnancy-related complications can be prevented with appropriate pre-pregnancy and prenatal care. We need a better understanding of inequities in care and outcomes, to optimize maternal and fetal health for the growing number of diabetic pregnancies across Ontario.

There is good evidence that the long-term complications from diabetes can be reduced or prevented through strategies aimed at lowering glucose, blood pressure and cholesterol levels.[33-39] However, not all groups benefit equally from these strategies. In general, men and women with lower income or lower levels of education report worse health status and have higher rates of mortality than those who have higher socioeconomic status.[40, 41] Similar trends are seen in people with diabetes.[42-44] Thus, differences in illness burden between subgroups of women may be larger than overall differences between women and men.[45] There is also evidence that minority and Aboriginal populations with diabetes have a greater rate of diabetic complications and mortality compared to the White population.[46-51] There may be several reasons for these disparities. First, new immigrants and minority groups often earn less income than longer-term residents. Therefore, these trends may reflect income-based inequities in access to care and medication. Indeed, while mortality rates among men and women with diabetes fell significantly over the last decade, improvements in survival have been substantially greater among wealthier individuals.[18] Diabetes poses a tremendous financial burden on people affected by this disease, and improved diabetes outcomes have been partly achieved through a shift to more complex medical care involving a greater number of drug therapies.[52] Thus, socially disadvantaged populations may not have benefited as much from advances in diabetes care due to financial barriers to needed treatments and services. Lower-income populations also have a higher prevalence of behavioural risk factors such as smoking, poor diet and sedentary lifestyle.[53] Low health literacy and cultural barriers in disadvantaged populations may have a greater impact on their ability and motivation to follow more complex medical regimens.[54] These barriers—which differentially affect socially disadvantaged populations—contribute to higher rates of preventable complications.

Not only is diabetes associated with numerous complications, but people with diabetes are more likely to have other comorbid conditions than those without diabetes.[55, 56] They are also more likely to experience limitations in their activities of daily living[57-59] and depression[60] which have a significant impact on their health and functional status and on the social and financial burden of diabetes due to lost productivity. In general, women report multiple chronic conditions,[61-64] depression[61, 65-68] and limitations in activities of daily living more often than men,[61, 69, 70] thus diabetes may disproportionately burden women. On the other hand men are more likely to experience adverse outcomes associated with diabetes, such as amputation.[71]

The ongoing rise of diabetes in our population will continue to place a growing demand on the health care system and negatively impact quality of life. This has important policy implications and addressing these issues is fundamental to health system sustainability.[72] Diabetes has been shown to be preventable with lifestyle modification,[73] thus, an increased focus on preventive strategies is urgently needed. We need to adopt wider public health initiatives to curb the epidemic of obesity and sedentary lifestyle so that new diabetes cases can be prevented. As well, we will not only need to ensure adequate resource allocation for the growing number of people who will need chronic diabetes care, and place greater emphasis on health system redesign to implement models of chronic disease prevention and management that improve quality and outcomes of care in this high-risk population.

A greater understanding of inequities in prevalence, quality of care and outcomes is necessary in order to better target resources and interventions. There is evidence for practice and health system-based interventions to improve the overall quality of diabetes care. Performance measurement and reporting has been shown to be a driver of change in this area. There are also interventions that have been shown to reduce inequities in care and outcomes in socially disadvantaged populations, including culturally tailored and community-based programs, and interventions delivered more frequently and for a longer duration.[74] A better understanding of where the gaps in diabetes care exist would help target such interventions appropriately.

This chapter examines the burden of diabetes in Ontario, with a focus on indicators of diabetes care and potential gender and income disparities. In the first section, the **health and functional status** of Ontario women and men with diabetes is profiled including: morbidity (the presence of other chronic conditions or probable depression), activity limitations, self-rated health and health behaviours. The second section includes indicators of **access and utilization of care**, including measures of primary and specialty physician care. In the section on **screening, assessment and monitoring,** clinical and self-monitoring of blood glucose and foot care as well as clinical monitoring of kidney function and eye examination are measured. In the section on **pharmacological treatment,** self-reported use of insulin and oral glucose-lowering medications is measured as well as the use of medications to treat hypertension and cholesterol among adults aged 65 and older with diabetes. The section on diabetes-related **health outcomes** includes measures of diabetes complications including glucose-related emergencies, retinopathy, cardiovascular, cerebrovascular and peripheral vascular disease and kidney damage. Finally, the section on **diabetes and pregnancy** measures indicators of prenatal care, obstetrical complications and fetal complications in women with pregestational diabetes and gestational diabetes compared to women without diabetes.

The indicators we report are the result of a systematic review of the literature and rigorous selection process (see Introduction to the POWER Study, chapter 1). The indicators that have been included have been identified through many sources including for example: Statistics Canada; Health Canada; the Canadian Diabetes Association; the Association of Public Health Epidemiologists of Ontario; the Institute for Clinical Evaluative Sciences; National Quality Measures Clearinghouse and the US Department of Health and Human Resources. Many of these indicators are widely used to measure quality of care. We build on these reports by incorporating a gender and equity analysis (see the POWER Study Framework, chapter 2). This is important because women and men have different patterns of disease, disability and mortality. Women and men also have different social contexts and different experiences with health care which, together with differences in biology, contribute to observed gender differences in health. Furthermore, well documented health inequities among women and men associated with sociodemographic

factors are such that differences between subgroups of women may be larger than overall differences between women and men.

Data from several sources were used to produce this section. These include: Statistics Canada's 2006 Census; Canadian Community Health Survey (CCHS), 2000/01 (Cycle 1.1), 2005 (Cycle 3.1) and 2007; Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); Ontario Drug Benefit (ODB) database; Ontario Health Insurance Plan (OHIP) data; National Ambulatory Care Reporting System (NACRS); Institute for Clinical Evaluative Sciences (ICES) Physician Database (IPDB); and ICES Mother-Baby (MOMBABY) Linked Database.

Depending on the data sources available to assess each indicator, we determined whether people had diabetes either based on self-report (for indicators using survey data) or using a validated administrative data algorithm that uses Ontario health care databases (for indicators using administrative data). Estimates of diabetes prevalence that are based on self-report are known to be lower than estimates based on diagnoses contained in health care databases.[75] Thus, the data based on self-reported diabetes should be interpreted with caution, as these people may have a higher awareness of their diabetes due to more advanced stage, greater health literacy, or greater interest in their health. These factors may in turn increase preventive health behaviours and health care utilization patterns. Data from the CCHS were first stratified by sex and then further stratified by annual household income, educational attainment, age, ethnicity, immigration, rural/urban residency and Local Health Integration Network (LHIN). Data from administrative sources were first stratified by sex and then further stratified by neighbourhood income quintiles, age and LHIN. Analyses were conducted as allowed by sample size. Age-adjustment, where appropriate, was done using indirect standardization and data were adjusted to the population with diabetes. Appendix 9.3 provides a more detailed description of research methods.

A complete list of the indicators in this chapter and their data sources can be found in Appendix 9.2. Appendix 9.1 indicates which of the Ontario Health Quality Council's (OHQC) nine attributes of a high-performing health system the indicator assesses. It also identifies which of the strategic objectives included in the Ontario Ministry of Health and Long-Term Care strategy map and the Ontario Diabetes Strategy would be met through improvement on this indicator.

LIST OF EXHIBITS

SECTION 9A

Health and Functional Status

SECTION 9B

Access and Utilization of Care

SECTION 9C

Screening, Assessment and Monitoring

SECTION 9D

Pharmacological Treatment

SECTION 9E

Health Outcomes

SECTION 9F

Diabetes and Pregnancy

A Guide to Reading Maps

Maps are the main visual representation of spatial patterns of data and analyses covered in this Report.

Ontario is difficult to map as a province, due to its vast areas in the North and detailed characteristics in the South. As such, all maps consist of three views—Northern Ontario, Toronto and surrounding areas, and Southern Ontario. The measures of distance and area on these views differ from one another.

There are two types of thematic maps in this Report that depict a magnitude of analyzed variables: 1) bar chart maps and 2) choropleth (shaded) maps. The following descriptions aim to help the reader correctly view and interpret these two map types.

BAR CHART MAPS

Bar chart maps can depict a variety of numeric variables including counts and ratios across Local Health Integration Networks (LHINs) in Ontario. In most of the maps in this Report, the bars show values of relative risks, odds ratios or rates (percentages).

The main feature to look for is the height of the bars, since it represents the value of the mapped attribute. The larger the attribute number (relative risk, odds ratio or rate), the taller the bar. The number at the top or beside each bar represents the actual value of the attribute.

If the attribute is presented in two subgroups (e.g., women and men) as in Figure 2, then each LHIN area on the map has two bars. When the attribute is presented in four subgroups (e.g., lower-education women, higher-education women, lower-education men, and higher-education men) as in Figure 3, then each LHIN area on the map has four bars. In all cases, the height of the bar is proportional to the value of the mapped attribute.

In the legend of the map the top set of bars reflects the highest observed value in the depicted data set. This can be used for visual comparison with the bars on the map.

The bottom set of bars shows the overall Ontario values of the depicted attributes and can be also compared visually to the bars on the map.

Figure 1: Example of a Two Bar Map

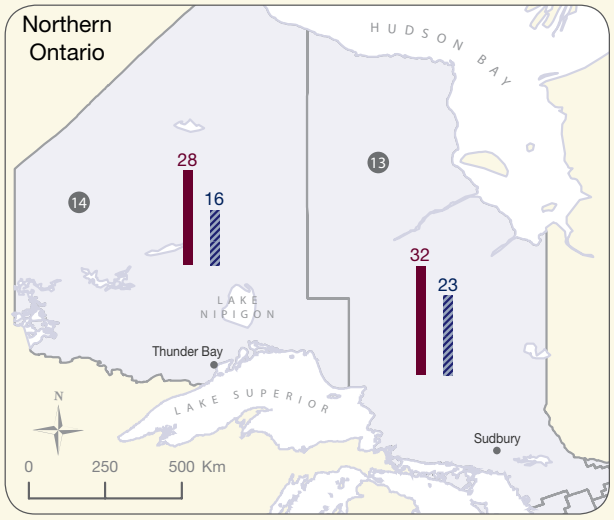
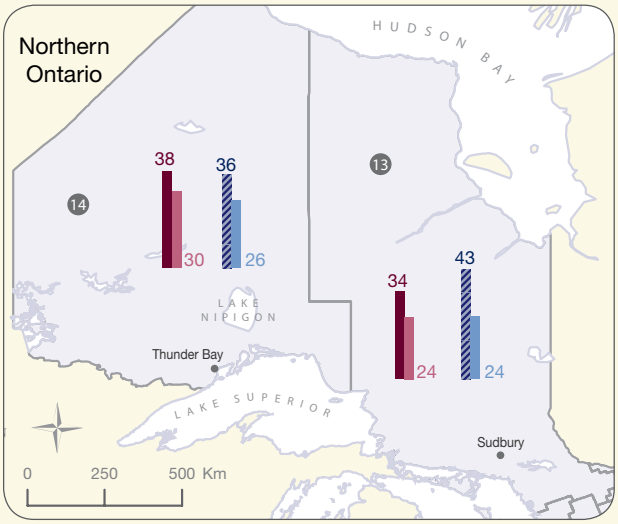


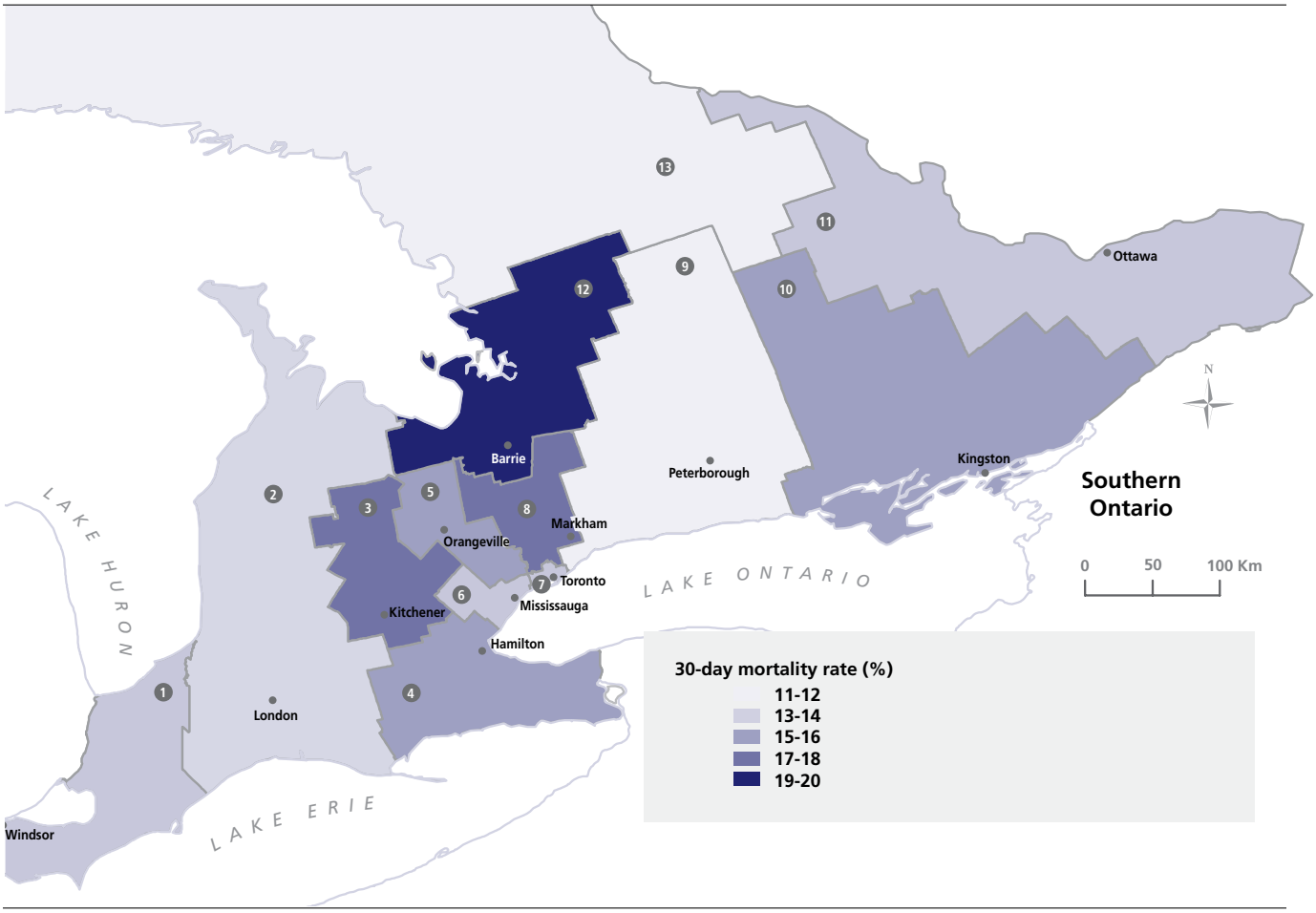
Figure 2: Example of a Four Bar Map



CHOROPLETH (SHADED) MAPS

Choropleth maps use different shades or colours to depict data values. Each colour generally represents a range of values, as shown in the map legend. In general, the darkness of the shade or colour is proportional to a larger data value—the larger the data value, the darker the shade or colour on the map. Shaded maps usually represent rate or ratio variables rather than raw counts or amounts.

Figure 3: Example of a Choropleth Map



Section 9A
Health and Functional Status

INTRODUCTION

Recent data from Ontario indicate that diabetes prevalence has increased dramatically over the last decade, due to increased incidence and reduced mortality.

By 2005, age- and sex-adjusted diabetes prevalence had increased by 69 percent from 5.2 percent in 1995 to 8.8 percent and had already surpassed the global prevalence predicted by the World Health Organization for 2030.[3, 4] Manuel and colleagues predicted, based on a validated model, that between 2007 and 2017, an additional 1.9 million Canadians would develop diabetes. This is the equivalent of nine percent of the adult population being newly diagnosed with diabetes during the 10-year period.[76] Diabetes rates are higher in older people and in men, however, the biggest rise in diabetes prevalence from 1995 to 2005 was seen in women aged 20-49, such that their prevalence is now equal to that of similarly aged men.[4]

Not only is diabetes associated with significant complications, but people with diabetes are more likely to have other comorbid conditions than those without diabetes.[55, 56] They are also more likely to experience limitations in their activities of daily living (ADL)[57-59] and depression,[60] which have a significant impact on their health and functional status and on the social and financial burden of diabetes due to lost productivity. In general, women report multiple chronic conditions,[61-64] depression[61, 65-68] and limitations in ADLs more often than men,[61, 69, 70] thus the burden of diabetes may be more significant in women than in men.

The majority of diabetes cases in adults are due to type 2 diabetes,[10, 77] which is associated with a number of modifiable risk factors including physical inactivity, poor nutrition and being overweight or obese.[73, 78-81] Diabetes has been shown to be preventable with lifestyle modification aimed at increased physical activity and better nutrition.[73] The treatment of diabetes should include aggressive targeting and modification of behavioural risk factors;[82] the persistence of these risk factors among people with diabetes highlights a significant unmet need in the care of diabetes. While women are more likely than men to be physically inactive, men are more likely than women to be overweight, have poor nutrition or to smoke;[61, 83, 84] smoking increases the risk of diabetes complications. A better understanding of differences in risk factors among population subgroups would help target preventive strategies.

Type 2 diabetes is more prevalent among lower-income populations and low income is a bigger risk factor for diabetes among women.[17] This trend may be because lower-income people are more susceptible to risk factors such as sedentary lifestyle, poor diet, and smoking.[53] The prevalence of diabetes is also higher among certain ethnic groups, such as those of South Asian, African, Aboriginal or Hispanic descent.[19, 20, 22] Low-income

populations and ethnic minorities populations may also have added socio-cultural barriers to adequate health care, which may increase their risk of diabetes complications and decrease their survival.[18] Canadians living in rural regions have higher rates of diabetes compared to their urban counterparts. Evidence indicates that rural residents have worse access to care, have lower income and more behavioural risk factors.[23] Rural regions may therefore be important to target for enhanced diabetes care and prevention.

In this section, we report the prevalence of diabetes and provide an analysis of the health and functional status of people who report having diabetes. Differences associated with sex, age, income, education, ethnicity, immigration status, rural/urban residency and Local Health Integration Network (LHIN) are examined, where data are available and sample size allows.

The indicators include:

Diabetes prevalence and comorbidity

- Prevalence of diabetes
- Comorbidity (multiple chronic conditions)
- Probable depression
- Hypertension

Health and functional status

- Self-rated health
- Limitations in instrumental activities of daily living (IADL) and/or activities of daily living (ADL)

Health behaviours

- Physical inactivity
- Inadequate fruit and vegetable intake
- Being overweight
- Being obese
- Current smoking

Diabetes prevalence was assessed using the Ontario Diabetes Database (ODD); combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess diabetes prevalence in ethnic groups. Combined data from the CCHS, 2005 (Cycle 3.1) and 2007 were also used to assess the prevalence of having at least two additional chronic conditions (comorbidity), prevalence of hypertension, self-rated health and health behaviours; data from CCHS, 2000/01 (Cycle 1.1) were used to assess the prevalence of probable depression and data from CCHS, 2005 (Cycle 3.1) were used to assess limitations in IADLs and/or ADLs among adults who reported having diabetes (see Appendix 9.3 for details).

EXHIBITS AND FINDINGS

DIABETES PREVALENCE AND COMORBIDITY

DIABETES PREVALENCE

Indicator: This indicator measures the prevalence of diabetes among adults aged 20 and older in Ontario.

Background: Diabetes is a large and growing health problem for Ontarians.[1-4] The high prevalence of diabetes has important implications for health care resources given the burden of diabetes and the projected growth of the affected population.[3, 85] It has been estimated that as many as one-third of all cases of diabetes are undiagnosed in Canada.[86] Diabetes is preventable;[73] therefore, improved prevention strategies are needed to stem the epidemic of diabetes.

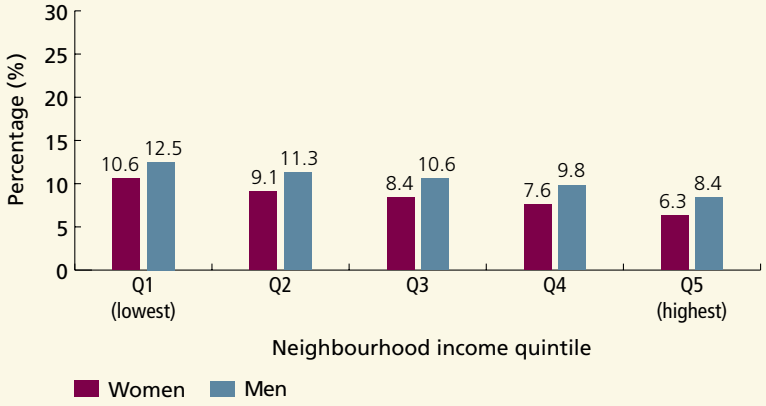
The prevalence of diabetes was established using a validated administrative data algorithm that uses Ontario health care databases to identify all Ontario adults who have been diagnosed with diabetes. Women with gestational diabetes are excluded (see Appendix 9.3 for more detail). Because information on ethnicity is not currently available from Ontario's health care databases, the prevalence of diabetes within ethnic groups was based on self-reported information from the Canadian Community Health Survey (CCHS), rather than physician diagnosis. The POWER Study Burden of Illness chapter found that the self-reported prevalence of diabetes among Ontario adults was six percent, which is lower than the prevalence reported using administrative data.[61] True prevalence is likely to be even higher than estimates based on administrative data as we are only able to report on those who have received a diagnosis of diabetes and some individuals with type 2 diabetes may go undiagnosed for many years. Furthermore, this may minimize our ability to identify inequities as low-income women and men may be less likely to have their condition diagnosed.

Findings: In Ontario, 9.4 percent of adults aged 20 and older had diabetes in 2006/07. Men were more likely than women to have diabetes (10.5 percent versus 8.4 percent, respectively).

Exhibit 9A.1 | Age-standardized prevalence of diabetes in adults aged 20 and older, by sex and neighbourhood income quintile, in Ontario, 2006/07

FINDINGS

- Diabetes prevalence increased with decreasing neighbourhood income in both women and men.
- The prevalence of diabetes ranged from 10.6 percent among women living in the lowest-income neighbourhoods to 6.3 percent among women living in the highest-income neighbourhoods.
- The prevalence of diabetes ranged from 12.5 percent among men living in the lowest-income neighbourhoods to 8.4 percent among men living in the highest-income neighbourhoods.
- Based on survey data, the prevalence of self-reported diabetes was almost twice as high among Black, Aboriginal and Arab, South and West Asian adults compared to White adults (10.6 percent, 9.2 percent, 9.2 percent versus 5.2 percent, respectively) (data not shown). Due to small sample sizes we were unable to report sex differences across ethnic groups (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Statistics Canada 2006 Census

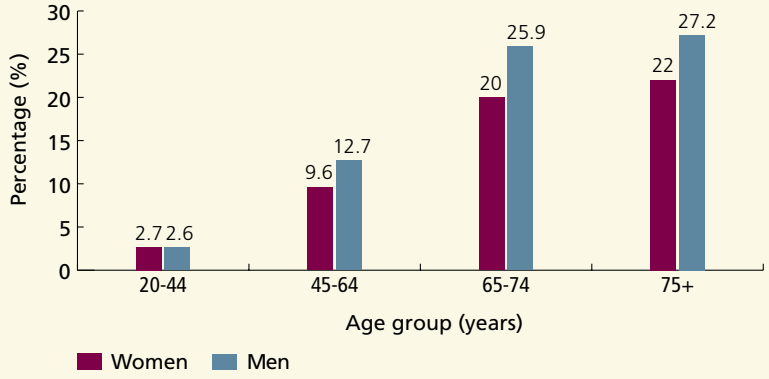
NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

POWER Study

Exhibit 9A.2 | Prevalence of diabetes in adults aged 20 and older, by sex and age group, in Ontario, 2006/07

FINDINGS

- The prevalence of diabetes increased with age in both women and men.
- More than one in five women and one in four men aged 65 and older had diabetes, compared to less than one in thirty adults aged 20-44.
- With the exception of adults aged 20-44, in whom there were no sex differences, men had higher rates of diabetes than women.



DATA SOURCE: Ontario Diabetes Database (ODD)

POWER Study

Exhibit 9A.3 | Age-standardized prevalence of diabetes in adults aged 20 and older, by sex, neighbourhood income and Local Health Integration Network (LHIN), in Ontario, 2006/07

FINDINGS

- Prevalence of diabetes varied across LHINs. Diabetes rates were higher among men than among women in all LHINs.
- The prevalence of diabetes ranged from 7.9 percent in the North Simcoe Muskoka LHIN to 13.1 percent in the Central West LHIN among women living in lower-income neighbourhoods and from 6.4 percent in the Waterloo Wellington LHIN to 9.7 percent in the Central West LHIN among women living in higher-income neighbourhoods.
- Among men, prevalence of diabetes ranged from 9.7 percent in the Waterloo Wellington and North Simcoe Muskoka LHINs to 15.1 percent in the Central West LHIN among those living in lower-income neighbourhoods and from 8.2 percent in the Waterloo Wellington LHIN to 11.8 percent in the Central West LHIN among men living in higher-income neighbourhoods.

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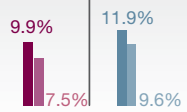
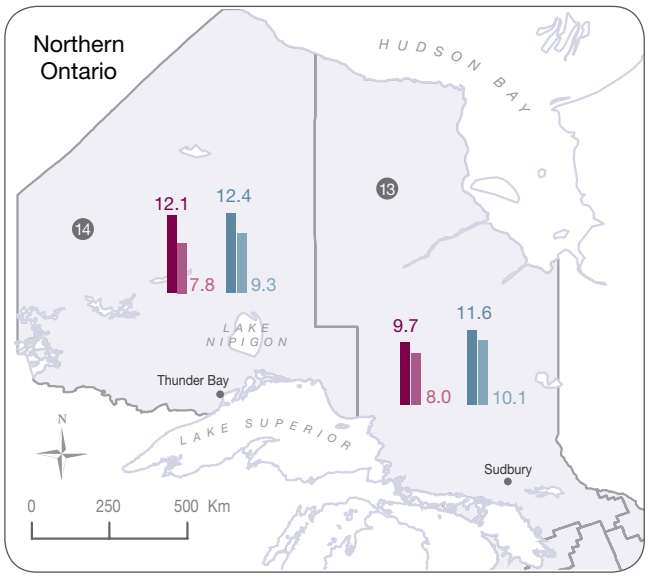
Overall Ontario

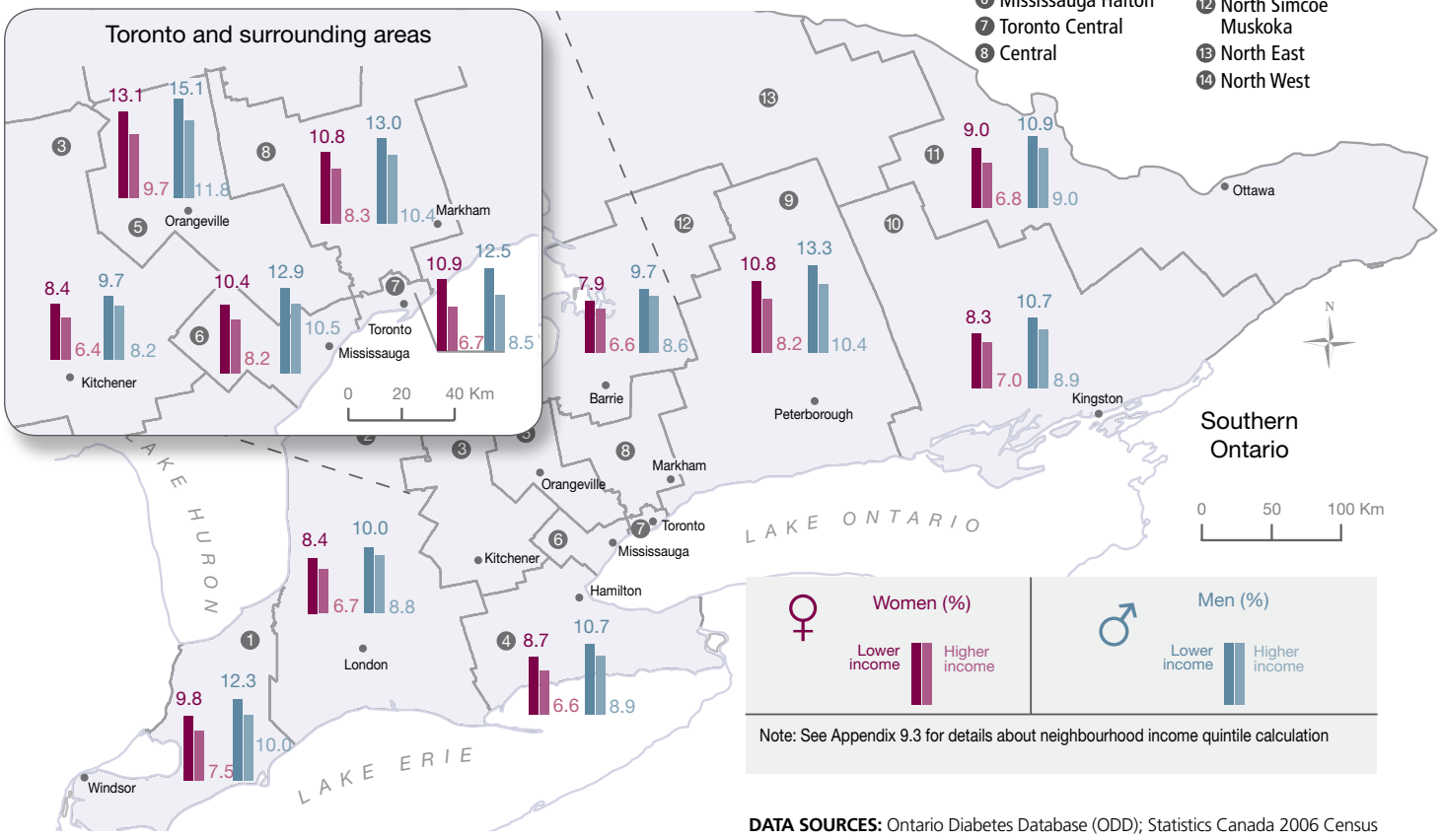
In Ontario, 9.9 percent of lower-income women, 7.5 percent of higher-income women, 11.9 percent of lower-income men and 9.6 percent of higher-income men aged 20 and older had been diagnosed with diabetes.





Local Health Integration Networks (LHINs)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West



Note: See Appendix 9.3 for details about neighbourhood income quintile calculation

DATA SOURCES: Ontario Diabetes Database (ODD); Statistics Canada 2006 Census

PREVALENCE OF COMORBIDITY (MULTIPLE CHRONIC CONDITIONS)

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who reported having at least two additional chronic conditions besides diabetes (comorbidity) diagnosed by a health professional. We compared the prevalence of comorbidity among people with and without diabetes.

Background: There are disparities in chronic disease prevalence in Ontario associated with gender, socioeconomic status, and ethnicity.[61] The burden of illness associated with diabetes is increased by the presence of other chronic conditions.[55, 56, 60] Risk factors for diabetes such as obesity, physical inactivity and inadequate fruit and vegetable intake are also risk factors for other common chronic conditions including cardiovascular and musculoskeletal disease, increasing the risk of multiple chronic conditions in people with these risk factors. Diabetes care itself is intensive, and the presence of other chronic conditions greatly increases the complexity of care for these patients.[87-89] This has significant implications regarding the allocation of resources and provision of diabetes care. The POWER Study Burden of Illness chapter reported that 29 percent of Ontarians (31 percent of women and 25 percent of men) had two or more chronic conditions in 2005.[61] Rates reported in this chapter will differ from those reported in the earlier chapter because of differences in the conditions included.

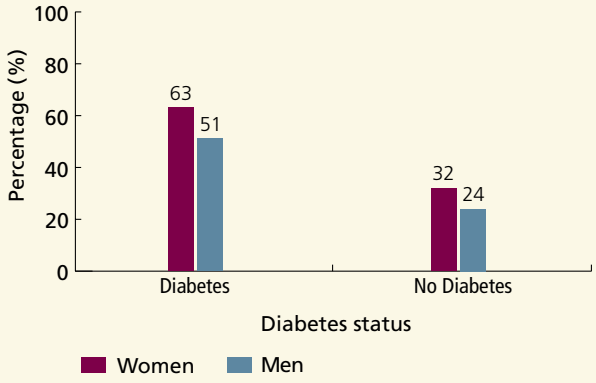
Data for this variable were derived from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007. Chronic conditions included in this indicator were: Alzheimer's disease or other dementia; bowel disorders; cancer; heart disease; stroke; high blood pressure; urinary incontinence; arthritis, rheumatism, or back problems (excluding fibromyalgia); and obstructive lung disease (for details, see Appendix 9.3). Because this indicator was derived from the CCHS, diabetes status and the presence of other conditions were based on self-reported information rather than physician diagnosis. Among people with diabetes, this indicator measures the percentage that had at least two additional chronic conditions besides diabetes (i.e., a total of three or more chronic conditions). Among people without diabetes, this indicator measures the percentage that had two or more chronic conditions.

Findings: In Ontario, 56 percent of adults aged 20 and older who reported having diabetes reported having at least two additional chronic conditions diagnosed by a health professional compared to 28 percent of adults without diabetes. Among those with diabetes, women were more likely than men to report having at least two additional chronic conditions (63 percent versus 51 percent, respectively).

Exhibit 9A.4 | Age-standardized percentage of adults aged 20 and older who reported having at least two chronic conditions^ diagnosed by a health professional, by sex and diabetes status, in Ontario, 2005 and 2007

FINDINGS

- Adults who reported having diabetes were more likely to have at least two additional chronic conditions than adults without diabetes.
- Women with diabetes were more likely to report having at least two additional chronic conditions compared to men with diabetes (63 percent versus 51 percent, respectively).
- Among people with diabetes, the likelihood of having at least two additional chronic conditions increased with age (28 percent of women and 20 percent of men aged 20-44 compared to 78 percent of women and 64 percent of men aged 65 and older). Irrespective of age, women were more likely than men to report having at least two additional chronic conditions (data not shown).
- The lowest-income men with diabetes were more likely than the highest-income men with diabetes to have at least two additional chronic conditions (66 percent versus 41 percent, respectively). This did not vary by income among women with diabetes (data not shown).
- Canadian born women with diabetes were more likely to report having at least two other chronic conditions compared to immigrant women (67 percent of Canadian born women versus 57 percent of immigrant women). This did not vary by immigration status among men with diabetes (data not shown).



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

^ Among people with diabetes, this refers to at least two chronic conditions in addition to diabetes

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PREVALENCE OF PROBABLE DEPRESSION

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who had probable depression. We compared the prevalence of probable depression in people with and without diabetes.

Background: Depression is twice as common in people with diabetes as in the general population.[60] Depression is associated with worse blood glucose management, health complications and decreased quality of life, and so poses additional health risks to individuals with diabetes.[87] Patient-centred care that focuses on identifying and treating comorbid depression is an important component of diabetes management.[82] According to the POWER Study Depression chapter, 7.4 percent of Ontarians aged 15 and older (9.8 percent of women and 4.9 percent of men) met the criteria for having probable depression in 2001.[90]

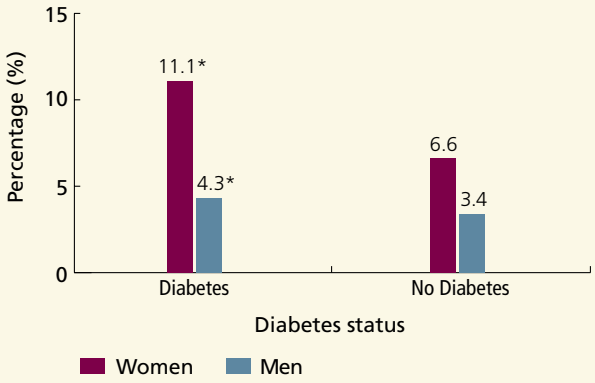
This measure was based on data from the Canadian Community Health Survey (CCHS), 2000/01 (Cycle 1.1) which measures depression using the Composite International Diagnostic Interview-Short Form (CIDI-SF) for Major Depression (see Appendix 9.3 for details). This scale was never fully validated, so rates reported here may differ from actual population prevalence. Because this indicator was derived from the CCHS, diabetes status was based on self-reported information rather than physician diagnosis.

Findings: In Ontario, 7.4 percent of adults aged 20 and older who reported having diabetes had probable depression compared to 5.0 percent of adults without diabetes. Among adults with diabetes, women were more than twice as likely as men to have probable depression (11.1 percent versus 4.3 percent, respectively). These estimates should be interpreted with caution due to small numbers.

Exhibit 9A.5 | Age-standardized percentage of adults aged 20 and older who had probable depression,^ by sex and diabetes status, in Ontario, 2000/01

FINDINGS

- Women were more likely to have probable depression than men, irrespective of diabetes status.
- Almost twice as many women who reported having diabetes had probable depression compared to women without diabetes (11.1 percent versus 6.6 percent, respectively); however, this difference was not significant, possibly due to small sample size and limited power to detect differences. The rates of probable depression did not vary by diabetes status among men.
- The differences in rates of probable depression by diabetes status were greater among women than among men.



DATA SOURCE: Canadian Community Health Survey (CCHS), 2000/01 (Cycle 1.1)

^ Composite International Diagnostic Interview-Short Form for Major Depression score of > 0.9

* Interpret with caution due to high sampling variability

POWER Study

PREVALENCE OF HYPERTENSION

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who also reported having been diagnosed with hypertension (high blood pressure) by a health professional. We compared the prevalence of hypertension in people with and without diabetes.

Background: Hypertension is an important risk factor for many complications of diabetes, including diabetic eye disease, kidney disease and cardiovascular disease.[91] A large proportion of patients with type 2 diabetes also have hypertension, since these two conditions share similar risk factors.[92] The presence of hypertension increases the risk of diabetic complications significantly, and multiple medications are often required to control blood pressure in addition to diabetes treatment.[93] The additional costs incurred with the increased number of medications needed for these patients may serve as a barrier to adequate care for more vulnerable patients and may worsen their prognosis.[18]

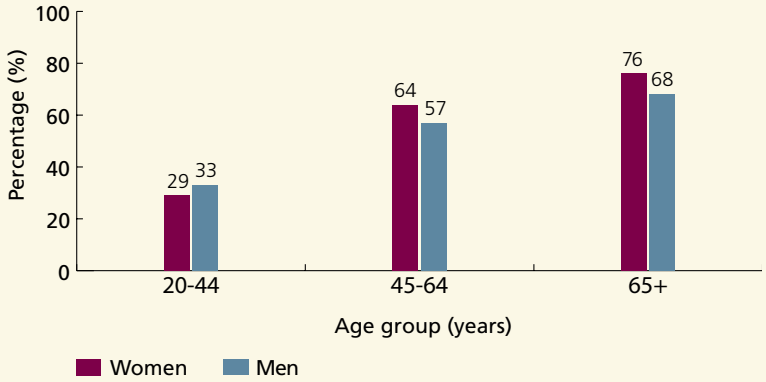
Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess this indicator. Because this indicator was derived from the CCHS, diabetes status and hypertension were based on self-reported information rather than physician diagnosis.

Findings: In Ontario, 61 percent of adults aged 20 and older who reported having diabetes also reported ever being diagnosed with hypertension by a health professional compared to 21 percent of adults who did not have diabetes. Rates of self-reported hypertension were similar between women and men with diabetes (64 percent versus 59 percent, respectively).

Exhibit 9A.6 | Percentage of adults aged 20 and older who reported having diabetes who reported having hypertension, by sex and age group, in Ontario, 2005 and 2007

FINDINGS

- Among adults who reported having diabetes, the percentage who reported having hypertension increased with age, from 31 percent among adults aged 20-44 to 72 percent among adults aged 65 and older. This was true for women and for men.
- The percentage who reported having hypertension did not vary by income (data not shown).
- Among adults with diabetes, the percentage who reported ever having been diagnosed with hypertension was higher among Canadian born adults as compared to immigrants who had been in Canada for less than 10 years (65 percent versus 42 percent, respectively) (data not shown).



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

POWER Study

HEALTH AND FUNCTIONAL STATUS

SELF-RATED HEALTH

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who rated their health as fair or poor. We compared the self-rated health of people with and without diabetes.

Background: Self-rated health—also referred to as global, self-reported or self-perceived health—is an indicator of how people rate their overall health status. Self-rated health is a well-validated measure of health status and has been shown to predict numerous health outcomes including mortality, health care utilization and health care costs in diverse populations.[94-96] People with diabetes are more likely to have poor self-rated health compared to people without diabetes.[43, 97, 98] In people with diabetes, poor self-rated health is associated with a higher risk for diabetes complications, cardiovascular events and mortality.[99-101]

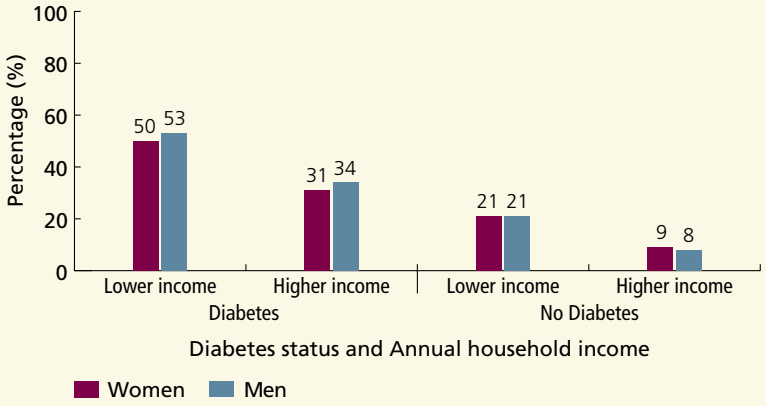
Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess this indicator. Because this indicator was derived from the CCHS, diabetes status was based on self-reported information rather than physician diagnosis.

Findings: In Ontario, 40 percent of adults aged 20 and older who reported having diabetes rated their health as fair or poor compared to 11 percent of adults without diabetes. Among adults with diabetes, this did not vary by sex (41 percent of women and 40 percent of men).

Exhibit 9A.7 | Age-standardized percentage of adults aged 20 and older who reported having diabetes who rated their own health as fair or poor, by sex, annual household income and diabetes status, in Ontario, 2005 and 2007

FINDINGS

- Adults who reported having diabetes were more than twice as likely to report fair or poor health as adults without diabetes, irrespective of household income.
- More than one-half of lower-income adults and one-third of higher-income adults with diabetes reported their health to be fair or poor compared to 21 percent of lower-income adults and less than 10 percent of higher-income adults without diabetes.
- Lower-income women and men were more likely to rate their health as fair or poor than higher-income adults, irrespective of diabetes status.



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

NOTE: See Appendix 9.3 for definitions of annual household income categories

POWER Study

LIMITATIONS IN IADLS (INSTRUMENTAL ACTIVITIES OF DAILY LIVING) AND/OR ADLS (ACTIVITIES OF DAILY LIVING)

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who reported that they needed the assistance of another person to carry out IADLs (instrumental activities of daily living—meal preparation, running errands, light and heavy household chores and money management) and/or ADLs (activities of daily living—washing, dressing, eating, taking medications, moving about inside the house). We compared IADL and/or ADL limitations among people with and without diabetes.

Background: People with diabetes have worse functional status (including greater limitations in IADLs and ADLs) than the general population.[57-59, 102, 103] Limitations in functional status can result from a multitude of factors, including diabetes complications, comorbid conditions and behavioural risk factors.[104] ADL limitations among people with diabetes have been shown to predict higher rates of hospitalizations.[105] The functional status of people with diabetes may be improved or maintained through proper disease management and promotion of healthy behaviours.[106]

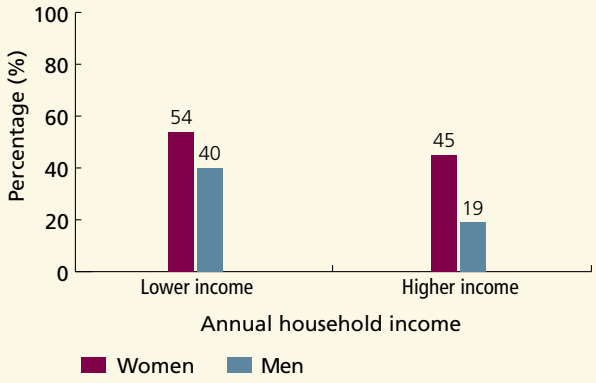
IADL limitations represent difficulties in carrying out routine life activities and are generally interpreted as an indicator of mild to moderate disability. Limitations in ADLs reflect difficulty in carrying out self-care activities, and therefore represent a more severe disability. IADL and ADL limitations may result from either physical or mental impairments. Most people who report ADL limitations will also have IADL limitations. The POWER Study Burden of Illness chapter reported that 16 percent of Ontarians aged 25 and older (20 percent of women and 11 percent of men) reported having IADL and/or ADL limitations in 2005.[61] Data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) were used to assess this indicator. Because this indicator was derived from the CCHS, diabetes status was based on self-reported information rather than physician diagnosis.

Findings: In Ontario, adults who reported having diabetes were more than twice as likely to report limitations in IADLs and/or ADLs than adults without diabetes (37 percent versus 16 percent, respectively). Women with diabetes were more likely than men with diabetes to experience limitations in carrying out IADLs and/or ADLs (49 percent versus 27 percent, respectively).

Exhibit 9A.8 | Age-standardized percentage of adults aged 20 and older who reported having diabetes who reported limitations in instrumental activities of daily living (IADLs) and/or activities of daily living (ADLs), by sex and annual household income, in Ontario, 2005

FINDINGS

- Among adults who reported having diabetes, lower-income women and men were more likely to report IADL and/or ADL limitations than higher-income women and men. Over half of lower-income women reported these limitations.
- Irrespective of income, women with diabetes were more likely than men to report IADL and/or ADL limitations.
- Women and men aged 65 and older were more likely to report limitations in IADLs and/or ADLs than those aged 20-64 (62 percent of women and 39 percent of men aged 65 and older compared to 39 percent of women and 19 percent of men aged 20-64) (data not shown).
- Almost two-thirds of women aged 65 and older with diabetes reported IADL and/or ADL limitations (data not shown).



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1)

NOTE: See Appendix 9.3 for definitions of annual household income categories

POWER Study

HEALTH BEHAVIOURS

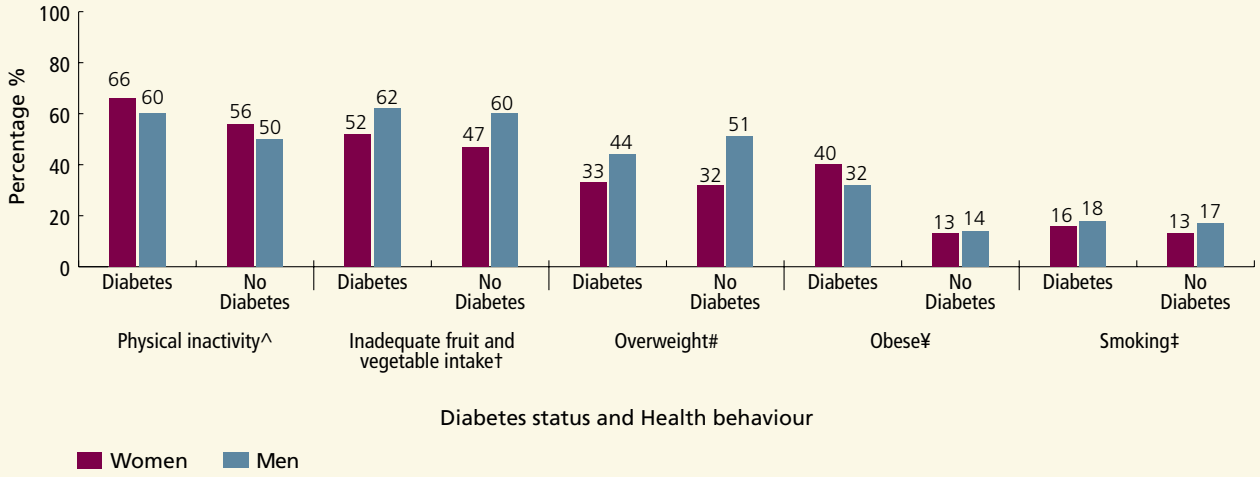
Indicator: This group of indicators measures the percentage of people who reported having diabetes who reported four major factors that increase the risk of diabetes, diabetes complications and premature mortality: physical inactivity, inadequate daily intake of fruits and vegetables, being overweight or obese, and smoking (see Appendix 9.3 for details on measurement of these indicators). We compared the health behaviours of people with and without diabetes.

Background: Inadequate physical activity, poor nutrition and being overweight or obese are risk factors for diabetes and are therefore important for diabetes prevention.[73,78-81] Promoting healthy behaviour is also an integral component of diabetes management;[82] physical activity, a healthy diet and weight management play an important role in the control of blood glucose, blood pressure and blood lipid levels.[107-109] The combined control of these endpoints has been shown to decrease the risk of diabetes complications and increase life expectancy.[34, 110] Smoking can aggravate many problems that people with diabetes already face (e.g., heart, blood vessel, kidney and eye disease), can lower life expectancy and can reduce quality of life.[111] According to the POWER Study Burden of Illness chapter, 51 percent of Ontario adults aged 25 and older were physically inactive, 57 percent reported inadequate fruit and vegetable intake, 53 percent were overweight or obese and 22 percent were current smokers.[61] Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess these indicators. Because these indicators were derived from the CCHS, diabetes status was based on self-reported information rather than physician diagnosis.

Findings: In Ontario, among adults aged 20 and older who reported having diabetes, 62 percent were physically inactive, 58 percent had inadequate fruit and vegetable intake, 39 percent were overweight, 35 percent were obese, and 17 percent were current smokers. Among adults without diabetes, 53 percent were physically inactive, 54 percent had inadequate fruit and vegetable intake, 42 percent were overweight, 13 percent were obese, and 15 percent were current smokers.

Among women with diabetes, 66 percent were physically inactive, 52 percent reported inadequate fruit and vegetable intake, 33 percent were overweight, 40 percent were obese and 16 percent were current smokers. Among men with diabetes, 60 percent were physically inactive, 62 percent reported inadequate fruit and vegetable intake, 44 percent were overweight, 32 percent were obese, and 18 percent were current smokers.

Exhibit 9A.9 | Age-standardized percentage of adults aged 20 and older who reported physical inactivity,^ inadequate fruit and vegetable intake,† being overweight,# being obese,¥ or being current smokers,‡ by sex and diabetes status, in Ontario, 2005 and 2007



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

^ Physical Activity Index of < 1.5 kcal/kg/day

† Daily consumption of less than five servings of fruits and vegetables

Overweight refers to a Body Mass Index (BMI) ≥ 25 but < 30 from self-reported height and weight

¥ Obese refers to a BMI ≥ 30; BMI calculated from self-reported height and weight

‡ Current smokers (daily or occasional)

FINDINGS

- The percentage of adults who reported inadequate fruit and vegetable intake, being overweight and smoking did not vary by diabetes status.
- Over 60 percent of men and women who reported having diabetes reported being physically inactive compared to 53 percent of adults without diabetes. Over half of all Ontarians reported being physically inactive.
- Women with diabetes were more than three times as likely as women without diabetes to be obese (40 percent versus 13 percent, respectively). Men with diabetes were more than twice as likely as men without diabetes to be obese (32 percent versus 14 percent, respectively). These percentages are lower than expected, which may be due to underestimation of BMI based on self-reported height and weight.
- Men were more likely to report inadequate fruit and vegetable intake than women and women were more likely than men to be physically inactive, irrespective of diabetes status.
- Women with diabetes were more likely to be obese than men with diabetes (40 percent versus 32 percent, respectively), whereas men with diabetes were more likely to be overweight compared to women with diabetes (44 percent versus 33 percent, respectively).
- Among those with diabetes, a greater proportion of people aged 20-64 were obese compared to those aged 65 and older (42 percent versus 26 percent). The proportion who were overweight increased with age (data not shown).
- Among those with diabetes, higher-income men were slightly less likely to be obese but more likely to be overweight than lower-income men (data not shown). The percentage of women with diabetes who reported being overweight or obese did not vary by income.

POWER Study

Section 9A

SUMMARY OF FINDINGS

This section reports on indicators for adults with diabetes and compared to people without diabetes. The indicators include measures of morbidity, health and functional status and health behaviours that increase the risk for diabetes and its complications. The indicators were measured in people who reported having diabetes in the Canadian Community Health Survey (CCHS), with the exception of diabetes prevalence. In general, adults with diabetes had worse health and functional status and were more likely to be physically inactive and obese. Indicators varied by gender and age and somewhat by income. Findings for the indicators reported in this section are summarized below.

Diabetes Prevalence

Almost one in ten Ontarians aged 20 and older had diabetes based on physician diagnosis, which is higher than the self-reported prevalence of diabetes based on survey data (six percent). Men were more likely to have diabetes than women, across all neighbourhood income quintiles and Local Health Integration Networks (LHINs). Men aged 45 and older were more likely to have diabetes than similarly aged women; however, diabetes prevalence did not vary by sex among adults aged 20-44. Diabetes prevalence increased as neighbourhood income quintile decreased, from 7.3 percent among adults living in the highest-income neighbourhoods to 11.5 percent among adults living in the lowest-income neighbourhoods. Diabetes prevalence also increased by age and varied by LHIN. Self-reported diabetes prevalence (based on CCHS data) varied by ethnicity, with lower rates reported in White adults compared to adults who were from visible minority populations.

Comorbidity (Multiple Chronic Conditions)

This indicator measured the percentage of adults who reported having diabetes who reported having at least two additional chronic conditions (for a total of three or more chronic conditions) and compared this to the percentage of adults without diabetes who had at least two chronic conditions. Adults with diabetes were twice as likely to report having at least two additional chronic conditions as adults without diabetes (56 percent versus 28 percent, respectively). Women with diabetes were more likely to have two or more additional chronic conditions than men with diabetes (63 percent versus 51 percent, respectively) and the prevalence of comorbidity increased as age increased. Low-income men with diabetes were more likely to have two other chronic conditions than those with higher incomes. Canadian born women with diabetes were more likely to have two or more other chronic conditions than immigrant women.

Prevalence of Probable Depression

Adults who reported having diabetes were slightly more likely to have probable depression than adults without diabetes (7.4 percent versus 5.0 percent, respectively). Among adults with diabetes, women were more likely to have probable depression than men (11.1 percent versus 4.3 percent, respectively); this is similar to the pattern seen in the population without diabetes. The differences in rates of probable depression by diabetes status were greater among women than among men.

Prevalence of Hypertension

Adults who reported having diabetes were almost three times as likely to have hypertension as adults without diabetes (61 percent versus 21 percent, respectively). The prevalence of hypertension among adults with diabetes did not vary by sex or income, but did increase with age.

Self-Rated Health

Forty percent of adults who reported having diabetes rated their health as fair or poor compared to 11 percent of adults without diabetes. This did not vary by sex but did vary by income. Among adults with diabetes more than one half of lower-income women and men reported their health as fair or poor compared to less than one-third of higher-income adults.

Limitations in IADLs and/or ADLs

The percentage of adults who reported limitations in their IADLs and/or ADLs was more than two times higher among those who reported having diabetes than among those without diabetes (37 percent versus 16 percent, respectively). Among adults with diabetes, women were more likely to report IADL and/or ADL limitations than men (49 percent versus 27 percent, respectively) and rates also varied by income and age. Lower-income women and men and older adults were more likely to report limitations in their IADLs and/or ADLs than their counterparts. Almost two-thirds of women with diabetes aged 65 and older reported IADL and/or ADL limitations.

Health Behaviours

Among adults who reported having diabetes, 62 percent were physically inactive, 58 percent had inadequate fruit and vegetable intake, 39 percent were overweight, 35 percent were obese, and 17 percent were current smokers. Rates of inadequate fruit and vegetable intake, being overweight or current smoking did not vary by diabetes status. Adults with diabetes were more likely to be physically inactive and were two to three times more likely to be obese than adults without diabetes. Given that obesity rates were based on self-reported height and weight, it is expected that these rates are an underestimate of the true rates.

Section 9B
Access and Utilization of Care

INTRODUCTION

Diabetes is a complex condition which benefits greatly from proactive and coordinated medical care where patients are actively involved in their management.[82]

This section includes indicators that measure access and utilization of care among adults with diabetes. These are important indicators of care because the literature shows that intensive management of risk factors for diabetes complications can reduce the rate of major complications such as heart attacks, stroke, amputation and death by 50 percent.[110] Studies have found that having a regular primary care provider is associated with better quality of diabetes care,[112, 113] and research on the management of chronic conditions has found that continuity of care is associated with better outcomes for chronic diseases such as diabetes.[114] Though the majority of diabetes patients are managed by primary care providers, access to specialists is important for more complex cases or for patients with type 1 diabetes.[115]

For diabetes care, access to and quality of care received has been shown to vary by socioeconomic status, race/ethnicity and age in the US.[116-121] Older women are more likely than older men to have worse access to effective care and to receive suboptimal levels of recommended health care services.[122] In Ontario, minority and immigrant women have worse access to health care services than white and Canadian born women.[116] Lower socioeconomic groups are less likely to have adequate access to health care and are more likely to receive fewer recommended evidence-based health care services.[117] Furthermore, disadvantaged populations encounter more barriers to care despite greater need, and benefit more from intensive and tailored programs to improve access, quality, and outcomes of diabetes care.[74] The magnitude of these disparities varies across systems and models of care, thus by effectively organizing care and addressing barriers encountered by disadvantaged populations it is possible to achieve more equitable access.[123]

Access to health care providers is key to high quality diabetes care, though this can be challenging. In Ontario, with universal health insurance coverage, the overwhelming majority (93 percent) of people report having a regular primary care provider.[116, 124] However, there are over 730,000 Ontarian adults who do not have a family doctor and over half of those are actively looking for a doctor but are unable to find one.[124] Importantly, when primary care is not organized efficiently, individuals may report difficulty accessing needed care including timely appointments despite having a primary care provider.[116, 124] Of the 2.8 million Canadians who visited a medical specialist in 2005, 19 percent reported that they faced difficulties accessing

care. Of these, 67 percent said they waited too long for an appointment and 27 percent said they had difficulty in getting an appointment.[125] In addition, as prescription drug coverage is not universal in Canada, 25 percent of Canadians with a chronic condition reported not filling prescriptions, visiting a doctor or performing a test due to costs, compared to seven percent of people in the Netherlands and 54 percent in the United States.[126] This is important because diabetes usually requires ongoing use of chronic medications to prevent complications.

In this section, we report on indicators of access to and utilization of care and examine the differences associated with sex, age, neighbourhood income and Local Health Integration Network (LHIN).

The indicators include:

- The percentage of adults aged 20 and older with diabetes who had continuity of primary care (i.e., with a general practitioner/family physician) (GP/FP)
- The average number of visits to a GP/FP per year among adults with diabetes
- The percentage of adults with diabetes who visited a specialist (endocrinologist, general internist, or geriatrician) in a two-year period
- The percentage of adults with diabetes who did not see a GP/FP or a specialist over a two-year period

The indicators of access to and utilization of care were assessed using the Ontario Diabetes Database (ODD) and the Ontario Health Insurance Plan (OHIP) physician claims data. The ODD was used to identify adults aged 20 and older who had prevalent diabetes as of March 31, 2005. The sample was linked to the OHIP database to assess access to primary and specialist care over the next two years. The Institute for Clinical Evaluative Sciences (ICES) Physician Database (IPDB) was used to identify specialists (endocrinologist, general internist, or geriatrician) (see Appendix 9.3 for details).

EXHIBITS AND FINDINGS

CONTINUITY OF PRIMARY CARE

Indicator: This indicator measures the percentage of adults aged 20 and older with diabetes who had continuity of primary care. Only those who accessed primary care at least three times in the two-year follow up period were included.

Background: Access to diabetes care and regular check-ups with a primary care provider are important for the optimal management of diabetes. Having an ongoing relationship with the same provider facilitates continuity of care and offers an opportunity for proactive care. Regular screening and management of risk factors together with optimal self-management can reduce rates of complications from the disease.[113, 114]

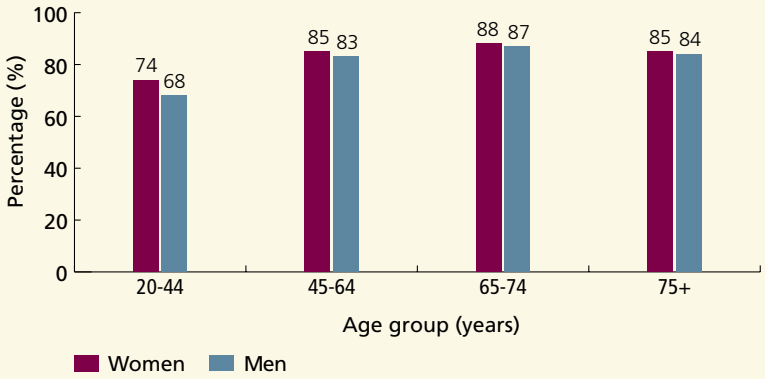
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes (see Appendix 9.3 for details). 'Continuity of primary care' was defined as having at least 50 percent of primary care visits over a two-year period (April 1, 2005 to March 31, 2007) to the same primary care provider (general practitioner/family physician (GP/FP)) based on Ontario Health Insurance Plan (OHIP) claims. Only one visit per primary care provider per day was counted. Patients were excluded if they had less than three primary care visits over the two-year period, which means that individuals who do not regularly access primary care or who had a usual care provider who was not a GP/FP would not be included in the denominator.

Findings: In Ontario, 83 percent of adults aged 20 and older with diabetes had continuity of primary care over a two-year period. Rates were slightly higher among women than men, though the difference was small (84 percent versus 82 percent, respectively).

Exhibit 9B.1 | Percentage of adults aged 20 and older with diabetes who had continuity of primary care, by sex and age group, in Ontario, 2005/06-2006/07

FINDINGS

- Adults aged 20-44 with diabetes were less likely to have continuity of primary care than those aged 45 and older (71 percent versus 85 percent, respectively).
- Among adults under age 65 with diabetes, women were more likely than men to have continuity of primary care than men. The gender difference was larger in the younger age group.
- The percentage of adults with diabetes who had continuity of primary care varied somewhat by neighbourhood income, however, the differences were small (data not shown).
- The percentage of women and men with diabetes who had continuity of primary care varied across Local Health Integration Networks (LHINs), ranging from 75 percent (North West LHIN) to 85 percent (Central East and South West LHINs) (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

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MEAN NUMBER OF VISITS TO A GENERAL PRACTITIONER/FAMILY PHYSICIAN (GP/FP)

Indicator: This indicator measures the mean number of visits made to a general practitioner/family physician (GP/FP) per year among adults aged 20 and older with diabetes.

Background: Access to diabetes care and regular check-ups with a primary care provider is important for optimal management of diabetes. While it is unclear what the right number of visits should be, all adults with diabetes should undergo annual screening for complications of diabetes and most require three or more assessments per year to control their disease.[82] Regular diabetes care is important because of the large number of routine screening tests and adjustment to treatment regimens required to optimize control of diabetes and associated risk factors.

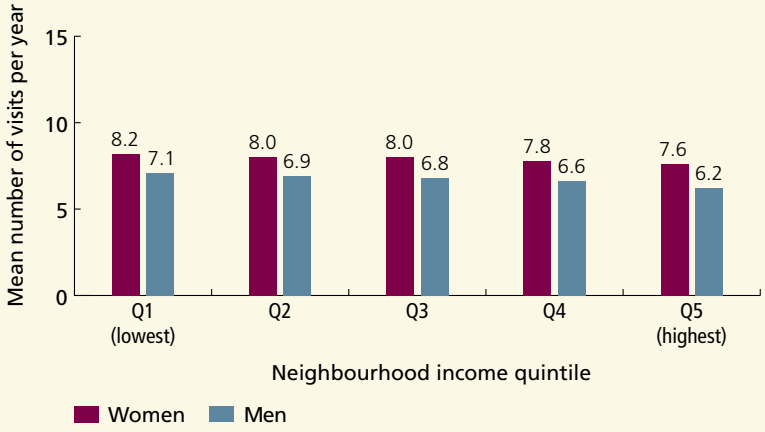
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes (see Appendix 9.3 for details). The mean number of primary care visits (for any reason) per year was calculated based on Ontario Health Insurance Plan (OHIP) data over a two-year period (April 1, 2005 to March 31, 2007). Primary care visits were based on fee-for-service claims submitted to OHIP; inpatient and emergency department visits were excluded. Services provided by physicians paid through alternate funding plans (AFPs) may not be completely captured using OHIP data. Their concentration in certain specialties or geographic areas may result in bias to our estimates.

Findings: In Ontario, adults aged 20 and older with diabetes had a mean of 7.3 GP/FP visits per year. Women had a higher mean number of GP/FP visits per year than men (8.0 versus 6.7 visits, respectively).

Exhibit 9B.2 | Age-standardized mean number of visits to a general practitioner/ family physician (GP/FP) per year among adults aged 20 and older with diabetes, by sex and neighbourhood income quintile, in Ontario, 2005/06-2006/07

FINDINGS

- Women and men with diabetes who lived in lower-income neighbourhoods had a higher mean number of GP/FP visits than adults who lived in higher-income neighbourhoods (7.7 versus 6.8 visits per year, respectively). This income gradient was observed among both women and men.
- Among adults with diabetes, men had a lower mean number of GP/FP visits than women, irrespective of neighbourhood income.
- The mean number of GP/FP visits per year increased with age for both women and men, ranging from 6.8 visits for women and 4.9 visits for men aged 20-44 to 9.8 visits for women and 8.8 visits for men aged 75 and older. Women had more GP/FP visits than men across all age groups, though the gap decreased with increasing age (data not shown).
- The mean number of GP/FP visits per year among people with diabetes varied widely across Local Health Integration Networks (LHINs). Among women with diabetes, the mean number of visits ranged from 5.5 visits in the North West LHIN to 9.0 visits in the Toronto Central LHIN. Among men with diabetes, the mean number of GP/FP visits per year ranged from 4.8 visits in the North West LHIN to 7.7 in the Toronto Central LHIN (data not shown).
- Some of the variation across LHINs may be due to regional variations in the use of alternate funding plans (AFPs) where OHIP billing information may be incomplete.



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Statistics Canada 2006 Census

NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

POWER Study

SPECIALIST CARE FOR ADULTS WITH DIABETES

Indicator: This indicator measures the percentage of adults aged 20 and older with diabetes who visited a specialist (endocrinologist, general internist, or geriatrician) at least once within a two-year period.

Background: Though primary care physicians provide the bulk of diabetes care, specialists are important members of a diabetes care team, particularly for patients with type 1 diabetes.[82, 127, 128] Access to specialist care and specialized diabetes services may be important for optimal management in complex patients, though mild cases of type 2 diabetes can be effectively managed in primary care and do not generally need specialist care. Individuals with type 1 diabetes (who tend to be younger) or those with more severe or complex disease are most likely to benefit from specialist care.

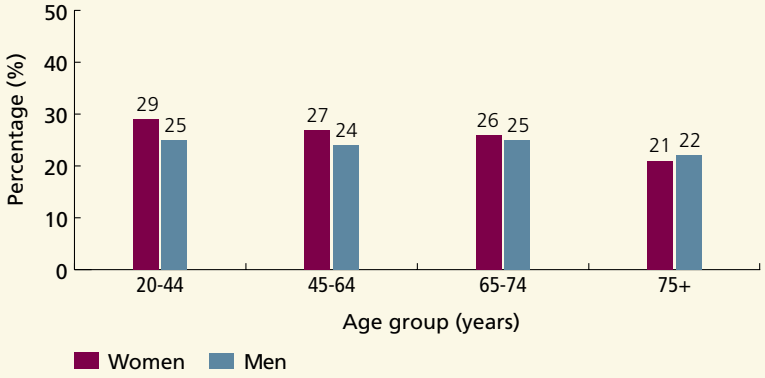
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes (see Appendix 9.3 for details). We were unable to distinguish between adults with type 1 and type 2 diabetes. This indicator includes all office visits to endocrinologists, general internists or geriatricians within a two-year period (April 1, 2005 to March 31, 2007). These three types of specialists are most likely to provide specialty care related to diabetes; however, general internists and geriatricians may vary in their capacity to provide diabetes specialty care. Services provided by physicians paid through alternate funding plans (AFPs) may not be completely captured using OHIP data. Their concentration in certain specialties or geographic areas may result in bias to our estimates.

Findings: In Ontario, 25 percent of adults aged 20 and older with diabetes saw a specialist (endocrinologist, general internist or geriatrician) at least once over a two-year period. Women were slightly more likely than men to have seen a specialist, though this difference was small (26 percent versus 24 percent, respectively).

Exhibit 9B.3 | Percentage of adults aged 20 and older with diabetes who saw a specialist† at least once over a two-year period, by sex and age group, in Ontario, 2005/06-2006/07

FINDINGS

- Younger people with diabetes were more likely to see a specialist than older people (27 percent of those aged 20-44 versus 21 percent of those aged 75 and older), likely due to the higher proportion of type 1 diabetes, and thus greater need for specialty care, in young adults.
- Among adults aged 20-44 with diabetes, women were more likely than men to see a specialist. Specialty care also differed by sex for adults with diabetes aged 45 and older, however, these differences were small.
- People with diabetes who lived in the lowest-income neighbourhoods were slightly less likely to have visited a specialist than those who lived in the highest-income neighbourhoods, however, this difference was small (24 percent versus 26 percent, respectively) (data not shown).

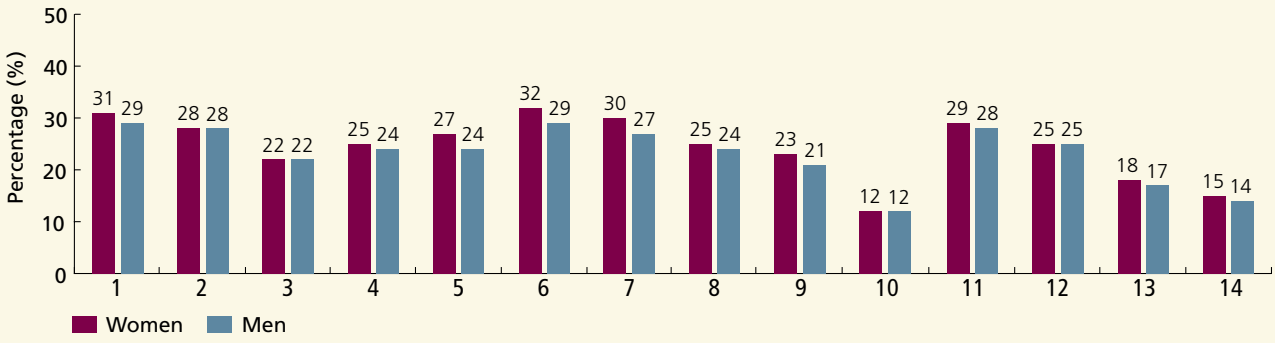


DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); ICES Physician Database (IPDB)

† Includes visits to endocrinologists, general internists or geriatricians

POWER Study

Exhibit 9B.4 | Age-standardized percentage of adults aged 20 and older with diabetes who saw a specialist† at least once over a two-year period, by sex and Local Health Integration Network (LHIN), in Ontario, 2005/06-2006/07



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); ICES Physician Database (IPDB)

† Includes visits to endocrinologists, general internists or geriatricians

FINDINGS

- The percentage of adults with diabetes who saw a specialist varied across LHINs.
- Among women with diabetes, the percentage that had seen a specialist at least once in two years ranged from 12 percent in the South East LHIN to 32 percent in the Mississauga Halton LHIN.
- Among men with diabetes, the percentage that had seen a specialist at least once in two years ranged from 12 percent in the South East LHIN to 29 percent in the Erie St. Clair and Mississauga Halton LHINs.
- Some of the variation may be due to alternate funding plans (AFPs) where OHIP billing information may be incomplete, as occurs in the South East LHIN, or due to out of province use of specialists, as occurs in the North West LHIN.

POWER Study

NO VISITS TO PRIMARY CARE PHYSICIANS OR SPECIALISTS

Indicator: This indicator measures the percentage of adults aged 20 and older with diabetes who did not have any visits to a general practitioner/family physician (GP/FP) or a specialist (endocrinologist, general internist, or geriatrician) over a two-year period.

Background: Regular physician visits (either to a GP/FP or a specialist) are necessary to make sure that patients receive the screening and monitoring activities required to manage diabetes and to ensure receipt of high quality diabetes care. Optimal management is also contingent on individualization and modification of treatment during these visits.[82]

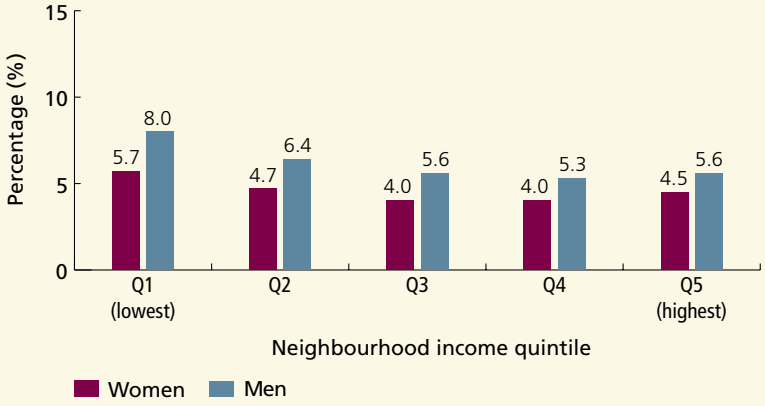
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes (see Appendix 9.3 for details). This indicator includes people who had no visits to a GP/FP or specialist (endocrinologist, general internist, or geriatrician) over a two-year period (April 1, 2005 to March 31, 2007), based on Ontario Health Insurance Plan (OHIP) data. Inpatient and emergency department visits were not included. Services provided by physicians paid through alternate funding plans (AFPs) may not be completely captured using OHIP claims data. Their concentration in certain specialties or geographic areas may result in bias to our estimates.

Findings: In Ontario, 5.5 percent of adults aged 20 and older with diabetes had no visits to a GP/FP or a specialist (endocrinologist, general internist, or geriatrician) over a two-year period. Men were more likely than women to have not seen these types of physicians (6.3 percent versus 4.7 percent, respectively).

Exhibit 9B.5 | Age-standardized percentage of adults aged 20 and older with diabetes who had no visits to a general practitioner/family physician (GP/FP) or a specialist† over a two-year period, by sex and neighbourhood income quintile, in Ontario, 2005/06-2006/07

FINDINGS

- The percentage of adults with diabetes who had not seen a GP/FP or a specialist in a two-year period varied by neighbourhood income.
- Among women with diabetes, 5.7 percent of those living in the lowest-income neighbourhoods had not seen either type of physician in two years compared to 4.0 and 4.5 percent of women living in the middle- to highest-income neighbourhoods.
- The income difference among men with diabetes was larger than the difference among women. Eight percent of men with diabetes who were living in the lowest-income neighbourhoods had not seen a GP/FP or a specialist in two years compared to 5.3 and 5.6 percent of men living in the middle- to highest-income neighbourhoods.



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); ICES Physician Database (IPDB); Statistics Canada 2006 Census

NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

† Includes visits to endocrinologists, general internists or geriatricians

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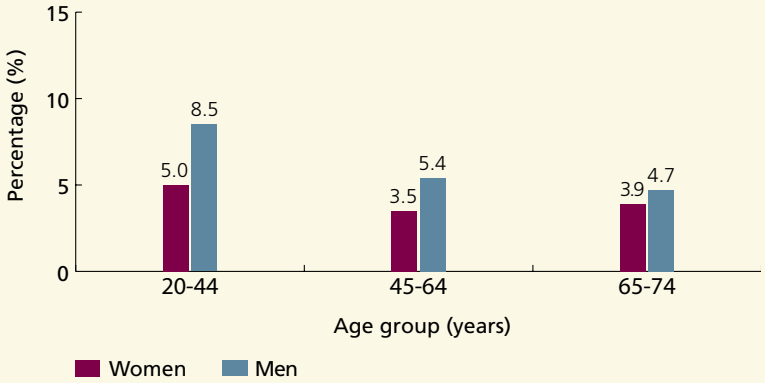
Exhibit 9B.6 | Percentage of adults aged 20-74 with diabetes who had no visits to a general practitioner/family physician (GP/FP) or a specialist† over a two-year period, by sex and age group, in Ontario, 2005/06-2006/07

FINDINGS

- Across all age groups, men were more likely than women to have had no visits to a GP/FP or a specialist over a two-year period; however, this gap was widest among adults aged 20-44.
- A sizable proportion (8.5 percent) of men with diabetes who were aged 20-44 had not seen a GP/FP or a specialist during a two-year period.

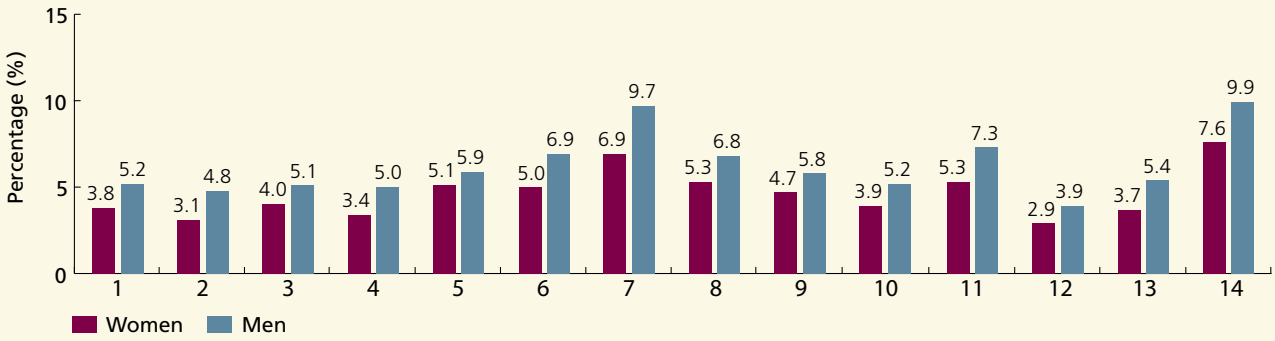


DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); ICES Physician Database (IPDB);

† Includes visits to endocrinologists, general internists or geriatricians

POWER Study

Exhibit 9B.7 | Age-standardized percentage of adults aged 20 and older with diabetes who had no visits to a general practitioner/family physician (GP/FP) or a specialist† over a two-year period, by sex and Local Health Integration Network (LHIN), in Ontario, 2005/06-2006/07



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); ICES Physician Database (IPDB)

† Includes visits to endocrinologists, general internists or geriatricians

FINDINGS

- The percentage of people with diabetes who had no visits to a GP/FP or a specialist over a two-year period varied significantly by LHIN.
- The percentage of women with diabetes who had no visits to a GP/FP or a specialist over a two-year period ranged from 2.9 percent (North Simcoe Muskoka LHIN) to 7.6 percent (North West LHIN).
- The percentage of men with diabetes who had no visits to a GP/FP or a specialist over a two-year period ranged from 3.9 percent (North Simcoe Muskoka LHIN) to 9.9 percent (North West LHIN).
- Some of the variation may be due to alternate funding plans (AFPs) where OHIP billing information may be incomplete, as occurs in the South East or Toronto Central LHINs or due to out of province use of specialists, as occurs in the North West LHIN.

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Section 9B

SUMMARY OF FINDINGS

This section reports on indicators of access and utilization of services for adults with diabetes. Overall, women had greater utilization of health services than men; low-income men and younger men were particularly disadvantaged. Access to care varied significantly by Local Health Integration Network (LHIN); however, some of the variation may be due to federally funded physicians, alternate funding plans (AFPs) where Ontario Health Insurance Plan (OHIP) billing information may be incomplete, or regional variations in care delivery. Equity can only be determined by measuring need and utilization of services, but since robust measures of need are not available in existing datasets, it cannot be reliably measured. For instance, the somewhat higher number of visits among low-income individuals—who may have more severe disease—may be reflective of greater need rather than 'better' access to care. With currently available data, it is not possible to determine whether their access to care is sufficient for their need.

Findings for the indicators reported in this section are summarized below.

Percentage of Adults with Diabetes who have Continuity of Primary Care

Among adults aged 20 and older with diabetes, 83 percent had continuity of primary care (more than 50 percent of their primary care visits were to the same general practitioner/family physician (GP/FP)). This varied across LHINs. There were small differences by sex and neighbourhood income. Younger men with diabetes (those aged 20-44) were least likely to have continuity of primary care (68 percent) compared to 74 percent of similarly aged women and 85 percent of older women and men with diabetes.

Mean Number of Primary Care Visits

Ontarians with diabetes aged 20 and older had a mean of 7.3 GP/FP visits per year over a two-year period from April 1, 2005 to March 31, 2007. Women had consistently higher mean numbers of GP/FP visits per year than men, irrespective of neighbourhood income, age or LHIN. Adults living in lower-income neighbourhoods had a slightly higher mean number of GP/FP visits per year than those living in higher-income neighbourhoods, which may represent missed opportunities to improve disease management. The mean number of GP/FP visits per year increased with age for women and for men. The mean number of GP/FP visits per year among people with diabetes varied widely across LHINs.

The Percentage of Adults with Diabetes who Visited a Specialist in a Two-Year Period

One-quarter of adults with diabetes had seen a specialist within a two-year period, with slightly higher rates among women than among men (26 percent versus 24 percent, respectively) and among adults living in higher-income neighbourhoods. Younger people with diabetes were more likely to have seen a specialist than older people, likely due to the higher proportion of type 1 diabetes in young adults. The percentage of adults with diabetes who had seen a specialist in a two-year period varied significantly by LHIN. Some of the variation may be due to alternate funding plans (AFPs) where physicians are salaried and shadow billing data to track the number of visits are incomplete. However, the number of specialists in practice also varies by region which may also partially account for the variation seen.

The Percentage of Adults with Diabetes Who Did Not See a GP/FP or a Specialist in a Two-Year Period

Among Ontarians with diabetes, 5.5 percent had not seen a GP/FP or a specialist (endocrinologist, general internist or geriatrician) during a two-year period. This varied by sex, income, age and LHIN. Men were more likely to have not received care from any of these types of physicians than women, irrespective of neighbourhood income, age or LHIN. Eight percent of men living in the lowest-income neighbourhoods and 8.5 percent of men aged 20-44 had not seen a GP/FP or specialist during the two-year period. The proportion of people with no primary care physician or specialist visits within a two-year period was particularly high in the North West LHIN, a region where much of diabetes care is delivered by nurses because of a paucity of doctors, and the Toronto Central LHIN, a region where services abound but poverty is more concentrated. Additionally, some patients in the North West LHIN may receive care out of province.

Section 9C
Screening, Assessment and Monitoring

INTRODUCTION

Diabetes management is complex and requires ongoing assessment and comprehensive screening for the prevention, early identification and treatment of complications.

Current clinical practice guidelines provide recommendations for ongoing screening and monitoring among people with diabetes, including regular monitoring of blood glucose levels, testing for microalbumin, foot examinations, and eye examinations.[82] Good glycemic (glucose) control is associated with the delay or prevention of diabetes complications—including diabetic eye disease, kidney disease and neuropathy.[129, 130] In addition, involving patients in their care is associated with better outcomes. For example, early detection of foot ulcers and infections—either by health care providers or by patients themselves—can allow for earlier treatment and prevent amputation, so regular screening is important.[131, 132] In addition, routine monitoring of blood glucose levels at home (self-monitoring) helps patients on insulin and possibly those on oral agents with poor control of blood glucose to improve glycemic control.[133, 134]

Quality of care for diabetes is suboptimal in most jurisdictions and Canada ranks in the middle in many international comparison studies of the quality of diabetes care. Routine screening measures like hemoglobin A1c (a measure of the average blood glucose in the past three months) is high at 90 percent, but foot exams and eye exams to screen for complications are lower, at 53 percent and 69 percent, respectively.[135] The large number of recommended screening activities for diabetes makes consistent, comprehensive care challenging, with only 29 percent of Canadian adults with diabetes receiving all screening measures (A1c, foot exams, eye exams and microalbumin tests) within the recommended interval.[135] In 2007, Ontario was slightly above the national average, with 31 percent receiving all four tests.[135] There are numerous examples of strategies to improve care for diabetes across a health system, most notably the Veteran's Administration QUERI-DM program and ongoing improvements documented in the United Kingdom.[136-138] These changes occurred in large and varied systems accompanying major episodes of health reform, suggesting that similar results are possible in Ontario.

This section assesses performance on indicators of the quality of screening, assessment and monitoring of diabetes in Ontario, covering key elements of care recommended by clinical practice guidelines. We also report on access to dental care. The indicators were measured among people who reported having diabetes in the Canadian Community Health Survey (CCHS), with the exception of eye examination. The choice of indicators was guided by clinical relevance (i.e., recommended in clinical practice guidelines), but limited by what data are available. Where possible and where data were available, we examined the differences associated with sex, income, education, age, ethnicity, immigration status, rural/urban residency and Local Health Integration Network (LHIN).

The indicators include:

Screening, assessment and monitoring for diabetes

- The percentage who were taking insulin who reported self-monitoring their blood glucose levels at least once per day.
- The percentage who reported that a health care professional had tested them for hemoglobin A1c within the past 12 months.
- The percentage who reported that a health care professional had tested them for microalbumin in the past 12 months.
- The percentage of adults (aged 30 and older) who had an eye examination within two years of diagnosis of diabetes.
- The percentage who reported usually performing a self foot examination at least once per year.
- The percentage who reported that a health care professional checked their feet for sores or irritations in the past 12 months.

Other preventive screening strategies

- The percentage who reported that they had visited a dentist in the past 12 months.

Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess the percentage of adults who reported having diabetes: who were on insulin or oral glucose-lowering medications who self-monitored their blood glucose levels at least daily; who performed self foot examinations at least annually; reported that a health care professional had checked their feet for sores or irritations, tested them for hemoglobin A1c, or tested them for microalbumin. Data from CCHS, 2005 (Cycle 3.1) were used to assess dental visits among people with diabetes. The Ontario Diabetes Database (ODD) was used to identify newly diagnosed cases of diabetes; these records were linked to Ontario Health Insurance Plan (OHIP) data to determine the percentage who had an eye examination within two years following their diabetes diagnosis date (see Appendix 9.3 for details).

EXHIBITS AND FINDINGS

SCREENING, ASSESSMENT AND MONITORING FOR DIABETES

SELF-MONITORING OF BLOOD GLUCOSE

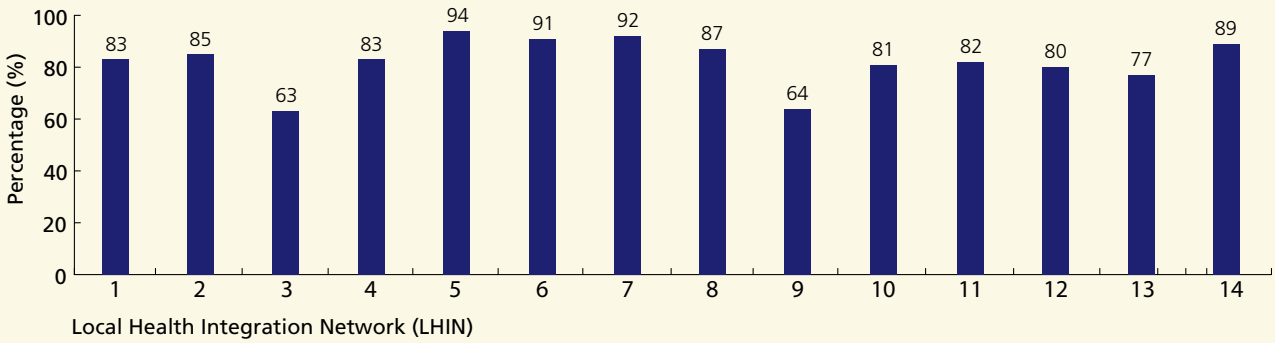
Indicator: Among adults aged 20 and older who reported having diabetes who were currently taking insulin, this indicator measures the percentage who reported monitoring their blood glucose levels at least daily.

Background: Self-management education, including a focus on appropriate monitoring and interpretation of blood glucose levels, contributes to good control of diabetes.[133, 134] Ongoing monitoring of blood glucose is an important component of diabetes self-care for patients on insulin, while the benefit for those on oral agents is not as clear.[139] Therefore, we also measured this indicator for adults with diabetes who were not on insulin but were on an oral glucose-lowering medication, but we report only overall rates for women and men.

Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess this indicator. People with diabetes were asked, "How often do you usually have your blood checked for glucose or sugar by yourself or by a family member or friend?" Respondents who indicated that they monitored their blood glucose at least daily were included. Because this indicator was derived from the CCHS, diabetes status, use of insulin and use oral glucose-lowering medications were based on self-reported information rather than physician information.

Findings: In Ontario, 81 percent of adults aged 20 and older who reported having diabetes and currently taking insulin reported self-monitoring their blood-glucose levels at least daily. This indicator did not vary by sex (84 percent of women and 78 percent of men). Among adults aged 20 and older who reported having diabetes and taking oral glucose-lowering medications, 49 percent reported daily self-monitoring of their blood glucose levels. This did not vary by sex (52 percent of women and 47 percent of men).

Exhibit 9C.1 | Age-standardized percentage of adults aged 20 and older who reported having diabetes who were on insulin who reported self-monitoring their blood glucose levels^ at least daily, by Local Health Integration Network (LHIN), in Ontario, 2005 and 2007



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

^ Refers to having their blood glucose levels checked by themselves, a family member or friend

FINDINGS

- The percentage of adults who reported having diabetes who were taking insulin and who self-monitored their blood glucose levels at least daily varied across LHINs, ranging from 63 percent in the Waterloo Wellington LHIN to 94 percent in the Central West LHIN. These data could not be reported by sex because of small numbers.
- Daily self-monitoring of blood glucose levels did not vary by age, income, education or rural/urban residency (data not shown).

POWER Study

HEMOGLOBIN A1C MONITORING

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who reported that a health care professional had tested them for hemoglobin A1c at least once in the past year.

Background: Hemoglobin A1c is a marker of long-term control of diabetes. This test measures the average level of blood glucose over a three-month period. Clinical practice guidelines recommend that people with diabetes should be tested every three to six months.[82] Regular monitoring of blood glucose may lead to better control, which in turn will result in fewer complications among people with type 1 and type 2 diabetes.

Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess this indicator. People with diabetes were asked, "In the past 12 months, has a health care professional tested you for hemoglobin 'A-one-C'? (An 'A-one-C' hemoglobin test measures the average level of blood sugar over a three-month period.)" Because this indicator was derived from the CCHS, people with diabetes were identified based on self-reported information rather than physician diagnosis.

Findings: In Ontario, 80 percent of adults aged 20 and older who reported having diabetes reported that a health care professional tested them for hemoglobin A1c at least once in the past 12 months. This did not vary by sex (79 percent of women and 82 percent of men) or by annual household income, educational attainment, age, visible minority status, immigrant status, rural/urban residence (data not shown). Due to small numbers and limited power to detect differences, we did not report variation by Local Health Integration Network (LHIN).

MICROALBUMIN MEASUREMENT

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who reported that a health care professional had tested them for microalbumin (protein in the urine) at least once in the past year.

Background: The microalbumin test is used to screen for kidney damage and early signs of diabetic nephropathy. As kidney damage is frequently seen in chronic diseases such as diabetes and hypertension, early detection and management may delay progression to end-stage renal disease. Based on expert opinion, the Canadian Diabetes Association (CDA) guidelines recommend annual screening for microalbumin.[82]

Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess this indicator. People with diabetes were asked, "In the past 12 months, has a health care professional tested your urine for protein (i.e., microalbumin)?" Because this indicator was derived from the CCHS, people with diabetes were identified based on self-reported information rather than physician diagnosis.

Findings: In Ontario, 73 percent of adults aged 20 and older who reported having diabetes reported that a health care professional tested them for microalbumin at least once in the past year. This did not vary by sex (71 percent of women and 75 percent of men) or by annual household income, educational attainment, age, visible minority status, immigration status or rural/urban residence (data not shown). Due to small numbers and limited power to detect differences, we did not report variation by Local Health Integration Network (LHIN).

EYE EXAMINATION

Indicator: This indicator measures the percentage of adults aged 30 and older with newly diagnosed diabetes who had a visit to a general practitioner/family physician (GP/FP), optometrist, or ophthalmologist for an eye examination within two years of diagnosis.

Background: As the prevalence of diabetes increases in Ontario, it is expected that blindness due to diabetic retinopathy will also increase. Diabetic retinopathy is the leading cause of new cases of blindness in adults aged 20-74.[140] Previous research has shown that systematic screening, referral and treatment for diabetic retinopathy can significantly reduce new onset of blindness[141] and is a cost-effective way to prevent or delay vision loss.[142] However, despite the proven benefits of screening, many Canadians with diabetes do not receive a regular dilated eye examination as recommended by the Diabetes Clinical Practice Guidelines.[82] The Canadian Diabetes Association (CDA) recommends that adults with diabetes receive a dilated eye examination every one to two years.[82]

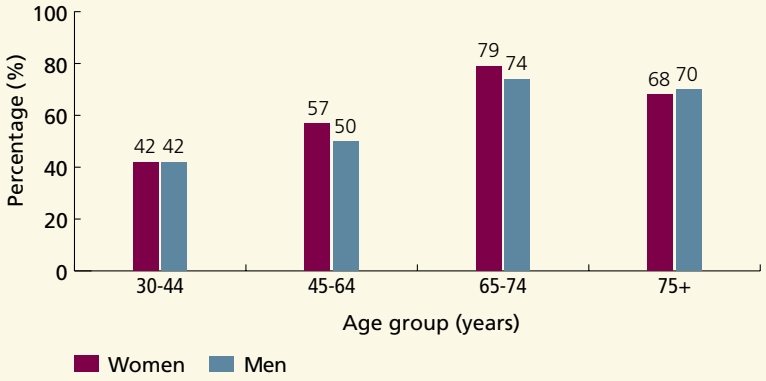
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes (see Appendix 9.3 for details). We were unable to distinguish between adults with type 1 and type 2 diabetes. The percentage of people who had an eye examination within two years of diabetes diagnosis was determined using Ontario Health Insurance Plan (OHIP) data. Adults aged 30 and older with newly diagnosed diabetes who had seen an ophthalmologist, optometrist, or a GP/FP for a major eye examination or assessment within 730 days of being newly diagnosed with diabetes were included. The analysis was limited to adults aged 30 or older at diagnosis to select people who were more likely to have new onset type 2 diabetes; prompt screening would be recommended for them. There is no specific OHIP fee code for retinopathy screening. Accordingly, OHIP claims were used to identify physician or optometry visits during which a dilated retinal examination would likely have occurred (see Appendix 9.3 for details). Services provided by physicians paid through alternate funding plans (AFPs) may not be completely captured using OHIP data. Their concentration in certain specialties or geographic areas may result in bias to our estimates. As well, people who may have paid directly or used private insurance to pay for an eye exam will not be captured, leading to further underestimation.

Findings: In Ontario, 58 percent of adults aged 30 and older with diabetes had an eye examination within two years of being diagnosed with diabetes. Women were more likely than men to have an eye examination (60 percent versus 56 percent, respectively).

Exhibit 9C.2 | Percentage of people aged 30 and older who had an eye examination within two years of being diagnosed with diabetes, by sex and age-group, in Ontario, 2003/04-2005/06

FINDINGS

- The proportion of people newly diagnosed with diabetes who underwent an eye examination within two years of diagnosis increased with age, with a slight decrease after age 75. Only slightly more than four in ten adults aged 30-44 had an eye examination within two years of being diagnosed with diabetes.
- Men aged 30 and older living in the highest-income neighbourhoods were slightly more likely to have an eye examination within two years of diagnosis than men living in the lowest-income neighbourhoods, however, this difference was small (55 percent versus 58 percent, respectively). This indicator did not vary by income among women (data not shown).
- The percentage of adults who underwent an eye examination within two years of being diagnosed with diabetes varied considerably by Local Health Integration Network (LHIN). The rates ranged from 53 percent in the Toronto Central LHIN to 65 percent in the North East and North West LHINs (data not shown). Across all LHINs, less than two-thirds of adults were screened according to recommendations.



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

POWER Study

SELF FOOT EXAMINATION

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who reported examining their feet for sores or irritations (or having a friend or relative do it) at least annually.

Background: Foot ulcers and lower limb amputations cause a significant amount of morbidity and reduced quality of life in people with diabetes.[143] Approximately 50 percent of all non-traumatic lower extremity amputations occur in people with diabetes.[140] In the US, being an older adult (aged 75 and older), male and African American increases the risk for diabetes-related lower extremity amputation.[144] These complications can be prevented with regular monitoring of feet and the lower legs and with early treatment of ulcers. Due to the preventable nature of these complications, foot care is a very important aspect of diabetes management. Reducing the likelihood of lower limb amputations requires multiple prevention strategies, including regular foot checks by patients as well as by their health care providers.[131, 132]

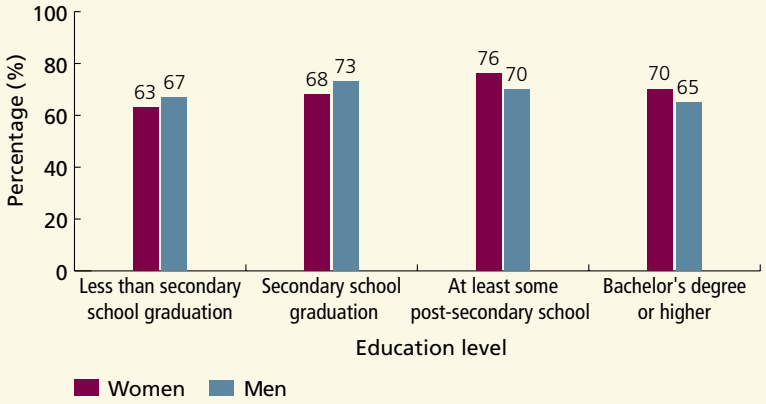
Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess this indicator. People with diabetes were asked, "How often do you usually have your feet checked for any sores or irritations by yourself or by a family member or friend?" Respondents who answered a minimum of once a year were included in the numerator. Because this indicator was derived from the CCHS, people with diabetes were identified based on self-reported information rather than physician diagnosis.

Findings: In Ontario, 68 percent of adults aged 20 and older who reported having diabetes reported having their feet checked for any sores or irritations by themselves, by a family member or by a friend at least annually. This indicator did not vary by sex (69 percent of women and 67 percent of men).

Exhibit 9C.3 | Age-standardized percentage of adults aged 25 and older who reported having diabetes who reported performing a self foot examination^ at least annually, by sex and education level, in Ontario, 2005 and 2007

FINDINGS

- Among women who reported having diabetes, those with less than a secondary school education were less likely than more educated women to have their feet checked for sores or irritations by themselves, or by a family member or friend. Self foot examinations did not vary by education among men with diabetes.
- The percentage of people with diabetes who had their feet checked for sores or irritations by themselves, or by a family member or friend at least annually did not vary by age or annual household income (data not shown).
- People with diabetes who were immigrants to Canada were less likely to check their feet at least annually than those who were Canadian born (62 percent versus 73 percent, respectively) (data not shown).
- Men with diabetes who lived in urban communities were less likely to monitor their feet than men who lived in rural communities (66 percent versus 75 percent, respectively). The percentage of women who checked their feet did not differ by rural/urban residency (data not shown).
- The percentage of people with diabetes who checked their feet for sores or irritations at least annually varied across LHINs, ranging from 62 percent (Central and Central East LHINs) to 79 percent (South East LHIN) (data not shown).



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

^ Self foot examination refers to having their feet checked for any sores or irritations by themselves, a family member or friend

POWER Study

FOOT EXAMINATION BY A HEALTH CARE PROFESSIONAL

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who reported that a health care professional checked their feet for sores or irritations in the past 12 months.

Background: People with diabetes are at increased risk for foot ulcers and amputations and foot problems are a major cause of morbidity and mortality in people with diabetes. Foot complications contribute to health care costs and are a major reason for hospitalization among people with diabetes. Annual, thorough foot examinations by a health care professional and management of risk factors can prevent or delay adverse outcomes.[132, 145] The Canadian Diabetes Association (CDA) recommends that people with diabetes receive a foot exam annually.[82]

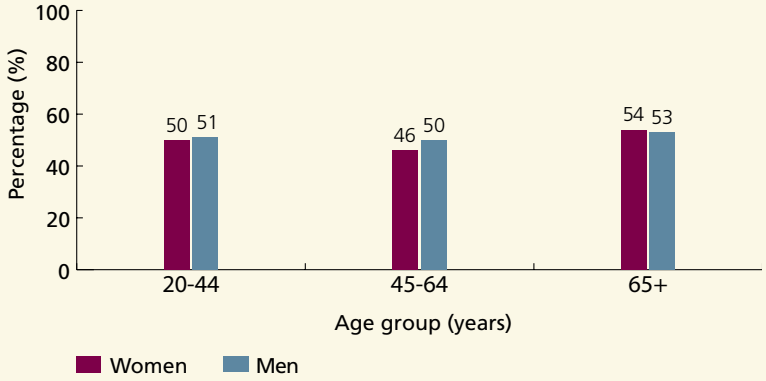
Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess this indicator. People with diabetes were asked, "In the past 12 months, has a health care professional checked your feet for any sores or irritations?" Because this indicator was derived from the CCHS, people with diabetes were identified based on self-reported information rather than physician diagnosis.

Findings: In Ontario, 51 percent of adults aged 20 and older who reported having diabetes reported that a health care professional had checked their feet for any sores or irritations in the past year. A similar proportion of women and men reported having had their feet checked by a health care professional (50 percent and 51 percent, respectively).

Exhibit 9C.4 | Percentage of adults aged 20 and older who reported having diabetes who reported that a health care professional checked their feet for any sores or irritations in the past year, by sex and age group, 2005 and 2007

FINDINGS

- The percentage of adults who reported having diabetes who reported having had their feet checked by a health care professional did not vary by age for women or for men.
- The percentage of people with diabetes who reported having had their feet checked by a health care professional did not vary by annual household income, education or rural/urban residency. We did not report variation by Local Health Integration Network (LHIN) due to small numbers and limited power to detect differences (data not shown).
- Adults with diabetes who immigrated to Canada less than 10 years ago were half as likely to have had their feet checked for any sores or irritations by a health care professional as immigrants who had been in Canada for 10 or more years or people born in Canada (26 percent versus 52 percent and 53 percent, respectively). This could not be reported by sex because of small numbers (data not shown).



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

POWER Study

OTHER PREVENTIVE SCREENING STRATEGIES

DENTAL CARE

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who reported that they had visited a dentist in the past year. We compared the percentage who had seen a dentist among people with and without diabetes.

Background: People with diabetes are at increased risk for destructive periodontitis (severe inflammation of their gums).[146] In addition, untreated periodontitis in people with diabetes may complicate glycemic control and is associated with heart and kidney disease.[147-151] Regular dental visits provide opportunities for prevention, early detection and treatment of periodontal problems.[152]

In Canada, dental care is not a universally insured benefit. Some Canadians receive dental insurance as an employment benefit, others must fund dental care using their own resources and government programs provide care to some. The literature shows that the burden of oral diseases and associated complications are more likely to affect low-income adults and children, the elderly and certain ethnic groups.[153, 154] In the POWER Study Access to Health Care Services chapter, 68 percent of Ontarians aged 25 and older had visited a dentist in the past 12 months (32 percent had not visited a dentist in the past 12 months) and this varied by income, education, ethnicity and length of time in Canada.[116]

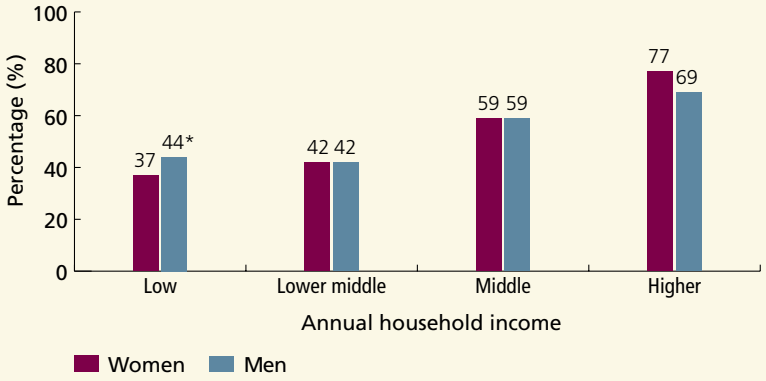
Data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) were used to assess this indicator. Adults were asked if they had visited a dentist in the past 12 months. Because this indicator was derived from the CCHS, diabetes status was identified based on self-reported information rather than physician diagnosis.

Findings: In Ontario, 56 percent of adults aged 20 and older who reported having diabetes reported that they visited a dentist in the past year compared to 65 percent of adults without diabetes. Among those with diabetes, the percentage who had a dental visit in the past year did not vary by sex (55 percent of women versus 56 percent of men).

Exhibit 9C.5 | Age-standardized percentage of adults aged 20 and older who reported having diabetes who reported having had a dentist visit in the past year, by sex and annual household income, in Ontario, 2005

FINDINGS

- The percentage of women and men who reported having diabetes who had a dentist visit in the past year increased with annual income. Low-income adults with diabetes were much less likely to visit a dentist than higher-income adults with diabetes (40 percent versus 72 percent, respectively). This was true for women and for men.
- The percentage of adults with diabetes who reported that they had visited a dentist in the past year increased with educational attainment for both women and men (36 percent of women and 43 percent of men with less than secondary school graduation compared to 75 percent of women and 69 percent of men with a Bachelor's degree or higher) (data not shown).
- Adults aged 65 and older with diabetes were less likely to visit a dentist than those under age 65 (47 percent versus 62 percent, respectively) (data not shown).
- Adults with diabetes who self-identified as visible minorities were less likely to visit a dentist than White individuals (46 percent versus 58 percent, respectively) (data not shown).
- The percentage of people with diabetes who had visited a dentist in the past year did not vary by rural/urban residency (data not shown). We did not report variation by Local Health Integration Network (LHIN) due to small numbers and limited power to detect differences.



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1)

* Interpret with caution due to high sampling variability

POWER Study

Section 9C

SUMMARY OF FINDINGS

This section reports on indicators of screening, monitoring and assessment of diabetes and dental care for adults with and without diabetes. Rates were compared across subgroups in the population and we found that, for the most part, care was comparable. However, there were significant gaps in dental care, similar to those noted in the POWER Study Access to Health Care Services chapter.[116] Findings for the indicators reported in this section are summarized below.

Daily Self-Monitoring of Blood Glucose Levels for Adults with Diabetes who were on Insulin

Eighty-one percent of adults who reported having diabetes who were taking insulin reported daily self-monitoring of their blood glucose levels; 49 percent of adults with diabetes who were not taking insulin but were on oral glucose-lowering medications also reported daily self-monitoring. Clinical practice guidelines currently recommend self-monitoring by all people with diabetes, but the evidence is stronger for those on insulin than those on oral medications alone.[139] Among adults with diabetes who were on insulin, the percentage who reported daily self-monitoring of blood glucose did not vary by sex, annual household income, educational attainment, age or rural/urban residency but did vary by LHIN.

A1c Monitoring in the Past 12 Months

Eighty percent of adults who reported having diabetes reported that they had a hemoglobin A1c to assess their blood glucose control in the past 12 months. This indicator did not vary by sex, annual household income, educational attainment, age, visible minority status or rural/urban residency.

Microalbumin Testing in the Past 12 Months

Among adults who reported having diabetes, 73 percent reported that they had a microalbumin test to assess for kidney disease in the past 12 months. This indicator did not vary by sex, annual household income, educational attainment, age, visible minority status, immigration status or rural/urban residency.

Eye Examination in Two Years of Diagnosis of Diabetes for Adults Aged 30 and Older

Less than six in ten adults had an eye examination within two years of being diagnosed with diabetes; while this indicator showed significant regional variation, in all LHINs, less than two-thirds of adults with diabetes underwent an eye examination within two years of being diagnosed. The percentage of adults who underwent an eye exam did not differ by sex or by income for women, however, the rate did increase with age with a slight decrease after age 75. Of concern, only slightly more than four in ten adults aged 30-44 had an eye examination within two years of being diagnosed with diabetes.

Self Foot Examination at Least Once Per Year

Almost 70 percent of adults who reported having diabetes reported having their feet checked for sores or irritation by themselves, a family member or by a friend (self foot examination) at least once per year. This did not vary by sex, annual household income or by age. Women with less than a secondary school education, immigrants to Canada and men who lived in urban communities were less likely than their counterparts to conduct self foot examination at least annually.

Foot Examination by a Health Professional in the Past 12 Months

Among adults who reported having diabetes, 51 percent reported that a health professional had checked their feet for any sores or irritations in the past 12 months. This indicator did not vary by sex, annual household income, educational attainment, age, visible status or rural/urban residency. Adults with diabetes who had been in Canada for less than 10 years were less likely to have had a foot examination by a health professional than immigrants who had been in Canada for a longer time or those who were Canadian born (26 percent versus 52 percent and 53 percent, respectively).

Dental Care in the Past 12 Months

Adults who reported having diabetes were less likely to have seen a dentist in the past 12 months than adults without diabetes (56 percent versus 65 percent, respectively). Among adults with diabetes, the percentage who had a dental visit in the past year did not vary by sex, but did vary by income, age, educational attainment and ethnicity. Adults from visible minority communities, those under age 65, those with lower annual household incomes or less education were less likely than their counterparts to have seen a dentist in the past 12 months.

Section 9D
Pharmacological Treatment

INTRODUCTION

Medications are an important part of managing diabetes.

In combination with lifestyle measures (including weight control, adequate physical activity and proper nutrition), medications can assist in controlling blood glucose levels and so reduce the risk of long-term diabetes complications.[36-38, 130, 155, 156] In addition to managing diabetes, other medications can be used to control blood pressure and reduce cholesterol, which, along with diabetes, are risk factors for cardiovascular disease (CVD), the most important cause of death for people with diabetes.[34, 110] Angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARB), which are used to treat high blood pressure, also protect against the development of kidney disease and cardiovascular outcomes.

In type 1 diabetes, insulin is needed to sustain life. In contrast, for people with type 2 diabetes, Canadian clinical practice guidelines recommend controlling blood glucose with a step-wise approach, starting with lifestyle measures and then adding first oral medications and then insulin as needed.[82] Studies have shown that blood glucose control gradually deteriorates over time for people with type 2 diabetes, necessitating gradual intensification of glucose-lowering therapy.[130] Several categories of oral medications are available, and often an individual patient may require medications from two or three different classes to control their blood glucose. For either type of diabetes, guidelines recommend a target fasting blood glucose of 4.0-7.0 mmol/L and a level two hours after eating of between 5.0-10.0 mmol/L.[82] In addition, patients are advised to have their A1c tested (a laboratory test that estimates the average blood glucose levels from the preceding three months) regularly. The target A1c is 7.0% or less.[82] However, individual goal setting based on patient risk and other clinical factors may be necessary and is often complex, particularly in the elderly where the risks of tight glycemic control (e.g., hypoglycemia) may outweigh the potential benefits of long-term prevention of complications. The recently-published ACCORD trial has spearheaded this debate, as study patients who tried to normalize their blood sugar levels had an increase in mortality compared to those attempting to achieve more standard blood glucose control.[157]

Because CVD leads to such significant morbidity and mortality for people with diabetes, and because people with diabetes are at significantly increased risk for these events,[158] control of cardiovascular risk factors such as hypertension and dyslipidemia are very important. The recommended blood pressure target for people with diabetes is systolic blood pressure less than 130 mmHg and diastolic blood pressure less than 80 mmHg.[82] Virtually all diabetes patients aged 65 and older will require at least one medication to control their blood pressure; many will require medications from three or more classes.[39] The recommended first-line agent is either an ACE inhibitor or an ARB.[82] These medications have the additional benefit of providing independent vascular protection and of being used for the treatment of microalbuminuria and diabetic kidney disease or nephropathy.[159-164] The primary cholesterol target for people with diabetes who are at high risk for vascular events (i.e., diabetic men aged 45 and older and diabetic women aged 50 and older, or those with multiple cardiovascular risk factors) is to achieve a low

density lipoprotein (LDL)-cholesterol level of 2.0 mmol/L or less.[82] The vast majority of seniors with diabetes will have levels above this without pharmacological intervention.[165] Although there are several lipid-lowering medications available, the statins have an overwhelming amount of clinical evidence to support their use, and are considered first-line therapy. In addition, statins have also been shown to reduce cardiovascular risk in people with diabetes, independent of their cholesterol levels.[166] The POWER Study Cardiovascular Disease chapter found few gender differences in medication use for ACE inhibitors, ARBs, other antihypertensive medications; however, women were less likely than men to receive statins.[167] Although there are limited data on inequities in performance on these indicators in Canada, disparities in performance associated with gender, socioeconomic status and ethnicity have been documented elsewhere.[168-172]

Another medication commonly prescribed for its cardiovascular protective effect is aspirin, however, aspirin therapy for patients with diabetes is controversial, as recent evidence has suggested it may not be of benefit, particularly for women.[173-176] Since aspirin can be purchased over-the-counter and is therefore not reliably captured in administrative data records, its use was not measured in this chapter.

There is mounting evidence that an increasing number of medications are needed to control diabetes and prevent complications. Indeed, there has been a marked rise in the complexity and cost of diabetes care over the last decade.[52] While this shift to more intensive treatment has no doubt contributed to an overall improvement in diabetes outcomes, the increasing cost of medications may now pose a greater challenge for lower-income and other disadvantaged populations. Studies have documented both a rise in the cost of diabetes drugs[177] and in the number of people who cannot afford their medications[178, 179] over the last decade. Indeed, higher out-of-pocket medication costs have been shown to lower adherence[180] and increase rates of adverse events.[181] Low health literacy in disadvantaged populations may also have an impact on adherence due to difficulty following more complex medical regimens.[182-184]

In this section, we report indicators of pharmacological treatment and, where possible and where data were available, we examine the differences associated with sex, income, education, age, ethnicity, immigration status, rural/urban residency and Local Health Integration Network (LHIN). Survey data were used to assess the use of glucose-lowering medications, so we were able to assess self-reported use of these agents among all adult women and men who reported having diabetes. Use of antihypertensive drugs, ACE inhibitors and ARBs, and statins was measured using administrative data that are only available for adults aged 65 and older. For some individuals in this age group decisions about clinical management are complicated by the greater presence of multiple chronic conditions[185] and geriatric syndromes including frailty and dementia.

The indicators include:

- Percentage of adults who reported having diabetes who were on insulin or at least one oral glucose-lowering medication
- Percentage of older adults (aged 65 and older) with diabetes who filled at least one prescription in a one-year period for:
  - an anti-hypertensive drug from any category
  - an ACE inhibitor and/or an ARB therapy
  - a statin

Combined data from the CCHS, 2005 (Cycle 3.1) and 2007 were used to assess the percentage of adults who reported having diabetes who reported being on insulin or at least one oral glucose-lowering medication. Data from the Ontario Diabetes Database (ODD) were linked to the Ontario Drug Benefit (ODB) database to determine the percentage of adults aged 65 and older with diabetes who filled prescriptions for anti-hypertensive agents and statins (see Appendix 9.3 for details). Data from the ODB are restricted to adults aged 65 and older because of access to provincially funded drug benefits.

EXHIBITS AND FINDINGS

USE OF INSULIN OR AT LEAST ONE ORAL GLUCOSE-LOWERING MEDICATION

Indicator: This indicator measures the percentage of adults aged 20 and older who reported having diabetes who reported using insulin or at least one oral glucose-lowering medication.

Background: Medications are an important part of managing diabetes. In combination with lifestyle measures such as weight control, proper nutrition and adequate exercise, medications can assist in controlling blood glucose levels to reduce the risk of developing long-term diabetes complications.[36-38, 130, 155, 156]

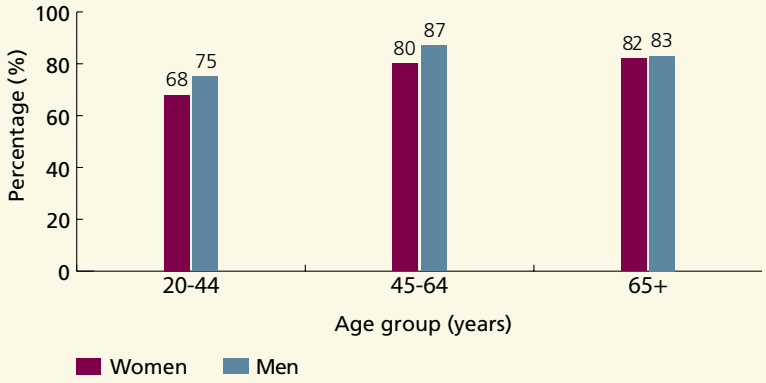
Combined data from the Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007 were used to assess this indicator. Because this indicator was derived from the CCHS, people with diabetes were identified based on self-reported information rather than physician diagnosis. Respondents who indicated that they had diabetes were asked (in two separate questions) if they were currently using insulin or if they had used an oral glucose-lowering medication in the previous month.

Findings: In Ontario, 82 percent of adults aged 20 and older who reported having diabetes were on insulin and/or at least one oral glucose-lowering medication. Medication use did not differ between women and men (79 percent of women and 84 percent of men).

Exhibit 9D.1 | Percentage of adults aged 20 and older who reported having diabetes who were on insulin and/or at least one oral glucose-lowering medication, by sex and age group, 2005 and 2007

FINDINGS

- Overall, younger people who reported having diabetes (aged 20-44) were less likely than older people to report using insulin and/or at least one oral glucose-lowering medication; however, the age differences were not significant among men, possibly due to small numbers and limited power to detect differences.
- Across all age groups, women were less likely than men to be on any glucose-lowering medication (including insulin). These differences were more pronounced in those under age 65; however, they were not significant, possibly due to small numbers and limited power to detect differences.
- The percentage of women and men who reported having diabetes who were on insulin and/or at least one oral glucose-lowering medication did not vary by annual household income, time since immigration, rural/urban residency or Local Health Integration Network (LHIN), but did vary somewhat by education among men. We could not assess use of glucose-lowering medication by ethnicity due to small numbers and limited power to detect differences (data not shown).



DATA SOURCE: Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

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USE OF ANTI-HYPERTENSIVE MEDICATIONS OR STATINS

Indicator: These indicators measure the percentage of adults aged 65 and older with diabetes who filled at least one prescription for the following medications during a one-year follow up period:

- at least one anti-hypertensive drug from any category
- an angiotensin-converting enzyme (ACE) inhibitor and/or an angiotensin receptor blocker (ARB)
- a statin

Background: To reduce the risk of cardiovascular disease (CVD) and other diabetes complications, good control of blood pressure is necessary. The majority of older people with diabetes will require anti-hypertensive drugs to reduce high blood pressure.[39] ACE inhibitors or ARBs are recommended as first-line therapy for people with diabetes.[82] In type 1 and type 2 diabetes, the presence of microalbuminuria or overt nephropathy is an indication for treatment with an ACE inhibitor or an ARB, even in the absence of hypertension, in order to reduce the progression of renal disease.[82] For people at high risk for CVD, ACE inhibitors or ARB therapy are also indicated for risk reduction.[161, 162, 186]

Just as for blood pressure, goals for blood cholesterol levels are stricter for individuals with diabetes than for the general population.[82] Statins reduce low-density lipoprotein (LDL) cholesterol and have modest effects on lowering triglyceride levels and raising high-density lipoprotein (HDL) cholesterol levels. Prescriptions for statins have been increasing but the proportion of people receiving lipid-lowering therapy remains markedly lower than the estimated 90 percent of individuals aged 65 or older whose LDL cholesterol levels are above the recommended target.[165] Most people with diabetes are considered to be at high risk for developing CVD,[82] therefore, treatment of elevated blood cholesterol levels should be broadly instituted to achieve targets.

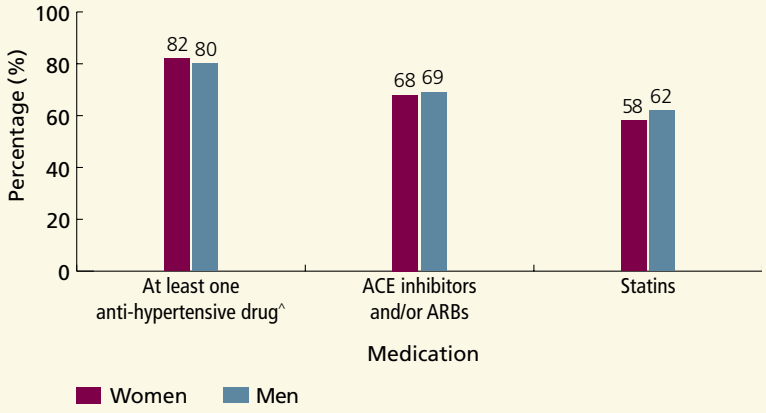
The Ontario Diabetes Database (ODD) was used to identify adult who had been diagnosed with diabetes as of April 1, 2006 (see Appendix 9.3 for details). Data from the Ontario Drug Benefits (ODB) database were used to evaluate medication use in patients with diabetes aged 65 and older. The sample was restricted to this age group because of access to provincially funded drug benefits in this population. The data do not include sufficient clinical information to exclude those with contraindications to medication use. Thus, all patients identified as having diabetes were included in these analyses and there may have been appropriate reasons for not receiving these medications in some cases (see Appendix 9.3 for a list of medications that were included).

Findings: In Ontario, 68 percent of adults aged 65 and older with diabetes (68 percent of women and 69 percent of men) filled at least one prescription for an ACE inhibitor or ARB within the one-year follow up period. The percentage who filled a prescription for any antihypertensive drug during this period rose to 81 percent (82 percent of women and 80 percent of men). Sixty percent of adults aged 65 and older with diabetes filled at least one prescription for a statin within the one-year follow up period. Women were slightly less likely than men to fill a prescription for a statin (58 percent versus 62 percent, respectively).

Exhibit 9D.2 | Age-standardized percentage of adults aged 65 and older with diabetes who filled a prescription for an anti-hypertensive drug or statin, by sex, in Ontario, 2006/07

FINDINGS

- Among adults aged 65 and older with diabetes, women were slightly less likely than men to have filled a prescription for a statin within the one-year follow up period. The percentage of adults aged 65 and older with diabetes who filled a prescription for an anti-hypertensive drug, or specifically for an ACE inhibitor or ARB therapy, varied minimally by sex and these differences were not clinically meaningful.
- There were small differences in the percentage of adults aged 65 and older with diabetes who filled a prescription for antihypertensive drugs in general, and for ACE inhibitors and/or ARBs specifically, varied somewhat by age and Local Health Integration Network (LHIN), but these differences were not clinically meaningful (data not shown). These indicators did not differ by neighbourhood income (data not shown).
- Adults aged 75 and older with diabetes were less likely to fill a prescription for statins (54 percent) compared to those aged 65-69 or 70-74 (64 percent and 65 percent, respectively) (data not shown). This may represent both underuse of effective therapies and a higher proportion of individuals with contraindications to therapy in this age group.
- There were small but clinically unimportant differences in statin use by LHIN, and no differences by neighbourhood income.



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Drug Benefits (ODB) database

^ Includes ACE Inhibitors and ARBs

ACE inhibitors = Angiotensin-converting enzyme inhibitors

ARBs = Angiotensin II receptor blockers

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Section 9D

SUMMARY OF FINDINGS

This section reports on indicators of pharmacological treatment for people with diabetes in Ontario, including medication management of blood glucose (insulin and/or oral glucose-lowering medications) and medications used to control blood pressure and reduce cholesterol levels. The indicators varied by age, but did not vary by income or meaningfully by Local Health Integration Network (LHIN). Medication use, did not vary by sex, with the exception of statins.

Findings for the indicators reported in this section are summarized below.

Percentage of Adults who reported having Diabetes who were on Insulin and/or at Least One Oral Glucose-Lowering Medication

Most women and men (82 percent) who self-identified as having diabetes were taking some type of medication to control their blood glucose levels, either insulin or oral glucose-lowering medications. However, this suggests that one in five adults with self-reported diabetes were not taking medication to control their blood glucose. As well, because these data relied on self-reported diabetes, it is possible that some people who were not using medications to control their blood sugars also did not acknowledge that they had diabetes; therefore, the observed rates of medication use may be overestimates. This did not vary by annual household income, time since immigration, rural/urban residency or LHIN, but did vary somewhat by education level among men. Adults aged 20-44 with diabetes were less likely to be on medication to control their diabetes than older adults (71 percent versus 83 percent, respectively). The age difference was not significant among men, however, this may be due to limited power to detect differences due to small sample size.

Percentage of Adults Aged 65 and Older with Diabetes who Filled Prescriptions for Anti-Hypertensive Drugs and Statins

More than 80 percent of seniors with diabetes had filled a prescription for at least one anti-hypertensive medication, with more than two-thirds filling prescriptions for an angiotensin-converting enzyme (ACE) inhibitor or angiotensin II receptor blocker (ARB), which are considered the first-line choices for blood pressure lowering. Sixty percent of seniors with diabetes had filled a prescription for at least one statin. There was virtually no variation in medication use by income or LHIN. However, women were slightly less likely than men to have filled a prescription for a statin (58 percent versus 62 percent, respectively) and statin use was lower in adults aged 75 and older than in younger adults.

Section 9E
Health Outcomes

INTRODUCTION

Diabetes can lead to both acute (short-term) and chronic complications, adding to the cost and burden associated with this disease.

Studies from Ontario have shown that up to 40 percent of hospital admissions for acute myocardial infarction (AMI), stroke and congestive heart failure (CHF), 50 percent of cases starting dialysis, and 70 percent of non-traumatic amputations occur among people with diabetes.[187-190] In addition diabetes is a leading cause of adult-onset blindness and a common cause of disability.[57, 191]

There is compelling evidence that the long-term complications from diabetes can be reduced or prevented through strategies aimed at controlling glucose, blood pressure and cholesterol levels.[33-39] In fact, targeting each of these simultaneously and in combination with lifestyle measures—healthy diet, increased physical activity and smoking cessation—may reduce the incidence of cardiovascular disease (CVD) by as much as 50 percent.[34] However, recent studies suggest that the relationship between glucose levels and CVD risk is more complex than once thought;[38, 157, 192] using near-normal glucose levels as a target in older patients with advanced diabetes was associated with higher mortality compared to usual care.[157]

The last decade has seen a fall in diabetes complication rates, suggesting that the growing body of evidence has influenced routine clinical practice and translated into better care and outcomes for people with diabetes.[18, 187, 193] Between 1995 and 2005, all-cause mortality rates fell by 34 percent in the population with diabetes, while mortality from AMI and stroke fell by 44 percent and 33 percent, respectively, over a comparable time frame.[187] While these trends have been similarly favourable for men and women, not all groups with diabetes have benefited equally.[18] Improvements in survival have been substantially greater among wealthier individuals suggesting that low-income individuals may have benefited less from advances in diabetes care.

Socioeconomic gradients in mortality have been demonstrated in many countries, including those, like Canada, that have universal access to health services.[194, 195] Low-income groups are also more vulnerable to adverse outcomes related to diabetes than their wealthier counterparts.[18, 196-198] A host of factors is thought to drive socioeconomic-related health inequities. Lower-income populations appear to be more susceptible to unhealthy behaviours such as smoking, poor diet and sedentary lifestyle[61, 199, 200] and they may face more barriers to achieving a healthy lifestyle because of a limited number of affordable opportunities for physical activity and healthy eating in their neighbourhood.[201-204] Diabetes is also an extremely costly condition to manage and high out-of-pocket costs of medications may impede adherence to treatment.[52] Competing social and medical problems[61] together with low health literacy, and language or cultural barriers[184] may also make it more difficult for lower-income groups to achieve target levels of glucose, blood pressure, and cholesterol.[200, 205, 206]

A number of studies have documented variations in the risk of diabetes complications by ethnicity. Among those with diabetes, African American and Hispanic groups in the US experience higher rates of end-stage renal disease, retinopathy and stroke compared to White populations;[47, 48, 51] data from the UK suggest that South Asians experience an excess of CVD and premature mortality;[46] and Canadian data suggest that Aboriginal populations share a disproportionate burden of diabetes complications.[49, 207] Poverty and poor access to care appear to be important predictors for adverse diabetes outcomes in Aboriginal groups, as they are in other populations.[49] It is often difficult to disentangle the influence of socioeconomic status in observational data since ethnic groups that have worse outcomes may also have higher levels of poverty and may, depending on the health system, have inadequate health insurance coverage or worse access to health care. In Canada, although there is universal access to physician care, prescription drugs are not universally covered, therefore socioeconomically disadvantaged groups may experience financial barriers to accessing required, but often expensive, medications to control their diabetes and associated risk factors. Furthermore, it is not clear from the literature whether the impact of socioeconomic status on diabetes complications affects men and women in the same manner.

The influence of gender on diabetes complications appears to vary depending on the complication studied. The incidence of retinopathy is similar between men and women, regardless of diabetes subtype.[208-210] However, retinopathy may progress more quickly in men.[209] In the general population, men have higher rates of CVD than women,[158] however, diabetes appears to greatly attenuate the usual protective effect afforded by female sex, thereby narrowing the relative gender gap in CVD risk.[158] Several studies involving patients in primary care practices in the US and Sweden have found that women with diabetes experienced less aggressive management of CVD risk factors than men with diabetes did, which may counteract any biological differences leading to lower rates of CVD in women.[211-215]

This section compares differences in diabetes complication rates between women and men, and across subgroups. The indicators include both acute complications (e.g., emergency management of hyper- or hypoglycemia) and chronic complications (e.g., CVD, end-stage kidney disease). Tracking disease outcomes is a critical step to ensuring the appropriate planning and provision of inpatient and outpatient health services. Complication rates also serve as an indicator of the quality of care received, since there are proven strategies to prevent or delay the onset of complications and to slow their progression—and therefore may be modifiable in response to changes in how health care is organized and delivered.

In this section, we report indicators of health outcomes and examine the differences associated with sex, neighbourhood income, age and Local Health Integration Network (LHIN).

The indicators include the number of adults aged 20 and older with diabetes per 100,000 who, over a one-year period had:

- at least one hospital visit (emergency department or admission) for hyperglycemia or hypoglycemia
- at least one hospitalization for skin and soft tissue infections

Cardiac disease

- at least one hospitalization for an AMI
- at least one hospitalization for CHF
- coronary artery bypass graft (CABG) surgery
- percutaneous coronary intervention (PCI)

Stroke

- at least one hospitalization for stroke
- carotid endarterectomy

Peripheral vascular disease

- major or minor amputation
- a peripheral revascularization procedure

Chronic dialysis

- chronic dialysis

Diabetic retinopathy

- laser photocoagulation
- a vitrectomy

The indicators of health outcomes among people with diabetes were assessed by linking the Ontario Diabetes Database (ODD) to administrative health care databases. For all outcome indicators, the ODD was used to identify adults aged 20 and older who had prevalent diabetes as of March 31, 2006. This sample was linked to the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) and followed for one year to assess rates of skin and soft tissue infections, acute myocardial infarction, congestive heart failure, coronary artery bypass graft (CABG) surgery, stroke, carotid endarterectomy, minor amputations, major amputations, and peripheral revascularization surgery. The sample was linked to the CIHI-DAD and National Ambulatory Care Reporting System (NACRS) to assess the rate of hospital visits for hypo- or hyperglycemia and the rate of percutaneous coronary interventions. The sample was linked to Ontario Health Insurance Plan (OHIP) data to assess rates of chronic dialysis (see Appendix 9.3 for details).

EXHIBITS AND FINDINGS

EMERGENCY ROOM VISITS AND HOSPITAL ADMISSIONS FOR HYPERGLYCEMIA OR HYPOGLYCEMIA

Indicator: This indicator measures the number of adults aged 20 and older with diabetes per 100,000 who had at least one hospital visit (emergency department visit or hospitalization) for hyperglycemia or hypoglycemia over a one-year period.

Background: Severe hyperglycemia (high blood glucose) and hypoglycemia (low blood glucose) are potentially life-threatening conditions that can be prevented with good outpatient care. Poor glucose control, particularly in the setting of acute illness, can lead to hyperglycemic states—diabetic ketoacidosis or hyperosmolar coma—that constitute a medical emergency. While tight glucose control can improve long-term outcomes for people with diabetes, running levels close to the normal range increases the risk of developing severe hypoglycemia—a state of low glucose that can lead to loss of consciousness.[36, 37] In many cases, these episodes can be averted through patient education to ensure early recognition, self-monitoring of blood glucose and by avoiding errors in management. Access to outpatient care appears to be a key factor influencing admission rates for hyper- and hypoglycemia.[187, 197] Diabetes education programs have also been shown to reduce rates of these admissions.[216]

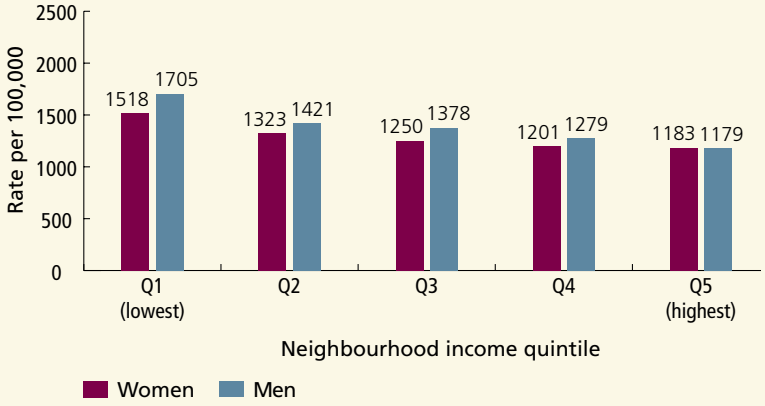
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes as of March 31, 2006 (see Appendix 9.3 for details). Data from the Canadian Institute of Health Information Discharge Abstract Database (CIHI-DAD) and the National Ambulatory Care Reporting System (NACRS) were used to measure the number of people with diabetes who had at least one hospital visit (emergency department visit or hospitalization) for hyper- or hypoglycemia in the 2006/07 fiscal year. Only the first visit per patient was counted during the year so the total number and rate of hospital visits is in fact higher because individuals (particularly those who are poorly controlled, encounter barriers to effective care or who have limited knowledge of self-management skills) may have multiple hospital visits over the course of a year. NACRS does not capture episodes of severe hypoglycemia that are only treated by emergency medical services in the field (i.e., do not lead to an emergency department visit). Conversely, in some regions, family practitioners may see patients in the emergency department for mild hyper- or hypoglycemia, or other aspects of diabetes management, thus inflating rates in some LHINs.

Findings: In Ontario, among adults aged 20 and older with diabetes, the rate of hospital visits (emergency department visit or hospitalization) for hyperglycemia or hypoglycemia was 1362 per 100,000 people in 2006/07. Women were slightly less likely to have a hospital visit than men (1316 per 100,000 women versus 1408 per 100,000 men).

Exhibit 9E.1 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had at least one hospital visit^ for hyperglycemia or hypoglycemia, by sex and neighbourhood income quintile, in Ontario, 2006/07

FINDINGS

- There was an inverse association between neighbourhood income and rates of hospital visits for hyperglycemia or hypoglycemia among women and men with diabetes.
- Women living in the lowest-income neighbourhoods were almost 30 percent more likely to have a hospital visit for hyperglycemia or hypoglycemia compared to women living in the highest-income neighbourhoods.
- The difference was even greater for men; those living in the lowest-income neighbourhoods were nearly 45 percent more likely to have a hospital visit than men living in the highest-income neighbourhoods.



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); National Ambulatory Care Reporting System (NACRS); Statistics Canada 2006 Census

NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

^ Emergency department visit or hospital admission

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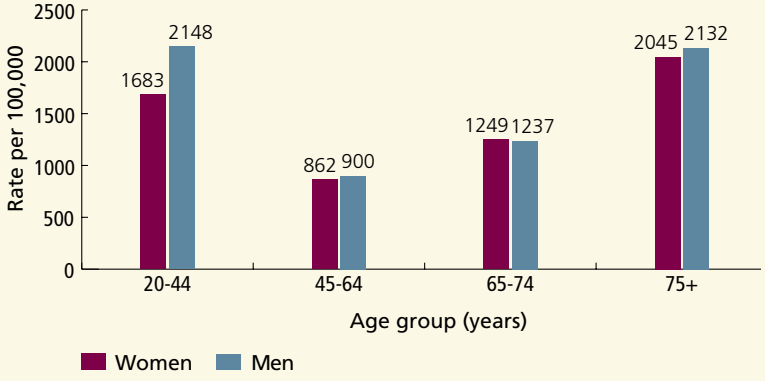
Exhibit 9E.2 | Number of adults aged 20 and older with diabetes per 100,000 who had at least one hospital visit^ for hyperglycemia or hypoglycemia, by sex and age group, in Ontario, 2006/07

FINDINGS

- The number of adults with diabetes who had at least one hospital visit for hyper- or hypoglycemia was highest in the youngest and oldest age groups. High rates in those under age 45 were likely related to the higher proportion of type 1 diabetes in this age group. High rates of admission among those aged 75 and older likely reflect the high prevalence of multi-morbidity and complexity in this age group.
- In the youngest age group, men were more likely than women to have a hospital visit for hyperglycemia or hypoglycemia. There were no gender differences in visit rates among the older age groups.



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); National Ambulatory Care Reporting System (NACRS)

^ Emergency department visit or hospital admission

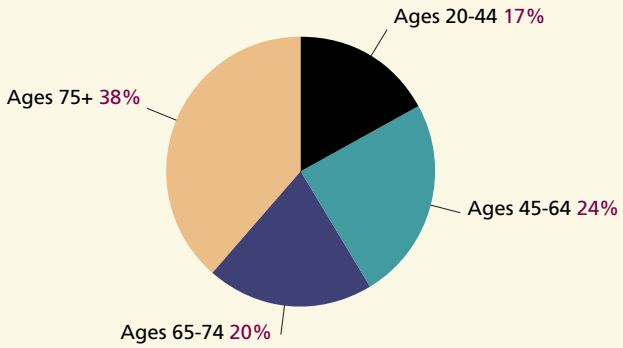
POWER Study

Exhibit 9E.3 | Age distribution of adults aged 20 and older with diabetes who had at least one hospital visit^ for hyperglycemia or hypoglycemia, by sex, in Ontario, 2006/07

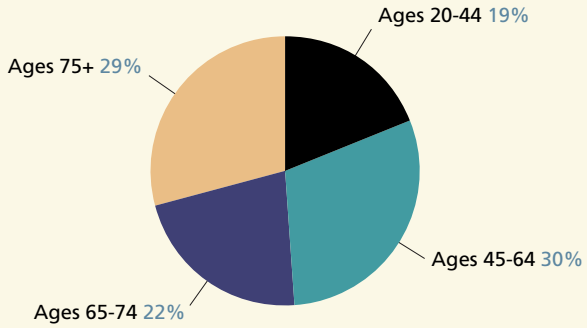
FINDINGS

- The elderly, those aged 65 and older, accounted for over half of all adults with diabetes who had at least one hospital visit for hyperglycemia or hypoglycemia (58 percent of women and 57 percent of men).

Women



Men



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); National Ambulatory Care Reporting System (NACRS)

^ Emergency department visit or hospital admission

POWER Study

Exhibit 9E.4 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had at least one hospital visit^ for hyperglycemia or hypoglycemia, by sex, neighbourhood income and Local Health Integration Network (LHIN), in Ontario, 2006/07

FINDINGS

- There was considerable variation across LHINs in the rates of hospital visits for hyperglycemia or hypoglycemia among both women and men with diabetes. In some regions, family practitioners may see patients in the emergency department for mild hyperglycemia or hypoglycemia or for other aspects of diabetes management, thus inflating rates in some LHINs.
- Among women with diabetes, rates of hospital visits ranged from 895 per 100,000 in the Central West LHIN to 2071 per 100,000 in the North East LHIN among women living in lower-income neighbourhoods and from 800 per 100,000 in the Central LHIN to 1865 per 100,000 in the North Simcoe Muskoka LHIN among women living in higher-income neighbourhoods.
- Among men with diabetes, rates of hospital visits ranged from 993 per 100,000 in the Mississauga Halton LHIN to 2392 per 100,000 in the North Simcoe Muskoka LHIN among men living in lower-income neighbourhoods and from 839 per 100,000 in the Central LHIN to 1946 per 100,000 in the South East LHIN among men living in higher-income neighbourhoods.

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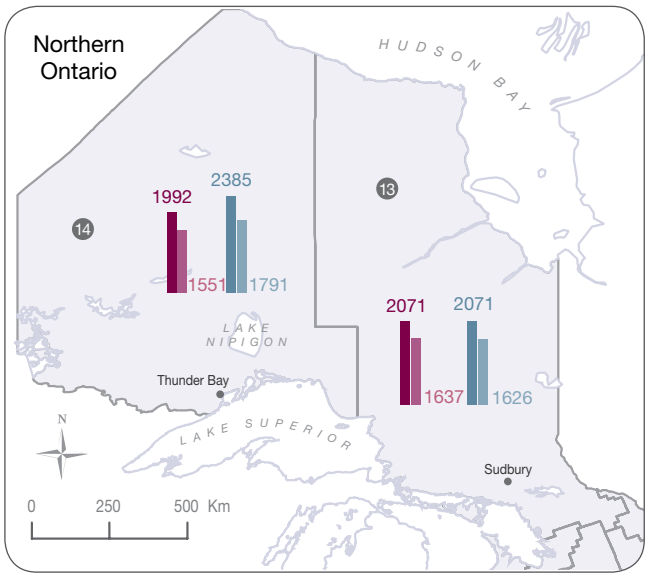
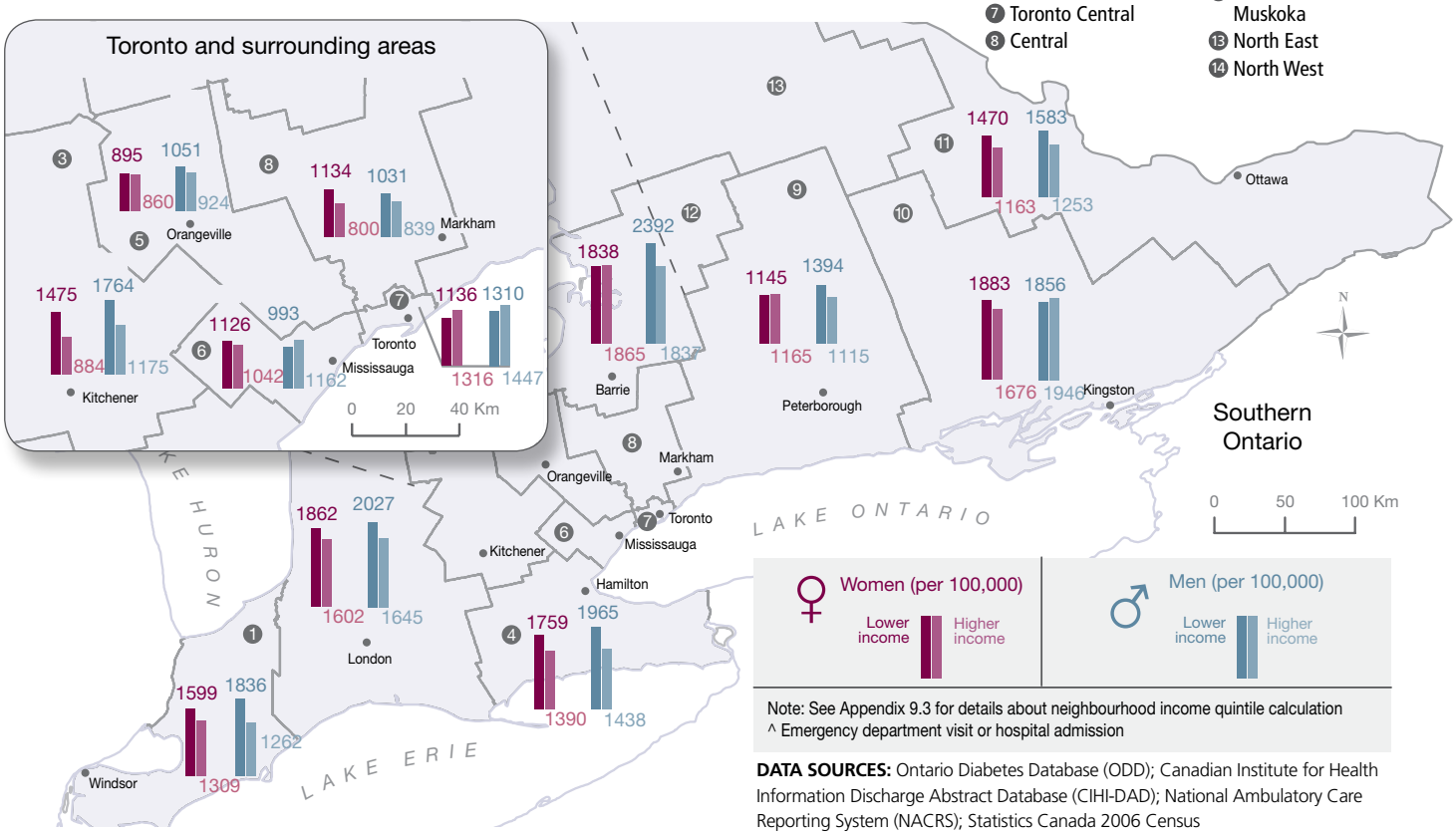
Overall Ontario

In Ontario, 1427 per 100,000 lower-income women, 1214 per 100,000 higher-income women, 1564 per 100,000 lower-income men and 1284 per 100,000 higher-income men aged 20 and older with diabetes had at least one hospital visit for hyperglycemia or hypoglycemia during 2006/07.



Local Health Integration Networks (LHINs)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West



Note: See Appendix 9.3 for details about neighbourhood income quintile calculation
^ Emergency department visit or hospital admission

DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); National Ambulatory Care Reporting System (NACRS); Statistics Canada 2006 Census

HOSPITALIZATION RATES FOR SKIN AND SOFT TISSUE INFECTIONS

Indicator: This indicator measures the number of people aged 20 and older with diabetes per 100,000 who had at least one hospitalization for a skin and soft tissue infection over a one-year period.

Background: People with diabetes are more susceptible to common infections, including those of the skin and soft tissue. Foot infections—which make up a significant proportion of this category—are a major cause of morbidity.[217] In the setting of diabetic neuropathy (nerve damage) or vascular disease, minor trauma to the foot can lead to skin ulceration, infection and potentially to gangrene, requiring amputation.[145, 218] Regular foot care and aggressive treatment of foot ulcers and infections early in their course may prevent the need for amputation.[131]

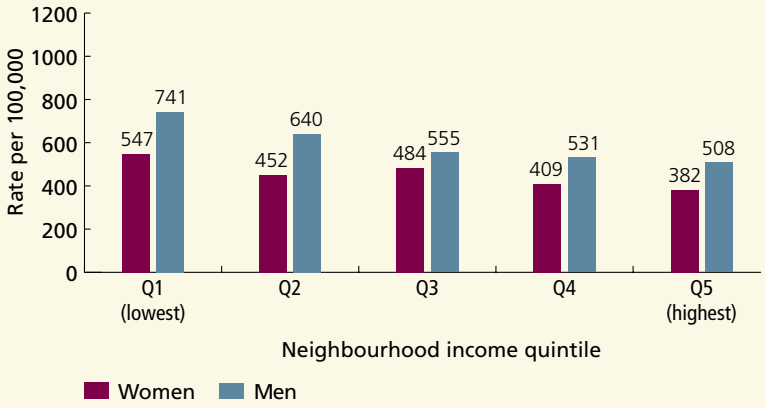
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes as of March 31, 2006 (see Appendix 9.3 for details). Data from the Canadian Institute of Health Information Discharge Abstract Database (CIHI-DAD) were used to measure the number people who were hospitalized for skin and soft tissue infections in the 2006/07 fiscal year. Only one admission was counted per patient so the actual rate of hospitalizations is higher because individuals (particularly those who are poorly controlled, encounter barriers to effective care, or who have limited knowledge of self-management skills) may have multiple hospitalizations over the course of a year.

Findings: In Ontario, in 2006/07, the hospitalization rate for skin and soft tissue infections was 534 per 100,000 among adults with diabetes aged 20 and older. Women were less likely to be hospitalized than men (464 per 100,000 versus 601 per 100,000, respectively).

Exhibit 9E.5 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had at least one hospitalization for a skin and soft tissue infection over a one-year period, by sex and neighbourhood income quintile, in Ontario, 2006/07

FINDINGS

- Among adults with diabetes, women and men living in the lowest-income neighbourhoods had hospitalization rates for skin and soft tissue infections that were over 40 percent higher than the rates seen among those living in highest-income neighbourhoods.
- Across all income quintiles men were more likely to be hospitalized for skin and soft tissue infections than women.



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); Statistics Canada 2006 Census

NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

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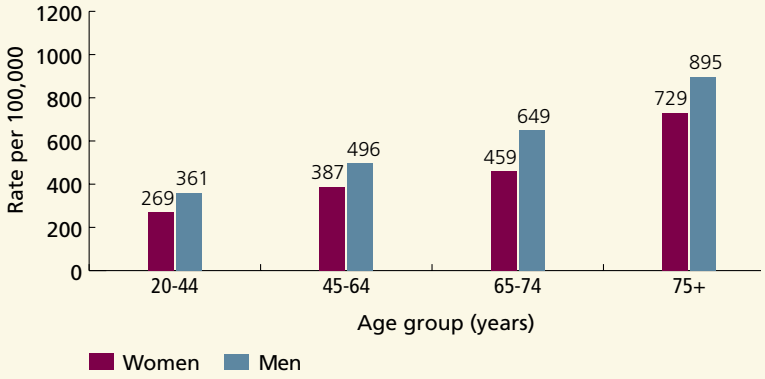
Exhibit 9E.6 | Number of adults aged 20 and older with diabetes per 100,000 who had at least one hospitalization for a skin and soft tissue infection over a one-year period, by sex and age group, in Ontario, 2006/07

FINDINGS

- The number of adults with diabetes who had at least one hospitalization for a skin and soft tissue infection increased with age; the rate among those aged 75 and older was two and half times higher than the rate among those aged 20-44.
- Men with diabetes had consistently higher rates of hospitalization for skin and soft tissue infections than women with diabetes across all age groups.
- Hospitalization rates for skin and soft tissue infections among adults with diabetes differed across Local Health Integration Networks (LHINs). Rates ranged from 287 per 100,000 (Central West LHIN) to 882 per 100,000 (North West LHIN) among women and from 376 per 100,000 (Central LHIN) to 1064 per 100,000 (North West LHIN) among men (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

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DIABETES AND CARDIAC DISEASE

Indicator: This group of indicators measures the rates of cardiac complications and related procedures among adults with diabetes aged 20 and older. We measured the number of women and men per 100,000 who, over a one-year period, had at least one:

- hospitalization for an acute myocardial infarction (AMI)
- hospitalization for congestive heart failure (CHF)
- coronary artery bypass graft (CABG) surgery
- percutaneous coronary intervention (PCI)

Background: Cardiovascular disease (CVD) is the leading cause of death among people with diabetes. Compared to the rest of the population, men and women with diabetes are two to five times more likely to develop CVD,[219] and to develop the condition at an earlier age.[158] Aggressive treatment of risk factors (e.g., high blood pressure, high cholesterol, smoking and sedentary lifestyle) and the use of risk modifying medications have been shown to reduce the risk of AMI and other cardiovascular complications in those with diabetes.[33-37, 39] In fact, a comprehensive, multifaceted approach to risk factor management can reduce the risk of AMI and other cardiovascular complications by as much as 50 percent.[34] While mortality rates have fallen significantly over the past two decades in people with diabetes, gaps in preventive management still remain.[18]

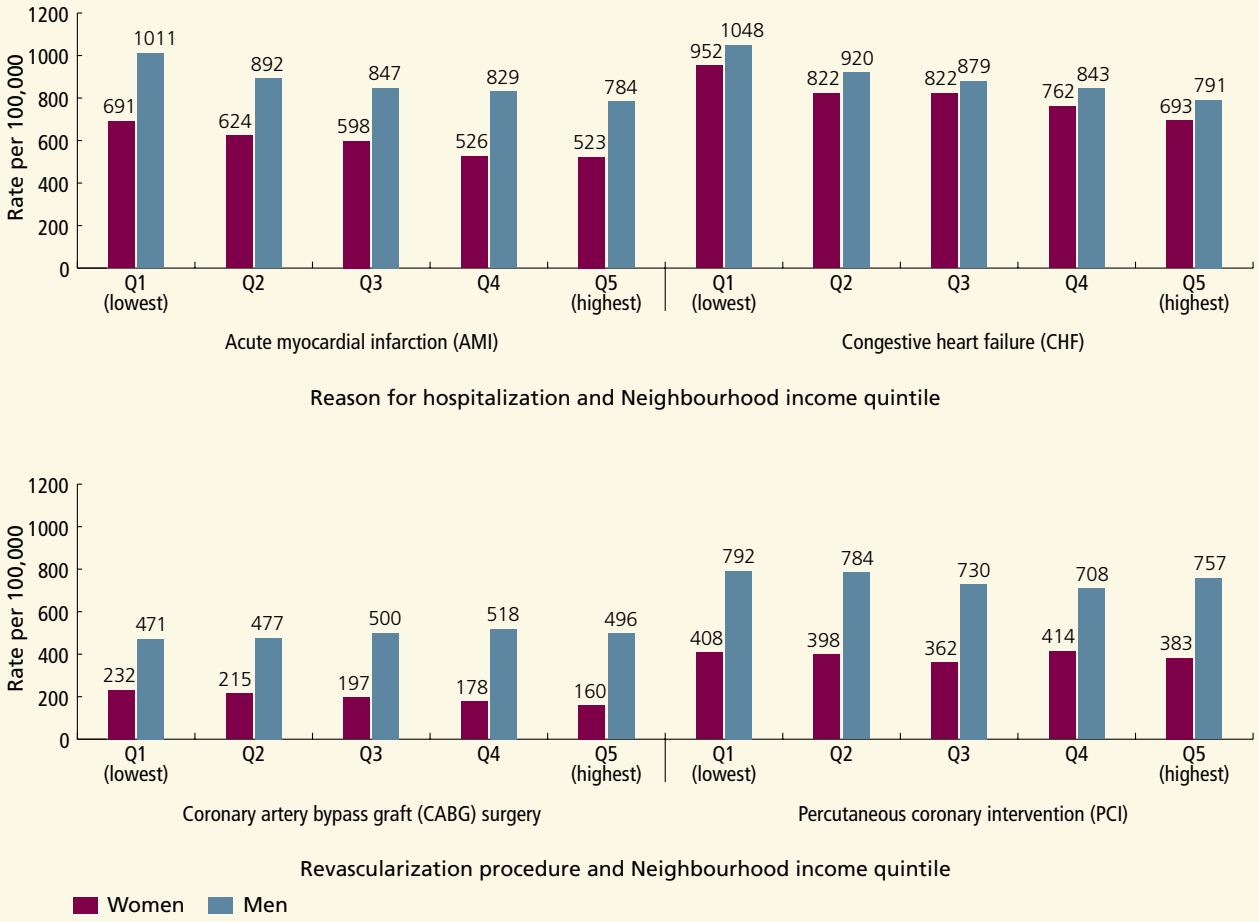
Timely access to cardiac procedures including coronary angiograms, PCI and CABG surgery is important for the detection and treatment of cardiac disease. Those waiting for advanced cardiac procedures may be at risk of serious complications such as AMI or death.[220] In addition, uncontrolled cardiac symptoms requiring intervention may result in reduced quality of life.

The Ontario Diabetes Database (ODD) was used to identify adults with diabetes as of March 31, 2006 (see Appendix 9.3 for details). Data from the Canadian Institute of Health Information Discharge Abstract Database (CIHI-DAD) were used to measure AMI, CHF and CABG surgery rates in the 2006/07 fiscal year. CIHI-DAD and the National Ambulatory Care Reporting System (NACRS) were used to measure PCI rates during the same period. Only one admission or procedure was counted for each patient.

Findings: In Ontario in 2006/07, the number of adults aged 20 and older with diabetes who were hospitalized were: 740 per 100,000 for AMI and 863 per 100,000 for CHF. Women were less likely than men to be hospitalized for AMI (603 per 100,000 versus 877 per 100,000, respectively) and CHF (826 per 100,000 versus 903 per 100,000, respectively).

In Ontario, 353 per 100,000 adults aged 20 and older with diabetes underwent CABG surgery and 583 per 100,000 underwent PCI. Women were less likely than men to have CABG surgery (200 per 100,000 versus 491 per 100,000, respectively) and PCI (394 per 100,000 versus 755 per 100,000, respectively).

Exhibit 9E.7 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had a hospitalization or revascularization procedure for cardiac disease, by sex and neighbourhood income quintile, in Ontario, 2006/07



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); National Ambulatory Care Reporting System (NACRS); Statistics Canada 2006 Census

NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

FINDINGS

- Adults with diabetes living in the lowest-income neighbourhoods had hospitalization rates for AMI and CHF that were about 30 percent higher than those living in the highest-income neighbourhoods. Similar income gradients were noted for both women and men, though the gradient was less pronounced in women.
- Women with diabetes who lived in the lowest-income neighbourhoods had higher rates of CABG surgery than women living in the highest-income neighbourhoods (232 per 100,000 versus 160 per 100,000, respectively). CABG surgery rates did not vary by neighbourhood income among men.
- Rates of PCI did not vary by neighbourhood income among either women or men, however, this may represent underuse among lower-income individuals who have higher rates of cardiovascular disease.

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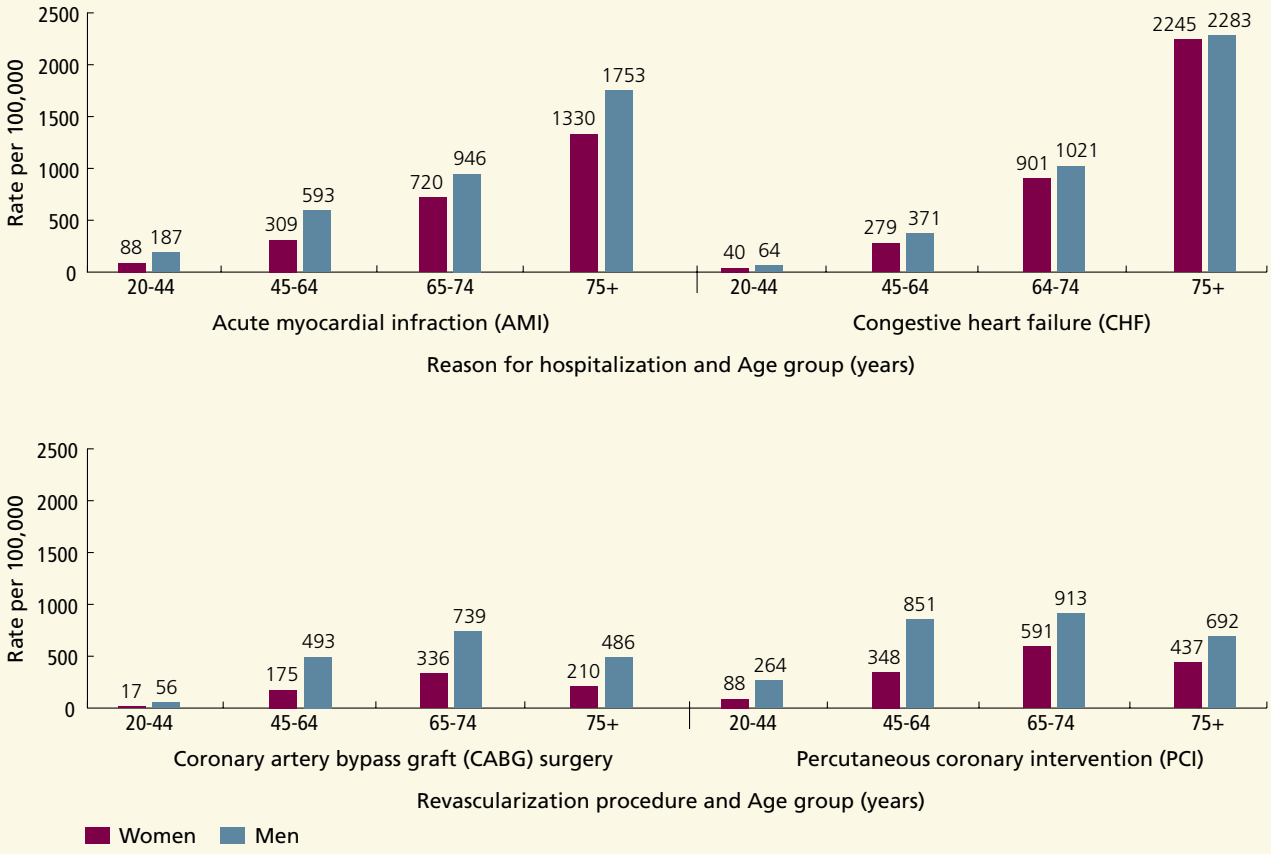
Exhibit 9E.8 | Number of adults aged 20 and older with diabetes per 100,000 who had a hospitalization or revascularization procedure for cardiac disease, by sex and age group, in Ontario, 2006/07



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

FINDINGS

- Among adults with diabetes, the proportion hospitalized for an AMI or for CHF increased sharply with age.
- Across most age groups, women with diabetes were less likely than men with diabetes to be hospitalized for AMI and CHF; however, the sex differences lessened with age.
- Among adults with diabetes under age 45, women had 50 percent lower rates of AMI and 40 percent lower rates of CHF than men. The gender difference decreased among those aged 75 and older; women had 25 percent lower rates of AMI but equivalent rates of CHF compared to men.
- Rates of cardiac revascularization procedures (CABG and PCI) among women and men with diabetes increased with age to age 74, and then declined among those aged 75 and older.
- Compared to men, women had lower rates of CABG surgery and PCI across all age groups.
- The sex differences in coronary procedure rates were greater than the observed sex differences in hospitalization rates for cardiac disease.

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Exhibit 9E.9 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had a hospitalization for an acute myocardial infarction (AMI), by sex, neighbourhood income and Local Health Integration Network (LHIN), in Ontario, 2006/07

FINDINGS

- Among adults with diabetes, hospitalization rates for AMI and congestive heart failure (CHF) varied significantly across LHINs (data on AMI admissions are shown).
- Among women with diabetes, AMI hospitalization rates ranged from 387 per 100,000 in the Mississauga Halton LHIN to 1059 per 100,000 in the North West LHIN among women living in lower-income neighbourhoods and from 355 per 100,000 in the Central LHIN to 999 per 100,000 in the North West LHIN among women living in higher-income neighbourhoods.
- Among men with diabetes, AMI hospitalization rates ranged from 649 per 100,000 in the Toronto Central LHIN to 1345 per 100,000 in the Erie St. Clair LHIN among men living in lower-income neighbourhoods and from 610 per 100,000 in the Central LHIN to 1176 per 100,000 in the North West LHIN among men living in higher-income neighbourhoods.
- Hospitalization rates for CHF ranged from 645 per 100,000 (Central LHIN) to 1263 per 100,000 (North East LHIN) among women and ranged from 677 per 100,000 (Central West LHIN) to 1322 per 100,000 (North West LHIN) among men (data not shown).

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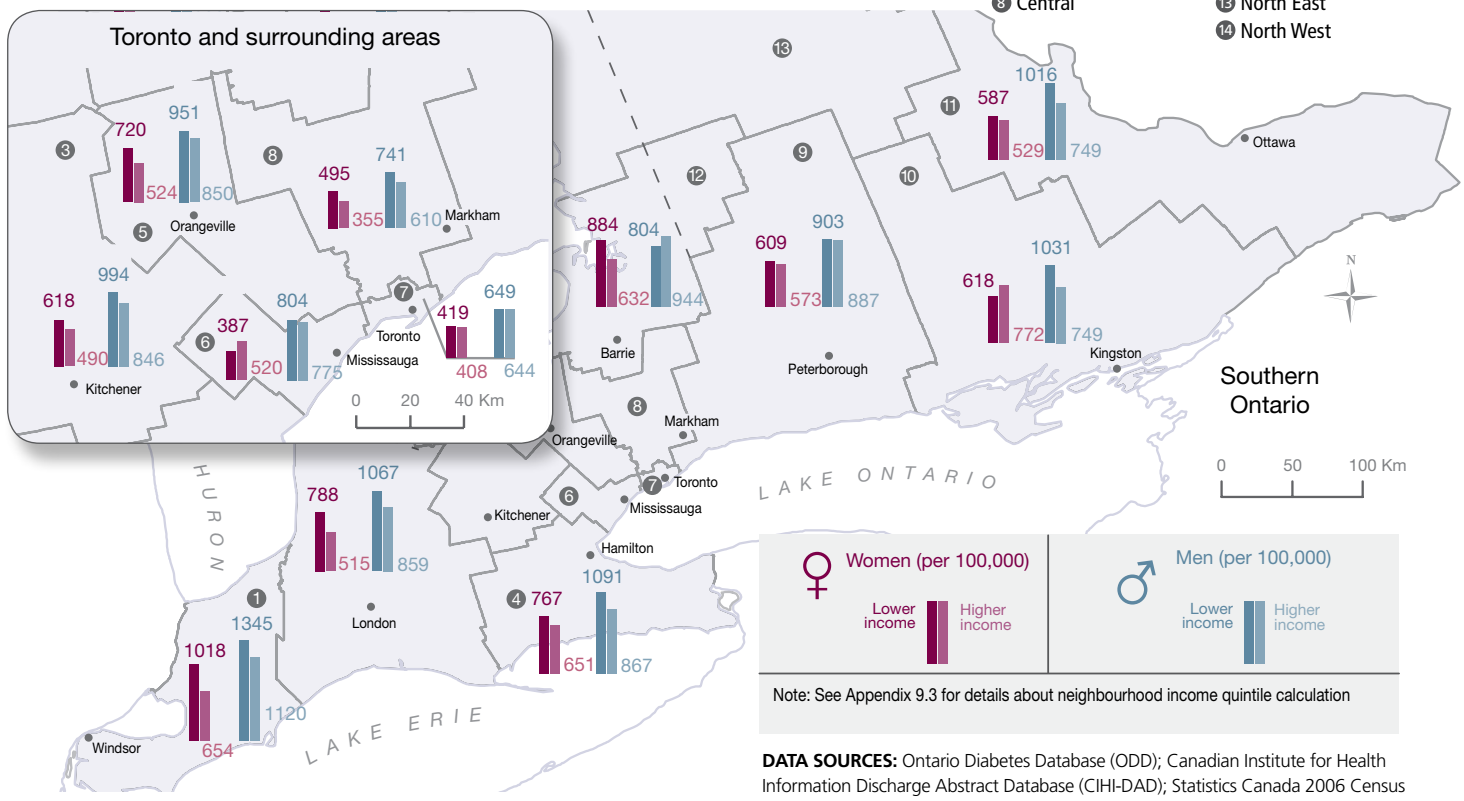

DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); Statistics Canada 2006 Census

Exhibit 9E.10 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had coronary artery bypass graft (CABG) surgery or a percutaneous coronary intervention (PCI), by sex and Local Health Integration Network (LHIN), in Ontario, 2006/07

FINDINGS

- Among adults with diabetes, rates of CABG surgery and PCI varied significantly across LHINs.
- Rates of CABG surgery from 140 per 100,000 (Toronto Central LHIN) to 275 per 100,000 (Hamilton Niagara Haldimand Brant LHIN) among women and from 366 per 100,000 (Toronto Central LHIN) to 686 per 100,000 (North West LHIN) among men.
- Rates of PCI ranged from 208 per 100,000 (Waterloo Wellington LHIN) to 697 per 100,000 (South East LHIN) among women and from 526 per 100,000 (South West LHIN) to 1109 per 100,000 (South East LHIN) among men.

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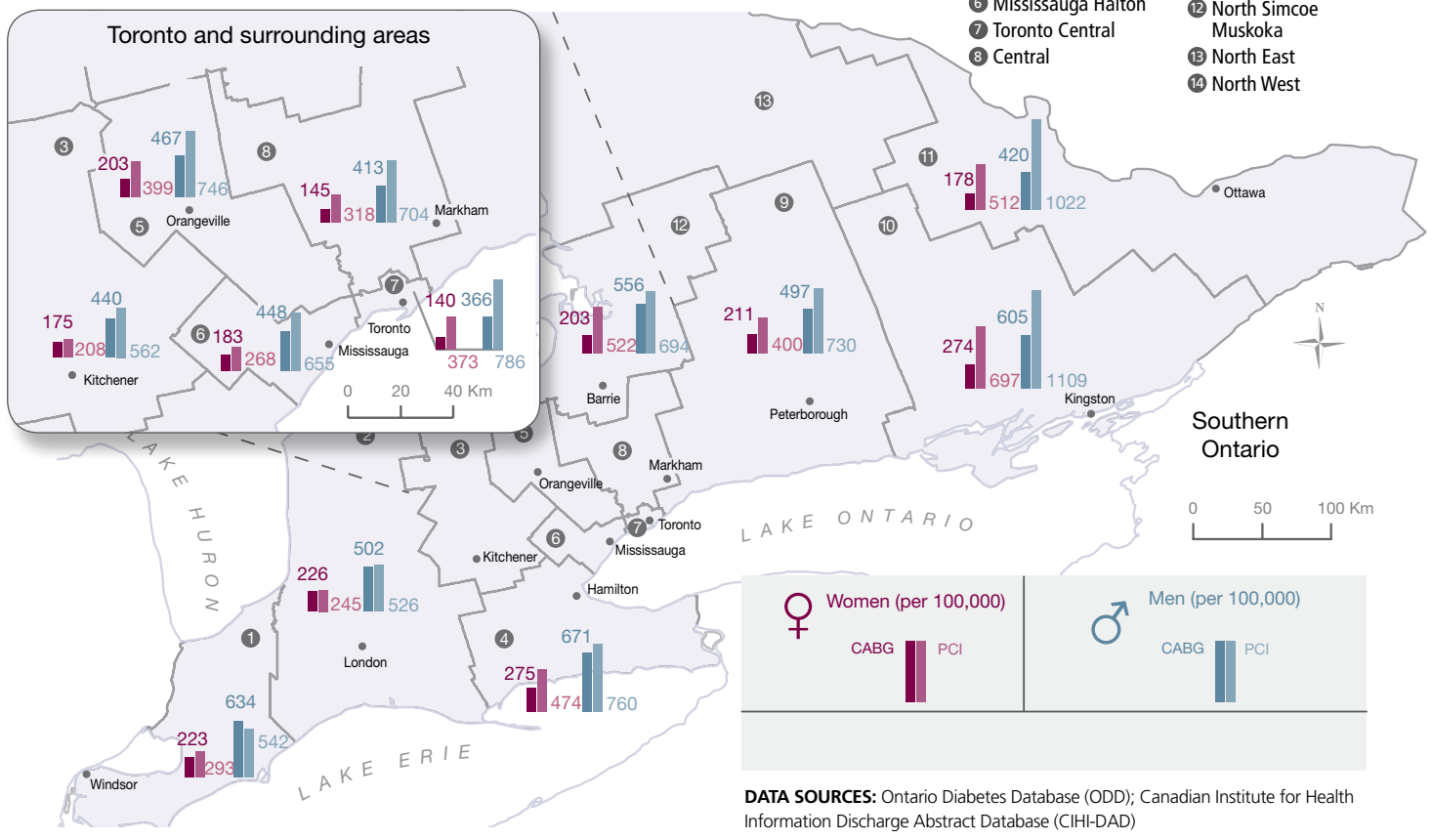


DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

DIABETES AND STROKE

Indicator: The following two indicators measure the number of adults aged 20 and older with diabetes per 100,000 who, over a one-year period, had at least one:

- hospitalization for stroke
- carotid endarterectomy

Background: Stroke is a leading cause of death and disability in Canada.[221] Diabetes is associated with a two- to three-fold elevation in the risk of stroke.[187, 189] The control of blood pressure and cholesterol levels can substantially reduce the risk of stroke in individuals with diabetes.[33, 39] Stroke admissions and case fatality rates have fallen considerably over the past decade, likely due to better management of risk factors and improvements in in-hospital stroke care.[187] Patients with symptomatic, moderate or severe carotid stenosis may be candidates for carotid endarterectomy, which is a highly effective treatment for secondary stroke prevention in appropriate patients.[222] Here we assess overall population-based rates of endarterectomy among people with diabetes. However, without clinical data, we cannot assess either the appropriateness of the procedure or underuse among those for whom the procedure is indicated.

The Ontario Diabetes Database (ODD) was used to identify adults with diabetes as of March 31, 2006 (see Appendix 9.3 for details). Data from the Canadian Institute of Health Information Discharge Abstract Database (CIHI-DAD) were used to measure stroke admissions and carotid endarterectomy rates in the 2006/07 fiscal year. Only one admission or procedure was counted for each patient.

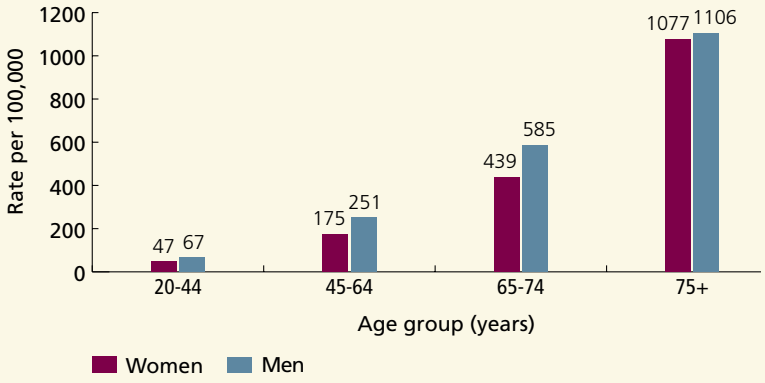
Findings: In Ontario in 2006/07, the number of adults aged 20 and older with diabetes hospitalized for a stroke was 457 per 100,000. Women were less likely than men to be hospitalized for stroke (420 per 100,000 versus 494 per 100,000, respectively).

The number of adults with diabetes aged 20 and older who underwent a carotid endarterectomy in 2006/07 was 50 per 100,000. Women were half as likely as men to have a carotid endarterectomy (33 per 100,000 versus 66 per 100,000, respectively).

Exhibit 9E.11 | Number of adults aged 20 and older with diabetes per 100,000 who had a hospitalization for stroke, by sex and age group, in Ontario, 2006/07

FINDINGS

- The risk of being hospitalized for a stroke increased sharply with age among both women and men.
- Among adults aged 20-74 with diabetes, women were less likely to be hospitalized for a stroke than men; however, the sex difference disappeared among people aged 75 and older.
- Adults with diabetes who lived in the lowest-income neighbourhoods had higher hospitalization rates for stroke compared to those living in the highest-income neighbourhoods (507 per 100,000 versus 416 per 100,000, respectively), however, these differences were not significant (data not shown).
- Hospitalization rates for stroke ranged from 356 per 100,000 in the Mississauga Halton Local Health Integration Network (LHIN) to 762 per 100,000 in the North West LHIN (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

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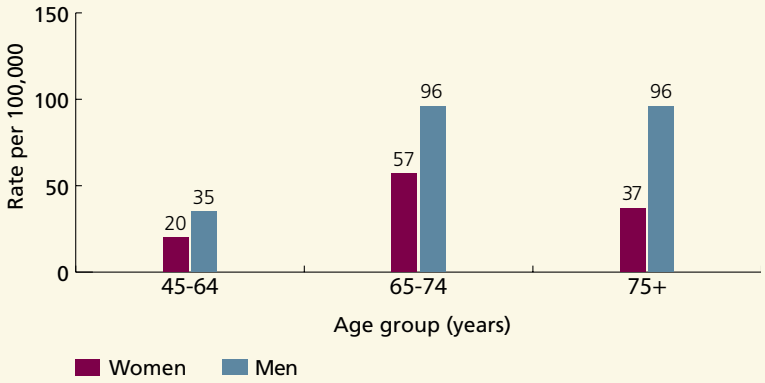
Exhibit 9E.12 | Number of adults aged 20 and older with diabetes per 100,000 who had a carotid endarterectomy, by sex and age group, in Ontario, 2006/07

FINDINGS

- Carotid endarterectomy rates were highest among those aged 65 and older. Carotid endarterectomy could not be examined in adults under age 45 due to the small numbers of procedures in that age group.
- Across all age groups, women with diabetes were less likely than men with diabetes to have a carotid endarterectomy.
- Sex differences in carotid endarterectomy rates were greater than the observed sex differences in hospitalization rates for stroke.
- Among adults with diabetes, rates of carotid endarterectomy did not vary by neighbourhood income (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

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DIABETES AND PERIPHERAL VASCULAR DISEASE

Indicator: The following indicators measure the number of adults aged 20 and older with diabetes per 100,000 who, over a one-year period, had at least one:

- major lower extremity amputation (below hip and above ankle)
- minor lower extremity amputation (ankle or lower)
- peripheral revascularization procedure

Background: Foot complications are a major cause of morbidity and mortality in people with diabetes.[145, 217] In Ontario, nearly two-thirds of non-traumatic lower extremity amputations occur in people with diabetes.[188] One-third of those undergoing amputation die within the following year. Amputations are potentially preventable through a combination of measures, including regular foot examinations, foot care education, use of proper footwear, good glucose control, smoking cessation, and early detection and treatment of diabetic foot ulcers.[82, 131] Peripheral revascularization may prevent amputation and promote healing in patients with ulcers by restoring the blood supply to the foot.[223]

The Ontario Diabetes Database (ODD) was used to identify adults with diabetes as of March 31, 2006. Data from the Canadian Institute of Health Information Discharge Abstract Database (CIHI-DAD) were used to measure these indicators in the 2006/07 fiscal year. In order to restrict the analysis to amputations related to diabetes, we excluded amputations that occurred during a hospital admission related to malignancy or to major trauma (see Appendix 9.3 for details).

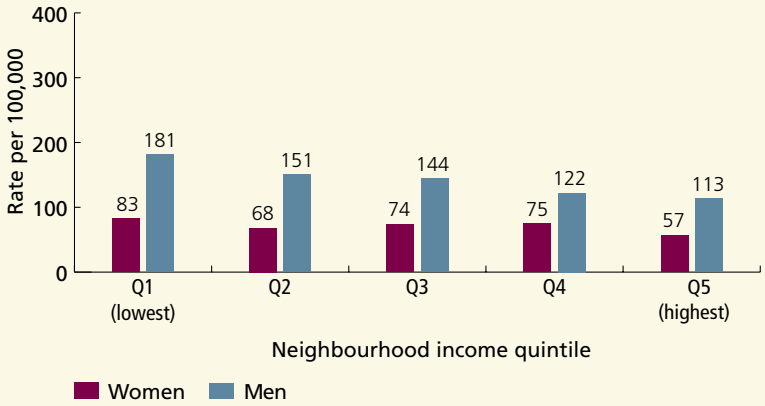
Findings: In Ontario, the rate of amputations was 109 major amputations and 78 minor amputations per 100,000 people aged 20 and older with diabetes. Women were less likely than men to have major amputations (72 per 100,000 versus 143 per 100,000, respectively) or minor amputations (44 per 100,000 versus 109 per 100,000, respectively).

The number of adults with diabetes aged 20 and older who underwent a peripheral revascularization procedure in 2006/07 was 111 per 100,000. Women were less likely than men to be revascularized (77 per 100,000 versus 143 per 100,000, respectively).

Exhibit 9E.13 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had a major amputation, by sex and neighbourhood income quintile, in Ontario, 2006/07

FINDINGS

- Among men with diabetes, those living in the lowest-income neighbourhoods were much more likely to have a major amputation than those living in the highest-income neighbourhoods (181 per 100,000 versus 113 per 100,000, respectively). The income gradient was not significant among women with diabetes, possibly due to small numbers and limited power to detect differences.
- Men living in the lowest-income neighbourhoods were more likely than men living in the highest-income neighbourhoods to undergo minor amputations (128 per 100,000 versus 76 per 100,000, respectively) or peripheral revascularization (161 per 100,000 versus 111 per 100,000, respectively). Again, these indicators did not differ by neighbourhood income among women (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); Statistics Canada 2006 Census

NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

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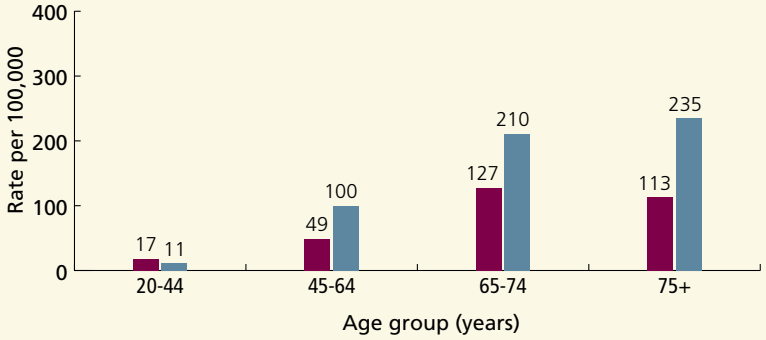
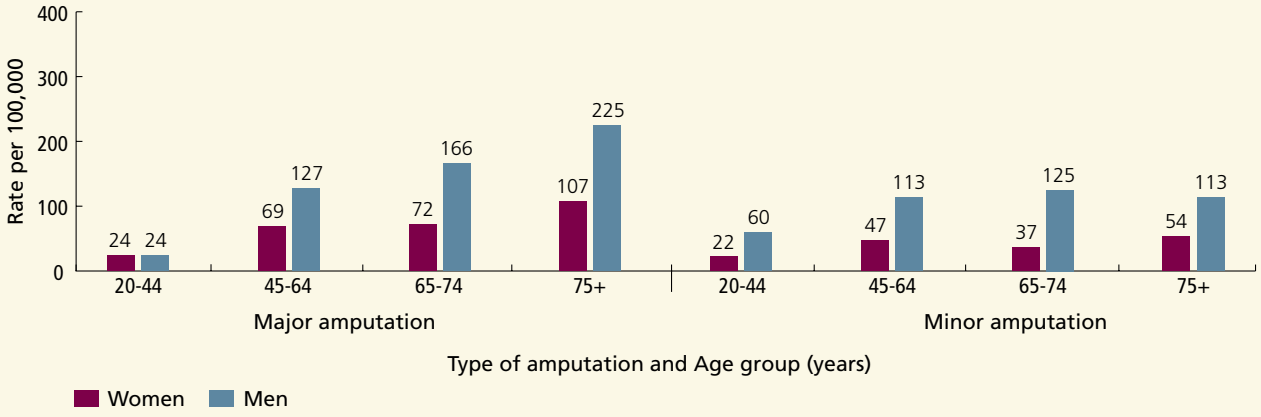
Exhibit 9E.14 | Number of adults aged 20 and older with diabetes per 100,000 who had a peripheral revascularization procedure or an amputation, by sex and age group, in Ontario, 2006/07

Peripheral revascularization procedure



Amputation



DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

FINDINGS

- Among adults with diabetes, rates of major amputation and peripheral revascularization were lowest among those aged 20-44 and increased sharply with age for both women and men.
- While the rate of minor amputations was still lowest among women and men aged 20-44, the difference associated with age was substantially smaller. Among adults aged 45 and older the rate of minor amputations did not vary by age for women or for men.
- Young women and men with diabetes (aged 20-44) had similar rates of major amputations and peripheral revascularization; however, in the older age groups, women were about half as likely to undergo one of these procedures as men were.
- Across all age groups, the rates of minor amputations were two to three times higher among men than among women.

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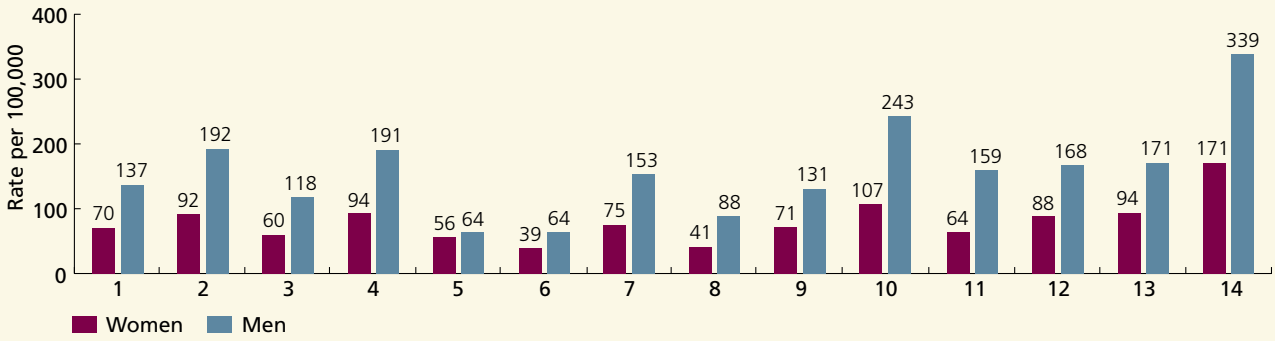
9E.15 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had a major amputation, by sex and Local Health Integration Network (LHIN), in Ontario, 2006/07



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

FINDINGS

- The rates of major and minor amputations varied across LHINs among women and men with diabetes (data on major amputations shown).
- Among adults with diabetes, the rates of major amputation ranged from 39 per 100,000 (Mississauga Halton LHIN) to 171 per 100,000 (North West LHIN) among women and from 64 per 100,000 (Central West and Mississauga Halton LHINs) to 339 per 100,000 (North West LHIN) among men.
- The rates of minor amputation ranged from 21 per 100,000 (Central LHIN) to 135 per 100,000 (North West LHIN) among women with diabetes and from 46 per 100,000 (Central West LHIN) to 256 per 100,000 (North East LHIN) among men with diabetes (data not shown).
- The rate of peripheral revascularization among adults with diabetes varied significantly across LHINs, ranging from 43 per 100,000 (Waterloo Wellington LHIN) to 151 per 100,000 (North East LHIN) among women and from 69 per 100,000 (North West LHIN) to 248 per 100,000 (North East LHIN) among men (data not shown).

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CHRONIC DIALYSIS THERAPY

Indicator: This indicator measures the number of adults aged 20 and older with diabetes per 100,000 who received chronic dialysis (dialysis duration of 90 days or more) over a one-year period.

Background: Chronic kidney disease remains one of the most common and serious complications of diabetes and can lead to chronic kidney failure, known as end-stage renal disease (ESRD). Diabetes is the leading cause of kidney failure in Canada, responsible for half of all new cases.[190] The onset of chronic kidney disease can be prevented or delayed through optimal glucose and blood pressure control, as well as the use of specific therapies (angiotensin converting enzyme (ACE) inhibitor or angiotensin II receptor blocker (ARB) therapy) in individuals who have early signs of kidney disease based on the presence of microalbuminuria (abnormal levels of protein in the urine).[130, 163, 224, 225] Identification and appropriate treatment of early kidney disease is critical for preventing the progression to ESRD. Once a person develops ESRD, survival depends on replacing kidney function by either dialysis or transplantation.

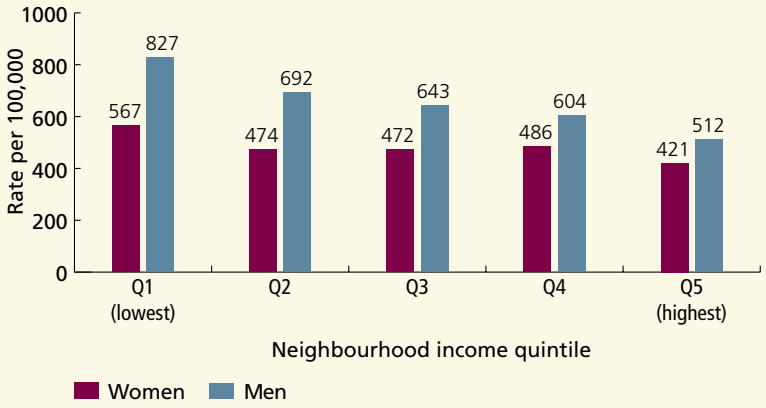
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes as of March 31, 2006 (see Appendix 9.3 for details). Data from the Ontario Health Insurance Plan (OHIP) were used to identify people who were on hemodialysis or peritoneal dialysis for a period of 90 days or more in the 2006/07 fiscal year (see Appendix 9.3 for more details).

Findings: In Ontario in 2006/07, the number of people who received chronic dialysis was 580 per 100,000 people aged 20 and older with diabetes. Women were less likely than men to receive chronic dialysis (492 per 100,000 versus 663 per 100,000, respectively).

Exhibit 9E.16 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who received chronic dialysis, by sex and neighbourhood income quintile, in Ontario, 2006/07

FINDINGS

- There was an inverse relationship between neighbourhood income and the rate of chronic dialysis among women and men with diabetes.
- Women living in the lowest-income neighbourhoods were more likely to receive chronic dialysis than women living in the highest-income neighbourhoods (567 per 100,000 versus 421 per 100,000, respectively).
- Men living in the lowest-income neighbourhoods were more likely to receive chronic dialysis than men living in the highest-income neighbourhoods (827 per 100,000 versus 512 per 100,000, respectively).
- Across all income quintiles, men were more likely than women to receive chronic dialysis, but the sex differences were greater in the lower-income neighbourhoods.



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Statistics Canada 2006 Census

NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

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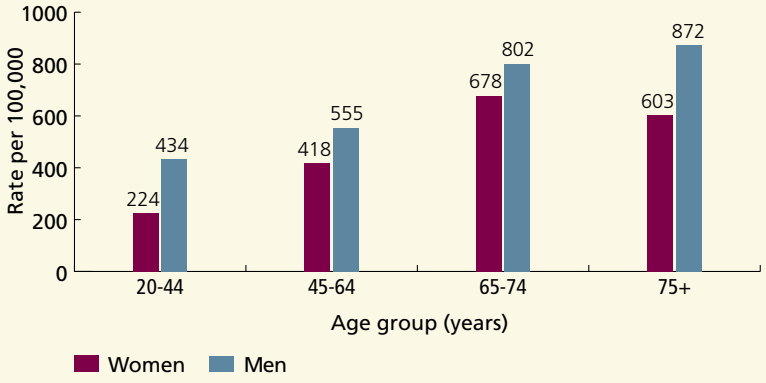
Exhibit 9E.17 | Number of adults aged 20 and older with diabetes per 100,000 who received chronic dialysis, by sex and age group, in Ontario, 2006/07

FINDINGS

- Among women with diabetes, the proportion who received chronic dialysis increased with age to age 74 and then declined slightly.
- Among men with diabetes, the proportion who received chronic dialysis increased with age across all age groups, however, the increase in the oldest age group was less marked.
- Across all age groups, women were less likely than men to receive chronic dialysis; however, the sex difference was greatest in the youngest and oldest age groups.



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

POWER Study

Exhibit 9E.18 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who received chronic dialysis, by sex and Local Health Integration Network (LHIN), in Ontario, 2006/07

FINDINGS

- The rates of chronic dialysis varied across LHINs among women and men with diabetes.
- Among women with diabetes, the proportion who received chronic dialysis ranged from 338 per 100,000 (Erie St. Clair LHIN) to 636 per 100,000 (North Simcoe Muskoka LHIN).
- Among men with diabetes, the proportion who received chronic dialysis ranged from 481 per 100,000 (Erie St. Clair LHIN) to 840 per 100,000 (North West LHIN).

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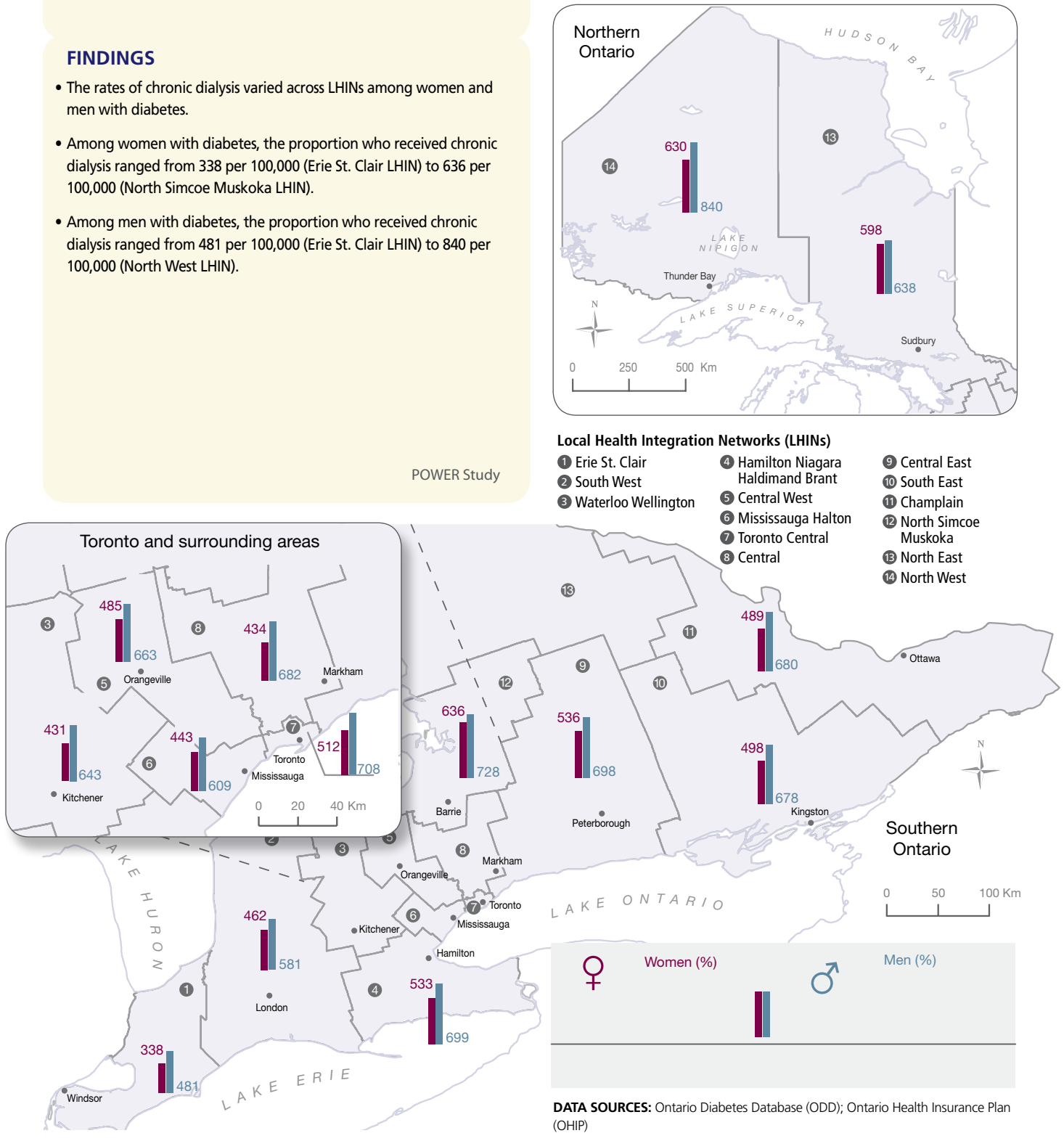


DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

DIABETIC RETINOPATHY

Indicator: These indicators measure the number of adults aged 20 and older with diabetes per 100,000 who, over a one-year period, had:

- laser photocoagulation
- a vitrectomy

Background: Diabetic retinopathy is a common complication of diabetes,[191, 226] and the leading cause of blindness in Canadians between the ages of 30-69.[227] Previous studies have shown the crude prevalence of retinopathy among adults with diabetes in the US to be approximately 40 percent, with higher rates among people with type 1 diabetes compared to those with type 2 diabetes.[226] The prevalence of sight threatening (proliferative) retinopathy is lower, 23 percent and 10 percent in type 1 and type 2 diabetes respectively.[228] The onset and progression of diabetic retinopathy can be reduced substantially through tight control of glucose and blood pressure.[39, 130, 229]

Retinal Photocoagulation: If proliferative diabetic retinopathy is detected early, vision loss may be prevented by retinal laser photocoagulation.[230, 231] Left untreated, proliferative diabetic retinopathy leads to blindness in 50 percent of patients within five years.[232]

Vitrectomy Surgery: Vitrectomy is a surgical procedure used to treat end-stage complications of diabetic retinopathy and hence may be regarded as a marker of poor outcomes.[233, 234]

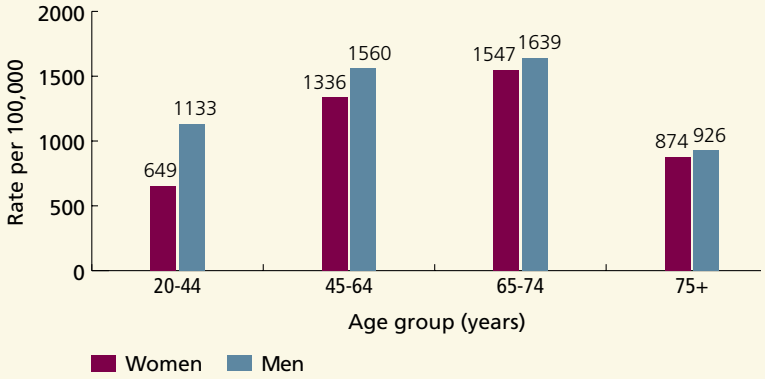
The Ontario Diabetes Database (ODD) was used to identify adults with diabetes as of March 31, 2006. Data from the Ontario Health Insurance Plan (OHIP) were used to identify people who underwent laser photocoagulation and vitrectomy in the 2006/07 fiscal year (see Appendix 9.3 for more detail).

Findings: In Ontario in 2006/07, among those aged 20 and older with diabetes, 1293 per 100,000 underwent retinal laser photocoagulation and 253 per 100,000 underwent a vitrectomy. Women were less likely men than to undergo either procedure (1194 per 100,000 women versus 1382 per 100,000 men for laser photocoagulation; 220 per 100,000 women versus 284 per 100,000 men for vitrectomy).

Exhibit 9E.19 | Number of adults aged 20 and older with diabetes per 100,000 who had laser photocoagulation, by sex and age group, in Ontario, 2006/07

FINDINGS

- Rates of laser photocoagulation were highest among women and men with diabetes aged 45-64 and 65-74.
- Among adults with diabetes aged 20-64, men had higher rates of laser photocoagulation than women; with the greatest sex difference among adults aged 20-44. The rates of laser photocoagulation did not vary significantly by sex among adults aged 65 and older.
- Adults with diabetes living in the highest-income neighbourhoods had slightly lower rates of laser photocoagulation than those living in the lowest-income neighbourhoods, however, these differences were small (data not shown).



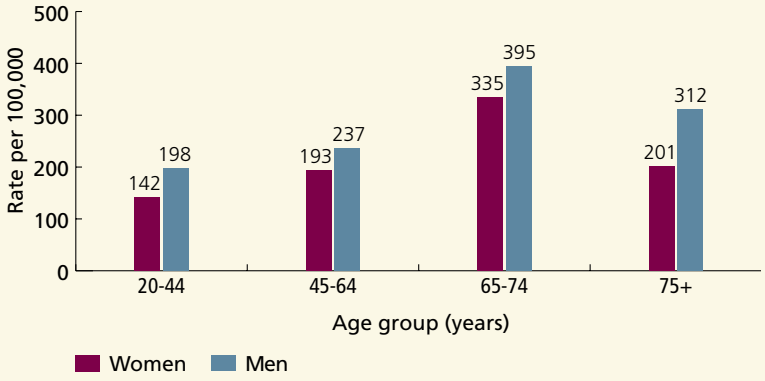
DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

POWER Study

Exhibit 9E.20 | Number of adults aged 20 and older with diabetes per 100,000 who had a vitrectomy, by sex and age group, in Ontario, 2006/07

FINDINGS

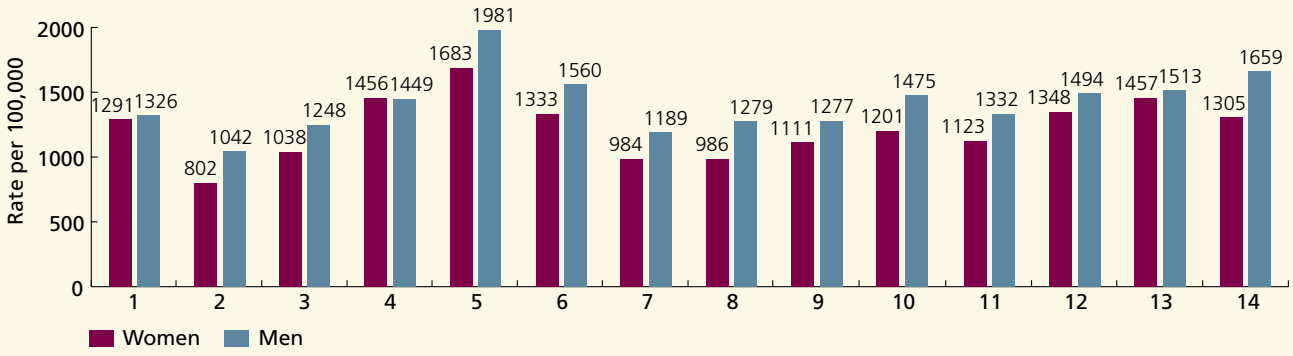
- Rates of vitrectomy among women and men with diabetes increased with age to age 74, and then declined among those aged 75 and older. Men had consistently higher rates than women, across all age groups.
- Vitrectomy rates did not differ by neighbourhood income for women or for men (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

POWER Study

Exhibit 9E.21 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had laser photocoagulation, by sex and Local Health Integration Network (LHIN), in Ontario, 2006/07



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

FINDINGS

- Rates of laser photocoagulation varied across LHINs among women and men with diabetes.
- Among women with diabetes, rates of laser photocoagulation ranged from 802 per 100,000 in the South West LHIN to 1683 per 100,000 in the Central West LHIN.
- Among men with diabetes, rates of laser photocoagulation ranged from 1042 per 100,000 in the South West LHIN to 1981 per 100,000 in the Central West LHIN.

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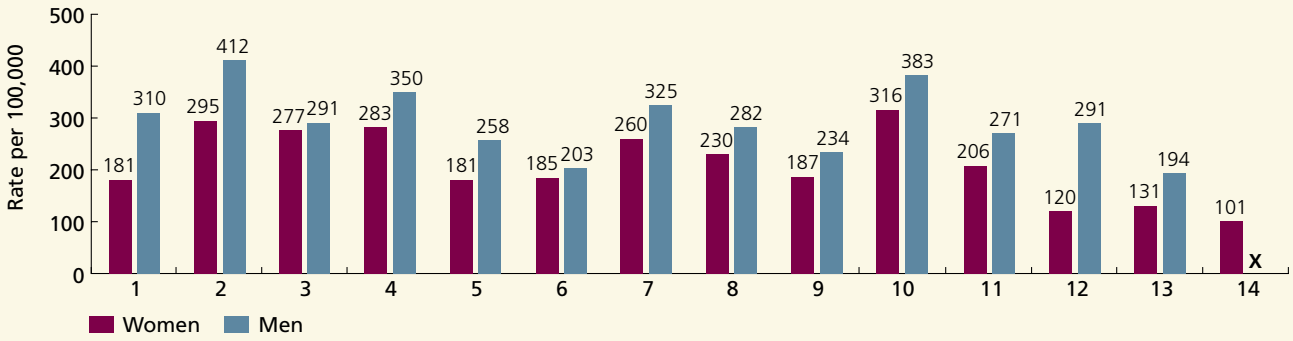
Exhibit 9E.22 | Age-standardized number of adults aged 20 and older with diabetes per 100,000 who had a vitrectomy, by sex and Local Health Integration Network (LHIN), in Ontario, 2006/07



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

X Suppressed due to small sample size

FINDINGS

- Vitrectomy rates varied across LHINs among women and men with diabetes.
- Among women with diabetes, vitrectomy rates ranged from 101 per 100,000 in the North West LHIN to 316 per 100,000 in the South East LHIN.
- Among men with diabetes, vitrectomy rates ranged from 194 per 100,000 in the North East LHIN to 412 per 100,000 in the South West, however, some data were suppressed due to small numbers.

POWER Study

Section 9E

SUMMARY OF FINDINGS

This section reports on outcome indicators associated with diabetes including hospital admissions related to glucose control, infections, cardiovascular and cerebrovascular complications, procedures related to circulatory complications of diabetes and chronic dialysis. Consistently, men had higher rates of diabetes complications than women and complication rates varied by age and Local Health Integration Network (LHIN) for most indicators. A number of the health outcome indicators also varied by neighbourhood income; low-income women and men generally had higher rates of hospitalizations and diabetic complications. The findings are summarized below.

Hospital Visits for Hyperglycemia and Hypoglycemia

In Ontario, 1362 per 100,000 adults with diabetes were either seen in an emergency department or hospitalized in 2006/07 because of hyperglycemia or hypoglycemia. Women were slightly less likely to be hospitalized than men and rates also varied by neighbourhood income, age and LHIN. Women and men living in lower-income neighbourhoods were more likely to have a hospital admission or emergency department visit for one of these two glucose-control related conditions than adults living in higher-income neighbourhoods (1605 per 100,000 versus 1181 per 100,000, respectively). The number of adults with diabetes who had at least one hospital visit for hyper- or hypoglycemia was highest in the youngest and oldest age groups. High rates in those under age 45 are likely related to the higher proportion of type 1 diabetes in this age group.

Hospitalizations for Skin and Soft Tissue Infections

In Ontario, 534 per 100,000 adults with diabetes were hospitalized for a skin and soft tissue infection in 2006/07. Women were somewhat less likely to be hospitalized than men (464 per 100,000 women versus 601 per 100,000 men) and the gender differences persisted across all age groups and neighbourhood income quintiles. Hospitalization rates increased with age and varied by LHIN and neighbourhood income. The hospitalization rates for skin and soft tissue infections among adults living in the lowest-income neighbourhoods was over 40 percent higher than the rate among adults living in the highest-income neighbourhoods.

Diabetes and Cardiac Disease

Among adults with diabetes aged 20 and older, 740 per 100,000 were hospitalized for an acute myocardial infarction (AMI), 863 per 100,000 were hospitalized for congestive heart failure (CHF), 583 per 100,000 underwent percutaneous coronary intervention (PCI) and 353 per 100,000 had coronary artery bypass graft (CABG) surgery in 2006/07. For all four indicators, men had higher rates of both hospital admissions and therapeutic interventions than women. Admission rates and PCI rates were higher among women living in the lowest-income neighbourhoods as compared to women living in the highest-income neighbourhoods, which likely reflects the higher burden of disease in this group; admission rates for AMI or for CHF varied by neighbourhood income among men, however, procedure rates did not. Hospitalizations for CHF and for AMI increased sharply with age and, across most age groups, women with diabetes experienced lower rates than men, however, the sex differences lessened with increasing age. Revascularization rates also increased with age, but declined again after age 75. Sex differences in coronary procedure rates were greater than those observed for AMI and CHF hospitalizations, however, we were unable to assess overuse or underuse of these procedures due to lack of clinical data.

Diabetes and Stroke

In Ontario in 2006/07, the hospitalization rate for stroke among adults aged 20 and older with diabetes was 457 per 100,000 and 50 per 100,000 underwent a carotid endarterectomy. Men had higher rates of stroke and carotid endarterectomy than women, but rates did not vary significantly by neighbourhood income. Hospitalization rates for stroke varied across LHINs. The risk of being hospitalized for a stroke increased sharply with age in both women and men. Among adults aged 20-74 with diabetes, women were less likely to be hospitalized for a stroke than men; however, the sex difference disappeared among people aged 75 and older. Carotid endarterectomy rates were highest in adults aged 65 and older. Across all age groups, women with diabetes were less likely than men with diabetes to have had a carotid endarterectomy; the sex difference was greatest in those aged 75 and older. Sex differences in carotid endarterecomy rates were greater than those observed in stroke admission rates, however, we were unable to assess overuse or underuse of these procedures due to lack of clinical data.

Diabetes and Peripheral Vascular Disease

In Ontario, among adults aged 20 and older with diabetes, 109 per 100,000 had a major amputation, 78 per 100,000 had a minor amputation, and 111 per 100,000 underwent a peripheral revascularization procedure in 2006/07. For all three indicators, women had considerably lower rates than men. Among men with diabetes, those living in the lowest-income neighbourhoods were more likely to have an amputation or a peripheral revascularization procedure than men living in the highest-income neighbourhoods; these rates did not differ by neighbourhood income among women. Rates of major amputation and of peripheral revascularization increased sharply with age in both sexes. While the rate of minor amputations also increased with age, the difference was substantially less. Young women and men with diabetes (aged 20-44) had similar rates of major amputations and peripheral revascularization; however, in the older age groups, women were about half as less likely to undergo one of these procedures as men were. Across all age groups, the rate of minor amputations was two to three times higher among men than among women. Rates of amputation and peripheral revascularization varied across LHINs.

Chronic Dialysis Therapy

In Ontario in 2006/07, the number of adults with diabetes who received chronic dialysis was 580 per 100,000. Women were less likely than men to receive chronic dialysis. Adults with diabetes living in the lowest-income neighbourhoods were more likely to be on chronic dialysis than women and men living in the highest-income neighbourhoods. Among women with diabetes, the proportion who were on chronic dialysis increased with age to age 74 and then declined slightly; while among men the proportion who were on chronic dialysis increased with age across all age groups. Although men with diabetes were more likely than women with diabetes to be on dialysis across all neighbourhood income quintiles and age groups, the sex differences were greater in the lower-income neighbourhoods, as well as in the youngest and oldest age groups. The rate of chronic dialysis varied across LHINs.

Diabetic Retinopathy

Among adults aged 20 and older with diabetes, 1293 per 100,000 underwent retinal laser photocoagulation and 253 per 100,000 underwent a vitrectomy in 2006/07. Women were less likely than men than to undergo either procedure. Adults with diabetes living in the highest-income neighbourhoods had slightly lower rates of laser photocoagulation than those living in the lowest-income neighbourhoods, however, these differences were minimal. Vitrectomy rates did not differ by neighbourhood income for women or for men. The highest rates of laser photocoagulation were seen among women and men with diabetes aged 45-64 and 65-74. Rates of vitrectomy increased with age to age 74, and then declined. The rates of laser photocoagulation and vitrectomy varied across LHINs.

Section 9F
Diabetes and Pregnancy

INTRODUCTION

Recent data suggest that while diabetes rates have risen across all age groups, young women have seen the greatest increase in diabetes over the last decade.[4]

As more women develop type 2 diabetes during their childbearing years, pregnancies complicated by diabetes are becoming increasingly common.[31] This trend has important implications for women, their offspring and the health care system. Women with pregestational diabetes (type 1 or type 2 diabetes that predated the pregnancy) have higher rates of adverse maternal and fetal outcomes than women who do not have diabetes,[25-30] including increased rates of caesarean section, obstructed labour, preeclampsia and hypertension in pregnancy. In addition, their infants have higher rates of perinatal mortality, shoulder dystocia (when the baby gets caught behind the mother's pubic bone, often because the baby is too large), birth injury, congenital anomalies, macrosomia (large size), neonatal hypoglycemia (low blood sugar) and hyperbilrubinemia (jaundice) requiring phototherapy.[25-30] Consistent with these adverse outcomes, more infants of mothers who have diabetes are admitted to the neonatal intensive care unit (NICU).

Studies have shown that both maternal and fetal outcomes can be improved for women with diabetes with appropriate pre-pregnancy and prenatal care provided by a multidisciplinary team. Optimal prenatal care for women with pregestational diabetes should involve access to a high-risk pregnancy team including specialists who are experts in both intensive diabetes management and the special circumstances of diabetes in pregnancy. The Canadian Diabetes Association (CDA) recommends "care by an interdisciplinary diabetes health care team composed of diabetes nurse educators, dieticians, obstetricians and endocrinologists, both prior to conception and during pregnancy" to "minimize maternal and fetal risks in women with diabetes."[82] The CDA also recommends that pregnant women with pregestational diabetes undergo an ophthalmologic evaluation by an eye care specialist during the first trimester and as needed during the rest of pregnancy.[82]

Congenital anomalies are directly associated with poor glycemic control (control of blood glucose) at the time of conception and in the first trimester. As a result, the deleterious effects of poor glycemic control occur even before many women know they are pregnant. Fortunately, rates of congenital anomalies can be reduced to those seen in the general population with proper pre-pregnancy planning and excellent glycemic control prior to conception.[235, 236] Strategies to improve early pregnancy glucose control must therefore be initiated before attempting to conceive; tight glycemic control prior to pregnancy has also been associated with reduced rates of spontaneous abortion, preeclampsia and progression of retinopathy in the mother.[237-239] Tight control of glucose and blood pressure levels during pregnancy have also been associated with improved maternal and fetal outcomes for women with pregestational diabetes.[240-244] However, studies have shown that rates of pre-pregnancy counselling are suboptimal in women with diabetes,[245-247] especially among visible minority women and those with lower income and less education.[246, 247]

For women with pregestational diabetes, the need for appropriate care can and should be identified prior to pregnancy. However, women with gestational diabetes,

which is diabetes that is diagnosed for the first time during pregnancy, also require specialized prenatal care to lower the risk of maternal and fetal complications. Pregnant women without diabetes are screened for gestational diabetes between 24 and 28 weeks of pregnancy, or earlier if pregestational diabetes is suspected. The identification of gestational diabetes does not exclude the possibility that the condition has preceded the pregnancy but was not identified.[248] Gestational diabetes varies in severity, may or may not resolve with the end of the pregnancy and may or may not require treatment with insulin. Since their hyperglycemia may occur later in pregnancy, women with gestational diabetes may not have increased rates of congenital anomalies. However, they do have many of the other adverse outcomes experienced by women with pregestational diabetes, including increased rates of hypertension, preeclampsia and caesarean section. In addition, their infants have increased rates of macrosomia, shoulder dystocia, neonatal hypoglycemia, hyperbilirubinemia requiring phototherapy, and NICU admissions.[249, 250] Specialized care aimed at excellent glycemic control during pregnancy reduces these risks,[251] therefore access to appropriate prenatal care needs to be assured for all women with gestational diabetes.

The prevalence of diabetes increases with age and varies with socioeconomic status. Similarly, older women and women with low socioeconomic status have an increased risk of developing gestational diabetes[252] and appear to also have worse pregnancy outcomes.[253, 254] However, the effect of age and socioeconomic status on pregnancy outcomes has not been specifically studied among women with diabetes during pregnancy.

In this section, we report indicators of prenatal care, obstetrical complications and fetal complications among women with pregestational diabetes and gestational diabetes compared to women without diabetes. We examine the differences associated with sex, neighbourhood income, age and Local Health Integration Network (LHIN).

The indicators include:

The percentage of pregnant women who received the following prenatal care:

- At least one visit to an obstetrician during pregnancy
- At least one visit to a endocrinologist or general internist during pregnancy (among women with pregestational diabetes only)
- At least one eye examination in the year before delivery (among women with pregestational diabetes only)

The percentage of pregnant women who had the following obstetrical complications:

- A diagnosis of hypertension (pre-existing or pregnancy induced) in the six months before or at delivery
- Preeclampsia/eclampsia in the six months before or at delivery
- Any obstructed labour (including shoulder dystocia) and specifically shoulder dystocia at delivery
- Caesarean section

The percentage or proportion of infants who had the following fetal complications:

- Stillbirth or in-hospital mortality (per 1,000)
- Congenital anomalies (major or minor)
- Premature delivery (less than 37 weeks)
- Phototherapy for hyperbilirubinemia
- NICU admission

Administrative data from the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) were used to identify all women aged 20 and older who gave birth between April 1st 2002 and March 31st 2007. Records were linked to the Ontario Health Insurance Plan (OHIP) database and the Ontario Diabetes Database (ODD) to determine whether these women had pregestational diabetes, gestational diabetes or no diabetes. The OHIP database was used to assess prenatal care. The Institute for Clinical Evaluative Sciences (ICES) Physician Database (IPDB) was used to classify specialists. The CIHI-DAD was used to measure obstetrical complications. The ICES Mother-Baby (MOMBABY) Linked database and CIHI-DAD were used to link women to offspring from their index pregnancy in order to examine complication rates (see Appendix 9.3 for details).

EXHIBITS AND FINDINGS

PRENATAL CARE

Indicator: These indicators measure the percentage of pregnant women aged 20 and older who received the following prenatal care:

- at least one visit to an obstetrician during pregnancy
- at least one visit to a endocrinologist or general internist during pregnancy (among women with pregestational diabetes only)
- at least one eye examination (from a general practitioner/family physician (GP/FP), optometrist, or ophthalmologist) in the year before delivery (among women with pregestational diabetes only)

Background: Optimal prenatal care for women with pregestational diabetes should involve access to a high-risk pregnancy team including specialists who are experts in both intensive diabetes management and the special circumstances of pregnancy.[82, 235] Because diabetic complications can worsen during pregnancy, these women should also be screened for the presence of microvascular disease, including diabetic retinopathy.[82, 239]

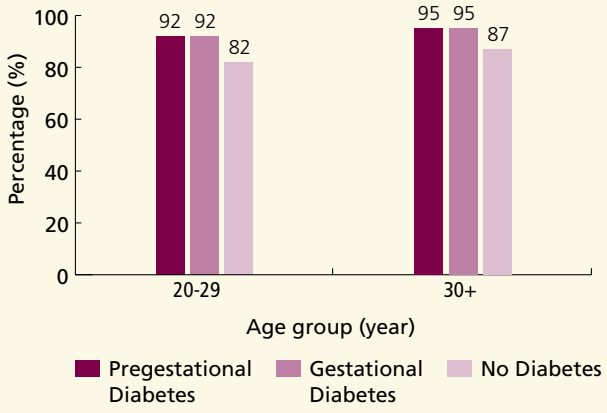
For these indicators, the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) was used to identify all women aged 20 and older who gave birth between April 1st 2002 and March 31st 2007. If a woman had multiple deliveries in this time period, one delivery was chosen at random. Diabetes status in pregnant women was established by linking births to the Ontario Diabetes Database (ODD) and hospital records. Prenatal care was identified using Ontario Health Insurance Plan (OHIP) data (see Appendix 9.3 for more detail). Services provided by physicians paid through alternate funding plans (AFPs) may not be completely captured using OHIP data. Their concentration in certain specialties or geographic areas could distort an analysis.

Findings: In Ontario, most, but not all, women with diabetes (94 percent with pregestational diabetes and 94 percent with gestational diabetes) visited an obstetrician for prenatal care compared to 85 percent of women without diabetes in pregnancy. Among women with pregestational diabetes, only 55 percent were seen by an endocrinologist or general internist during pregnancy and only 31 percent had an eye examination in the year prior to delivery.

Exhibit 9F.1 | Age-standardized percentage of pregnant women who saw an obstetrician during pregnancy,^ by diabetes status and age group, in Ontario, 2002/03-2006/07

FINDINGS

- Women with pregestational or gestational diabetes were more likely to see an obstetrician in the nine months before delivery than women without diabetes.
- The percentage of pregnant women who saw an obstetrician in the nine months before delivery did not vary by age for women with pregestational and gestational diabetes, but did vary for women without diabetes.
- The percentage of pregnant women with diabetes (pregestational or gestational) who saw an obstetrician did not vary by neighbourhood income (data not shown).
- The percentage of pregnant women who saw an obstetrician in the nine months before delivery varied significantly by Local Health Integration Network (LHIN) regardless of diabetes status. In all LHINs women with pregestational and gestational diabetes were more likely to see an obstetrician than women without diabetes (data not shown).

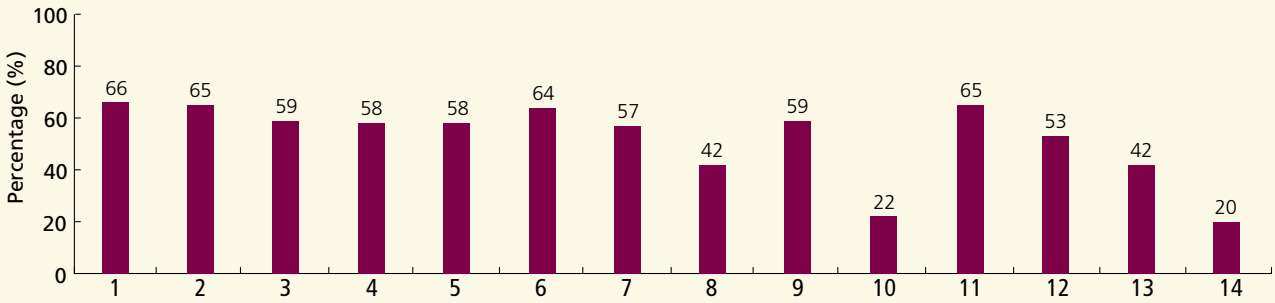


DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); ICES Physician Database (IPDB)

^ Within nine months prior to delivery

POWER Study

Exhibit 9F.2 | Age-standardized percentage of pregnant women with pregestational diabetes who saw an endocrinologist and/or an internist during pregnancy,^ by Local Health Integration Network (LHIN), in Ontario, 2002/03-2006/07



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); ICES Physician Database (IPDB)

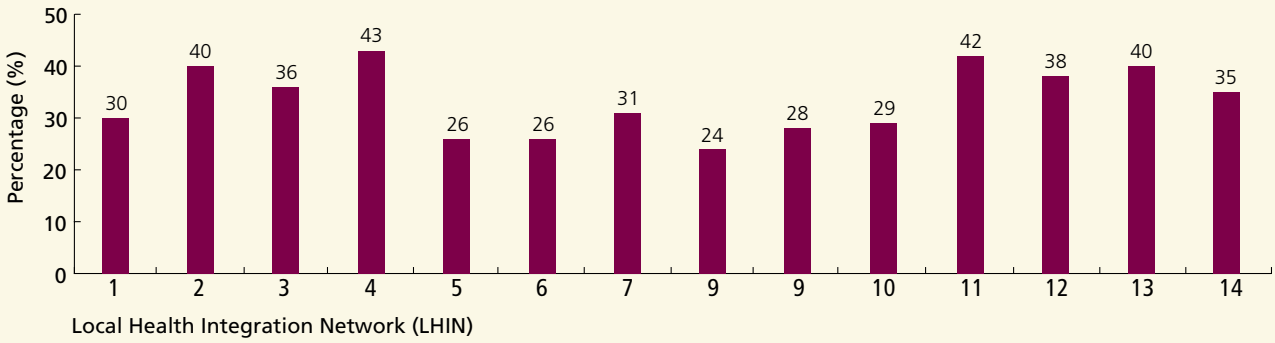
^ Within nine months prior to delivery

FINDINGS

- The percentage of women with pregestational diabetes who saw an endocrinologist or internist in the nine months prior to delivery varied significantly across LHINs.
- Some of the variation may be due to alternate funding plans (AFPs) where OHIP billing information may be incomplete, as occurs in the South East LHIN, or due to out of province use of specialists, as occurs in the North West LHIN.
- Pregnant women with pregestational diabetes who were living in the lowest-income neighbourhoods were somewhat more likely to be seen by an endocrinologist or internist in the nine months prior to delivery than those living in the highest-income neighbourhoods (59 percent versus 52 percent, respectively) (data not shown).
- Women with pregestational diabetes who were aged 30 and older were more likely to be seen by an endocrinologist or internist in the nine months prior to delivery than women aged 20-29 (57 percent versus 50 percent, respectively) (data not shown).

POWER Study

Exhibit 9F.3 | Age-standardized percentage of pregnant women with pregestational diabetes who had at least one eye examination in the year before delivery, by Local Health Integration Network (LHIN), in Ontario, 2002/03-2006/07



1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

FINDINGS

- The percentage of pregnant women with pregestational diabetes who had an eye examination in the year prior to delivery varied across LHINs from 24 percent (Central LHIN) to 43 percent (Hamilton, Niagara Haldimand Brant LHIN). In all LHINs, less than half of women received recommended eye care.
- Women aged 20-29 were more likely than older women (aged 30 and older) to have had an eye examination, but this difference was small (34 percent versus 30 percent, respectively) (data not shown).
- The percentage of pregnant women with pregestational diabetes who had an eye examination in the year prior to delivery did not vary by neighbourhood income (data not shown).

POWER Study

OBSTETRICAL COMPLICATIONS

Indicator: The following indicators measure the percentage of pregnant women aged 20 and older with pregestational diabetes, gestational diabetes and no diabetes who delivered over a five-year period who had the following obstetrical complications:

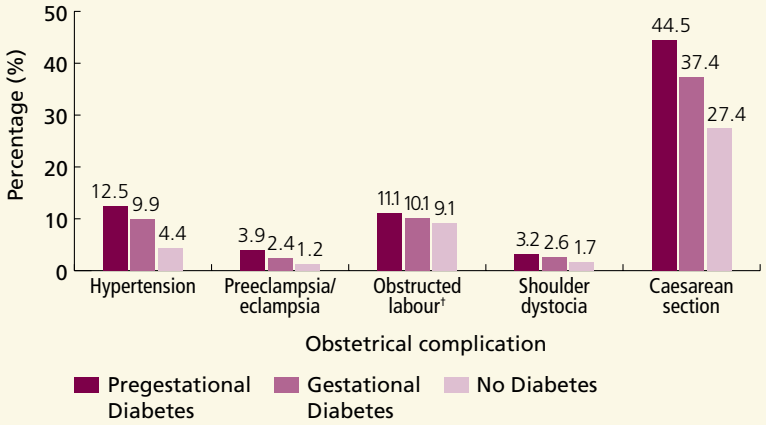
- A diagnosis of hypertension (pre-existing or pregnancy-induced) in the six months before or at delivery
- Preeclampsia/eclampsia in the six months before or at delivery
- Any obstructed labour (including shoulder dystocia)
  – shoulder dystocia at delivery
- Caesarean section

Background: Evidence shows that pregnant women with diabetes are more likely than women without diabetes to have obstetrical complications such as hypertension, obstructed labour and caesarean section.[25-27, 29, 30] Obstructed labour, and in particular shoulder dystocia, can lead to birth injury and asphyxia in infants at delivery. In order to avoid complications associated with obstructed labour, infants may be delivered by caesarean section. The risk of complications is further increased by the presence of hypertension. Infants born to women with preexisting or gestational hypertension have an increased risk of serious morbidity or perinatal death. Many adverse outcomes in this population may be preventable through high quality care prior to conception and throughout pregnancy.[237, 240, 241, 243, 244]

For these indicators, the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) was used to identify all women aged 20 and older who gave birth between April 1st 2002 and March 31st 2007. If a woman had multiple deliveries in this time period, one delivery was chosen at random. Diabetes status in pregnant women was established by linking births to the Ontario Diabetes Database (ODD), OHIP physician claims and hospital records. The CIHI-DAD was used to measure the rates of obstetrical complications (see Appendix 9.3 for more detail), however, the completeness of reporting of some complications will vary.

Findings: In Ontario, the percentages of women with pregestational diabetes who had obstetrical complications were: 12.5 percent (hypertension); 3.9 percent (preeclampsia or eclampsia); 11.1 percent (obstructed labour); 3.2 percent (shoulder dystocia). Almost half of all women with pregestational diabetes (45 percent) delivered by caesarean section. For all indicators, women with pregestational diabetes had higher rates of obstetrical complications than women without diabetes. For some indicators, women with gestational diabetes also had higher rates of obstetrical complications than women without diabetes (see Exhibit 9F.4).

Exhibit 9F.4 | Age-standardized percentage of pregnant women who had obstetrical complications, by diabetes status, in Ontario, 2002/03-2006/07



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

† Includes shoulder dystocia

FINDINGS

- Compared to women without diabetes, women with pregestational diabetes had rates that were about three times higher for hypertension and preeclampsia/eclampsia and almost twice as high for shoulder dystocia and caesarean section. Rates of obstructed labour were slightly higher among women with pregestational diabetes compared to women without diabetes.
- Compared to women without diabetes, women with gestational diabetes had rates that were about two times higher for hypertension and preeclampsia/eclampsia. Rates of caesarean section, obstructed labour and shoulder dystocia were also higher in this group compared to women without diabetes, however, the differences in rates of obstructed labour and shoulder dystocia were small.
- The rates of hypertension varied somewhat by Local Health Integration Network (LHIN) and ranged from 7.9 percent (Mississauga Halton LHIN) to 21.9 percent (North Simcoe Muskoka LHIN) among women with pregestational diabetes and from 7.4 percent (Central LHIN) to 15.9 percent (North East LHIN) women among with gestational diabetes (data not shown).
- The preeclampsia/eclampsia rates ranged from 2.0 percent (Mississauga Halton LHIN) to 7.4 percent (South West LHIN) among women with pregestational diabetes and from 1.1 percent (Erie St. Clair LHIN) to 4.8 percent (North East LHIN) among women with gestational diabetes (data not shown).
- The rates of obstructed labour and shoulder dystocia also varied by LHIN. Obstructed labour rates ranged from 8.9 percent (Mississauga Halton and Central LHINs) to 16.1 percent (Hamilton Niagara Haldimand LHIN) among women with pregestational diabetes and from 8.0 percent (Central West LHIN) to 12.1 percent (Hamilton Niagara Haldimand LHIN) among women with gestational diabetes. Shoulder dystocia rates ranged from 1.6 percent (Central West LHIN) to 5.3 percent (South West LHIN) among women with pregestational diabetes and from 1.0 percent (Central West LHIN) to 4.6 percent (North West LHIN) among women with gestational diabetes (data not shown).

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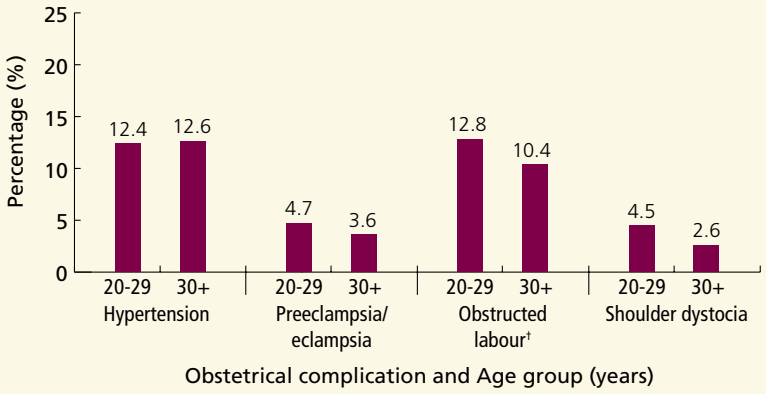
Exhibit 9F.5 | Percentage of pregnant women with pregestational diabetes who had obstetrical complications, by age group, in Ontario, 2002/03-2006/07

FINDINGS

- Among women with pregestational diabetes, younger women (aged 20-29) had higher rates of preeclampsia/eclampsia, obstructed labour and shoulder dystocia than older women. Rates of hypertension among women with pregestational diabetes did not vary with age. Higher rates of preeclampsia/eclampsia among younger women with pregestational diabetes may reflect the fact that this complication is more common in the first pregnancy.
- Among women with gestational diabetes, those aged 20-29 had slightly higher rates of shoulder dystocia than older women (3.0 percent versus 2.3 percent for shoulder dystocia), however, the overall rates of obstructed labour did not vary by age (data not shown).
- Rates of obstetrical complications (hypertension, preeclampsia and eclampsia, obstructed labour and shoulder dystocia) among women with pregestational or gestational diabetes did not vary by neighbourhood income (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

† Includes shoulder dystocia

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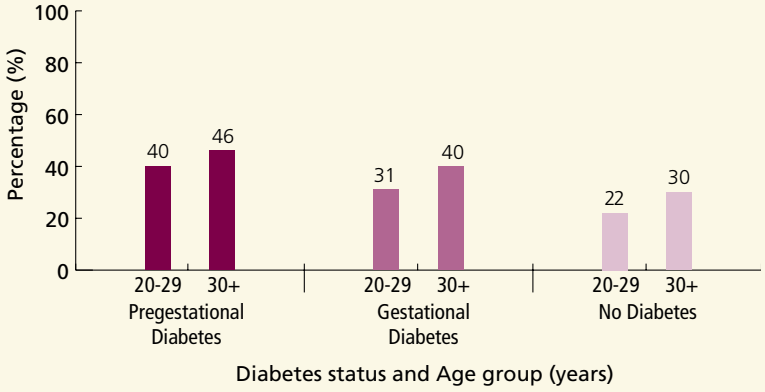
Exhibit 9F.6 | Percentage of pregnant women who had a caesarean section, by age group and diabetes status, in Ontario, 2002/03-2006/07

FINDINGS

- Women with pregestational or gestational diabetes had higher caesarean section rates than women without diabetes, irrespective of age.
- Women aged 30 and older were more likely to have a caesarean section than younger women, regardless of diabetes status.
- Caesarean section rates did not vary by neighbourhood income (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

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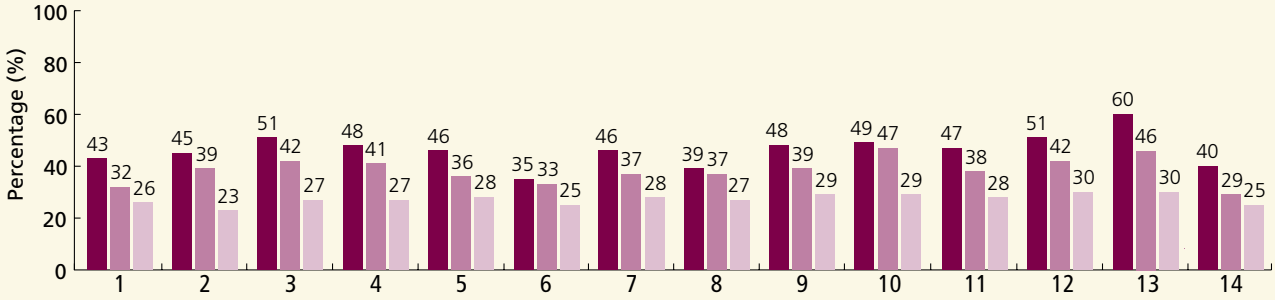
Exhibit 9F.7 | Age-standardized percentage of pregnant women who had a caesarean section, by Local Health Integration Network (LHIN) and diabetes status, in Ontario, 2002/03-2006/07



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)

FINDINGS

- Caesarean section rates varied by LHIN among women with pregestational diabetes, with the highest rate found in the North East LHIN (60 percent) and the lowest rate in the Mississauga Halton LHIN (35 percent).
- Among women with gestational diabetes, the percentage who delivered by caesarean section ranged from 29 percent (North West LHIN) to 47 percent (South East LHIN).

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FETAL COMPLICATIONS

Indicator: The following indicators measure the percentage or proportion of pregnant women aged 20 and older with pregestational diabetes, gestational diabetes and without diabetes whose infants had the following fetal complications:

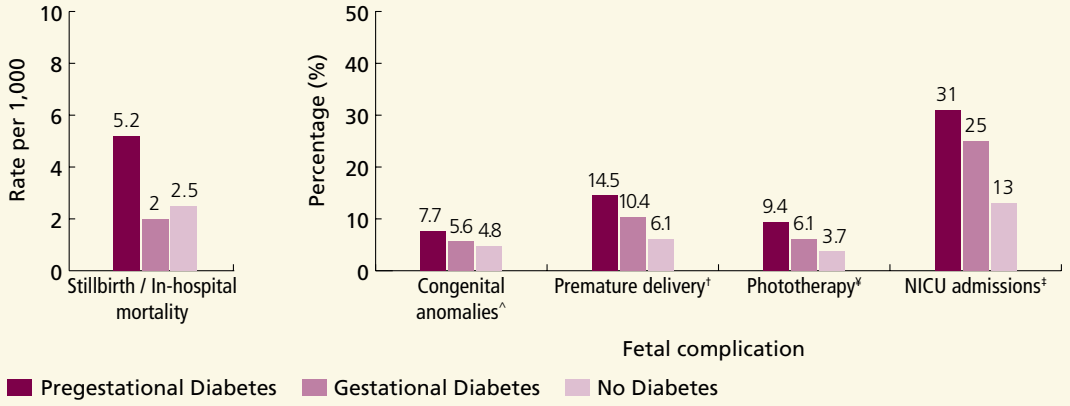
- stillbirth/in-hospital mortality (per 1000)
- congenital anomalies (major and minor)
- premature delivery (delivered before 37 weeks gestation)
- hyperbilirubinemia requiring phototherapy
- neonatal intensive care unit (NICU) admissions (all levels)

Background: Evidence shows that infants of women with diabetes are more likely to have fetal complications such as perinatal mortality, congenital anomalies, premature delivery and hyperbilirubinemia (jaundice) requiring phototherapy compared with infants of women without diabetes.[25-30, 238] Because of these fetal complications, infants of women with diabetes are more often admitted to NICUs. Many adverse outcomes in this population may be preventable through high quality care prior to conception and during the prenatal period.[235, 236, 240-244]

For these indicators, the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) was used to identify all women aged 20 and older who gave birth between April 1st 2002 and March 31st 2007. If a woman had multiple deliveries in this time period, one delivery was chosen at random. Diabetes status in pregnant women was established by linking births to the Ontario Diabetes Database (ODD) and hospital records. The Institute for Clinical Evaluative Sciences (ICES) Mother-Baby (MOMBABY) linked database and the CIHI-DAD were used to link women to the offspring of their index pregnancy in order to measure fetal outcomes (see Appendix 9.3 for details). Infants may be admitted to a lower-acuity NICU for a limited time for observation of minor concerns. For this reason, this indicator is an imprecise measure of absolute morbidity; however, variation in this measure may reflect true variations in need and care received.

Findings: In Ontario, the rate of stillbirth/in-hospital mortality was 5.2 per 1,000 infants born to women with pregestational diabetes, compared to 2.0 per 1,000 infants born to women with gestational diabetes and 2.5 per 1,000 infants born to women without diabetes. The percentages of infants born to women with pregestational diabetes who had other fetal complications were 7.7 percent (congenital anomalies); 14.5 percent (premature delivery); 9.4 percent (phototherapy for hyperbilirubinemia) and 31 percent (NICU admissions). Infants born to women with diabetes had higher rates of fetal complications than those born to women without diabetes (see Exhibit 9F.8).

Exhibit 9F.8 | Age-standardized rates of fetal complications, by maternal diabetes status, in Ontario, 2002/03-2006/07



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); ICES Mother-Baby (MOMBABY) Linked Database

^ Includes major and minor congenital anomalies

† Delivered before 37 weeks gestation

¥ Hyperbilirubinemia requiring phototherapy

‡ Includes all admissions to a neonatal intensive care unit (NICU), including low-acuity units and admissions of short duration (e.g., a few hours only)

FINDINGS

- The rate of stillbirth/in-hospital mortality was twice as high among infants born to women with pregestational diabetes compared to infants born to women with no diabetes (5.2 per 1,000 versus 2.5 per 1,000, respectively). Rates of stillbirth or in-hospital mortality did not differ between infants born to women with gestational diabetes and women without diabetes.
- Rates of premature delivery, phototherapy for hyperbilirubinemia and NICU admissions were two to three times higher among infants born to women with pregestational diabetes compared to infants born to women without diabetes. Rates of congenital anomalies were also higher among infants born to women with pregestational diabetes compared to infants born to women without diabetes (7.7 percent versus 4.8 percent, respectively).
- Compared to infants born to women without diabetes, infants born to women with gestational diabetes had higher rates of congenital anomalies, premature delivery, phototherapy for hyperbilirubinema and NICU admissions.

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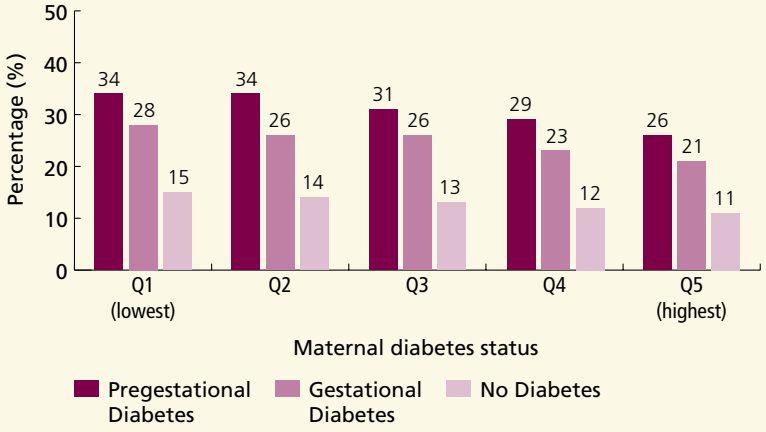
Exhibit 9F.9 | Age-standardized neonatal intensive care unit (NICU) admission rates,^ by neighbourhood income quintile and maternal diabetes status, in Ontario, 2002/03-2006/07

FINDINGS

- Infants born to women from lower-income neighbourhoods had higher NICU admission rates than infants born to women from higher-income neighbourhoods, regardless of maternal diabetes status.
- Across all income quintiles, NICU admission rates were higher among infants born to women with pregestational or gestational diabetes compared to infants born to women without diabetes.
- Rates of congenital anomalies, premature delivery, and phototherapy for hyperbilirubinemia did not differ by neighbourhood income, regardless of maternal diabetes status (data not shown).



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); ICES Mother-Baby (MOMBABY) Linked Database; Statistics Canada 2006 Census

NOTE: See Appendix 9.3 for details about neighbourhood income quintile calculation

^ Includes all admissions to NICUs, including low-acuity units and admissions of short duration (e.g., a few hours only)

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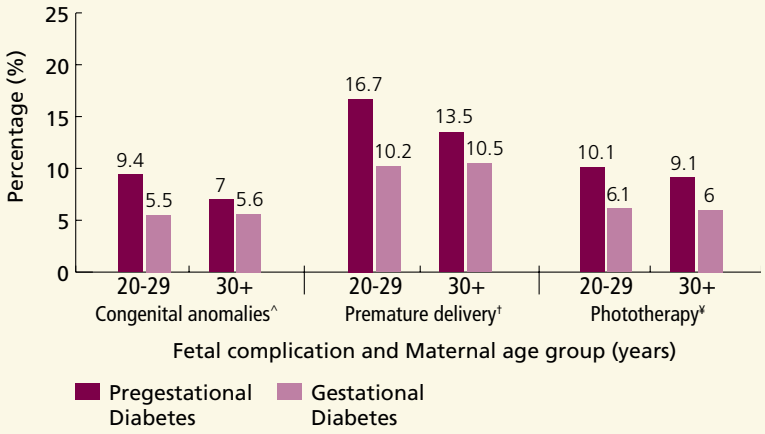
Exhibit 9F.10 | Percentage of infants who had congenital anomalies, premature delivery or who received phototherapy, by maternal age group and maternal diabetes status, in Ontario, 2002/03-2006/07

FINDINGS

- Infants born to younger women (aged 20-29) with pregestational diabetes had higher rates of congenital anomalies and premature delivery than those born to older women. Rates of phototherapy for hyperbilirubinemia did not vary by maternal age.
- Infants born to women aged 20-29 with pregestational diabetes had higher rates of stillbirth or in-hospital mortality than those born to women aged 30 and older (8.3 per 1,000 versus 3.8 per 1,000, respectively) (data not shown).
- Among infants born to women with gestational diabetes, rates of fetal complications did not vary by maternal age.



DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); ICES Mother-Baby (MOMBABY) Linked Database

^ Includes major and minor congenital anomalies

† Delivered before 37 weeks gestation

¥ Hyperbilirubinemia requiring phototherapy

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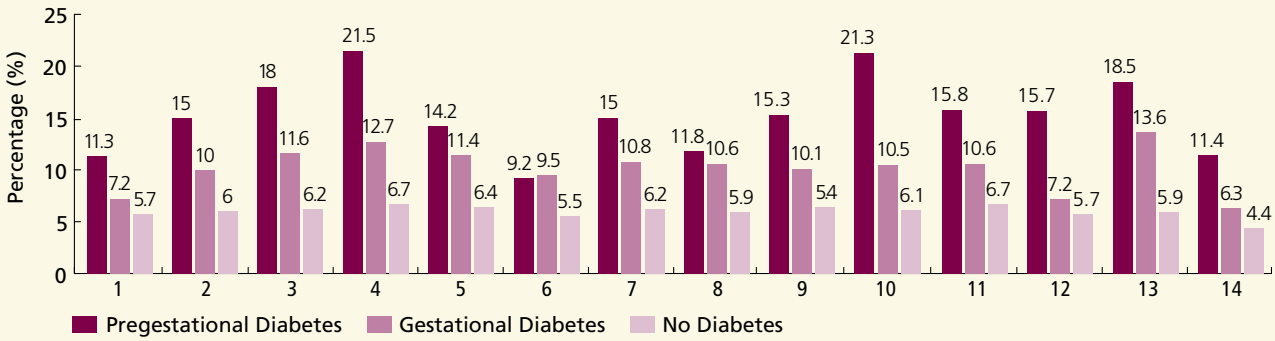
Exhibit 9F.11 | Age-standardized percentage of infants who were delivered prematurely,^ by Local Health Integration Network (LHIN) and maternal diabetes status, in Ontario, 2002/03-2006/07



Local Health Integration Network (LHIN)

1. Erie St. Clair
2. South West
3. Waterloo Wellington
4. Hamilton Niagara Haldimand Brant
5. Central West
6. Mississauga Halton
7. Toronto Central
8. Central
9. Central East
10. South East
11. Champlain
12. North Simcoe Muskoka
13. North East
14. North West

DATA SOURCES: Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); ICES Mother-Baby (MOMBABY) Linked Database

^ Delivered before 37 weeks gestation

FINDINGS

- The percentage of infants born to women with pregestational or gestational diabetes who were delivered prematurely varied significantly by LHIN.
- In all LHINS, a higher percentage of women with pregestational and gestational diabetes delivered prematurely compared to women without diabetes.
- Among infants born to women with pregestational and gestational diabetes, rates of congenital anomalies and phototherapy for hyperbilirubinemia varied significantly across LHINs. In almost all LHINS, women with pregestational diabetes had higher congenital anomaly rates than women without diabetes (data not shown).

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Section 9F

SUMMARY OF FINDINGS

This section reports on indicators of pregnancy care, obstetrical complications and fetal complications among pregnant women with pregestational diabetes, gestational diabetes and women without diabetes. Almost all indicators in this section varied by maternal diabetes status and Local Health Integration Network (LHIN). Consistently, women with pregestational diabetes and their infants experienced more complications and worse outcomes than women without diabetes. Finding for the indicators reported in this section are summarized below.

Prenatal Care

Among pregnant women with pregestational diabetes, 94 percent had seen an obstetrician; but only 55 percent had seen an endocrinologist or general internist in the nine months prior to delivery; and only 31 percent had an eye examination in the one year prior to delivery. Women with pregestational or gestational diabetes were more likely to receive care from an obstetrician than women without diabetes.

Older pregnant women with pregestational diabetes were more likely to receive care from an endocrinologist or general internist during pregnancy than women aged 20-29, but were less likely to undergo an eye examination. Pregnant women with pregestational diabetes who were living in the lowest-income neighbourhoods were more likely to be seen by an endocrinologist or internist than those living in the highest-income neighbourhoods (59 percent versus 52 percent, respectively). All three measures of prenatal care varied by LHIN.

Obstetrical Complications

Pregnant women with diabetes had higher rates of obstetrical complications than women without diabetes; women with pregestational diabetes had particularly high rates (12.5 percent had hypertension, 3.9 percent had preeclampsia/eclampsia, 11.1 percent had obstructed labour, and 3.2 percent had shoulder dystocia). Almost half of all pregnant women with pregestational diabetes (45 percent) delivered by caesarean section compared to 37 percent of women with gestational diabetes and 27 percent of women without diabetes. For women with pregestational or gestational diabetes, the indicators of obstetrical complications did not vary by neighbourhood income, but did vary by LHIN. Among women with pregestational diabetes, women aged 20-29 had higher rates of preeclampsia/eclampsia, obstructed labour, and shoulder dystocia than older women; among women with gestational diabetes, younger women had higher rates of should dystocia, but overall rates of obstructed labour did not vary by age. Women aged 30 and older with pregestational or gestational diabetes had higher rates of caesarean sections compared to younger women.

Fetal Complications

Infants born to women with diabetes had higher rates of fetal complications than infants born to women without diabetes. The percentage of infants born to women with pregestational diabetes who suffered fetal complications were: 7.7 percent (congenital anomalies); 14.5 percent (premature delivery); 9.4 percent (phototherapy for hyperbilirubinemia); 31 percent (neonatal intensive care unit (NICU) admissions). The rate of stillbirth/in-hospital mortality was twice as high among infants born to women with pregestational diabetes compared to infants born to women without diabetes (5.2 per 1,000 versus 2.5 per 1,000, respectively). Rates of stillbirth/in-hospital mortality did not differ

between offspring of women with gestational diabetes and without diabetes. Compared to infants born to women without diabetes, infants born to women with gestational diabetes had higher rates of congenital anomalies, premature delivery, phototherapy for hyperbilirubinemia, and NICU admissions.

Regardless of diabetes status, rates of congenital anomalies, premature delivery and phototherapy did not differ by neighbourhood income; however, rates of NICU admissions decreased with higher maternal neighbourhood income. Rates of all fetal complications varied across LHINs among women with pregestational and gestational diabetes. Among women with pregestational diabetes, infants born to younger women (aged 20-29) had higher rates of stillbirth/in-hospital mortality, congenital anomalies and premature delivery than those born to older women; rates of phototherapy for hyperbilirubinemia did not vary by maternal age. This age-related difference may be explained by a higher proportion of type 1 diabetes in younger women, as well as a higher rate of unplanned pregnancies and consequent poor glucose control in that age group. Among women with gestational diabetes, fetal complication rates did not vary by maternal age.

Chapter Summary of Findings

In this chapter, we present results pertaining to the burden of illness due to diabetes and the performance of Ontario's health care system on indicators of care for diabetes. The chapter includes the following six sections.

The chapter includes the following six sections:

A. Health and Functional Status
B. Access and Utilization of Care
C. Screening, Assessment and Monitoring
D. Pharmacological Treatment
E. Health Outcomes
F. Diabetes and Pregnancy

Diabetes prevalence was higher among men than among women; men also suffered more complications related to diabetes and had fewer physician visits. However, women who reported having diabetes were more likely than men to report worse health and more disability. Low-income women and men were more likely to have diabetes and, once they had the disease, they had worse health and functional status, higher rates of hospitalizations, and more diabetic complications. Medication use did not show important variation by sex, with the exception of statins to lower cholesterol, where lower rates were reported in women than in men. While many indicators of health and functional status, access and utilization of care and health outcomes varied by neighbourhood income, few indicators of screening, assessment and monitoring, pharmacological treatment or diabetes and pregnancy did. Most indicators varied by age, with the exception of indicators of screening, assessment and monitoring. There was important variation on almost all indicators by Local Health Integration Network (LHIN). Table 1 provides a summary of differences observed by sex, age, income, education, immigration, ethnicity, rural/urban residency and LHIN.

Health and Functional Status

According to a validated administrative data algorithm, 9.4 percent of Ontario adults had diabetes; this rate increased to 24 percent among adults aged 65 and older. In general, women had lower rates of diabetes than men, except in the youngest age group where prevalence was similar. Diabetes prevalence varied by LHIN, age and neighbourhood income. Diabetes prevalence increased as neighbourhood income quintile decreased from 7.3 percent among adults living in the highest-income neighbourhoods to 11.5 percent among adults living in the lowest-income neighbourhoods. The percentage of people who reported having diabetes varied by ethnicity, with lower rates reported by White adults compared to adults from visible minority populations. Adults who reported having diabetes were more likely than those without diabetes to have at least two other chronic conditions (56 percent versus 28 percent, respectively), probable depression (7.4 percent versus 5.0 percent, respectively) and hypertension (61 percent versus 21 percent, respectively). Among adults with diabetes, women were more likely than men to have at least two additional chronic conditions (63 percent versus 51 percent, respectively) and probable depression (11.1 percent versus 4.3 percent, respectively), but not hypertension. The relative difference in rates of probable depression by diabetes status was greater among women than among men.

Forty percent of adults who reported having diabetes rated their health as fair or poor compared to 11 percent of adults without diabetes. This did not vary by sex but did increase with declining annual household income; more than one half of lower-income adults reported their health as fair or poor compared to less than one-third of higher-income

adults. The percentage of adults with diabetes who reported limitations in their instrumental activities of daily living (IADL) and/or their activities of daily living (ADL) was twice as high as the rate among those without diabetes (37 percent versus 16 percent, respectively). Women were more likely to report IADL and/or ADL limitations than men (49 percent versus 27 percent, respectively) and rates also increased with age and were higher among women and men with lower annual household incomes.

Among adults who reported having diabetes, 62 percent were physically inactive, 58 percent had inadequate fruit and vegetable intake, 39 percent were overweight, 35 percent were obese and 17 percent were current smokers. Physical inactivity, inadequate fruit and vegetable intake, being overweight or being a current smoker did not vary by diabetes status, however, adults who reported having diabetes were two to three times more likely to be obese than adults without diabetes. High rates of risk behaviours in the population with diabetes has an impact on diabetes control and complication rates, and high rates in the general population contribute to the increasing incidence of diabetes in Ontario.

Access and Utilization of Care

Among adults aged 20 and older with diabetes, 83 percent had continuity of primary care (more than 50 percent of their primary care visits were to the same provider). This did not vary by income, but did vary somewhat by sex, LHIN and age; men aged 20-44 with diabetes were least likely to have continuity of primary care (68 percent). While 17 percent of Ontarians with diabetes did not have continuity of primary care, adults with diabetes still had a mean of 7.3 visits per year to a general practitioner/family physician (GP/FP). Women had consistently higher mean numbers of GP/FP visits per year than men and adults living in lower-income neighbourhoods had a slightly higher mean number of GP/FP visits per year than adults living in higher-income neighbourhoods (7.7 versus 6.8 visits per year, respectively). The mean number of GP/FP visits per year among people with diabetes varied widely across LHINs from 5.2 visits in the North West LHIN to 8.4 visits in the Toronto Central LHIN. One-quarter of adults with diabetes had seen a specialist (endocrinologist, general internist or geriatrician) during a two-year period, with slightly higher rates among women than among men and among adults living in higher-income neighbourhoods compared to adults living in lower-income neighbourhoods. Younger people with diabetes were more likely to see a specialist than older people, likely due to the higher proportion of type 1 diabetes in young adults.

Given the need for regular screening and monitoring as part of diabetes care, it is concerning that 5.5 percent of Ontarians with diabetes had not seen a GP/FP or a specialist (endocrinologist, general internist or geriatrician) during a two-year period. This varied by sex, income, age and LHIN. Men were more likely to have not received care from any of these types of physicians than women, irrespective of neighbourhood income, age or LHIN. Eight percent of men living in the lowest-income neighbourhoods and 8.5 percent of men aged 20-44 had not seen a GP/FP or specialist during the two-year period. Some LHIN variation may be due to alternate funding plans (AFPs) where OHIP billing information may be incomplete or due to out of province use of specialists.

Screening, Assessment and Monitoring

Clinical practice guidelines recommend self-monitoring of blood glucose on a daily basis for all people with diabetes who are on insulin and on an individualized basis for those on diet or oral medications alone. More recent data have shown that—for the latter group—the benefit of routine self-monitoring of blood glucose is less clear and may not improve glucose control.[139] Among adults who reported having diabetes, 81 percent of those who were taking insulin and 48 percent of those who were on oral glucose-lowering medications reported daily self-monitoring of

blood glucose. Eighty percent of adults who reported having diabetes reported that they had a hemoglobin A1c to assess their blood glucose control and 73 percent reported that they had a microalbumin test to screen for kidney disease in the past 12 months. For these indicators, there was little variation by sex, socio-economic status, demographic characteristics or LHIN, where sample size allowed comparison.

Less than six in ten adults aged 30 and older had an eye examination within two years of being diagnosed with diabetes and this rate declined to slightly more than four in ten among adults aged 30-44. This indicator varied regionally, but in all LHINs, less than two-thirds of adults with diabetes underwent an eye examination within two years of being diagnosed. The percentage of adults who underwent an eye exam did not differ by sex.

Almost 70 percent of adults who reported having diabetes reported having their feet checked for sores or irritation by themselves, a family member or by a friend (self foot examination) at least once per year. This did not vary by sex, annual household income or by age. Among adults who reported having diabetes, 51 percent reported that a health professional had checked their feet for any sores or irritations in the past 12 months. This did not vary by sex, annual household income, educational attainment, age, visible minority status, rural/urban residency or LHIN. Adults with diabetes who had been in Canada for less than 10 years were less likely to have had a foot examination by a health professional than immigrants who had been in Canada for a longer time or adults who were Canadian born (26 percent, versus 52 percent and 53 percent, respectively).

Adults who reported having diabetes were less likely to have seen a dentist in the past 12 months than adults without diabetes, 56 percent versus 65 percent, respectively. Among adults who reported having diabetes, the percentage that had a dental visit in the past year did not vary by sex but did vary by income, age, educational attainment, ethnicity and LHIN.

Pharmacological Treatment

Most women and men who reported having diabetes were taking some type of medication to control their blood glucose levels, either insulin or oral glucose-lowering medications. This did not vary by annual household income, visible minority status, time since immigration, rural/urban residency or LHIN, but did vary by age and by educational attainment. Adults aged 20-44 were less likely to be on medication to control their diabetes than older adults (71 percent versus 83 percent, respectively). The age difference was not significant for men when stratified by sex; however, this may be due to limited power to detect differences due to small sample size. More than 80 percent of seniors (aged 65 and older) with diabetes had filled a prescription for at least one anti-hypertensive medication, with two-thirds filling prescriptions for an angiotensin-converting enzyme (ACE) inhibitor or angiotensin II receptor blocker (ARB), which are considered the first line of therapy for blood pressure reduction. Sixty percent of seniors with diabetes filled a prescription for at least one statin. There were virtually no variations in medication use by income or LHIN; however, statin use was slightly lower in women than in men and also in adults aged 75 and older compared to younger seniors.

Health Outcomes

In Ontario in 2006/07 among adults with diabetes: 1362 per 100,000 were either seen in an emergency department or hospitalized for hyperglycemia or hypoglycemia; 534 per 100,000 were hospitalized for a skin and soft tissue infection; 740 per 100,000 were hospitalized for an acute myocardial infarction (AMI); 863 per 100,000 for congestive heart failure (CHF) and 457 per 100,000 were hospitalized for a stroke. A significant proportion of adults with diabetes also underwent interventions to address complications related to diabetes in 2006/07: 583 per 100,000 underwent percutaneous coronary intervention (PCI); 353 per 100,000 had coronary artery bypass

graft (CABG) surgery; 50 per 100,000 underwent a carotid endarterectomy; 109 per 100,000 had a major amputation; 78 per 100,000 had a minor amputation; 111 per 100,000 underwent a peripheral revascularization procedure; 580 per 100,000 received chronic dialysis; 1293 per 100,000 underwent retinal laser photocoagulation and 253 per 100,000 underwent a vitrectomy. Nearly all health outcomes showed variation by LHIN. As well, women consistently experienced lower complication rates than men, but sex differences in cardiac and stroke procedure rates were greater than the observed sex differences in hospitalization rates for AMI, CHF or stroke.

Adults living in lower-income neighbourhoods were more likely than those living in higher-income neighbourhoods to have had a hospital visit for hyper- or hypoglycemia, a hospitalization for a skin and soft tissue infection or to receive chronic dialysis. Men and women with diabetes who were living in lower-income neighbourhoods were more likely than those living in higher-income neighbourhoods to be admitted to hospital for CHF or an AMI, but not for stroke. Procedure rates for cardiac disease (CABG and PCI) did not vary by neighbourhood income, with the exception of CABG surgery rates in women, which decreased as income increased. Men living in the lowest-income neighbourhoods were more likely to undergo major or minor amputations than men living in the highest-income neighbourhoods; these rates did not vary by income among women.

The proportion of adults with diabetes who had at least one hospital visit for hyper- or hypoglycemia was highest in the youngest and oldest age groups. High rates in those under age 45 are likely related to the higher proportion of type 1 diabetes in this age group. For cardiac and stroke hospitalizations and for amputations, peripheral revascularization, CABG, PCI and carotid endarterectomy, rates increased with increasing age. Among women with diabetes, the proportion that received chronic dialysis increased with age to age 74 and then declined slightly; among men the proportion that received chronic dialysis increased with age across all age groups. The highest rates of laser photocoagulation were seen among women and men with diabetes aged 45-74; while rates of vitrectomy increased with age to age 74, and then declined among those aged 75 and older.

Diabetes and Pregnancy

Among women with pregestational diabetes, 94 percent had seen an obstetrician. Only 55 percent had seen an endocrinologist or general internist in the nine months prior to delivery and only 31 percent had an eye examination in the one year prior to delivery. Women with pregestational or gestational diabetes were more likely to receive care from an obstetrician than women without diabetes and all three measures of care for pregnant women with diabetes varied by LHIN. Some of the LHIN variation may be due to AFPs where OHIP billing information may be incomplete or due to out of province use of specialists. Pregnant women with pregestational diabetes who were living in the lowest-income neighbourhoods were more likely to be seen by an endocrinologist or internist than those living in the highest-income neighbourhoods (59 percent versus 52 percent, respectively).

Women with pregestational diabetes and gestational diabetes had higher rates of obstetrical complications than women without diabetes. Women with pregestational diabetes had the highest complication rates (hypertension, preeclampsia/eclampsia, obstructed labour, shoulder dystocia) and almost half (45 percent) delivered by caesarean section compared to 37 percent of women with gestational diabetes and 27 percent of women without diabetes. Women with gestational diabetes also had higher rates of hypertension, preeclampsia/eclampsia and caesarean section, but did not have higher rates of obstructed labour or shoulder dystocia than women without diabetes. Indicators of obstetrical complications did not vary by neighbourhood income but did vary by LHIN for

women with pregestational and gestational diabetes. Rates of caesarean section and obstructed labour varied by age for women with pregestational and gestational diabetes; younger women had higher rates of obstructed labour but older women had higher caesarean section rates.

Infants born to women with diabetes had higher rates of fetal complications (minor or major congenital anomalies, premature delivery, phototherapy for hyperbilirubinemia and neonatal intensive care unit (NICU) admissions) compared to infants born to women without diabetes. The rate of stillbirth or in-hospital mortality was twice as high among infants born to women with pregestational diabetes compared to infants born to women without diabetes (5.2 per 1,000 versus 2.5 per 1,000, respectively). Infants born to women with gestational diabetes had higher rates of congenital anomalies, premature delivery, phototherapy for hyperbilirubinemia, and NICU admissions than women without diabetes.

Regardless of diabetes status, rates of congenital anomalies, premature delivery and phototherapy did not differ by neighbourhood income; however, rates of NICU admissions decreased with maternal neighbourhood income. Rates of all fetal complications varied across LHINs. Among women with pregestational diabetes, infants born to younger women (aged 20-29) had higher rates of stillbirth/in-hospital mortality, congenital anomalies and premature delivery than those born to older women.

Table 1 | Factors associated with differences in diabetes burden of disease, access to care, quality of care and outcomes among people with diabetes

Indicators	Overall Result Among People with Diabetes	Diabetes Status¥	Stratification Factor							
			Sex	Age	Income	Education	Ethnicity	Immigration	Rural/ Urban Residence	LHIN
Health and Functional Status (11 Indicators)										
Diabetes prevalence and comorbidity										
Prevalence of diabetes^	9.4%	N/A	Y	Y	Y	Y	Y	N	N	Y
Percentage who had at least two additional chronic conditions†	56%	Y	Y	Y	Y[b]	N	N	N	N	Y
Prevalence of probable depression	7.4%	Y	Y	-	-	-	-	-	-	-
Prevalence of hypertension	61%	Y	N	Y	N	N	N	Y[c]	N	Y[a]
Health and functional status										
Percentage who reported their health to be fair or poor	40%	Y	N	N	Y	Y	N	N	N	Y[b]
Percentage with limitations in instrumental activities of daily living (IADL) and/ or activities of daily living (ADL)	37%	Y	Y	Y	Y	N	N	-	N	-
Health behaviours										
Percentage who reported being physically inactive	62%	Y	Y	Y[a]	Y[a]	Y[a]	N	N	N	-

POWER Study

Indicators	Overall Result Among People with Diabetes	Diabetes Status¥	Stratification Factor							
			Sex	Age	Income	Education	Ethnicity	Immigration	Rural/ Urban Residence	LHIN
Percentage who reported having inadequate daily intake of fruits and vegetables	58%	N	Y	Y[b]	Y[a]	Y	N	N	N	-
Percentage who reported being overweight	39%	N	Y	Y	N	Y[a]	N	-	N	-
Percent who reported being obese	35%	Y	Y	Y	N	Y[b]	Y[b]	-	Y[b]	-
Percent who reported being a current smoker	17%	N	N	Y	N	Y[b]	Y[a]	-	N	-
Access and Utilization of Care (4 Indicators)										
Percentage who had continuity of primary care	83%	•	Y	Y	Y	•	•	•	•	Y
Mean number of primary care visits per year	7.3 visits	•	Y	Y	Y	•	•	•	•	Y
Percentage who had at least one visit to a specialist (endocrinologist, general internist, or geriatrician) in the past two years	25%	•	Y	Y	Y	•	•	•	•	Y
Percentage who did not have any visits to a general practitioner/ family physician or a specialist in the past year	5.5%	•	Y	Y	Y	•	•	•	•	Y

POWER Study

Indicators	Overall Result Among People with Diabetes	Diabetes Status[¥]	Stratification Factor							
			Sex	Age	Income	Education	Ethnicity	Immigration	Rural/ Urban Residence	LHIN
Screening, Assessment and Monitoring (7 Indicators)										
Screening, assessment and monitoring for diabetes										
The percentage who were currently taking insulin who monitor their blood glucose at least once daily	81%	•	N	N	N	N	-	-	N	Y[c]
Percentage who reported that a health care professional had tested them for hemoglobin A1c within the past 12 months	80%	•	N	N	N	N	N	N	N	-
Percentage who reported that a health care professional had tested them for microalbumin within the past 12 months	73%	•	N	N	N	N	N	N	N	-
Percentage of adults (aged 30 and older) who had an eye examination within two years of being diagnosed with diabetes	58%	•	Y	Y	Y[b]	•	•	•	•	Y
Percentage who reported usually performing a self foot examination at least once per year	68%	•	N	N	N	Y[a]	N	Y	Y[b]	Y
Percentage who reported that a health care professional checked their feet for sores or irritations in the past 12 months	51%	•	N	N	N	N	N	Y[c]	N	-

POWER Study

Indicators	Overall Result Among People with Diabetes	Diabetes Status¥	Stratification Factor							
			Sex	Age	Income	Education	Ethnicity	Immigration	Rural/ Urban Residence	LHIN
Other preventive screening strategies										
Percentage who reported that they had visited a dentist in the past 12 months	56%	Y	N	Y	Y	Y	Y[c]	-	N	-
Pharmacological Treatment (4 Indicators)										
Percentage who reported being on insulin or at least one glucose-lowering medication	82%	•	N	Y[a]	N	Y[b]	N	N		N
Percentage of adults aged 65 and older who filled a prescription for at least one anti-hypertensive drug	81%	•	Y	Y	N	•	•	•	•	Y
Percentage of adults aged 65 and older who filled a prescription for an ACE Inhibitors and/or an ARB	68%	•	Y	Y	N	•	•	•	•	Y
Percentage of adults aged 65 and older who filled a prescription for a statin	60%	•	Y	Y	N	•	•	•	•	Y
Health Outcomes (14 Indicators)										
Number with at least one hospital visit (emergency department or hospital admission) for hyperglycemia or hypoglycemia	1362#	•	Y	Y	Y	•	•	•	•	Y
Number with at least one hospitalization for skin and soft tissue infections	534#	•	Y	Y	Y	•	•	•	•	Y

POWER Study

Indicators	Overall Result Among People with Diabetes	Diabetes Status¥	Stratification Factor							
			Sex	Age	Income	Education	Ethnicity	Immigration	Rural/ Urban Residence	LHIN
Cardiac disease										
Number with at least one hospitalization for AMI	740#	•	Y	Y	Y	•	•	•	•	Y
Number with at least one hospitalization for CHF	863#	•	Y	Y	Y	•	•	•	•	Y
Number who had a coronary artery bypass graft (CABG) surgery	353#	•	Y	Y	Y[a]	•	•	•	•	Y
Number who had a percutaneous coronary intervention (PCI)	583#	•	Y	Y	N	•	•	•	•	Y
Stroke										
Number with at least one hospitalization for stroke	457#	•	Y	Y	Y[b]	•	•	•	•	Y
Number who had a carotid endarterectomy	50#	•	Y	Y	N	•	•	•	•	-
Peripheral vascular disease										
Number who had a minor amputation	78#	•	Y	Y	Y[b]	•	•	•	•	Y
Number who had a major amputation	109#	•	Y	Y	Y[b]	•	•	•	•	Y
Number who had a peripheral revascularization procedure	111#	•	Y	Y	Y[b]	•	•	•	•	Y

POWER Study

Indicators	Overall Result Among People with Diabetes	Diabetes Status[¥]	Stratification Factor							
			Sex	Age	Income	Education	Ethnicity	Immigration	Rural/ Urban Residence	LHIN
Number who were on chronic dialysis	580[#]	•	Y	Y	Y	•	•	•	•	Y
Retinopathy										
Number who had laser photocoagulation	1293[#]	•	Y	Y	Y	•	•	•	•	Y
Number who had vitrectomy	253[#]	•	Y	Y	N	•	•	•	•	Y
Diabetes and Pregnancy Indicators (13 Indicators)										
Prenatal Care										
The percentage who had at least one visit to an obstetrician during pregnancy	94% 94%[‡]	Y		N	N	•	•	•	•	Y
The percentage with pregestational diabetes who had at least one visit to a specialist (endocrinologist or general internist) during pregnancy	55%	•		Y	Y	•	•	•	•	Y
The percentage with pregestational diabetes who had at least one eye examination in the year before delivery	31%	•	N/A	Y	N	•	•	•	•	Y
Obstetrical Complications										
The percentage with hypertension in the 6 months before delivery	9.9% 12.5%[‡]	Y	N/A	N	N	•	•	•	•	Y
The percentage with preeclampsia/ eclampsia in the 6 months before delivery	2.4% 3.9%[‡]	Y	N/A	Y[d]	N	•	•	•	•	Y
The percentage with obstructed labour	10.1% 11.1%[‡]	Y	N/A	Y[d]	N	•	•	•	•	Y

POWER Study

Indicators	Overall Result Among People with Diabetes	Diabetes Status¥	Stratification Factor							
			Sex	Age	Income	Education	Ethnicity	Immigration	Rural/ Urban Residence	LHIN
The percentage with shoulder dystocia during labour	2.6% 3.2%‡	Y	N/A	Y	N	•	•	•	•	Y
The percentage that delivered by caesarean section	37% 45%‡	Y	N/A	Y	N	•	•	•	•	Y
Fetal complications										
The proportion whose infants were stillborn or suffered in-hospital mortality (per 1,000)	0.20% 0.52%‡	Y	N/A	Yᵈ	-	•	•	•	•	-
The percentage whose infants had a congenital anomaly (major or minor)	5.6% 7.7%‡	Y	N/A	Yᵈ	N	•	•	•	•	Y
The percentage whose infants were delivered prematurely	10.4% 14.5%‡	Y	N/A	Yᵈ	N	•	•	•	•	Y
The percentage whose infants underwent phototherapy for hyperbilirubinemia	6.1% 9.4%‡	Y	N/A	N	N	•	•	•	•	Y
The percentage whose infants had a NICU admission	25% 31%‡	Y	N/A	N	Y	•	•	•	•	Y

¥ Comparison between people with and without diabetes, with the exception of the Diabetes and Pregnancy indicators which compare women with pregestational diabetes, gestational diabetes and no diabetes

^ Stratifications by sex, age, income and LHIN were based on ODD; stratifications by education, ethnicity, immigration, time since immigrating, and rural/urban residence were based on self-reported data.

† Among people with diabetes, this refers to at least two chronic conditions in addition to diabetes.

N/A Not applicable

• Data not available

- Limited power to detect differences due to small sample sizes n some subgroups

a Significant in women, but not significant in men

b Significant in men, but not significant in women

c Significant for the overall population, but not significant when stratified by sex

d Significant in women with pregestational diabetes, but not significant in women with gestational diabetes

Rate per 100,000 population

‡ The first number reflects the rate in women with gestational diabetes; the second number reflects the rate in women with pregestational diabetes

Discussion

Globally, the prevalence of diabetes has risen dramatically in concert with soaring rates of obesity.[9, 13, 255]

The rate of obesity in Canada has nearly tripled since 1980 fueled by unfavourable trends, including increased consumption of high-calorie, nutrient poor foods and an increasingly sedentary lifestyle.[256-259] The growing diabetes epidemic has had a profound impact on the health care system and will continue to do so for years to come.[118]

In this chapter, we examined the burden of illness due to diabetes in Ontario, as well as gender differences in the health, functional status and quality of care of individuals with diabetes. We also assessed how socioeconomic status, demographic characteristics and where one lives affected women and men differently. Stratifying data in this way allowed us to identify where care can be improved for different subgroups of the population. We found considerable differences in diabetes prevalence and outcomes by age, sex, income and region across the province (see Table 1). Low-income women and men were more likely to have diabetes and once they had the disease to have worse health and functional status, higher rates of hospitalizations and diabetic complications. We provide a comprehensive picture of diabetes in Ontario, however, this picture is by no means complete. The data in this chapter came primarily from administrative and survey data, which do not provide detailed clinical information or insights into patient experiences with care or treatment decision-making processes. With the indicators we measured, we identify many opportunities where interventions can reduce adverse outcomes related to diabetes, present objective evidence to inform priority setting and provide a baseline from which to measure progress. The key findings from the chapter are discussed below.

KEY FINDINGS

Diabetes is one of the most common conditions in our society.

Nearly one in ten adults in Ontario have been diagnosed with diabetes—however, by age 65, this figure reaches nearly one in four. While rates were generally higher in men than in women, in women of reproductive age (aged 20-44) diabetes rates rival that of young men. Developing diabetes at an early age can have devastating consequences for both sexes, but in women there are additional implications; we found that diabetes prior to pregnancy was associated with a substantially increased risk of adverse pregnancy outcomes and, if poorly controlled, can cause serious harm to an unborn child. According to recent data from national surveys conducted in the US, the fastest rise in body weight and waist size is occurring in young women.[260] Therefore in coming years a new cohort of young women will be facing an even greater burden of diabetes.

Diabetes rates continue to climb.

This is fueled in large part by the dramatic rise in obesity. The rise in diabetes over the past decade has already surpassed levels the World Health Organization (WHO) had predicted would be reached by 2030.[3, 4] Compared to earlier reports, we found that the prevalence of diabetes among adults in Ontario has doubled in just 12 years.[118] Aging of the population has contributed; as well as the immigration of ethnic groups at high risk for developing diabetes. A recent study showed that immigrants of South Asian, African

Caribbean or Latin American origin, are at high risk for diabetes and develop this condition at an earlier age; women were at particularly high risk.[21] We found that diabetes prevalence rates were extremely high in the Greater Toronto Area, which sees more than 70,000 new immigrants each year. Diabetes prevention strategies are urgently needed, particularly those targeting high-risk groups—including high-risk ethnicities, low-income populations and women with recent gestational diabetes.

The ongoing rise in diabetes prevalence creates a significant challenge for those who provide and fund health care.

Diabetes is one of the most commonly encountered conditions in primary practice,[261] accounting for nearly seven million visits to family physicians each year in Ontario alone.[262] Innovation and improvement of diabetes prevention and management in primary care are critical to addressing this challenge. We found that people with diabetes visited a primary care provider an average of 7.3 times per year. Similar to the overall gender differences reported in the POWER Study Access to Health Care Services chapter, women with diabetes had greater utilization of health services than men.[116] Adults living in lower-income neighbourhoods also had a higher mean number of visits to primary care physicians, yet they suffered more complications from diabetes, suggesting that current models of care are not sufficient to meet their health needs.

Men had higher rates of diabetes complications than women.

This includes more cardiovascular disease (CVD); however, the observed gender gap in revascularization procedures exceeded gender differences in the burden of CVD—suggesting a potential underutilization of these procedures in women with diabetes or gender-related differences in the appropriate use of revascularization. Gender differences in hospitalizations for acute myocardial infarction (AMI), congestive heart failure (CHF) and stroke, and gender differences in dialysis and laser photocoagulation therapy for diabetic eye disease were greatest in younger age groups and tended to diminish with increasing age—which may reflect differences between men and women in the biology leading to complications; or worse control of risk factors in young men. Studies involving patients in primary care practices in the US and Sweden found that women with diabetes experienced less aggressive management of risk factors than men with diabetes did.[211-215] Health care utilization was higher in women with diabetes overall which could provide women with more opportunities to reach target levels of blood pressure, cholesterol and other risk factors. We found that young men and lower-income men were less likely to have continuity of primary care and more likely to have not received care over a two-year period. Young men and men living in lower-income neighbourhoods were more likely to visit a hospital for emergency management of hyper- or hypoglycemia—complications that could be avoided through good access to outpatient management and improved self-management.[193, 197]

Another important gender difference was in the rates of amputation and peripheral revascularization which were two to three times higher among men than women—across most age groups. Men and women may vary with respect to risk factors for peripheral vascular disease, attention to routine foot care or treatment of foot ulcers/infections, or they may have differential exposures to minor trauma—a common precipitating event that can lead to infection and potentially to gangrene and amputation.[71, 263] From our data, self-reported rates of foot examination by a health professional and performing a self foot examination at least annually did not vary by gender; however, the latter may be an insensitive measure of routine foot care and both measures may be biased due to self-report. Men may be more likely than women to delay seeking care for foot ulcers until they reach a stage where the process is unlikely to be reversed. With fewer primary care visits per year, there are perhaps fewer opportunities for men to receive preventive counselling and management.

Diabetes in pregnancy is associated with higher rates of complications.

Compared to pregnant women without diabetes, pregnant women with pregestational diabetes (diagnosed prior to pregnancy) were at one and a half to three times greater risk for serious obstetrical complications, including hypertension, preeclampsia and obstructed labour (shoulder dystocia); and had high rates of caesarean section. Women with gestational diabetes (diagnosed in pregnancy) were also at higher risk for complications than women without diabetes. Of great concern, infants of women with pregestational diabetes had nearly twice the rate of fetal complications compared to infants of women without diabetes, including major and minor congenital anomalies and stillbirth or in-hospital mortality—outcomes that can be largely prevented through optimal control of glucose and blood pressure at the time of conception and during pregnancy. Infants of younger women with diabetes (aged 20-29) had the highest rates of fetal complications, reflecting a need in this group for more targeted pre-pregnancy counselling and better pregnancy care. We also found that a significant percentage of pregnant women with diabetes were not being seen by specialists who are experienced in intensive diabetes management and the special circumstances of diabetes and pregnancy; the rate of specialist use varied across Local Health Integration Networks (LHINs). LHIN variation may partly be due to alternate funding plans (AFPs) where OHIP billing information may be incomplete or due to out of province use of specialists. The prevalence of gestational and pregestational diabetes in pregnancy is rising in Ontario.[32, 252] Strategies are needed to ensure accessibility of specialized services throughout the province and to promote appropriate referral to care.

Income matters when it comes to diabetes prevalence and complications.

Lower-income groups share a disproportionate burden of diabetes and suffer more diabetes complications. In fact, socioeconomic status was a strong and inverse risk factor for virtually all diabetes complications that we studied, including CVD and renal disease. Income-related gradients were steeper in men with respect to hyper- or hypoglycemic emergencies, amputations and end-stage renal disease requiring dialysis. Coronary revascularization procedures were largely unaffected by neighbourhood income, despite a higher burden of vascular disease in adults living in lower-income neighbourhoods. This finding suggests a potential underutilization of these procedures in this population, although higher smoking rates in lower-income groups may result in those individuals being less ideal candidates for revascularization.[61, 264] Of note, no significant income-related differences in eye procedures were found.

Socioeconomic gradients in health have been studied in other countries as well and appear to be widespread.[194, 195, 265] A host of factors are thought to drive health inequities related to income, including the propensity for lower-income groups to have risk factors for CVD and other conditions (e.g., smoking, physical inactivity, obesity and poor quality diets), to experience language barriers to accessing care, and to differ with respect to their level of health literacy, their knowledge of diseases, and their health beliefs.[184, 264] Among those without prescription drug insurance, out-of-pocket costs of medications could lead to differences in adherence across income groups. In Ontario, lower-income groups with diabetes have worse outcomes despite greater use of primary care services suggesting missed opportunities for intervention. Evidence suggests that lower-income groups need more frequent and more intensive interactions with a health care team to achieve improvements in diabetes control.[74] Rates of specialist visits were unaffected by socioeconomic status; however, this may reflect problems with accessing these services, given the greater burden of complications among lower-income groups. Moreover, we found that men living in the lowest-income neighbourhoods were more likely to not receive any care

within a two-year period (primary or specialist care) than men living in the highest-income neighbourhoods, suggesting that the former have problems accessing care or a preference for not seeking care as it is currently offered. Changes in services and focused outreach could help to address this problem.

Performance on many measures varied across the province.

We found that where you live in Ontario matters with respect to the risk of diabetes complications. The highest rates of complications were found in northern and rural areas of the province where access to care is more challenging. In addition regional differences in prevalence, population characteristics and risk factors may have contributed to these findings. The proportion of people with no primary care physician or specialist visits within a two-year period may be high in some LHINs due to a shortage of doctors in under-serviced or differently serviced areas or to variations in access to services due to language, socioeconomic or cultural barriers to care. As well, LHIN variation may be due to AFPs where OHIP billing information may be incomplete or due to out of province use of specialists.

Age is a strong risk factor for diabetes complications.

Therefore, the burden of diabetes complications will likely continue to rise with the aging of the population. This has tremendous implications for the planning and provision of health services including the need for in-hospital beds, dialysis and cardiac rehabilitation services, among others. Seniors with diabetes already exhibit high rates of use of primary care services and will continue to do so. We found that age was associated with a reduced likelihood of seeing a specialist. Older individuals may have mild disease with recent onset and doctors may be less likely to refer older patients to specialists either due to patient preference or a more conservative approach to treatment in this group.

People with diabetes have worse functional status and poorer self-rated health than those without diabetes.

Having diabetes was associated with higher rates of comorbidity; over 50 percent of men and women with diabetes report having two or more additional chronic health conditions besides diabetes, they also were more likely to report having probable depression and three times as likely to have hypertension, increasing the complexity of care delivery. Among adults with diabetes, there were important gender differences with women experiencing higher rates of comorbidity, depression and disability than men with diabetes. The differences in rates of probable depression by diabetes status were greater among women than among men. Lower-income groups fared the worst; over 50 percent of those in lower-income groups who had diabetes described their health as fair or poor. Comorbidity can have a considerable impact on quality of life and complicate diabetes management. For practitioners, competing medical and social issues may detract from diabetes care. For patients, disability and comorbid conditions such as depression and osteoarthritis (see the POWER Study Musculoskeletal Conditions chapter)[266] can impede the ability to make changes in diet or activity levels, to lose weight and to self-manage diabetes, and may also affect adherence to medications. These findings have implications for Ontario's chronic disease strategy and underscore the need for patient-centred models of chronic disease management that address multiple medical conditions concurrently.

Despite growing evidence on best practices for diabetes, gaps in care persist.

We found that rates of foot exams and dental care were suboptimal. For dental care, rates were particularly low for older, lower-income and less educated groups, which may reflect a decreased propensity to seek care and/or financial barriers to accessing care due to a lack of insurance coverage for these services. We also noted that rates of eye examination in the

two years following the diagnosis of diabetes were low in women and men provincially and in all regions of Ontario. Based on our findings, the likelihood of receiving an eye examination within two years of diagnosis is no higher today than it was a decade ago.[267] However, our data rely solely on fee-for-service claims and do not include reimbursement from private insurance providers, out-of-pocket payment for retinal photography, or telemedicine and mobile eye programs in Northern Ontario—which may have led to an underestimation of the true level of retinal screening in the province and in specific LHINs. It is also not clear whether wait times for eye care services have influenced these rates, or alternatively, whether people with diabetes are not accessing available services. The delisting of general optometry visits from OHIP may have unwittingly impaired access to eye care particularly in areas that are dependent on these services—despite the fact that individuals with diabetes are exempt from this policy.

There was good news as well.

A large proportion of seniors with diabetes are receiving therapies proven to reduce the risk of CVD. In fact, we noted a dramatic increase in the use of medications for both glucose-lowering and CVD risk reduction compared to the late 1990s and early 2000s,[50] similar to trends elsewhere.[268] Furthermore, there were virtually no variations in medication use among seniors by sex, age, income or LHIN, except where expected (e.g., glucose-lowering medication use increases with age). This implies that when drug costs are universally reimbursed, income has little influence on access to important therapies. Improvements in survival rates over the past decade have been well documented and show little variation by socioeconomic status among those over age 65.[18] However, the same is not true for groups with diabetes who are under age 65 in whom the gap in mortality between rich and poor is in fact widening. Out-of-pocket costs of medications are likely to be substantial in the absence of insurance coverage, thus income-related differences in access to therapies may exist for younger groups with diabetes, but could not be examined in our study.

Finally, our report illustrates the **importance of looking at subgroups of individuals** when evaluating quality of care. Stratification by age, sex, income or other factors allows us to identify specific subgroups of individuals who are more vulnerable which in turn can identify areas for further study or facilitate targeted improvement efforts.

REDUCING THE BURDEN OF DIABETES AND IMPROVING DIABETES CARE: DIFFERENT APPROACHES

Strategies to Prevent Diabetes

Randomized controlled trials have proven that lifestyle changes that promote weight loss, namely physical activity and healthy food consumption, can delay or prevent diabetes in high-risk populations.[73, 80] Lifestyle interventions delivered by a team of experts in nutrition, exercise training and behaviour modification led to a dramatic reduction in the progression from 'prediabetes' (a condition preceding diabetes where blood sugar levels are mildly elevated) to full blown diabetes. However, the costs and resources required for these interventions were so were considerable, raising the question of how best to deliver such interventions on a wider scale. Recent data suggest that a small shift in the average body weight of the general population may prevent as many cases of diabetes as highly effective interventions targeting only those at highest risk for developing diabetes.[76]

A variety of population-level or community-based interventions have been devised to promote positive lifestyle changes; however, few have been formally evaluated.[269-272] Moreover, the social and physical environment in which we live challenge the sustainability of changes in behaviour outside the setting of a

randomized trial. Such barriers include the ubiquity of high-calorie, low-cost, convenience foods; increasing portion sizes of food sold in stores and restaurants; the relatively higher costs and more time-consuming preparation of healthy foods; and the lack of opportunities for physical activity within one's neighbourhood, school or workplace. Many high-risk groups live in communities that are developed in such a way as to encourage car use and discourage walking or bicycling; and have limited access to public transit, parks and public recreational spaces.

There is a growing body of research which suggests that modifying aspects of our environment could help to curb the rise in obesity-related conditions like diabetes.[270, 271, 273-275] This is a fundamental shift in the paradigm in which we view the etiology of chronic diseases—like diabetes—from purely 'biomedical' to one that incorporates the larger world in which we live. This opens up other avenues for the prevention of obesity-related diseases, such as improving access to safe parks and playgrounds, recreational spaces, public transit and healthy food retailers in underserved areas, as well as more global policies around zoning, urban development and design, and food labelling and preparation (among others).[270, 271, 273, 276]

Obesity prevention needs to start in childhood since obesity is very hard to treat once present. A recent White House Task Force on Childhood Obesity outlined a comprehensive and multifaceted approach to tackle this problem which included strategies to promote healthier food choices and physical education in schools; to encourage active transport between homes, schools and community destinations and to limit marketing of unhealthy food products to children.[276] Drawing on lessons learned from successful anti-smoking campaigns, the simultaneous implementation of different but complementary approaches will be needed to help curb the ongoing rise in obesity over the coming years.

Coordinated Strategies to Improve Diabetes Care

There is substantial evidence that the long-term complications from diabetes can be reduced or prevented through strategies aimed at lowering glucose, blood pressure and cholesterol levels.[33, 35-37, 277] In fact, targeting each of these simultaneously, in combination with lifestyle measures—a healthy diet, increased physical activity and smoking cessation—may reduce the incidence of CVD by as much as 50 percent.[34]

Clinical practice guidelines recommend that diabetes care be organized around the person with diabetes and involve a multi- or interdiscliplinary diabetes health care team centred on self-care management.[82] Because of its complexity, diabetes is difficult to manage in the current 'acute' care model of primary care. There is mounting evidence that suggests that diabetes care is more effective in models of care that support chronic disease management in a systematic and proactive way.[278, 279] Specific health care interventions that have been shown to improve glucose control or other clinical parameters include: the addition of diabetes health care team members from different disciplines; expansion of team members' roles (which may include case management, care coordination, and delegated tasks such as medication adjustment using treatment algorithms); self-management support; and the use of clinical information systems that allow patient outcomes to be tracked over time, provide automatic reminders for patients and clinicians, support quality improvement activities and offer real-time decision support.[280, 281] Telemedicine-based interventions have also been shown to facilitate the delivery of self-management support.[282, 283]

Traditional models of diabetes education that use didactic teaching methods have had variable results[284, 285] and are largely unsuccessful when applied to low-income populations.[270] Socially disadvantaged groups appear to require more frequent and intensive (one-on-one) interaction with the diabetes health care team over a longer duration in order to

see improvements in glucose control.[270] A systematic review on this topic found that the more successful interventions were those that were culturally tailored to the population (often enlisting the help of community educators or lay people in delivering the intervention), and those incorporating individualized assessments and treatment algorithms and focusing on behaviour change.[270] These findings highlight the need for a comprehensive and coordinated, patient-centred chronic disease management strategy to facilitate care and improve outcomes for all patients with diabetes, and specific, tailored interventions for those who are socially disadvantaged. The Ontario Diabetes Strategy is working to reduce variations in diabetes care in part by expanding access to patient-centred, team-based care and self-management information and through targeted initiatives to support the management of diabetes in primary care. By implementing interventions at the policy, population health and practice levels and coordinating these interventions for maximum impact, it will be possible to hasten progress.

LIMITATIONS

Our study has a number of limitations that merit discussion. For instance, administrative data, while highly sensitive and specific for identifying individuals with diagnosed diabetes,[75] cannot ascertain the true burden of diabetes in the population, since as many as one-third of cases are estimated to be undiagnosed,[261] while others may not be captured by the algorithm we employed.[75] Using administrative data, we were also unable to discriminate between type 1 and type 2 diabetes, which may influence our interpretation of age-related trends in diabetes complications and health service utilization.

Due to lack of clinical detail in administrative data, we were not able to identify 'ideal' patients for specific medications or interventions, or contraindications to use of medications or procedures. Furthermore, using administrative data we are not able to ascertain when patient preference played a role in treatment decisions. In some cases, procedures conducted for a diabetes complication (such as retinal photocoagulation or vitrectomy) were measured rather than the complication itself (diabetic eye disease) since the latter could not be assessed using our data sources. In the case of retinal photocoagulation, low rates could indicate better disease control (fewer cases of severe diabetic retinopathy) or suboptimal use of this vision-sparing procedure in those who could benefit from it. Lastly, it is challenging to report on quality in real time because some of the administrative data sources need time to receive and verify data. Our primary purpose was to assess whether there were gender or socioeconomic differences on these measures.

Retinopathy screening rates were also likely under-captured in our study because we relied solely on fee-for-service claims to measure eye examinations and were unable to capture reimbursement from private insurance providers, out-of-pocket payment for retinal photography, or provincially run programs involving telemedicine and mobile screening programs. We also could not examine differences in wait times for eye screening or other procedures due to a lack of available data. In addition, health care utilization in areas where physicians receive payment through AFPs may be under reported due to incomplete shadow billing. Thus, caution should be exercised when reviewing regional differences in outcomes that are based solely on physician visits.

Indicators measured using the Canadian Community Health Survey (CCHS) are based on self-report. While these are widely used for reporting the prevalence of health conditions and considered to be well-validated, they are subject to reporting error and bias. Some indicators are more subject to measurement

error than others. For example, the overweight and obesity indicator is subject to measurement error as people may over- or underreport their height and weight. Quality of care indicators may be particularly prone to error in reporting as some participants may be unaware of the relevance of specific tests (e.g., what a hemoglobin A1c measurement is) or may have difficulty recalling whether specific tests (such as microalbumin tests or a foot examination) were done within the specified time frame. In other circumstances important questions may not be asked. The measure of disability we used assesses the prevalence of the population who need the assistance of another person to carry out instrumental activities of daily living (IADL) and/or activities of daily living (ADL). The definition of IADLs included the need for assistance to perform heavy household work, such as gardening and home repairs, and so may overestimate the absolute burden of disability in the population; although relative comparisons of disability between those with and without diabetes and across subgroups of the diabetic population should be unaffected. Lastly, because people with diabetes made up a relatively small proportion of those enrolled in the CCHS, we were unable to report all outcomes within certain subgroups because of insufficient sample size. In particular, we lacked sufficient data to examine indicators of diabetes care and outcomes by ethnicity or immigration status.

WHAT CAN'T BE MEASURED

There were many important areas where well validated indicators exist that we were unable to measure due to data limitations. We were unable to assess many aspects of diabetes care and management in the outpatient setting. We measured fairly advanced complications of diabetes including hospitalization for AMI or stroke, dialysis for end-stage renal disease or the need for amputation. Our data sources, however, lack the ability to discern less advanced complications—such as the presence of neuropathy, foot ulcers, high albumin excretion rates or elevated creatinine levels—and whether target levels of glucose, blood pressure or cholesterol are being met. We also could not measure use of non-physician services such as nurses, dieticians and other important members of a diabetes health care team.

Drug data were not available for those under age 65. Therefore we could not determine whether sex and income differences in medication management were present in this age group. Also, while we were able to measure drug use in seniors with diabetes, the Ontario Drug Benefit database only includes claims when a prescription has been filled. Therefore, we could not assess whether a prescription was given but not filled by the patient or whether a prescription was filled but the medication was not taken.

This chapter takes an extensive, but not completely comprehensive, look at diabetes burden and diabetes care in the province. The indicators we used were selected using a rigorous and systematic process, but there were many others we could have used. Most of the indicators we report are from 2006/07. There is a need for real time data on quality to assess performance and to evaluate the effectiveness of improvement interventions. We have provided a baseline from which to monitor progress that can be updated as newer data become available.

KEY MESSAGES

We took a broad look at the burden of diabetes and quality and outcomes of care for diabetes in the province, focusing on gender, socioeconomic, demographic and regional variations. While much progress has been made in improving quality and outcomes of care for diabetes, much work remains to be done. Our findings point to a number of key areas for intervention and improvement. Health inequities in health and functional status associated with gender and socioeconomic status were much greater than inequities in the provision of diabetes care, underscoring the need to address the social determinants of health to reduce the burden of diabetes. For many indicators, there was sizable LHIN variation. The Ontario Diabetes Strategy is working to reduce regional variations in diabetes care. The results of our analyses are available for the LHINs to use in their priority setting, planning and quality improvement activities. By implementing interventions at the policy, population health and practice levels and coordinating these interventions for maximum impact, it will be possible to hasten progress. To address regional needs, the Ontario Diabetes Strategy has established 14 Diabetes Regional Coordination Centres, within each LHIN, to provide leadership in integration of diabetes best practices across service providers, and to further strengthen coordination within the system and support improved care across the continuum.

The following five actions can help accelerate progress in reducing the burden of diabetes, improve health outcomes among women and men with diabetes and reduce health inequities related to diabetes. For these actions to be truly successful, gender and socioeconomic differences in the burden of diabetes and experiences with care will need to be addressed.

Strategies to halt the diabetes epidemic are critically needed in order to minimize future burden on the health care system caused by diabetes and other obesity-related illnesses.

- Halting the obesity and consequent diabetes epidemics will require a multifaceted approach that promotes positive lifestyle changes at the population level acknowledging the need to address enabling factors such as access to healthy food and safe, walkable neighbourhoods to promote physical activity. Obesity prevention needs to start in childhood since obesity is very hard to treat once present. Using anti-smoking campaigns as a model, a strategy that combines social and public policy changes, public awareness campaigns and clinical interventions aimed at promoting physical activity and healthier eating could help curb the ongoing rise in diabetes.
- More intensive diabetes prevention strategies should be targeted towards high-risk populations, including those from lower-income groups, immigrants, Aboriginal communities, and women with gestational diabetes. Overcoming socioeconomic and demographic barriers to achieving a healthy lifestyle are likely to require innovative and cross-sectoral approaches. Culturally appropriate programs and services are also likely needed to enhance levels of physical activity and promote healthier eating patterns in ethnically diverse groups. For women with recent gestational diabetes, the demands of child-rearing in the postpartum period in combination with the balancing of work, family and other commitments pose additional barriers.

Reduce income-related disparities in diabetes outcomes.

- Focusing efforts upstream through cross-sectoral collaboration can serve to address the root causes of income-related health inequities while reducing the

burden of diabetes in the population. A multifaceted approach would likely be required to tackle the many complex problems which contribute to greater diabetes prevalence and poorer health in these groups.

- Measures to improve the health of low-income groups and other high-risk populations will also have to address barriers to accessing care related to poverty and immigration, such as language barriers and high medication costs, if health promotion and chronic disease prevention and management programs are to be successful.

Comprehensive patient-centred chronic disease management can improve quality and outcomes of care for diabetes.

- Diabetes is a complex chronic disease that requires close follow up by a multidisciplinary diabetes health care team for optimal management. Individuals with diabetes often have multiple chronic conditions making diabetes management more challenging. Therefore, implementation of a comprehensive, coordinated, patient-centred chronic disease prevention and management strategy—one that addresses the needs of at-risk populations—is the key to improving quality and outcomes of care for people with diabetes.

Province-wide, integrated, organized models of care delivery can improve health outcomes and reduce inequities in care.

- We found sizable regional variations in diabetes outcomes likely due in part to differences in human resources and regional capacity, as well as regional differences in practice patterns and the complexity of the population being served. Interventions such as performance measurement and quality improvement in primary care, the regional coordination of care, use of telemedicine, enhancing the availability of diabetes team members and providing training and support for local practitioners are approaches that—when coupled with better patient education and support for healthy lifestyle changes—could reduce regional variations in care. Technological approaches such as telemedicine can improve access to effective care in underserviced communities. Including performance measurement and quality improvement initiatives when these programs are being implemented will provide timely information on what is working.

Improve quality, availability and timeliness of data to assess diabetes outcomes and care delivery in the province.

- While data to assess diabetes care in the province have improved, there is still much to be done to improve the quality, completeness, availability and timeliness of data. Specifically, medication data on people under age 65, laboratory data on screening and monitoring indicators and clinical data such as blood pressure levels or foot examinations to assess the quality of diabetes management in routine care settings are needed. As well, given the importance of eye examinations to detect early changes from retinopathy, data on the frequency of retinopathy screening are also needed.
- Diabetes is primarily managed in the ambulatory care setting through primary care and specialty care. As a result, high quality clinical data are lacking. Better and more comprehensive data collection on management of diabetes in primary care and other ambulatory care settings is needed. Especially needed is more complete data on care that is provided through AFPs.
- Given the known variation in diabetes prevalence in different ethnic communities as well as issues of access to care in recent immigrant populations, data on diabetes care and outcomes that can be stratified by ethnicity and recency of immigration would allow us to assess disease burden, target interventions, as well as to evaluate access, quality, and outcomes of care in Ontario's diverse communities.

Appendix 9.1

INDICATORS AND THEIR LINKS TO PROVINCIAL STRATEGIC OBJECTIVES

APPENDIX 9.1 | Diabetes indicators: links to the Ontario Diabetes Strategy (ODS) Objectives, Ontario Health Quality Council (OHQC) Attributes of a High-Performing Health System and the Ministry of Health and Long-Term Care (MOHLTC) Strategic Objectives

Indicator	Link(s) to Ontario Diabetes Strategy (ODS) Objectives	Link(s) to OHQC Attributes of a High-Performing Health System	Link(s) to MOHLTC Strategic Objectives
Section 9A – Health and Functional Status			
Prevalence of diabetes	• Diabetes prevention initiatives	• Effective • Focused on population health	• Improve healthy behaviours, health promotion and disease prevention • Improve health status of Ontarians • Influence broader determinants of health • Increase sustainability of the health system
Percentage who had at least two additional chronic conditions	• Improving management of disease • Improving coordination of care and leveraging best practices • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Effective • Focused on population health	• Influence broader determinants of health • Improve health status of Ontarians • Increase sustainability of the health system
Prevalence of probable depression	• Improving management of disease • Improving coordination of care and leveraging best practices • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Effective • Focused on population health	• Influence broader determinants of health • Improve clinical and population health outcomes • Improve health status of Ontarians
Prevalence of hypertension	• Improving management of disease • Improving coordination of care and leveraging best practices • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Effective • Focused on population health	• Improve healthy behaviours, health promotion and disease prevention • Influence broader determinants of health • Improve health status of Ontarians • Increase sustainability of the health system

APPENDIX 9.1 | Diabetes indicators: links to the Ontario Diabetes Strategy (ODS) Objectives, Ontario Health Quality Council (OHQC) Attributes of a High-Performing Health System and the Ministry of Health and Long-Term Care (MOHLTC) Strategic Objectives

Indicator	Link(s) to Ontario Diabetes Strategy (ODS) Objectives	Link(s) to OHQC Attributes of a High-Performing Health System	Link(s) to MOHLTC Strategic Objectives
Section 9A – Health and Functional Status (Continued)			
Percentage who reported their health to be fair or poor	• Improving management of disease • Improving coordination of care and leveraging best practices • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Effective • Patient-centred • Focused on population health	• Improve chronic disease management • Improve clinical and population health outcomes • Improve health status of Ontarians
Percentage with limitations in instrumental activities of daily living (IADL) and/or activities of daily living (ADL)	• Improving management of disease • Improving coordination of care and leveraging best practices • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Effective • Patient-centred • Focused on population health	• Improve chronic disease management • Improve clinical and population health outcomes • Improve health status of Ontarians
Health behaviours—percentage who reported: • physical inactivity • inadequate fruit and vegetable intake • being overweight • being obese • smoking	• Diabetes prevention initiatives • Improving management of disease • Expanding medical interventions	• Effective • Focused on population health	• Improve chronic disease management • Improve healthy behaviours, health promotion and disease prevention • Improve clinical and population health outcomes • Improve health status of Ontarians
Section 9B – Access and Utilization of Care			
Percentage who had continuity of primary care	• Improving coordination of care and leveraging best practices • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Accessible • Effective • Equitable • Efficient • Appropriately resourced	• Increase productive use and appropriate distribution of resources across the system • Improve access to appropriate health services • Improve chronic disease management • Improve clinical and population health outcomes • Improve health status of Ontarians • Increase sustainability of the health system • Increase equity of the health system

APPENDIX 9.1 | Diabetes indicators: links to the Ontario Diabetes Strategy (ODS) Objectives, Ontario Health Quality Council (OHQC) Attributes of a High-Performing Health System and the Ministry of Health and Long-Term Care (MOHLTC) Strategic Objectives

Indicator	Link(s) to Ontario Diabetes Strategy (ODS) Objectives	Link(s) to OHQC Attributes of a High-Performing Health System	Link(s) to MOHLTC Strategic Objectives
Section 9B – Access and Utilization of Care (Continued)			
Mean number of primary care visits per year	• Improving coordination of care and leveraging best practices • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Accessible • Effective • Equitable • Efficient • Appropriately resourced	• Increase productive use and appropriate distribution of resources across the system • Improve access to appropriate health services • Improve chronic disease management • Improve clinical and population health outcomes • Improve health status of Ontarians • Increase sustainability of the health system • Increase equity of the health system
Percentage who had at least one visit to a specialist (endocrinologist, general internist, or geriatrician) in the past two years	• Improving management of disease • Improving coordination of care and leveraging best practices • Expanding medical interventions	• Accessible • Equitable • Efficient • Appropriately resourced	• Improve access to appropriate health services • Improve safety and effectiveness of health services
Percentage who did not have any visits to a general practitioner/ family physician or a specialist in the past year	• Improving management of disease • Improving coordination of care and leveraging best practices • Expanding medical interventions	• Accessible • Effective • Appropriately resourced	• Improve health system capacity and resources • Improve access to appropriate health services • Improve chronic disease management
Section 9C – Screening, Assessment and Monitoring			
Percentage who were currently taking insulin who monitored their blood glucose at least daily	• Improving management of disease • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Effective • Patient-centred	• Improve patient-centeredness • Improve safety and effectiveness of health services • Improve chronic disease management • Improve healthy behaviours, health promotion and disease prevention • Improve clinical & population health outcomes

APPENDIX 9.1 | Diabetes indicators: links to the Ontario Diabetes Strategy (ODS) Objectives, Ontario Health Quality Council (OHQC) Attributes of a High-Performing Health System and the Ministry of Health and Long-Term Care (MOHLTC) Strategic Objectives

Indicator	Link(s) to Ontario Diabetes Strategy (ODS) Objectives	Link(s) to OHQC Attributes of a High-Performing Health System	Link(s) to MOHLTC Strategic Objectives
Section 9C – Screening, Assessment and Monitoring (Continued)			
Percentage who reported that a health care professional had tested them for hemoglobin A1c in the past 12 months	• Improving management of disease • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Accessible • Effective	• Improve access to appropriate health services • Improve chronic disease management • Improve clinical & population health outcomes
Percentage who reported that a health care professional had tested them for microalbumin in the past 12 months	• Improving management of disease • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Accessible • Effective	• Improve access to appropriate health services • Improve chronic disease management • Improve clinical & population health outcomes
Percentage of adults (aged 30 and older) who had an eye examination within two years of being diagnosed with diabetes	• Improving management of disease • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Accessible • Effective • Integrated	• Improve access to appropriate health services • Improve chronic disease management • Improve clinical & population health outcomes
Percentage who reported usually performing a self foot examination at least once per year	• Improving management of disease • Expanding existing diabetes programming • Diabetes prevention initiatives • Leveraging information to improve health outcomes	• Effective • Patient-centred	• Improve patient-centeredness • Improve safety and effectiveness of health services • Improve chronic disease management • Improve healthy behaviours, health promotion and disease prevention • Improve clinical and population health outcomes
Percentage who reported that a health care professional checked their feet for sores or irritations in the past 12 months	• Improving management of disease • Expanding existing diabetes programming • Leveraging information to improve health outcomes	• Accessible • Effective	• Improve chronic disease management • Improve clinical and population health outcomes

APPENDIX 9.1 | Diabetes indicators: links to the Ontario Diabetes Strategy (ODS) Objectives, Ontario Health Quality Council (OHQC) Attributes of a High-Performing Health System and the Ministry of Health and Long-Term Care (MOHLTC) Strategic Objectives

Indicator	Link(s) to Ontario Diabetes Strategy (ODS) Objectives	Link(s) to OHQC Attributes of a High-Performing Health System	Link(s) to MOHLTC Strategic Objectives
Section 9C – Screening, Assessment and Monitoring (Continued)			
Percentage who reported that they had visited a dentist in the past 12 months	• Improving management of disease • Improving coordination of care and leveraging best practices	• Accessible • Equitable • Appropriately resourced	• Improve access to appropriate health services • Improve healthy behaviours, health promotion and disease prevention • Improve clinical and population health outcomes • Increase equity of the health system
Section 9D – Pharmacological Treatment			
Percentage who reported being on insulin or at least one glucose-lowering medication	• Improving management of disease • Expanding medical interventions	• Effective	• Improve safety and effectiveness of health services • Improve chronic disease management • Improve clinical and population health outcomes
Percentage of adults aged 65 and older who filled a prescription for: • at least one anti-hypertensive drug • an ACE inhibitors and/or an ARB • statin	• Improving management of disease • Improving coordination of care and leveraging best practices	• Effective	• Improve safety and effectiveness of health services • Improve chronic disease management • Improve clinical and population health outcomes
Section 9E – Health Outcomes			
Number of adults with diabetes with at least one hospital visit (emergency department or hospital admission) for hyperglycemia or hypoglycemia	• Improving management of disease • Leveraging information to improve health outcomes	• Accessible • Effective • Equitable	• Increase productive use and appropriate distribution of resources across the system • Improve access to appropriate health services • Improve safety and effectiveness of health services • Improve clinical and population health outcomes • Increase sustainability of the health system

APPENDIX 9.1 | Diabetes indicators: links to the Ontario Diabetes Strategy (ODS) Objectives, Ontario Health Quality Council (OHQC) Attributes of a High-Performing Health System and the Ministry of Health and Long-Term Care (MOHLTC) Strategic Objectives

Indicator	Link(s) to Ontario Diabetes Strategy (ODS) Objectives	Link(s) to OHQC Attributes of a High-Performing Health System	Link(s) to MOHLTC Strategic Objectives
Section 9E – Health Outcomes (Continued)			
Number of adults with diabetes who had at least one hospitalization for skin and soft tissue infections	• Improving management of disease • Leveraging information to improve health outcomes	• Accessible • Effective • Equitable	• Improve health system capacity and resources • Increase productive use and appropriate distribution of resources across the system • Improve access to appropriate health services • Improve safety and effectiveness of health services • Improve clinical and population health outcomes • Increase sustainability of the health system
Cardiac disease: Number of adults with diabetes who had: • at least one hospitalization for AMI • at least one hospitalization for CHF • a coronary artery bypass graft (CABG) surgery • a percutaneous coronary intervention (PCI)	• Improving management of disease • Leveraging information to improve health outcomes	• Accessible • Effective • Equitable • Appropriately resourced	• Increase productive use and appropriate distribution of resources across the system • Improve access to appropriate health services • Improve safety and effectiveness of health services • Improve chronic disease management • Improve clinical and population health outcomes • Increase sustainability of the health system
Stroke: Number of adults with diabetes who had: • at least one hospitalization for stroke • a carotid endarterectomy	• Improving management of disease • Leveraging information to improve health outcomes	• Accessible • Effective • Equitable • Appropriately resourced	• Improve access to appropriate health services • Improve safety and effectiveness of health services • Improve chronic disease management • Improve clinical and population health outcomes • Increase sustainability of the health system

APPENDIX 9.1 | Diabetes indicators: links to the Ontario Diabetes Strategy (ODS) Objectives, Ontario Health Quality Council (OHQC) Attributes of a High-Performing Health System and the Ministry of Health and Long-Term Care (MOHLTC) Strategic Objectives

Indicator	Link(s) to Ontario Diabetes Strategy (ODS) Objectives	Link(s) to OHQC Attributes of a High-Performing Health System	Link(s) to MOHLTC Strategic Objectives
Section 9E – Health Outcomes (Continued)			
Peripheral vascular disease: Number of adults with diabetes who had: • a minor amputation • a major amputation • a peripheral revascularization procedure	• Improving management of disease • Leveraging information to improve health outcomes	• Accessible • Effective • Equitable	• Improve access to appropriate health services • Improve safety and effectiveness of health services • Improve chronic disease management • Improve clinical and population health outcomes • Increase sustainability of the health system
Number of adults with diabetes who were on chronic dialysis	• Improving management of disease • Expanding medical interventions • Leveraging information to improve health outcomes	• Accessible • Effective • Equitable	• Improve access to appropriate health services • Improve safety and effectiveness of health services • Improve chronic disease management • Improve clinical and population health outcomes • Improve health status of Ontarians
Retinopathy: Number of adults with diabetes who had: • laser photocoagulation • vitrectomy	• Improving management of disease • Leveraging information to improve health outcomes	• Effective • Equitable • Efficient • Appropriately resourced	• Improve access to appropriate health services • Improve safety and effectiveness of health services • Improve chronic disease management • Improve clinical and population health outcomes • Improve health status of Ontarians

APPENDIX 9.1 | Diabetes indicators: links to the Ontario Diabetes Strategy (ODS) Objectives, Ontario Health Quality Council (OHQC) Attributes of a High-Performing Health System and the Ministry of Health and Long-Term Care (MOHLTC) Strategic Objectives

Indicator	Link(s) to Ontario Diabetes Strategy (ODS) Objectives	Link(s) to OHQC Attributes of a High-Performing Health System	Link(s) to MOHLTC Strategic Objectives
Section 9F – Diabetes and Pregnancy			
Prenatal care: The percentage: • who had at least one visit to an obstetrician during pregnancy • with pregestational diabetes who had at least one visit to a specialist (endocrinologist or general internist) during pregnancy • with pregestational diabetes who had at least one eye examination in the year before delivery	• Specific population based programming • Improving management of disease • Expanding existing diabetes programming	• Accessible • Effective • Equitable • Focused on population health • Appropriately resourced • Integrated	• Improve access to appropriate health services • Improve healthy behaviours, health promotion and disease prevention • Improve clinical and population health outcomes • Improve health status of Ontarians
Obstetrical complications: The percentage: • with hypertension in the 6 months before delivery • with preeclampsia/ eclampsia in the 6 months before delivery • with obstructed labour • with shoulder dystocia during labour • who delivered by caesarean section		• Accessible • Effective • Equitable • Focused on population health	• Improve healthy behaviours, health promotion and disease prevention • Improve clinical and population health outcomes • Improve health status of Ontarians
Fetal complications: The percentage or proportion of women whose infants: • were stillborn or suffered in-hospital mortality (per 1,000) • had a congenital anomaly (major or minor) • were delivered prematurely • underwent phototherapy for hyperbilirubinemia • had a NICU admission		• Accessible • Effective • Equitable	• Improve healthy behaviours, health promotion and disease prevention • Improve clinical and population health outcomes • Improve health status of Ontarians

Appendix 9.2

INDICATORS AND THEIR SOURCES

APPENDIX 9.2 | Diabetes indicators—indicator sources^ and data sources

Indicator	Indicator Source(s)	Data Source(s)
Section 9A – Health and Functional Status		
Prevalence of diabetes	• Health Canada. Responding to the challenge of diabetes in Canada: first report of the National Diabetes Surveillance System, 2003[286] • Health Canada. Diabetes in Canada 2nd edition, 2002[287] • ICES Atlas. Diabetes in Ontario, Chapter 1: Patterns of prevalence and incidence of diabetes, June 2003[267] • Association of Public Health Epidemiologists of Ontario (APHEO)[288]	Ontario Diabetes Database (ODD); Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Percentage who had at least two additional chronic conditions	• Health Council of Canada. Why health care renewal matters: lessons from diabetes, 2007[72] • Australian Institute of Health and Welfare. Burden of disease and injury in Australia, 1999[289]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Prevalence of probable depression	• Association of Public Health Epidemiologists of Ontario (APHEO)[288] • Statistics Canada. Comparable Health Indicators—Canada, Provinces and Territories, 2004[290] • Kessler RC et al. The World Health Organization composite international diagnostic interview short form (CIDI-SF),1998[291] • ICES Atlas. Diabetes in Ontario, Chapter 4: Diabetes health status and risk factors, June 2003[55]	Canadian Community Health Survey (CCHS), 2000/01 (Cycle 1.1)
Prevalence of hypertension	• National Quality Measures Clearinghouse. Diabetes Mellitus[292] • Health Resources and Services Administration. Health Disparities Collaboratives: Diabetes Collaborative, 2006[293] • ICES Atlas. Diabetes in Ontario, Chapter 4: Diabetes health status and risk factors, June 2003[55] • Health Canada. Diabetes in Canada 2nd edition, 2002[287] • Healthcare Effectiveness Data and Information Set (HEDIS)[294]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

APPENDIX 9.2 | Diabetes indicators—indicator sources^ and data sources

Indicator	Indicator Source(s)	Data Source(s)
Section 9A – Health and Functional Status (Continued)		
Percentage who reported their health to be fair or poor	• Association for Public Health Epidemiologist of Ontario (APHEO)[288] • Statistics Canada. Comparable Health Indicators—Canada, Provinces and Territories, 2004[290] • Public Health Research, Education and Development. Report on the Health Status of the Residents of Ontario, 2000[295] • Health Canada. Diabetes in Canada 2nd edition, 2002[287] • ICES Atlas. Diabetes in Ontario, Chapter 4: Diabetes health status and risk factors, June 2003[55]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Percentage with limitations in instrumental activities of daily living (IADL) and/or activities of daily living (ADL)	• Association for Public Health Epidemiologist of Ontario (APHEO)[288] • Public Health Research, Education and Development. Report on the Health Status of the Residents of Ontario, 2000[295] • ICES Atlas. Diabetes in Ontario, Chapter 4: Diabetes health status and risk factors, June 2003[55]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1)
Health behaviours—percentage who reported: • physical inactivity • inadequate fruit and vegetable intake • being overweight • being obese • smoking	• Association of Public Health Epidemiologists of Ontario (APHEO)[288] • Statistics Canada. Comparable Health Indicators—Canada, Provinces and Territories, 2004[290] • ICES Atlas. Diabetes in Ontario, Chapter 4: Diabetes health status and risk factors, June 2003[55] • Health Canada. Diabetes in Canada 2nd edition, 2002[287] • Health Resources and Services Administration. Health Disparities Collaboratives: Diabetes Collaborative, 2006[293]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Section 9B – Access and Utilization of Care		
Percentage who had continuity of primary care	• Canadian Diabetes Association. Clinical Practice Guidelines, 2008[82] • Association of Public Health Epidemiologists of Ontario (APHEO)[288]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

APPENDIX 9.2 | Diabetes indicators—indicator sources^ and data sources

Indicator	Indicator Source(s)	Data Source(s)
Section 9B – Access and Utilization of Care (Continued)		
Mean number of primary care visits per year	• ICES Atlas. Diabetes in Ontario, Chapter 14: Supply and utilization of health care services for diabetes, June 2003[262] • Institute of Health Economics. Alberta Diabetes Atlas 2007[296] • A Canadian consensus for the standardized evaluation of quality improvement interventions in type 2 diabetes, 2005[297]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)
Percentage who had at least one visit to a specialist (endocrinologist, general internist, or geriatrician) in the past two years	• ICES Atlas. Diabetes in Ontario, Chapter 9: Sources of physician care for people with diabetes, June 2003[115]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); ICES Physician Database (IPDB)
Percentage who did not have any visits to a general practitioner/ family physician or a specialist in the past year	• ICES Atlas. Diabetes in Ontario, Chapter 9: Sources of physician care for people with diabetes, June 2003[115]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); ICES Physician Database (IPDB)
Section 9C – Screening, Assessment and Monitoring		
Percentage who were currently taking insulin who monitored their blood glucose at least daily	• U.S. Department of Health and Human Services. Healthy People 2010, 2000[298] • Canadian Diabetes Association. Clinical Practice Guidelines, 2008[82]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Percentage who reported that a health care professional had tested them for hemoglobin A1c in the past 12 months	• National Quality Measures Clearinghouse. Diabetes Mellitus[292] • Health Resources and Services Administration. Health Disparities Collaboratives: Diabetes Collaborative, 2006[293] • U.S. Department of Health and Human Services. Healthy People 2010, 2000[298] • Canadian Diabetes Association. Clinical Practice Guidelines, 2008[82] • Healthcare Effectiveness Data and Information Set (HEDIS)[294]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Percentage who reported that a health care professional had tested them for microalbumin in the past 12 months	• National Quality Measures Clearinghouse. Diabetes Mellitus[292] • Health Resources and Services Administration. Health Disparities Collaboratives: Diabetes Collaborative, 2006[293] • U.S. Department of Health and Human Services. Healthy People 2010, 2000[298] • Healthcare Effectiveness Data and Information Set (HEDIS)[294]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007

APPENDIX 9.2 | Diabetes indicators—indicator sources^ and data sources

Indicator	Indicator Source(s)	Data Source(s)
Section 9C – Screening, Assessment and Monitoring (Continued)		
Percentage of adults (aged 30 and older) who had an eye examination within two years of being diagnosed with diabetes	• ICES Atlas. Diabetes in Ontario, Chapter 10: Diabetes and the eye, June 2003[299]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)
Percentage who reported usually performing a self foot examination at least once per year	• Canadian Diabetes Association. Clinical Practice Guidelines, 2008[82] • A Canadian consensus for the standardized evaluation of quality improvement interventions in type 2 diabetes, 2005[297]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Percentage who reported that a health care professional checked their feet for sores or irritations in the past 12 months	• National Quality Measures Clearinghouse. Diabetes Mellitus[292] • Health Resources and Services Administration. Health Disparities Collaboratives: Diabetes Collaborative, 2006[293] • U.S. Department of Health and Human Services. Healthy People 2010, 2000[298] • Canadian Diabetes Association. Clinical Practice Guidelines, 2008[82]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Percentage who reported that they had visited a dentist in the past 12 months	• U.S. Department of Health and Human Services. Healthy People 2010, 2000[298] • Association for Public Health Epidemiologist of Ontario (APHEO)[288] • National Quality Measures Clearinghouse. Diabetes Mellitus[292] • Health Resources and Services Administration. Health Disparities Collaboratives: Diabetes Collaborative, 2006[293]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1)
Section 9D – Pharmacological Treatment		
Percentage who reported being on insulin or at least one glucose-lowering medication	• Health Canada. Diabetes in Canada, 2nd ed., 2002[287] • ICES Atlas. Diabetes in Ontario, Chapter 3: Drug use in older people with diabetes, June 2003[50]	Canadian Community Health Survey (CCHS), 2005 (Cycle 3.1) and 2007
Percentage of adults aged 65 and older who filled a prescription for: • at least one anti-hypertensive drug • an ACE inhibitors and/or an ARB • statin	• ICES Atlas. Diabetes in Ontario, Chapter 3: Drug use in older people with diabetes, June 2003[50] • National Quality Measures Clearinghouse. Diabetes Mellitus[292] • Health Resources and Services Administration. Health Disparities Collaboratives: Diabetes Collaborative, 2006[293] • Health Quality Council, Saskatchewan. Quality of diabetes management in Saskatchewan, 2006[268]	Ontario Diabetes Database (ODD); Ontario Drug Benefits (ODB) database

APPENDIX 9.2 | Diabetes indicators—indicator sources^ and data sources

Indicator	Indicator Source(s)	Data Source(s)
Section 9E – Health Outcomes		
Number of adults with diabetes with at least one hospital visit (emergency department or hospital admission) for hyperglycemia or hypoglycemia	• ICES Atlas. Diabetes in Ontario, Chapter 2: Acute complications of diabetes, June 2003[300] • Agency for Healthcare Research and Quality. Prevention Quality Indicators[301]	Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); National Ambulatory Care Reporting System (NACRS)
Number of adults with diabetes who had at least one hospitalization for skin and soft tissue infections	• ICES Atlas. Diabetes in Ontario. Chapter 2: Acute complications of diabetes, June 2003[300]	Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)
Cardiac disease: Number of adults with diabetes who had: • at least one hospitalization for AMI • at least one hospitalization for CHF • a coronary artery bypass graft (CABG) surgery • a percutaneous coronary intervention (PCI)	• ICES Atlas. Diabetes in Ontario. Chapter 5: Diabetes and Cardiac Disease, June 2003[302] • A Canadian consensus for the standardized evaluation of quality improvement interventions in type 2 diabetes, 2005[297] • Institute of Health Economics. Alberta Diabetes Atlas 2007[296]	Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); National Ambulatory Care Reporting System (NACRS)
Stroke: Number of adults with diabetes who had: • at least one hospitalization for stroke • a carotid endarterectomy	• ICES Atlas. Diabetes in Ontario. Chapter 7: Diabetes and stroke, June 2003[189] • Institute of Health Economics. Alberta Diabetes Atlas 2007[296]	Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)
Peripheral vascular disease: Number of adults with diabetes who had: • a minor amputation • a major amputation • a peripheral revascularization procedure	• ICES Atlas. Diabetes in Ontario. Chapter 6: Diabetes and peripheral vascular disease, June 2003[188] • National Quality Measures Clearinghouse. Diabetes Mellitus[292] • Agency for Healthcare Research and Quality. Prevention Quality Indicators[301]	Ontario Diabetes Database (ODD); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)
Number of adults with diabetes who were on chronic dialysis	• Health Council of Canada: Why health care renewal matters—lessons from diabetes, 2007[70] • ICES Atlas. Diabetes in Ontario, Chapter 8: Dialysis therapy for people with diabetes, June 2003[303]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)
Retinopathy—Number of adults with diabetes who had: • laser photocoagulation • vitrectomy	• ICES Atlas. Diabetes in Ontario, Chapter 10: Diabetes and the eye, June 2003[299] • Institute of Health Economics. Alberta Diabetes Atlas 2007[296]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP)

APPENDIX 9.2 | Diabetes indicators—indicator sources^ and data sources

Indicator	Indicator Source(s)	Data Source(s)
Section 9F – Diabetes and Pregnancy		
Prenatal care: The percentage: • who had at least one visit to an obstetrician during pregnancy • with pregestational diabetes who had at least one visit to a specialist (endocrinologist or general internist) during pregnancy • with pregestational diabetes who had at least one eye examination in the year before delivery	• ICES Atlas. Diabetes in Ontario, Chapter 11: Diabetes and pregnancy, June 2003[304]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); ICES Physician Database (IPDB)
Obstetrical complications: The percentage: • with hypertension in the 6 months before delivery • with preeclampsia/ eclampsia in the 6 months before delivery • with obstructed labour • with shoulder dystocia during labour • who delivered by Caesarean section	• ICES Atlas. Diabetes in Ontario, Chapter 11: Diabetes and pregnancy, June 2003[304] • Feig DS et al. Trends in deliveries, prenatal care, and obstetrical complications in women with pregestational diabetes: a population-based study in Ontario, Canada, 1996-2001. Diabetes Care 2006;29(2):232-235[32]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD)
Fetal complications: The percentage of women whose infants: • were stillborn or suffered in-hospital mortality (per 1,000) • had a congenital anomaly (major or minor) • were delivered prematurely • underwent phototherapy for hyperbilirubinemia • had a NICU admission	• ICES Atlas. Diabetes in Ontario, Chapter 11: Diabetes and pregnancy, June 2003[304] • Evers IM et al. Risk of complications of pregnancy in women with type 1 diabetes: nationwide prospective study in the Netherlands. BMJ 2004;328(7445):915[27] • Crowther CA et al. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. N Engl J Med 2005;352(24):2477-2486[251]	Ontario Diabetes Database (ODD); Ontario Health Insurance Plan (OHIP); Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD); ICES Mother-Baby (MOMBABY) Linked Database
^ There may be small differences in the indicator reported compared to the indicator source(s) listed here.		

Appendix 9.3

HOW THE RESEARCH WAS DONE

1. Indicator Selection and Reporting

The indicators we report are the result of a rigorous selection process, which included an extensive literature review of peer-reviewed and grey literature (see chapter 1, Introduction to the POWER Study).[305] The review of literature identified a number of indicators that were reviewed by the working group using defined indicator selection criteria (see the POWER Study Framework, chapter 2).[306] A final list containing potential indicators was prepared for review by a Technical Expert Panel (TEP). Indicators were then selected through a modified Delphi process by the TEP using a two step process—first through an online questionnaire and then at a face-to-face meeting on September 19, 2008. The final list included 53 diabetes indicators (See Appendix 9.1 for a complete indicator list).

All the indicators were reported at the provincial level and at the Local Health Integration Network (LHIN) level when sample size allowed. At the provincial level, these indicators were first stratified by sex, and then further stratified by age, income, education, time since immigration, ethnicity and rural/urban residence as allowed by sample size and data availability. At the LHIN level, indicators were stratified by sex and then by income as allowed by sample size and data availability. When reporting indicators other than by age, age-adjusted rates are reported. Indicators reported by age reflect crude rates. Age-adjustment was done using indirect standardization.

2A. Datasets—Survey Data

Canadian Community Health Survey (CCHS)

The CCHS is a nationally representative, cross-sectional survey of the Canadian community-dwelling population conducted every two years by Statistics Canada. The CCHS is offered in English and in French. To remove language as a barrier to conducting interviews, each of the Statistics Canada Regional Offices recruits interviewers with a wide range of language competencies. When necessary, cases are transferred to an interviewer with the language competency needed to complete an interview. In addition, the survey questions are translated into the following languages: Chinese, Punjabi and Inuktitut. Chinese and Punjabi were the most common language barriers identified by the regional offices. The Inuktitut translation was used to facilitate collection in Nunavut. The survey is conducted via face-to-face interviews and covers material that alternates between a general overview of the health of Canadians (the x.1 cycle surveys) and more in-depth issues (the x.2 cycle surveys). In 2007, major changes were made to the CCHS design. Data are now collected on an ongoing basis with annual releases rather than every two years as was the case prior to 2007. As such, as of 2007, the naming convention has also changed to reflect the year of the survey rather than the cycle. Residents living on Indian Reserves and on Crown Lands, institutional residents, full-time members of the Canadian Armed Forces and residents of certain remote regions are excluded from the survey. The Ontario share files for the survey were used for all analyses.

For some of the indicators, it was possible to use the combined CCHS, 2005 (Cycle 3.1) and 2007. This was only possible when questions were similarly asked in both cycles and response options were also the same. The cycles were combined using a method developed by Statistics Canada[307] that adjusted the sample weights for each of the cycles by a function of their health region sample sizes. To use the combined cycles, it was necessary to assume the two share files to be independent, i.e., no duplicate respondents, as it would

be difficult to identify these and the probability of duplicate records is very low.

For CCHS-based indicators, we included all respondents aged 20 and older. Data from CCHS, 2000/01 (Cycle 1.1) were used to assess the prevalence of probable depression. Limitations in instrumental activities of daily living (IADL) and/or activities of daily living (ADL) and dental visits were measured using CCHS, 2005 (Cycle 3.1). Data from CCHS, 2005 (Cycle 3.1) and 2007 were combined to assess: self-reported prevalence of multiple chronic conditions; prevalence of hypertension; self-rated health status; behavioural risk factors; self-monitoring of blood glucose levels; self foot examinations; foot examinations by health care professionals; hemoglobin A1c tests; microalbumin tests; use of anti-hyperglycemic agents and diabetes prevalence by ethnicity.

For the overall population and for women and men we assessed the relationship between the indicators reported in this chapter and income, education, age, ethnicity, immigrant status, and rural/urban residence. When stratifying by education, only people aged 25 and older were included. The variable measuring rural/urban residency is a derived variable by Statistics Canada based on population density and size. In analyses that use the CCHS, income levels were based on information collected about annual household income, a variable derived by Statistics Canada that accounts for total household income and household size (see Table 2 for more detail regarding variable categories). Income data were missing for 9.4 percent of the sample from CCHS, 2000/01 (Cycle 1.1), 13.4 percent of the sample from CCHS 2005 (Cycle 3.1) and 13.7 percent of the sample from the CCHS, 2005 (Cycle 3.1) and CCHS, 2007 combined sample. The studentized range test was used to assess the significance of differences in the rates. The standard errors and 95 percent confidence intervals were calculated using 500 bootstrap weights provided by Statistics Canada.

Statistics Canada rules were followed in the reporting of estimates using the Ontario share file as follows:

- Estimates should not be reported if the unweighted sample is less than 10 (or less than 30 for data from CCHS 2000/01 (Cycle 1.1))
- Estimates are adequate and can be reported if the coefficient of variation is 16.5 or less
- Estimates should be reported with caution if the coefficient of variation is between 16.6 and 33.3
- Estimates should be suppressed if the coefficient of variation is greater than 33.3

Table 2 | Stratifying variables for CCHS indicators

Sex	
Female	
Male	
Age (years) – 3-level variable	
20–44	
45–64	
65+	
Age (years) – 2-level variable	
20–64	
65+	
Household income – 4-level variable	
Lowest income	< $15,000 if 1or 2 people < $20,000 if 3 or 4 people < $30,000 if 5+ people
Lower middle income	$15,000 to $29,999 if 1 or 2 people $20,000 to $39,999 if 3 or 4 people $30,000 to $59,999 if 5+ people
Upper middle income	$30,000 to $59,999 if 1 or 2 people $40,000 to $79,999 if 3 or 4 people $60,000 to $79,999 if 5+ people
Highest income	≥ $60,000 if 1 or 2 people ≥ $80,000 if 3+ people
Household income – 2-level variable	
Lower income (Lowest / Lower Middle)	< $30,000 if 1 or 2 people < $40,000 if 3 or 4 people < $60,000 if 5+ people
Higher income (Upper Middle / Highest)	≥ $30,000 if 1 or 2 people ≥ $40,000 if 3 or 4 people ≥ $60,000 if 5+ people

Education – 4-level variable	
Less than secondary school graduation	
Secondary school graduation	
At least some post-secondary school	
Bachelor's degree or higher	

Immigration – 3-level variable	
0-9 years of residency in Canada	
10+ years of residency in Canada	
Born in Canada	

Immigration – 2-level variable	
Immigrant	
Canadian born	

Ethnicity – 6-level variable	
White	
Black	
East and Southeast Asian	Filipino, Japanese, Korean, Chinese, Southeast Asian
Arab, West and South Asian	South Asian, Arab, and West Asian
Other	Latin American, other racial or cultural origins, multiple racial origins
Aboriginal people	North American Indian, Métis or Inuit

Ethnicity – 2-level variable	
White	
Visible minority	Black, Filipino, Japanese, Korean, Chinese, Southeast Asian, South Asian, Arab, and West Asian, Latin American, other racial or cultural origins, multiple racial origins, North American Indian, Métis or Inuit

Rural/urban residence	
Urban	Urban core; Urban fringe; Urban area outside CMAs and CAs
	Secondary urban core
Rural	Missing; Rural fringe inside CMAs and CAs; Rural fringe outside CMAs and CAs

2B. Datasets—Administrative Data

Ontario Diabetes Database (ODD)

The ODD employs a validated algorithm to identify people with diabetes using data on hospitalizations and physician visits. Hospital discharge abstracts, collected by the Canadian Institute for Health Information (CIHI) from April 1988 onwards were used to identify Ontarians with a valid health card number who had been hospitalized with a new or pre-existing diagnosis of diabetes, based on a specific code (ICD-9 code: 250.x; ICD10 code: any of E10, E11, E13, E14) in any diagnostic field. Physician claim records held by the Ontario Health Insurance Plan (OHIP) from July 1991 onwards were also used to identify individuals with visits to a physician for diabetes (diagnostic code 250). When there was a hospital record with a diagnosis of pregnancy care or delivery (ICD-9 code: 641-676, V27; ICD10 code: O10-O16; O21-O95,O98, O99, Z37) close to a diabetic record (i.e., diabetic record date between 120 days before and 180 days after a gestational admission date), the diabetic record was considered to be for gestational diabetes and was excluded. Individuals were considered to have diabetes if they had at least one hospitalization or two physician service claims over a two-year period. People enter the ODD as incident cases when they are defined as having diabetes (i.e., the first of CIHI admission date or OHIP service date over the two-year period as incident date). The database contains an encrypted patient identifier that can be linked to hospital discharge abstracts from CIHI, physician claims from OHIP and sociodemographic information from the Registered People Database (RPDB). For our analysis, we restricted the sample to adults aged 20 and older with prevalent diabetes as of March 31, 2007. An analysis by Hux and colleagues reported that the current algorithm had a sensitivity of 86 percent and a specificity of 97 percent for identifying diabetes in the population. The positive predictive value of the algorithm was 80 percent.[75]

Ontario Health Insurance Plan (OHIP)

The OHIP claims database covers all reimbursement claims to the Ontario Ministry of Health and Long-Term Care (MOHLTC) made by fee-for-service physicians, community-based laboratories and radiology facilities. The OHIP database at the Institute for Clinical Evaluative Sciences (ICES) contains encrypted patient and physician identifiers, codes for services provided, date of service, the associated diagnosis and fee paid. Services which are missing from the OHIP data include: some lab services; services received in provincial psychiatric hospitals; services provided by health service organizations and other alternate providers; diagnostic procedures performed on an inpatient basis and lab services performed at hospitals (both inpatient and same day). Also excluded is remuneration to physicians through alternate funding plans (AFPs). Their concentration in certain specialties or geographic areas could distort analyses.

Canadian Institute of Health Information Discharge Abstract Database (CIHI-DAD)

The CIHI-DAD is a database of information abstracted from hospital records. It includes patient-level data for acute- and chronic care hospitals, rehabilitation hospitals and day surgery clinics in Ontario. The main data elements of the CIHI-DAD database are encrypted patient identifier, patient demographics (age, sex, geographic location), diagnoses, procedures, and administrative information (institution number, admission category, length of stay).

National Ambulatory Care Reporting System (NACRS)

NACRS is a data collection tool used to capture patient and clinical information on patient visits to hospital and community based ambulatory care: same day surgery, outpatient clinics and emergency departments.

Ontario Drug Benefit Program (ODB)

The ODB database contains information about the use of medications in seniors aged 65 and older as well as individuals on welfare assistance who are covered by the ODB. The ODB tracks all filled prescriptions for medications listed in its Formulary and each record represents a unique drug claim (i.e., a dispensed prescription) paid for by the MOHLTC. The ODB database at ICES contains patient, pharmacy and physician identifiers, drug identifiers (drug identification numbers) quantity supplied, cost and dispensing date.

Registered People Database (RPDB)

The RPDB is a historical listing of the unique health numbers issued to each person eligible for Ontario health services. This listing includes corresponding demographic information such as date of birth, sex, address, date of death (where applicable) and changes in eligibility status. When new RPDB data arrive at ICES, personal information such as name and street address are removed, and each unique health number is converted into an anonymous identifier, ensuring the protection of each individual's privacy. Data from the RPDB are enhanced with available information through other administrative data sources at ICES; however, even the enhanced dataset overestimates the number of people living in Ontario for several reasons, including the source of death information and record linkage issues. Although improvements have been made in recent years, the RPDB still contains a substantial number of individuals who are deceased or no longer living in Ontario. As such, the RPDB will underestimate mortality.[308] To ensure that rates and estimates are correct, a methodology has been developed to adjust the RPDB so that regional population counts by age and sex match estimates from Statistics Canada. The adjusted dataset was used to determine population denominators.

ICES Physician Database (IPDB)

The IPDB contains information on physician demographics and specialty training. The IPDB incorporates information from the Corporate Provider Database (CPDB), the Ontario Physician Human Resource Data Centre (OPHRDC) database and the OHIP database of physician billings. The CPDB contains information about physician demographics, specialty training and certification and practice location. This information is validated against the OPHRDC database, which verifies this information through periodic telephone interviews with all physicians practicing in Ontario.

ICES Mother-Baby (MOMBABY) Linked Database

The MOMBABY dataset is a cumulative database created by linking the CIHI-DAD inpatient admission records of delivering mothers to those of their newborns. The linking algorithm makes use of maternal and newborn chart numbers, institutions, postal codes, admission/discharge dates and procedure codes. The database includes information on maternal gestational age at admission and at delivery, newborn gestational weeks at delivery and flags that identify multiple births and still births.

3. Analysis and Regional and Socioeconomic Variables

Analysis

For survey data (CCHS), analyses were conducted at the provincial level, first by sex and then by annual household income, educational attainment, age group, ethnicity, time since immigration, rural/urban residence and LHIN. Where possible, relative rates were calculated for women-to-men, lowest-to-highest income groups, lowest-to-highest education level, and rural-to-urban residence. Ninety-five percent confidence intervals were calculated for all rates and rate comparisons. At the LHIN level, indicators were stratified by sex as allowed by sample size and data availability.

For all indicators, with the exception of comparisons across age groups age-adjusted rates were reported. Indirect standardization was used to age adust rates; this method compares the age specific rates to the standard population average for that age group. For this chapter, the standard population was adults aged 20 and older with diabetes. The standardized rates will differ from the crude rates, in a way that reflects: (i) how the indicator varies by age and (ii) how the strata differ by age. The observed over the expected rate tells us how a particular stratum compares to the overall population and the relative rate tells us how a specific stratum compares to another (i.e., women versus men or low versus high income).

The results based on CCHS data should be interpreted with caution for the following reasons:

- The survey relies on self-reports and voluntary participation of randomly selected participants, and thus the data reflect individuals' interpretation of questions and how they perceive their own health. Hence, results may be an under- or over-estimation of the prevalence of some conditions.
- The CCHS does not survey Aboriginal people living on reserves, institutionalized individuals, individuals unable to be surveyed in English or French, or people in the armed forces. While the findings pertain to a large proportion of Ontarians (those living in households), they may be biased if the group not surveyed have significantly different need or utilization rates.
- The CCHS survey sampling strategy is based on health regions and thus may not be fully representative of the LHINs and in some cases there is inadequate sample size for some measures for some LHINs. This prevents comparative analysis at the LHIN level for some indicators.

For administrative data, analyses were conducted at the provincial level, first by sex and then by neighbourhood income quintile, age group, and LHIN. Analyses at the LHIN level were stratified by sex. For indicators based on administrative data, indirect age-standardization was applied. For this chapter, administrative data were adjusted to the diabetic population. Pregnancy indicators were adjusted to the pregestational diabetic population. Where numbers were too small, results were either not reported or were aggregated. Where possible, relative rates were calculated for women-to-men and lowest-to-highest income groups. Ninety-five percent confidence intervals were calculated for all rates and rate comparisons.

Neighbourhood Income Quintile

Average neighbourhood income is calculated by Statistics Canada and is updated every five years when new Census data become available. Income was calculated using the neighbourhood income per person equivalent (IPPE), which is a household size adjusted measure of household income based on 2006 census summary data at the dissemination area level and using person-equivalents implied by the 2006 low income cut-offs. Average income estimates were calculated by dissemination area. Ontario neighbourhoods are classified into one of five approximately equal-sized groups (quintiles), ranked from poorest (Q1) to wealthiest (Q5). These income quintiles are used as a proxy for overall socioeconomic status, which has been shown to be related to population health status and levels of health care utilization. Individual geographic information from ICES databases was used to define the best known postal code for each person on July 1st of each year (available from 1991 to 2004). Postal codes were then used to assign people to enumerations areas or dissemination areas (using the Statistics Canada Postal Code Conversion File) and thus to one of the income quintiles. Two-level income data compare people from the first two income quintiles (Q1, Q2) against people from the remaining three quintiles (Q3, Q4, Q5). Enumeration areas and dissemination areas are small adjacent geographic areas, designated for collection of census data. Dissemination areas replaced enumeration areas in 2001 and have a population of 400–700 people.

Location of Residence (Urban Versus Rural)

In the administrative data, rural/urban residency was assigned based on a Statistics Canada derived variable. Urban areas are those continuously built-up areas having a population concentration of 1,000 or more and a population density of 400 or more per square kilometre based on current census population counts. Areas are designated as rural, urban core, urban fringe, urban area outside CMAs and CAs, secondary urban code and mix or urban/rural areas. This variable is further dichotomized into rural and urban location by Statistics Canada.

Patients' Residence

For all analyses presented in the report, the definition of LHIN was based on the residence of the patient rather than where they received care.

4. Indicators

Prevalence of Diabetes

The percentage of adults aged 20 and older who had diabetes as of March 31, 2007 was measured using the ODD. Crude and age-adjusted rates (adjusted to the Ontario population aged 20 and older from Canadian census data on July 1, 2006) were calculated. Currently data from Ontario's administrative health care databases do not allow for analyses by some important sociodemographic variables (i.e., education, ethnicity, etc). Therefore, data from the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset were used to assess self-reported diabetes prevalence by other sociodemographic variables. Respondents to the CCHS are asked whether they have diabetes that has been diagnosed by a health professional.

Comorbidity

The percentage of adults aged 20 and older who reported having two or more additional chronic conditions (Alzheimer's disease or other dementia; Crohn's disease, ulcerative colitis, Irritable Bowel Syndrome or bowel incontinence; cancer; heart disease; stroke; high blood pressure; urinary incontinence; arthritis, rheumatism, or back problems, excluding fibromyalgia; asthma, emphysema or chronic obstructive pulmonary disease) diagnosed by a health professional was measured using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. We compared the prevalence of comorbidity among people who reported having diabetes to those who did not have diabetes. Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Probable Depression

The prevalence of probable depression among adults aged 20 and older was assessed using the Composite International Diagnostic Interview-Short Form for Major Depression (CIDI-SFMD). This series of questions is used to calculate the predicted probability of major depressive episodes occurring within the year preceding the interview. Respondents who had a CIDI-SFMD predicted probability score of 0.9 or greater were considered to have probable depression. However, since the CIDI-SF was designed to predict the probability that a person would be considered depressed using the full set of CIDI depression questions, it may somewhat overestimate prevalence. We compared the prevalence of probable depression among people who reported having diabetes to those who did not have diabetes. Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Hypertension

The percentage of adults aged 20 and older who reported ever being diagnosed with hypertension by a health professional was measured using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. We compared the prevalence of hypertension among people who reported having diabetes to those who did not have diabetes. Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Self-Rated Health

The percentage of adults aged 20 and older who reported that their health was fair or poor compared to others their own age was measured using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. We compared self-rated health among people who reported having diabetes to those who did not have diabetes. Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Limitations in Instrumental Activities of Daily Living (IADL) and/or Activities of Daily Living (ADL)

The percentage of adults aged 20 and older who reported having IADL and/or ADL limitations was measured using data from the CCHS, 2005 (Cycle 3.1). ADL limitations include washing, dressing, eating and moving about inside the house. IADLs include light and heavy housework, laundry, meal preparation, transportation, grocery shopping, using the telephone and money management. IADL limitations represent difficulties in carrying out routine life activities and are generally interpreted as an indicator of mild to moderate disability. Limitations in ADLs reflect difficulty in carrying out self-care activities, and therefore represent a more severe disability. We compared the prevalence of IADL and/or ADL limitations among people who reported having diabetes to those who did not have diabetes. Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Health Behaviours

The following health behaviours were assessed among adults aged 20 and older using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset.

- The percentage who were overweight (defined as a Body Mass Index (BMI) ≥ 25 but < 30) or obese (BMI ≥ 30), calculated from self-reported height and weight;
- The percentage who were physically inactive, defined as a Physical Activity Index of < 1.5 kcal/kg/day;
- The percentage who had inadequate daily intake of fruits and vegetables, defined as a daily consumption of less than 5 servings of fruits and vegetables;
- The percentage who were current daily or occasional smokers.

We compared the health behaviours of people who reported having diabetes to those who did not have diabetes. Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Continuity of Primary Care

Continuity of primary care was measured as the percentage of adults with diabetes who had 50 percent or more of their primary care visits over a two year period to the same primary care provider. This indicator was assessed during the period April 1, 2005 to March 31, 2007. Data from the ODD were used to identify adults aged 20 and older who were diagnosed with diabetes as of March 31, 2005. These records were linked to the OHIP database to identify visits to primary care providers based on specialty code '00' (Family Practice and Practice in General). Physician identification numbers in OHIP claims were used to confirm multiple visits to the same physician. Patients were excluded if they had less than three primary care visits over the two-year period. Only one visit per primary care provider per day was counted. We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals.

Average Number of Primary Care Visits Per Year

Data from the ODD were used to identify adults aged 20 and older who were diagnosed with diabetes as of March 31, 2005. These records were linked to OHIP claims to calculate the mean number of primary care visits per year among adults with diabetes. Means

were calculated per year for two years of OHIP data (April 1, 2005 to March 31, 2007). Primary care visits were defined based on OHIP claims with a specialty code of '00' (Family Practice and Practice in General), excluding inpatient and emergency department visits. We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals.

Specialist Care

Data from the ODD were used to identify adults aged 20 and older who were diagnosed with diabetes as of March 31, 2005. These records were linked to the OHIP database and the IPDB to calculate the percentage of adults with diabetes who had one or more OHIP claims for an 'office' visit with a specialist (endocrinologist, internist or geriatrician) over a two-year period (April 1, 2005 to March 31, 2007). Specialists were defined as having an OHIP specialty code of '13' (Internal Medicine) and an IPDB MAIN-SPECIALTY of 'Endocrinology', 'Internal Medicine', or 'Geriatric Medicine'. We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals.

No Primary or Specialist Care

Using the definitions above, we calculated the percentage of diabetic adults who did not have any primary care or specialist (endocrinologist, general internist, or geriatrician) visits over a two-year period (April 1, 2005 to March 31, 2007). Data from the ODD were used to identify adults aged 20 and older who were diagnosed with diabetes as of March 31, 2005. These records were linked to OHIP claims to identify individuals who did not have any visits to physicians with specialty codes of '00' (Family Practice and Practice in General) or '13' (Internal Medicine). We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals.

Self-Monitoring of Blood Glucose

The percentage of adults aged 20 and older who reported having diabetes who reported that they self-monitored they blood glucose levels on at least a daily basis was measured using data from the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. The population of people with diabetes was limited to those who reported they were taking glucose-lowering medications and stratified into those who were currently taking insulin ("Are you currently taking insulin for your diabetes?") and those who were not on insulin but who had taken an oral glucose-lowering medication in the past month ("In the past month, did you take pills to control your blood sugar?"). People with diabetes were asked "How often do you usually have your blood checked for glucose or sugar by yourself or by a family member or friend?" The percentage who indicated that they monitored their blood glucose at least daily was reported. We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals.

Hemoglobin A1c Test

The percentage of adults aged 20 and older who reported having diabetes who reported that a health care professional had tested them for hemoglobin A1c within the past year was measured using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. Respondents who indicated they had diabetes were asked "In the past 12 months has a health care professional tested you for hemoglobin 'A-one-C'? (An 'A-one-C' hemoglobin test measures the average level of blood sugar over a 3-month period.)" Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Microalbumin Measurement

The percentage of adults aged 20 or older who reported having diabetes who reported that a health

care professional had tested them for microalbumin (protein in the urine) within the past year was measured using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. Respondents who indicated they had diabetes were asked "In the past 12 months has a health care professional tested your urine for protein (i.e., microalbumin)?" Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Eye Examination

The ODD was used to identify incident diabetes cases among people aged 30 and older between April 1, 2003 and March 31, 2006. The sample was restricted to adults aged 30 and older at diagnosis to select people who were more likely to have new onset type 2 diabetes as prompt screening would be recommended for them. These records were linked to the OHIP database to determine the percentage that underwent an eye care visit within two years following the diagnosis date.

There is no specific OHIP fee code for retinopathy screening. Accordingly, OHIP claims were used to identify physician or optometry visits during which a dilated retinal examination would likely have occurred. Visits to optometrists (specialty code '56') were included for billing codes

- V401, V405, V406, V450, V451 (for all diagnostic codes)
- V402, V407 (if the diagnostic code was 250 or 362)
- V408, V409 (if the diagnostic code was 250, 361 or 362)

Visits to primary care physicians (specialty code '00') or ophthalmologists (specialty code '23') were included for billing codes:

- A111, A112 (for all diagnostic codes)
- A114 (if the diagnostic code was 250 or 362)
- A115 (if the diagnostic code was 250, 361 or 362)

Additional ophthalmology billing codes included A233-A236, A238-A240, C233-C236, K065 and K066 for all diagnostic codes. We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals.

Self Foot Examination

The percentage of adults aged 20 and older who reported having diabetes who reported ever having their feet checked for any sores or irritations by themselves, or by a family member or friend was measured using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. Respondents who indicated they had diabetes were asked "How often do you usually have your feet checked for any sores or irritations by yourself or by a family member or friend?" We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals.

Foot Exam by a Health Care Professional

The percentage of adults aged 20 and older who reported having diabetes who reported that a health care professional checked their feet for sores or irritations within the past 12 months was measured using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. Respondents who indicated they had diabetes were asked "In the past 12 months has a health care professional checked your feet for any sores or irritations?" Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Dentist Visit

The percentage of adults aged 20 and older who reported that they had visited a dentist in the past 12 months was measured using the CCHS, 2005 (Cycle 3.1) dataset. We compared the rate of dental care among people who reported having diabetes to those who did not have diabetes. Crude and age-adjusted rates

(adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Insulin or at Least One Oral Glucose-Lowering Medication

The percentage of adults aged 20 and older who reported having diabetes who reported taking pills to control their blood glucose levels in the past month ("In the past month, did you take pills to control your blood sugar?") or who were currently taking insulin ("Are you currently taking insulin for your diabetes?") was measured using the CCHS, 2005 (Cycle 3.1) and 2007 combined dataset. Crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals were calculated.

Anti-Hypertensive Drugs and Statins

Data from the ODD were used to identify adults aged 65 and older who were diagnosed with diabetes as of April 1, 2006. The sample was restricted to patients aged 65 and older because of access to provincially funded drug benefits in this population and additionally restricted to people who were alive as of March 31, 2007. This cohort was linked to the ODB database to calculate the percentage of people aged 65 and older with diabetes who filled at least one prescription between April 1st 2006 and March 31st 2007 for:

- **any antihypertensive agent:**
  - Acebutolol, Amiloride, Amlodipine, Atenolol, Benazepril, Bisoprolol, Candesartan, Captopril, Carvedilol, Chlorthalidone, Cilazapril, Clonidine, Diltiazem, Doxazosin, Enalapril, Eprosartan, Felodipine, Fosinopril, Guanethidine, Hydralazine, Hydrochlorothiazide, Indapamide, Irbesartan, Labetalol, Lisinopril, Losartan, Methyldopa, Metoprolol, Minoxidil, Nadolol, Nicardipine, Nifedipine, Oxprenolol, Perindopril, Pindolol, Prazosin, Propranolol, Quinapril, Ramipril, Reserpine, Spironolactone, Telmisartan, Terazosin, Timolol, Trandolapril, Triamterene, Valsartan, Verapamil
- **an angiotensin converting enzyme (ACE) inhibitor or an angiotensin II receptor blocker (ARB):**
  - Benazepril, Captopril, Cilazapril, Enalapril, Fosinopril, Lisinopril, Perindopril, Quinapril, Ramipril, Trandolapril, Telmisartan, Valsartan, Candesartan, Eprosartan, Irbesartan, Losartan
- **Statins:**
  - Atorvastatin, Rosuvastatin, Lovastatin, Pravastatin, Simvastatin, Fluvastatin

We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals.

HEALTH OUTCOMES

A number of indicators were measured in a cohort of patients aged 20 and older who were identified through the ODD as having been diagnosed with diabetes as of March 31, 2006. This cohort of patients was linked to data from CIHI-DAD, NACRS and OHIP to measure outcomes in the 2006/07 fiscal year including: rates of hospital visits (emergency department and hospitalizations), hospitalizations and procedure rates per 100,000 adults aged 20 and older with diabetes. We calculated the crude and age-adjusted rates (adjusted to the diabetic population) and the associated 95 percent confidence intervals. See the descriptions below for details on the specific health outcome indicators that were measured.

Hospital Visits for Hyperglycemia or Hypoglycemia

The cohort with diabetes was linked to the CIHI-DAD and NACRS to calculate the number of people who had at least one hospital visit (including emergency department visits and hospitalizations) for hyperglycemia or hypoglycemia (ICD10 codes: E100, E101, E110, E111, E130, E131, E140, E141, E15, E160, E161, E162, E1063, E1163, E1363, E1463 in dxtype M (most responsible diagnosis) or 1 (pre-admit comorbidity; ICD10 codes: R73802, R73812 in dxtype M).

Hospitalization Rate for Skin and Soft Tissue Infections

The cohort with diabetes was linked to the CIHI-DAD to calculate the number of people who had at least one hospitalization for skin or soft tissue infection (ICD10 codes: L01, L02, L03, L04, L05, L08, A480, E1051, E1151, E1351, E1451, R02, E1071, E1171, E1371, E1471 E1061 E1161 E1361 E1461 in dxtype M (most responsible diagnosis) or 1 (pre-admit comorbidity)).

Diabetes and Cardiac Disease

The cohort with diabetes was linked to the CIHI-DAD to calculate the number of people who had:

- A hospitalization with a most responsible diagnosis of acute myocardial infarction (AMI) (ICD10 codes: I21, I22);
- A hospitalization with a most responsible diagnosis of congestive heart failure (CHF) (ICD10 code: I50);
- Coronary artery bypass graft (CABG) surgery (CCI code: 1IJ76)

The CIHI-DAD and same day surgery data from NACRS were used to identify the number of people who had:

- A percutaneous coronary intervention (PCI) (CCI code: 1IJ50).

Diabetes and Stroke

The cohort with diabetes was linked to the CIHI-DAD to calculate the number of people who had:

- At least one hospitalization with a most responsible diagnosis of stroke (ICD10 code: I61, I63, I64);
- At least one carotid endarterectomy (CCI code: 1JE57).

Diabetes and Peripheral Vascular Disease

The cohort with diabetes was linked to the CIHI-DAD to calculate the number of people who had:

- At least one peripheral revascularization procedure (CCI code: 1KG50, 1KG57, 1KG76, 1KG35HAC1, 1KG35HHC1), excluding patients with a diagnosis code of aneurysm during same hospitalization (ICD10 code: I67.1, I71, I72, I60, I77.0, I79.0, Q codes);
- At least one major lower extremity amputation (below hip and above ankle) (CCI codes: 1VC93, 1VG93, 1VQ93)
- At least one minor lower extremity amputation (ankle or lower) (CCI codes: 1WL93, 1WA93, 1WE93, 1WJ93, 1WM93)

In order to restrict the analysis to amputations due to diabetes, we excluded amputations that occurred during a hospital admission that included codes related to certain types of malignancies (ICD10 codes: C40.2, C40.3, C46.1, C47.2, C49.2, D16.2, D16.3, D21.2) or major trauma (ICD10 codes: S72-S79, S82-S89, S97, S98, T02.3, T02.5, T02.6, T02.7, T02.8, T02.9, T03.3-T03.9, T04.3-T04.9, T05.3-T05.9, T07, T13.2-T13.9, T14.2-T14.9) anywhere on the same admission.

Dialysis Therapy

The cohort with diabetes was linked to OHIP data to calculate the number of people who received chronic dialysis in 2006/07. The dialysis fee codes that were included were: fee codes: R849, G323, G326, G860, G862, G333, G863, G865, G866, G330, G331, G332, G864, G861, S435, E769, S434, E771. For each individual, the dialysis billing claims were sorted by date, and the duration of dialysis was calculated as the time between the first and last dialysis records. To account for significant gaps in dialysis treatments between the first and last billing claims, gaps in time between consecutive claims were calculated. Each single gap longer than 21 days was subtracted from the total dialysis duration. After accounting for gaps, if an individual's dialysis treatment period was at least 90 days, they were considered to have received chronic dialysis. Only claims that were billed in the 2006/07 fiscal year were included and so the rate reported may be an underestimate if people started dialysis at the end of the follow up period or completed dialysis

early in the follow up period. As our objective was to assess whether there were gender or socioeconomic difference in dialysis rates, it is unlikely that this would have been affected.

Diabetic Retinopathy

The cohort with diabetes was linked to OHIP data to calculate the number of people who had:

- Laser photocoagulation (OHIP fee code E154)
- Vitrectomy (OHIP fee code E148)

DIABETES AND PREGNANCY

A number of indicators were measured in a cohort of women aged 20 and older who gave birth in hospital. Data from the CIHI-DAD were used to identify all women aged 20 and older who gave birth in hospital over a five year period, between April 1, 2002 and March 31, 2007. For women who had multiple deliveries during this period, one delivery was chosen at random for inclusion into the cohort.

The cohort of women was then linked to the ODD, hospital administration data and OHIP data to determine diabetes status. Women were defined as having pregestational diabetes if they met the ODD definition of diabetes 150 days or more before the date of delivery (see previous description of the ODD). Gestational diabetes was defined as not meeting the ODD definition of diabetes before the delivery date, but having a hospital record at delivery with an ICD10 code of either 'E1' or '024' within any of the diagnostic fields. Women were defined as being without diabetes if they did not have pregestational or gestational diabetes and did not have any of the following in the nine months before delivery: an OHIP record containing the diagnostic code 250; a CIHI-DAD record containing an ICD9 code of 250.x or an ICD10 code of E10, E11, E13 or E14 in any diagnostic field.

Indicators of obstetrical prenatal care, obstetrical complications and fetal complications were measured in all three groups of women and other indicators of appropriate prenatal for women with diabetes were measures only in the cohort of women with pregestational diabetes. We calculated the crude and age-adjusted rates (adjusted to the population of women with pregestational diabetes) and the associated 95 percent confidence intervals.

Prenatal Care

Among each of the three groups of women described above (women with pregestational diabetes, gestational diabetes and no diabetes), we examined the percentage who had at least one OHIP claim for an 'office' visit to an obstetrician within the nine months prior to delivery. An obstetrician was defined as a physician with an IPDB MAINSPECIALTY of 'Obstetrics and Gynecology'.

Among the cohort of women with pregestational diabetes, we examined the following two indicators:

- The percentage who had at least one OHIP claim for an 'office' visit to an endocrinologist or internist within the nine months prior to delivery (defined as a physician with an IPDB MAINSPECIALTY of 'Endocrinology' or 'Internal Medicine')
- The percentage who had at least one OHIP claim for an eye examination in the one year before delivery (see the indicator description for EYE EXAMINATION for more details on codes)

Obstetrical Complications

Among each of the three groups of women defined above (women with pregestational diabetes, gestational diabetes and no diabetes), we used the CIHI-DAD to examine the percentage who:

- Had hypertension (gestational or pre-existing) in the six months before or at delivery (ICD10 codes: O10, O13, O16; ICD-9 codes: 642.0, 642.1, 642.2, 642.9, 401x, 402x, 403x, 404x, 405x)

- Had preeclampsia or eclampsia in the six months before or at delivery (ICD10 codes: O11, O14, O15; ICD-9 codes: 642.4-642.7)
- Experienced any obstructed labour (including shoulder dystocia) (All obstructions O64.0-O66.99)
- Experienced shoulder dystocia during labour (ICD10 O66.0)
- Underwent a caesarean section (CCI 5.MD.60)

Fetal Complications

For each of the three groups of women defined above (women with pregestational diabetes, gestational diabetes and no diabetes), records were linked to ICES Mother-Baby (MOMBABY) Linked Database to examine fetal outcomes (if deliveries involved multiple births, one infant was chosen at random). We examined the percentage of infants of women who had the following complications:

- Stillbirth or in-hospital mortality (ICD10 codes: P96.4, P95; or baby's discharge disposition 07 or 09; or stillbirth code under the mother)
- Congenital anomalies (ICD10 codes: Q00.0-Q99.9)
- Premature delivery defined as less than 37 weeks gestation (ICD10 P07.2, P07.3)
- Phototherapy for hyperbilirubinemia (CCI: 1YZ12JADQ)
- Admission to any level neonatal intensive care unit (NICU) (SCU Special Care Unit=50)

  There are many levels of NICU, representing levels of intensity of care. Infants may be admitted to a lower-acuity NICU (i.e., level 2) for a limited time (less than a few hours) for observation of minor concerns (e.g., if they are breathing fast or—in the case of infants of mothers with diabetes—to check their sugar level). There are also financial incentives associated with NICU admissions. For these reasons, this indicator is an imprecise measure of absolute morbidity.

REFERENCE LIST

(1) Gregg EW, Cadwell BL, Cheng YJ, Cowie CC, Williams DE, Geiss L, et al. Trends in the prevalence and ratio of diagnosed to undiagnosed diabetes according to obesity levels in the U.S. Diabetes Care 2004;27(12):2806-2812.

(2) King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. Diabetes Care 1998;21(9):1414-1431.

(3) Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27(5):1047-1053.

(4) Lipscombe LL, Hux JE. Trends in diabetes prevalence, incidence, and mortality in Ontario, Canada 1995-2005: a population-based study. Lancet 2007;369(9563):750-756.

(5) Atkins RC. The epidemiology of chronic kidney disease. Kidney Int 2005;67(Suppl 94):S14-S18.

(6) Congdon NG, Friedman DS, Lietman T. Important causes of visual impairment in the world today. JAMA 2003;290(15):2057-2060.

(7) Barzilay JI, Spiekerman CF, Kuller LH, Burke GL, Bittner V, Gottdiener JS, et al. Prevalence of clinical and isolated subclinical cardiovascular disease in older adults with glucose disorders: the Cardiovascular Health Study. Diabetes Care 2001;24(7):1233-1239.

(8) Tavani A, Bertuzzi M, Gallus S, Negri E, La Vecchia C. Diabetes mellitus as a contributor to the risk of acute myocardial infarction. J Clin Epidemiol 2002;55(11):1082-1087.

(9) World Health Organization. Global strategy on diet, physical activity and health: diabetes. Accessed August 17, 2010 at http://www.who.int/dietphysicalactivity/publications/facts/diabetes/en/.

(10) American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2005;28(Suppl 1):S37-S42.

(11) Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999-2000. JAMA 2002;288(14):1723-1727.

(12) Hu FB, Manson JE, Stampfer MJ, Colditz G, Liu S, Solomon CG, et al. Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. N Engl J Med 2001;345(11):790-797.

(13) Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. JAMA 2003;289(1):76-79.

(14) Zimmet P, Alberti KG, Shaw J. Global and societal implications of the diabetes epidemic. Nature 2001;414(6865):782-787.

(15) Stovring H, Andersen M, Beck-Nielsen H, Green A, Vach W. Rising prevalence of diabetes: evidence from a Danish pharmaco-epidemiological database. Lancet 2003;362(9383):537-538.

(16) Thomas RJ, Palumbo PJ, Melton LJ, 3rd, Roger VL, Ransom J, O'Brien PC, et al. Trends in the mortality burden associated with diabetes mellitus: a population-based study in Rochester, Minn, 1970-1994. Arch Intern Med 2003;163(4):445-451.

(17) Ross NA, Gilmour H, Dasgupta K. 14-year diabetes incidence: the role of socio-economic status. Health Rep 2010;21(3).

(18) Lipscombe LL, Austin PC, Manuel DG, Shah BR, Hux JE, Booth GL. Income-related differences in mortality among people with diabetes mellitus. CMAJ 2010;182(1):E1-E17.

(19) Anand SS, Yusuf S, Vuksan V, Devanesen S, Teo KK, Montague PA, et al. Differences in risk factors, atherosclerosis, and cardiovascular disease between ethnic groups in Canada: the Study of Health Assessment and Risk in Ethnic groups (SHARE). Lancet 2000;356(9226):279-284.

(20) Borrell LN, Crawford ND, Dailo FJ. Race/ethnicity and self-reported diabetes among adults in the National Health Interview Survey: 2000-2003. Public Health Rep 2007;122(5):616-625.

(21) Creatore MI, Moineddin R, Booth G, Manuel DH, DesMeules M, McDermott S, et al. Age- and sex-related prevalence of diabetes mellitus among immigrants to Ontario, Canada. CMAJ 2010;182(8):781-789.

(22) Health Canada. Diabetes Among Aboriginal (First Nations, Inuit and Métis) People in Canada: The Evidence. Ottawa: Health Canada, Aboriginal Diabetes Initiative, 2000.

(23) Canadian Institute for Health Information. How healthy are rural Canadians? An assessment of their health status and health determinants. A component of the initiative "Canada's rural communities: understanding rural health and its determinants". Ottawa: Canadian Population Health Initiative, the Canadian Institute for Health Information, the Public Health Agency of Canada, and the Centre for Rural and Northern Health Research, 2006.

(24) Roumain J, Charles MA, de Courten MP, Hanson RL, Brodie TD, Pettitt DJ, et al. The relationship of menstrual irregularity to type 2 diabetes in Pima Indian women. Diabetes Care 1998;21(3):346-359.

(25) Clausen TD, Mathiesen E, Ekbom P, Hellmuth E, Mandrup-Poulsen T, Damm P. Poor pregnancy outcome in women with type 2 diabetes. Diabetes Care 2005;28(2):323-328.

(26) Diabetes in Pregnancy Group France. French multicentric survey of outcome of pregnancy in women with pregestational diabetes. Diabetes Care 2003;26(11):2990-2993.

(27) Evers IM, de Valk HW, Visser GH. Risk of complications of pregnancy in women with type 1 diabetes: nationwide prospective study in the Netherlands. BMJ 2004;328(7445):915.

(28) Macintosh MC, Fleming KM, Bailey JA, Doyle P, Modder J, Acolet D, et al. Perinatal mortality and congenital anomalies in babies of women with type 1 or type 2 diabetes in England, Wales, and Northern Ireland: population based study. BMJ 2006;333(7560):177-180.

(29) Penney GC, Mair G, Pearson DW. Outcomes of pregnancies in women with type 1 diabetes in Scotland: a national population-based study. BJOG 2003;110(3):315-318.

(30) Shand AW, Bell JC, McElduff A, Morris J, Roberts CL. Outcomes of pregnancies in women with pre-gestational diabetes mellitus and gestational diabetes mellitus; a population-based study in New South Wales, Australia, 1998-2002. Diabet Med 2008;25(6):708-715.

(31) Feig DS, Palda VA. Type 2 diabetes in pregnancy: a growing concern. Lancet 2002;359(9318):1690-1692.

(32) Feig DS, Razzaq A, Sykora K, Hux JE, Anderson GM. Trends in deliveries, prenatal care, and obstetrical complications in women with pregestational diabetes: a population-based study in Ontario, Canada, 1996-2001. Diabetes Care 2006;29(2):232-235.

(33) Colhoun HM, Betteridge DJ, Durrington PN, Hitman GA, Neil HA, Livingstone SJ, et al. Primary prevention of cardiovascular disease with atorvastatin in type 2 diabetes in the Collaborative Atorvastatin Diabetes Study (CARDS): multicentre randomised placebo-controlled trial. Lancet 2004;364(9435):685-696.

(34) Gaede P, Lund-Andersen H, Parving HH, Pedersen O. Effect of a multifactorial intervention on mortality in type 2 diabetes. N Engl J Med 2008;358(6):580-591.

(35) Heart Outcomes Prevention Evaluation Study Investigators. Effects of ramipril on cardiovascular and microvascular outcomes in people with diabetes mellitus: results of the HOPE study and MICRO-HOPE substudy. Lancet 2000;355(9200):253-259.

(36) Holman RR, Paul SK, Bethel MA, Matthews DR, Neil HAW. 10-Year follow-up of intensive glucose control in type 2 diabetes. N Engl J Med 2008;359(15):1577-1589.

(37) Nathan DM, Cleary PA, Backlund JYC, Genuth SM, Lachin JM, Orchard TJ, et al. Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. N Engl J Med 2005;353(25):2643-2653.

(38) Patel A, MacMahon S, Chalmers J, Neal B, Billot L, Woodward M, et al. Intensive blood glucose control and vascular outcomes in patients with type 2 diabetes. N Engl J Med 2008;358(24):2560-2572.

(39) UK Prospective Diabetes Study Group. Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. BMJ 1998;317(7160):703-713.

(40) Bierman AS, Clancy CM. Health disparities among older women: identifying opportunities to improve quality of care and functional health outcomes. J Am Med Womens Assoc 2001;56(4):155-159, 188.

(41) Belanger A, Martel L, Berthelot JM, Wilkins R. Gender differences in disability-free life expectancy for selected risk factors and chronic conditions in Canada. J Women Aging 2002;14(1-2):61-83.

(42) Chaturvedi N, Jarrett J, Shipley MJ, Fuller JH. Socioeconomic gradient in morbidity and mortality in people with diabetes: Cohort study findings from the Whitehall study and the WHO multinational study of vascular disease in diabetes. BMJ 1998;316(7125):100-105.

(43) Jimenez-Garcia R, Jimenez-Trujillo I, Hernandez-Barrera V, Carrasco-Garrido P, Lopez A, Angel G. Ten-year trends in self-rated health among Spanish adults with diabetes, 1993-2003. Diabetes Care 2008;31(1):90-92.

(44) Saydah S, Lochner K. Socioeconomic status and risk of diabetes-related mortality in the U.S. Public Health Reports 2010;125(3):377-388.

(45) Bierman AS, Ko B, Mawani F. Equity and women's health. Measuring health inequalities among Canadian women: developing a basket of indicators. Ottawa: Report to Health Canada, 2007.

(46) Bellary S, O'Hare JP, Raymond NT, Mughal S, Hanif WM, Jones A, et al. Premature cardiovascular events and mortality in south Asians with type 2 diabetes in the United Kingdom Asian Diabetes Study - effect of ethnicity on risk. Curr Med Res Opin 2010;26(8):1873-1879.

(47) Jiang HJ, Andrews R, Stryer D, Friedman B. Racial/ethnic disparities in potentially preventable readmissions: the case of diabetes. Am J Public Health 2005;95(9):1561-1567.

(48) Karter AJ, Ferrara A, Liu JY, Moffet HH, Ackerson LM, Selby JV. Ethnic disparities in diabetic complications in an insured population. JAMA 2002;287(19):2519-2527.

(49) Martens PJ, Martin BD, O'Neil JD, MacKinnon M. Diabetes and adverse outcomes in a first nations population: associations with healthcare access, and socioeconomic and geographical factors. Can J Diabetes 2007;31(3):223-232.

(50) Shah BR, Mamdani M, Kopp A. Chapter 3: Drug use in older people with diabetes. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(51) Wong TY, Klein R, Islam FM, Cotch MF, Folsom AR, Klein BE, et al. Diabetic retinopathy in a multi-ethnic cohort in the United States. Am J Ophthalmol 2006;141(3):446-455.

(52) Grant RW, Pirraglia PA, Meigs JB, Singer DE. Trends in complexity of diabetes care in the United States from 1991 to 2000. Arch Intern Med 2004;164(10): 1134-1139.

(53) Pomerleau J, Pederson LL, Ostbye T, Speechley M, Speechley KN. Health behaviours and socio-economic status in Ontario, Canada. Eur J Epidemiol 1997;13(6):613-622.

(54) Aikens JE, Piette JD. Diabetic patients medication underuse, illness outcomes, and beliefs about Antihyperglycemic and Antihypertensive treatments. Diabetes Care 2009;32(1):19-24.

(55) Manuel DG, Schultz SE. Chapter 4: Diabetes health status and risk factors. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(56) Mo F, Pogany LM, Li FCK, Morrison H. Prevalence of diabetes and cardiovascular comorbidity in the Canadian Community Health Survey 2002-2003. ScientificWorldJournal 2006;6:96-105.

(57) Manuel DG, Schultz SE. Health-related quality of life and health-adjusted life expectancy of people with diabetes in Ontario, Canada, 1996-1997. Diabetes Care 2004;27(2):407-414.

(58) Wray LA, Ofstedal MB, Langa KM, Blaum CS. The effect of diabetes on disability in middle-aged and older adults. J Gerontol A Biol Sci Med Sci 2005;60(9):1206-1211.

(59) Wu JH, Haan MN, Liang J, Ghosh D, Gonzalez HM, Herman WH. Diabetes as a predictor of change in functional status among older Mexican Americans: a population-based cohort study. Diabetes Care 2003;26(2):314-319.

(60) Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes - a meta-analysis. Diabetes Care 2001;24(6):1069-1078.

(61) Bierman AS, Ahmad F, Angus J, Glazier RH, Vahabi M, Damba C, et al. Burden of Illness In: Bierman AS, editor. Project for an Ontario Women's Health Evidence-Based Report. Toronto, 2009.

(62) Fortin M, Bravo G, Hudon C, Vanasse A, Lapointe L. Prevalence of multimorbidity among adults seen in family practice. Ann Fam Med 2005;3(3):223-228.

(63) Marengoni A, Winblad B, Karp A, Fratiglioni L. Prevalence of chronic diseases and multimorbidity among the elderly population in Sweden. Am J Public Health 2008;98(7):1198-1200.

(64) van den Akker M, Buntinx F, Metsemakers JFM, Roos S, Knottnerus JA. Multimorbidity in general practice: prevalence, incidence, and determinants of co-occurring chronic and recurrent diseases. J Clin Epidemiol 1998;51(5):367-375.

(65) Kessler RC. Epidemiology of women and depression. J Affect Disord 2003;74(1):5-13.

(66) Kessler RC, McGonagle KA, Nelson CB, Hughes M, Swartz M, Blazer DG. Sex and depression in the National Comorbidity Survey II: Cohort effects. J Affect Disord 1994;30(1):15-26.

(67) Nolen-Hoeksema S. Sex-differences in unipolar depression: evidence and theory. Psychol Bull 1987;101(2):259-282.

(68) Wolk SI, Weissman MM. Women and depression: an update. American Psychiatric Press Review of Psychiatry 1995;14:227-259.

(69) Wilkins K, Park E. Chronic conditions, physical limitations and dependency among seniors living in the community. Health Rep 1996;8(3):7-15.

(70) Zunzunegui MV, Nunez O, Durban M, de Yebenes MJG, Otero A. Decreasing prevalence of disability in activities of daily living, functional limitations and poor self-rated health: a 6-year follow-up study in Spain. Aging Clin Exp Res 2006;18(5):352-358.

(71) Chen HF, Ho CA, Li CY. Age and sex may significantly interact with diabetes on the risks of lower-extremity amputation and peripheral revascularization procedures: evidence from a cohort of a half-million diabetic patients. Diabetes Care 2006;29(11):2409-2414.

(72) Health Council of Canada. Why health care renewal matters: lessons from diabetes. Toronto: Health Council of Canada, 2007.

(73) Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med 2002;346(6):393-403.

(74) Glazier RH, Bajcar J, Kennie NR, Willson K. A systematic review of interventions to improve diabetes care in socially disadvantaged populations. Diabetes Care 2006;29(7):1675-1688.

(75) Hux JE, Ivis F, Flintoft V, Bica A. Diabetes in Ontario: determination of prevalence and incidence using a validated administrative data algorithm. Diabetes Care 2002;25(3):512-516.

(76) Manuel DG, Rosella LCA, Tuna M, Bennett C. How many Canadians will be diagnosed with diabetes between 2007 and 2017? Assessing population risk. ICES Investigative Report. Toronto: Institute for Clinical Evaluative Sciences, 2010.

(77) Congdon P. Estimating diabetes prevalence by small area in England. J Public Health 2006;28(1):71-81.

(78) Lindstrom J, Ilanne-Parikka P, Peltonen M, Aunola S, Eriksson JG, Hemio K, et al. Sustained reduction in the incidence of type 2 diabetes by lifestyle intervention: follow-up of the Finnish Diabetes Prevention Study. Lancet 2006;368(9548):1673-1679.

(79) Tonstad S. Cigarette smoking, smoking cessation, and diabetes. Diabetes Res Clin Pract 2009;85(1):4-13.

(80) Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. N Engl J Med 2001;344(18):1343-1350.

(81) Willi C, Bodenmann P, Ghali WA, Faris PD, Cornuz J. Active smoking and the risk of type 2 diabetes: a systematic review and meta-analysis. JAMA 2007;298(22):2654-2664.

(82) Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2008 clinical practice guidelines for the prevention and management of diabetes in Canada. Can J Diabetes 2008;32(Suppl 1):S1-S201.

(83) Shields M, Tremblay MS. Sedentary behaviour and obesity. Health Rep 2008;19(2):19-30.

(84) Shields M. Smoking—prevalence, bans and exposure to second-hand smoke. Health Rep 2007;18(3):67-85.

(85) Mamdani M, Hux JE. The increasing burden of diabetes in Canada. Can J Diabetes 2004;28(2):112-113.

(86) Young TK, Mustard CA. Undiagnosed diabetes: does it matter? CMAJ 2001;164(1):24-28.

(87) de Groot M, Kushnick M, Doyle T, Merrill J, McGlynn M, Shubrook J, et al. Depression among adults with diabetes: prevalence, impact, and treatment options. Diabetes Spectr 2010;23(1):15-18.

(88) Durso SC. Using clinical guidelines designed for older adults with diabetes mellitus and complex health status. JAMA 2006;295(16):1935-1940.

(89) Williams J. Diabetes and the older adult: what care do they need and what do they receive? Journal of Diabetes Nursing 2009;13(8):308-310.

(90) Lin E, Diaz-Granados N, Stewart D, Rhodes A, Yeritsyan N, Johns A, et al. Depression In: Bierman AS, editor. Project for an Ontario Women's Health Evidence-Based Report Toronto, 2009

(91) Adler AI, Stratton IM, Neil HAW, Yudkin JS, Matthews DR, Cull CA, et al. Association of systolic blood pressure with macrovascular and microvascular complications of type 2 diabetes (UKPDS 36): prospective observational study. BMJ 2000;321(7258):412-419.

(92) Czupryniak L, Saryusz-Wolska M, Pawlowski M, Loba J. Elevated systolic blood pressure is present in almost all individuals with newly diagnosed diabetes. J Hum Hypertens 2006;20(3):231-233.

(93) Turner R, Holman R, Stratton I, Cull C, Frighi V, Manley S, et al. Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. BMJ 1998;317(7160):703-713.

(94) Bierman AS, Bubolz TA, Fisher ES, Wasson JH. How well does a single question about health predict the financial health of Medicare managed care plans? Eff Clin Pract 1999;2(2):56-62.

(95) DeSalvo KB, Bloser N, Reynolds K, He J, Muntner P. Mortality prediction with a single general self-rated health question: a meta-analysis. J Gen Intern Med 2006;21(3):267-275.

(96) Shields M, Shooshtari S. Determinants of self-perceived health. Health Rep 2001;13(1):35-52.

(97) Bourdel-Marchasson I, Dubroca B, Manciet G, Decamps A, Emeriau JP, Dartigues JF. Prevalence of diabetes and effect on quality of life in older French living in the community: the PAQUID Epidemiological Survey. J Am Geriatr Soc 1997;45(3):295-301.

(98) Tsai J, Ford ES, Li C, Zhao G, Balluz LS. Physical activity and optimal self-rated health of adults with and without diabetes. BMC Public Health 2010;10(365)

(99) Dasbach EJ, Klein R, Klein BEK, Moss SE. Self-rated health and mortality in people with diabetes. Am J Public Health 1994;84(11):1775-1779.

(100) Hayes AJ, Clarke PM, Glasziou PG, Simes RJ, Drury PL, Keech AC. Can self-rated health scores be used for risk prediction in patients with type 2 diabetes? Diabetes Care 2008;31(4):795-797.

(101) McEwen LN, Kim C, Haan MN, Ghosh D, Lantz PM, Thompson TJ, et al. Are health-related quality-of-life and self-rated health associated with mortality? Insights from Translating Research Into Action for Diabetes (TRIAD). Prim Care Diabetes 2009;3(1):37-42.

(102) Ahroni JH, Boyko EJ, Davignon DR, Pecoraro RE. The health and functional status of veterans with diabetes. Diabetes Care 1994;17(4):318-321.

(103) Gregg EW, Beckles GLA, Williamson DF, Leveille SG, Langlois JA, Engelgau MM, et al. Diabetes and physical disability among older U.S. adults. Diabetes Care 2000;23(9):1272-1277.

(104) Bruce DG, Davis WA, Davis TME. Longitudinal predictors of reduced mobility and physical disability in patients with type 2 diabetes: the Fremantle Diabetes Study. Diabetes Care 2005;28(10):2441-2447.

(105) Li C-L, Chang H-Y, Wang H-H, Bai Y-B. Diabetes, functional ability, and self-rated health independently predict hospital admission within one year among older adults: a population based cohort study. Arch Gerontol Geriatr in press. Available online 24 March 2010.

(106) Wilhide C, Hayes JR, Farah JR. Impact of behavioral adherence on clinical improvement and functional status in a diabetes disease management program. Dis Manag 2008;11(3):169-175.

(107) American Diabetes Association. Nutrition recommendations and interventions for diabetes: a position statement of the American Diabetes Association. Diabetes Care 2008;31(Suppl 1):S61-S78.

(108) Sigal RJ, Kenny GP, Wasserman DH, Castaneda-Sceppa C, White RD. Physical activity/exercise and type 2 diabetes: a consensus statement from the American Diabetes Association. Diabetes Care 2006;29(6):1433-1438.

(109) Wing RR, Goldstein MG, Acton KJ, Birch LL, Jakicic JM, Sallis Jr JF, et al. Behavioral science research in diabetes: lifestyle changes related to obesity, eating behavior, and physical activity. Diabetes Care 2001;24(1):117-123.

(110) Gaede P, Vedel P, Larsen N, Jensen GVH, Parving H, Pedersen O. Multifactorial intervention and cardiovascular disease in patients with type 2 diabetes. N Engl J Med 2003;348(5):383-393.

(111) Fagard RH, Nilsson PM. Smoking and diabetes—the double health hazard! Prim Care Diabetes 2009;3(4):205-209.

(112) Hueston WJ. Does having a personal physician improve quality of care in diabetes? J Am Board Fam Med 2010;23(1):82-87.

(113) O'Connor PJ, Desai J, Rush WA, Cherney LM, Solberg LI, Bishop DB. Is having a regular provider of diabetes care related to intensity of care and glycemic control? J Fam Pract 1998;47(4):290-297.

(114) Cabana MD, Jee SH. Does continuity of care improve patient outcomes? J Fam Pract 2004;53(12):974-980.

(115) Jaakkimainen L, Shah BR, Kopp A. Chapter 9: Sources of physician care for people with diabetes. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(116) Bierman AS, Angus J, Ahmad F, Degani N, Vahabi M, Glazier RH, et al. Access to Health Care Services. In: Bierman AS, editor. Project for an Ontario Women's Health Evidence-Based Report. Toronto, 2010.

(117) Fiscella K, Franks P, Gold MR, Clancy CM. Inequality in quality: addressing socioeconomic, racial and ethnic disparities in health care. JAMA 2000;283(19):2579-2584.

(118) Hux JE, Booth GL, Slaughter PM, Laupacis A. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(119) Jencks SF, Cuerdon T, Burwen DR, Fleming B, Houck PM, Kussmaul AE, et al. Quality of medical care delivered to medicare beneficiaries: a profile at state and national levels. JAMA 2000;284(13):1670-1676.

(120) Kosiak B, Sangl J, Correa-de-Araujo R. Quality of health care for older women: what do we know? Womens Health Iss 2006;16(2):89-99.

(121) Shah BR. Utilization of physician services for diabetic patients from ethnic minorities. J Public Health 2008;30(3):327–331.

(122) Bird CE, Fremont AM, Bierman AS, Wickstrom S, Shah M, Rector T, et al. Does quality of care for cardiovascular disease and diabetes differ by gender for enrollees in managed care plans? Womens Health Iss 2007;17(3):131-138.

(123) Brown AF, Gregg EW, Stevens MR, Karter AJ, Weinberger M, Safford MM, et al. Race, ethnicity, socioeconomic position, and quality of care for adults with diabetes enrolled in managed care: the Translating Research Into Action for Diabetes (TRIAD) study. Diabetes Care 2005;28(12):2864-2870.

(124) Ontario Health Quality Council. Quality Monitor: 2010 Report on Ontario's Health System. Toronto: Ontario Health Quality Council, 2010.

(125) Statistics Canada. Access to Health Care Services in Canada: January to December 2005. Accessed August 9, 2010 at http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=82-575-XIE2006002&lang=eng&issnote=1

(126) Davis K, Schoen C, Stremikis K. Mirror, Mirror on the Wall: How the Performance of the U.S. Health Care System Compares Internationally, 2010 Update. New York The Commonwealth Fund, 2010.

(127) Shah BR, Hux JE, Laupacis A, Zinman B, Austin PC, Van Walraven C. Diabetic patients with prior specialist care have better glycaemic control than those with prior primary care. J Evaluation Clin Prac 2005;11(6):568-575.

(128) Zgibor JC, Songer TJ, Kelsey SF, Drash AL, Orchard TJ. Influence of health care providers on the development of diabetes complications: Long-term follow-up from

the Pittsburgh Epidemiology of Diabetes Complications Study. Diabetes Care 2002;25(9):1584-1590.

(129) The Diabetes Control and Complications Trial/ Epidemiology of Diabetes Interventions and Complications Research Group. Retinopathy and nephropathy in patients with type 1 diabetes four years after a trial of intensive therapy. N Engl J Med 2000;342(6):381-389.

(130) UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). Lancet 1998;352(9131):837-853.

(131) McCabe CJ, Stevenson RC, Dolan AM. Evaluation of a diabetic foot screening and protection programme. Diabet Med 1998;15(1):80-84.

(132) Litzelman DK, Slemenda CW, Langefeld CD, Hays LM, Welch MA, Bild DE, et al. Reduction of lower extremity clinical abnormalities in patients with non-insulin-dependent diabetes mellitus: a randomized, controlled trial. Ann Intern Med 1993;119(1):36-41.

(133) Karter AJ, Ackerson LM, Darbinian JA, D'Agostino Jr RB, Ferrara A, Liu J, et al. Self-monitoring of blood glucose levels and glycemic control: the Northern California Kaiser Permanente Diabetes Registry. Am J Med 2001;111(1):1-9.

(134) Heller SR. Self monitoring of blood glucose in type 2 diabetes. BMJ 2007;335(7611):105-106.

(135) Leatherman S, Sutherland K. Quality of health care in Canada: a chartbook. Ottawa: Canadian Health Services Research Foundation, 2010.

(136) Jha AK, Perlin JB, Kizer KW, Dudley RA. Effect of the transformation of the veterans affairs health care system on the quality of care. N Engl J Med 2003;348(22):2218-2227.

(137) Khunti K, Gadsby R, Millett C, Majeed A, Davies M. Quality of diabetes care in the UK: comparison of published quality-of-care reports with results of the Quality and Outcomes Framework for Diabetes. Diabet Med 2007;24(12):1436-1441.

(138) Krein SL, Hayward RA, Pogach L, Bootsmiller BJ. Department of Veterans Affairs' Quality Enhancement Research Initiative for Diabetes Mellitus. Med Care 2000;38(6 Suppl 1):I38-I48

(139) Clar C, Barnard K, Cummins E, Royle P, Waugh N. Self-monitoring of blood glucose in type 2 diabetes: systematic review. Health Technol Assess 2010;14(12):1-140.

(140) Centers for Disease Control and Prevention. National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2007. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2008.

(141) Bäcklund LB, Algvere PV, Rosenqvist U. New blindness in diabetes reduced by more than one-third in Stockholm County. Diabet Med 1997;14(9):732-740.

(142) Jones S, Edwards RT. Diabetic retinopathy screening: a systematic review of the economic evidence. Diabet Med 2010;27(3):249-256.

(143) Winkley K, Stahl D, Chalder T, Edmonds ME, Ismail K. Quality of life in people with their first diabetic foot ulcer: a prospective cohort study. J Am Podiatr Med Assoc 2009;99(5):406-414.

(144) White JC, Bell RA, Langefeld CD, Jackson SA. Preventive foot-care practices among adults with diabetes in North Carolina, 1997 to 2001. J Am Podiatr Med Assoc 2004;94(5):483-491.

(145) Bild DE, Selby JV, Sinnock P, Browner WS, Braveman P, Showstack JA. Lower-extremity amputation in people with diabetes. Epidemiology and prevention. Diabetes Care 1989;12(1):24-31.

(146) Chávarry NG, Vettore MV, Sansone C, Sheiham A. The relationship between diabetes mellitus and destructive periodontal disease: a meta-analysis. Oral Health Prev Dent 2009;7(2):107-127.

(147) Nagasawa T, Noda M, Katagiri S, Takaichi M, Takahashi Y, Wara-Aswapati N, et al. Relationship between periodontitis and diabetes - importance of a clinical study to prove the vicious cycle. Intern Med 2010;49(10):881-885.

(148) Saremi A, Nelson RG, Tulloch-Reid M, Hanson RL, Sievers ML, Taylor GW, et al. Periodontal disease and mortality in type 2 diabetes. Diabetes Care 2005;28(1):27-32.

(149) Shultis WA, Weil EJ, Looker HC, Curtis JM, Shlossman M, Genco RJ, et al. Effect of periodontitis on overt nephropathy and end-stage renal disease in type 2 diabetes. Diabetes Care 2007;30(2):306-311.

(150) Taylor GW, Burt BA, Becker MP, Genco RJ, Shlossman M, Knowler WC, et al. Severe periodontitis and risk for poor glycemic control in patients with non-insulin-dependent diabetes mellitus. J Periodontol 1996;67(Suppl 10):1085-1093.

(151) Thorstensson H, Kuylenstierna J, Hugoson A. Medical status and complications in relation to periodontal disease experience in insulin-dependent diabetics. J Clin Periodontol 1996;23(3 Pt 1):194-202.

(152) Ryan ME. Diagnostic & therapeutic strategies for the management of the diabetic patient. Compend Contin Educ Dent 2008;29(1):32-38, 40-44.

(153) Schwartz B. Access to dental care: a social justice discussion. Alpha Omegan 2007;100(3):143-147.

(154) Main P, Leake J, Burman D. Oral health care in Canada—a view from the trenches. J Can Dent Assoc 2006;72(4):319.

(155) Shamoon H, Duffy H, Fleischer N, Engel S, Saenger P, Strelzyn M, et al. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med 1993;329(14):977-986.

(156) UK Prospective Diabetes Study (UKPDS) Group. Effect of intensive blood-glucose control with metformin on complications in overweight patients with type 2 diabetes (UKPDS 34). Lancet 1998;352(9131):854-865.

(157) Gerstein HC, Miller ME, Byington RP, Goff DC, Jr., Bigger JT, Buse JB, et al. Effects of intensive glucose lowering in type 2 diabetes. N Engl J Med 2008;358(24):2545-2559.

(158) Booth GL, Kapral MK, Fung K, Tu JV. Relation between age and cardiovascular disease in men and women with diabetes compared with non-diabetic people: a population-based retrospective cohort study. Lancet 2006;368(9529):29-36.

(159) Brenner BM, Cooper ME, De Zeeuw D, Keane WF, Mitch WE, Parving HH, et al. Effects of losartan on renal and cardiovascular outcomes in patients with type 2 diabetes and nephropathy. N Engl J Med 2001;345(12):861-869.

(160) de Galan BE, Perkovic V, Ninomiya T, Pillai A, Patel A, Cass A, et al. Lowering blood pressure reduces renal events in type 2 diabetes. J Am Soc Nephrol 2009;20(4):883-892.

(161) Gerstein HC, Yusuf S, Mann JFE, Hoogwerf B, Zinman B, Held C, et al. Effects of ramipril on cardiovascular and microvascular outcomes in people with diabetes mellitus: results of the HOPE study and MICRO-HOPE substudy. Lancet 2000;355(9200):253-259.

(162) Lindholm LH, Ibsen H, Dahlöf B, Devereux RB, Beevers G, De Faire U, et al. Cardiovascular morbidity and mortality in patients with diabetes in the Losartan Intervention For Endpoint reduction in hypertension study (LIFE): a randomised trial against atenolol. Lancet 2002;359(9311):1004-1010.

(163) Parving HH, Lehnert H, Brochner-Mortensen J, Gomis R, Andersen S, Arner P. The effect of irbesartan on the development of diabetic nephropathy in patients with type 2 diabetes. N Engl J Med 2001;345(12):870-878.

(164) The TRANSCEND Investigators. Effects of the angiotensin-receptor blocker telmisartan on cardiovascular events in high-risk patients intolerant to angiotensin-converting enzyme inhibitors: a randomised controlled trial. Lancet 2008;372(9644):1174-1183.

(165) MacLean DR, Petrasovits A, Connelly PW, Joffres M, O'Connor B, Little JA. Plasma lipids and lipoprotein reference values, and the prevalence of dyslipoproteinemia in Canadian adults. Can J Cardiol 1999;15(4):434-444.

(166) Heart Protection Study Collaborative Group. MRC/BHF Heart Protection Study of cholesterol-lowering with simvastatin in 5963 people with diabetes: a randomised placebo-controlled trial. Lancet 2003;361(9374):2005-2016.

(167) Bierman AS, Jaakkimainen RL, Abramson BL, Kapral MK, Azad N, Hall R, et al. Cardiovascular Disease. In: Bierman AS, editor. Project for an Ontario Women's Health Evidence-Based Report. Toronto, 2009.

(168) Gouni-Berthold I, Berthold HK, Mantzoros CS, BÃ¶hm M, Krone W. Sex disparities in the treatment and control of cardiovascular risk factors in type 2 diabetes. Diabetes Care 2008;31(7):1389-1391.

(169) Safford M, Eaton L, Hawley G, Mangala Rajan MB, Li H, Pogach L. Disparities in use of lipid-lowering medications among people with type 2 diabetes mellitus. Arch Intern Med 2003;163(8):922-928.

(170) Sequist TD, Adams A, Zhang F, Ross-Degnan D, Ayanian JZ. Effect of quality improvement on racial disparities in diabetes care. Arch Intern Med 2006;166(6):675-681.

(171) Tseng CW, Tierney EF, Gerzoff RB, Dudley RA, Waitzfelder B, Ackermann RT, et al. Race/ethnicity and economic differences in cost-related medication underuse among insured adults with diabetes: The translating research into action for diabetes study. Diabetes Care 2008;31(2):261-266.

(172) Weinstock RS, Izquierdo R, Goland R, Palmas W, Teresi JA, Eimicke JP, et al. Lipid treatment in ethnically diverse underserved older adults with diabetes mellitus: statin use, goal attainment, and health disparities in the informatics for diabetes education and telemedicine project. J Am Geriatr Soc 2010;58(2):401-402.

(173) De Berardis G, Sacco M, Strippoli GF, Pellegrini F, Graziano G, Tognoni G, et al. Aspirin for primary prevention of cardiovascular events in people with diabetes: meta-analysis of randomised controlled trials. BMJ 2009;339:b4531.

(174) Calvin AD, Aggarwal NR, Murad MH, Shi Q, Elamin MB, Geske JB, et al. Aspirin for the primary prevention of cardiovascular events: a systematic review and meta-analysis comparing patients with and without diabetes. Diabetes Care 2009;32(12):2300-2306.

(175) Pignone M, Alberts MJ, Colwell JA, Cushman M, Inzucchi SE, Mukherjee D, et al. Aspirin for primary prevention of cardiovascular events in people with diabetes: a position statement of the American Diabetes Association, a scientific statement of the American Heart Association, and an expert consensus document of the American College of Cardiology Foundation. Diabetes Care 2010;33(6):1395-1402.

(176) Zhang C, Sun A, Zhang P, Wu C, Zhang S, Fu M, et al. Aspirin for primary prevention of cardiovascular events in patients with diabetes: a meta-analysis. Diabetes Res Clin Pract 2010;87(2):211-218.

(177) Alexander GC, Sehgal NL, Moloney RM, Stafford RS. National trends in treatment of type 2 diabetes mellitus, 1994-2007. Arch Intern Med 2008;168(19):2088-2094.

(178) Grant RW, McCarthy EP, Singer DE, Meigs JB. Frequent outpatient contact and decreasing medication affordability in patients with diabetes from 1997 to 2004. Diabetes Care 2006;29(6):1386-1388.

(179) Kwan J, Razzaq A, Leiter LA, Lillie D, Hux JE. Low socioeconomic status and absence of supplemental health insurance as barriers to diabetes care access and utilization. Canadian Journal of Diabetes 2008;32(3):174-181.

(180) Piette JD, Heisler M, Wagner TH. Problems paying out-of-pocket medication costs among older adults with diabetes. Diabetes Care 2004;27(2):384-391.

(181) Tamblyn R, Laprise R, Hanley JA, Abrahamowicz M, Scott S, Mayo N, et al. Adverse events associated with prescription drug cost-sharing among poor and elderly people. JAMA 2001;285(4):421-429.

(182) Gazmararian JA, Kripalani S, Miller MJ, Echt KV, Ren J, Rask K. Factors associated with medication refill adherence in cardiovascular- related diseases: A focus on health literacy. J Gen Intern Med 2006;21(12):1215-1221.

(183) Kripalani S, Gatti ME, Jacobson TA. Association of age, health literacy, and medication management strategies with cardiovascular medication adherence. Patient Educ Couns, in press.

(184) Schillinger D, Grumbach K, Piette J, Wang F, Osmond D, Daher C, et al. Association of health literacy with diabetes outcomes. JAMA 2002;288(4):475-482.

(185) Boyd CM, Darer JD, Boult C, Fried LP, Boult L, Wu AW. Clinical practice guidelines for older patients with comorbid diseases [4]. JAMA 2006;295(1):34-35.

(186) The ONTARGET Investigators. Telmisartan, ramipril, or both in patients at high risk for vascular events. N Engl J Med 2008;358(15):1547-1559.

(187) Booth GL, Kapral MK, Fung K, Tu JV. Recent trends in cardiovascular complications among men and women with and without diabetes. Diabetes Care 2006;29(1):32-37.

(188) Hux JE, Jacka R, Fung K, Rothwell DM. Chapter 6: Diabetes and peripheral vascular disease. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(189) Kapral MK, Rothwell DM, Fung K, Tang M, Booth GL, Laupacis A. Chapter 7: Diabetes and stroke. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(190) Lok CE, Oliver MJ, Rothwell DM, Hux JE. The growing volume of diabetes-related dialysis: a population based study. Nephrol Dial Transplant 2004;19(12):3098-3103.

(191) Klein R, Klein BEK. Vision disorders in diabetes. In: National Diabetes Data Group, editor. Diabetes in America. 2nd ed. Washington: National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, 1995:293-338.

(192) Duckworth W, Abraira C, Moritz T, Reda D, Emanuele N, Reaven PD, et al. Glucose control and vascular complications in veterans with type 2 diabetes. N Engl J Med 2009;360(2):129-139.

(193) Booth GL, Hux JE, Fang J, Chan BT. Time trends and geographic disparities in acute complications of diabetes in Ontario, Canada. Diabetes Care 2005;28(5):1045-1050.

(194) Thomas B, Dorling D, Smith GD. Inequalities in premature mortality in Britain: observational study from 1921 to 2007. BMJ 2010;341:c3639.

(195) Rognerud MA, Zahl PH. Social inequalities in mortality: changes in the relative importance of income, education and household size over a 27-year period. Eur J Public Health 2006;16(1):62-68.

(196) Bachmann MO, Eachus J, Hopper CD, Smith GD, Proppert C, Pearson NJ, et al. Socio-economic inequalities in diabetes complications, control, attitudes and health service use: a cross-sectional study. Diabet Med 2003;20(11):921-929.

(197) Booth GL, Hux JE. Relationship between avoidable hospitalizations for diabetes mellitus and income level. Arch Intern Med 2003;163(1):101-106.

(198) Dray-Spira R, Gary TL, Brancati FL. Socioeconomic position and cardiovascular disease in adults with and without diabetes: United States trends, 1997-2005. J Gen Intern Med 2008;23(10):1634-1641.

(199) Chaturvedi N, Stephenson JM, Fuller JH. The relationship between socioeconomic status and diabetes control and complications in the EURODIAB IDDM Complications Study. Diabetes Care 1996;19(5):423-430.

(200) Larranaga I, Arteagoitia JM, Rodriguez JL, Gonzalez F, Esnaola S, Piniés JA. Socio-economic inequalities in the prevalence of Type 2 diabetes, cardiovascular risk factors and chronic diabetic complications in the Basque Country, Spain. Diabet Med 2005;22(8): 1047-1053.

(201) Drewnowski A, Darmon N, Briend A. Replacing fats and sweets with vegetables and fruits—a question of cost. Am J Public Health 2004;94(9):1555-1559.

(202) Glazier RH, Creatore MI, Gozdyra P, Weyman J, Booth GL. Access to healthy resources. In: Glazier RH, Booth GL, editors. Neighbourhood environments and resources for healthy living: A focus on diabetes in Toronto. Toronto: Institute for Clinical Evaluative Sciences, 2007.

(203) Hemphill E, Raine K, Spence JC, Smoyer-Tomic KE. Exploring obesogenic food environments in Edmonton, Canada: the association between socioeconomic factors and fast-food outlet access. Am J Health Promot 2008;22(6):426-432.

(204) Morland K, Wing S, Diez Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. Am J Prev Med 2002;22(1):23-29.

(205) Jotkowitz AB, Rabinowitz G, Segal AR, Weitzman R, Epstein L, Porath A. Do patients with diabetes and low socioeconomic status receive less care and have worse outcomes? A National study. Am J Med 2006;119(8):665-669.

(206) Wild S, MacLeod F, McKnight J, Watt G, MacKenzie C, Ford I, et al. Impact of deprivation on cardiovascular risk factors in people with diabetes: an observational study. Diabet Med 2008;25(2):194-199.

(207) Shah BR, Anand S, Zinman B, Duong-Hua M. Chapter 13: Diabetes and First Nations People. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(208) Janghorbani M, Jones RB, Allison SP. Incidence of and risk factors for proliferative retinopathy and its association with blindness among diabetes clinic attenders. Ophthalmic Epidemiol 2000;7(4):225-241.

(209) Klein R, Klein BEK, Moss SE, Cruickshanks KJ. The wisconsin epidemiologic study of diabetic retinopathy: XVII. The 14- year incidence and progression of diabetic retinopathy and associated risk factors in type 1 diabetes. Ophthalmology 1998;105(10):1801-1815.

(210) Orchard TJ, Dorman JS, Maser RE, Becker DJ, Drash AL, Ellis D, et al. Prevalence of complications in IDDM by sex and duration. Pittsburgh Epidemiology of Diabetes Complications Study II. Diabetes 1990;39(9):1116-1124.

(211) Ferrara A, Williamson DF, Karter AJ, Thompson TJ, Kim C. Sex differences in quality of health care related to ischemic heart disease prevention in patients with diabetes: the translating research into action for Diabetes (TRIAD) study, 2000-2001. Diabetes Care 2004;27(12):2974-2976.

(212) McFarlane SI, Castro J, Kaur J, Shin JJ, Kelling D, Jr., Farag A, et al. Control of blood pressure and other cardiovascular risk factors at different practice settings: outcomes of care provided to diabetic women compared to men. J Clin Hypertens (Greenwich) 2005;7(2):73-80.

(213) Nilsson PM, Theobald H, Journath G, Fritz T. Gender differences in risk factor control and treatment profile in diabetes: a study in 229 swedish primary health care centres. Scand J Prim Health Care 2004;22(1):27-31.

(214) Sarafidis PA, McFarlane SI, Bakris GL. Gender disparity in outcomes of care and management for diabetes and the metabolic syndrome. Curr Diab Rep 2006;6(3):219-224.

(215) Wexler DJ, Grant RW, Meigs JB, Nathan DM, Cagliero E. Sex disparities in treatment of cardiac risk factors in patients with type 2 diabetes. Diabetes Care 2005;28(3):514-520.

(216) Mühlhauser I, Bruckner I, Berger M, Cheta D, Jorgens V, Ionescu-Tirgoviste C, et al. Evaluation of an intensified insulin treatment and teaching programme as routine management of type 1 (insulin-dependent) diabetes. The Bucharest-Dusseldorf Study. Diabetologia 1987;30(9):681-690.

(217) Frykberg RG, Veves A. Diabetic foot infections. Diabetes Metab Rev 1996;12(3):255-270.

(218) Reiber GE, Pecoraro RE, Koepsell TD. Risk factors for amputation in patients with diabetes mellitus. A case-control study. Ann Intern Med 1992;117(2):97-105.

(219) Lee WL, Cheung AM, Cape D, Zinman B. Impact of diabetes on coronary artery disease in women and men: a meta-analysis of prospective studies. Diabetes Care 2000;23(7):962-968.

(220) Morgan CD, Sykora K, Naylor CD, the Steering Committee of the Cardiac Care Network of Ontario. Analysis of deaths while waiting for cardiac surgery among 29,293 consecutive patients in Ontario, Canada. Heart 1998;79(4):345-349.

(221) Statistics Canada. Leading Causes of Death in Canada, 2006. Accessed August 17, 2010 at http://www.statcan.gc.ca/pub/84-215-x/84-215-x2010000-eng.htm.

(222) Cina CS, Clase CM, Haynes BR. Refining the indications for carotid endarterectomy in patients with symptomatic carotid stenosis: a systematic review. J Vasc Surg 1999;30(4):606-617.

(223) Pomposelli FB, Kansal N, Hamdan AD, Belfield A, Sheahan M, Campbell DR, et al. A decade of experience with dorsalis pedis artery bypass: analysis of outcome in more than 1000 cases. J Vasc Surg 2003;37(2):307-315.

(224) Lewis EJ, Hunsicker LG, Bain RP, Rohde RD. The effect of angiotensin-converting-enzyme inhibition on diabetic nephropathy. The Collaborative Study Group. N Engl J Med 1993;329(20):1456-1462.

(225) The Diabetes Control and Complications (DCCT) Research Group. Effect of intensive therapy on the development and progression of diabetic nephropathy in the Diabetes Control and Complications Trial. Kidney Int 1995;47:1703-1720.

(226) Kempen JH, O'Colmain BJ, Leske MC, Haffner SM, Klein R, Moss SE, et al. The prevalence of diabetic retinopathy among adults in the United States. Arch Ophthalmol 2004;122(4):552-563.

(227) CNIB National Office. Canadian National Institute of Blindness Client Database. Toronto, 2002.

(228) Klein R, Klein BE, Moss SE. Epidemiology of proliferative diabetic retinopathy. Diabetes Care 1992;15(12):1875-1891.

(229) The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med 1993;329(14):977-986.

(230) Early Treatment Diabetic Retinopathy Study Research Group. Photocoagulation for diabetic macular edema. Early Treatment Diabetic Retinopathy Study report number 1. Arch Ophthalmol 1985;103(12):1796-1806.

(231) The Diabetic Retinopathy Study Research Group. Photocoagulation treatment of proliferative diabetic retinopathy: the second report of diabetic retinopathy study findings. Ophthalmology 1978;85(1):82-106.

(232) Caird FI, Burditt AF, Draper GJ. Diabetic retinopathy. A further study of prognosis for vision. Diabetes 1968;17(3):121-123.

(233) The Diabetic Retinopathy Vitrectomy Study Research Group. Early vitrectomy for severe proliferative diabetic retinopathy in eyes with useful vision. Results of a randomized trial—Diabetic Retinopathy Vitrectomy Study Report 3. Ophthalmology 1988;95(10):1307-1320.

(234) The Diabetic Retinopathy Vitrectomy Study Research Group. Early vitrectomy for severe vitreous hemorrhage in diabetic retinopathy. Four-year results of a randomized trial: Diabetic Retinopathy Vitrectomy Study Report 5. Arch Ophthalmol 1990;108(7):958-964.

(235) Ray JG, O'Brien TE, Chan WS. Preconception care and the risk of congenital anomalies in the offspring of women with diabetes mellitus: a meta-analysis. Q J Med 2001;94(8):435-444.

(236) McElvy SS, Miodovnik M, Rosenn B, Khoury JC, Siddiqi T, Dignan PS, et al. A focused preconceptional and early pregnancy program in women with type 1 diabetes reduces perinatal mortality and malformation rates to general population levels. J Matern Fetal Med 2000;9(1):14-20.

(237) Hiilesmaa V, Suhonen L, Teramo K. Glycaemic control is associated with pre-eclampsia but not with pregnancy-induced hypertension in women with type I diabetes mellitus. Diabetologia 2000;43(12):1534-1539.

(238) Jovanovic L, Knopp RH, Kim H, Cefalu WT, Zhu XD, Lee YJ, et al. Elevated pregnancy losses at high and low extremes of maternal glucose in early normal and diabetic pregnancy: evidence for a protective adaptation in diabetes. Diabetes Care 2005;28(5):1113-1117.

(239) The Diabetes Control and Complications Trial Research Group. Effect of pregnancy on microvascular complications in the diabetes control and complications trial. Diabetes Care 2000;23(8):1084-1091.

(240) Jovanovic L, Druzin M, Peterson CM. Effect of euglycemia on the outcome of pregnancy in insulin-dependent diabetic women as compared with normal control subjects. Am J Med 1981;71(6):921-927.

(241) Jovanovic L, Nakai Y. Successful pregnancy in women with type 1 diabetes: from preconception through postpartum care. Endocrinol Metab Clin North Am 2006;35(1):79-97, vi.

(242) Mello G, Parretti E, Mecacci F, La Torre P, Cioni R, Cianciulli D, et al. What degree of maternal metabolic control in women with type 1 diabetes is associated with normal body size and proportions in full-term infants? Diabetes Care 2000;23(10):1494-1498.

(243) Nielsen GL, Moller M, Sorensen HT. HbA1c in early diabetic pregnancy and pregnancy outcomes: a Danish population-based cohort study of 573 pregnancies in women with type 1 diabetes. Diabetes Care 2006;29(12):2612-2616.

(244) Temple R, Aldridge V, Greenwood R, Heyburn P, Sampson M, Stanley K. Association between outcome of pregnancy and glycaemic control in early pregnancy in type 1 diabetes: population based study. BMJ 2002;325(7375):1275-1276.

(245) Casele HL, Laifer SA. Factors influencing preconception control of glycemia in diabetic women. Arch Intern Med 1998;158(12):1321-4.

(246) Holing EV, Beyer CS, Brown ZA, Connell FA. Why don't women with diabetes plan their pregnancies? Diabetes Care 1998;21(6):889-95.

(247) Janz NK, Herman WH, Becker MP, Charron-Prochownik D, Shayna VL, Lesnick TG, et al. Diabetes and pregnancy. Factors associated with seeking pre-conception care. Diabetes Care 1995;18(2):157-65.

(248) Berger H, Crane J, Farine D, Armson A, De La Ronde S, Keenan-Lindsay L, et al. Screening for gestational diabetes mellitus. J Obstet Gynaecol Can 2002;24(11):894-912.

(249) Reece EA, Leguizamon G, Wiznitzer A. Gestational diabetes: the need for a common ground. Lancet 2009;373(9677):1789-1797.

(250) The HAPO Study Cooperative Research Group. Hyperglycemia and adverse pregnancy outcomes. N Engl J Med 2008;358(19):1991-2002.

(251) Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. N Engl J Med 2005;352(24):2477-2486.

(252) Feig DS, Zinman B, Wang X, Hux JE. Risk of development of diabetes mellitus after diagnosis of gestational diabetes. CMAJ 2008;179(3):229-234.

(253) Montan S. Increased risk in the elderly parturient. Curr Opin Obstet Gynecol 2007;19(2):110-112.

(254) Kramer MS, Seguin L, Lydon J, Goulet L. Socio-economic disparities in pregnancy outcome: why do the poor fare so poorly? Paediatr Perinat Epidemiol 2000;14(3):194-210.

(255) Centers for Disease Control and Prevention (CDC). Vital signs: state-specific obesity prevalence among adults—United States, 2009. MMWR Morb Mortal Wkly Rep. 2010;59(30):951-955.

(256) Brownson RC, Boehmer TK, Luke DA. Declining rates of physical activity in the United States: what are the contributors? Annu Rev Public Health 2005;26:421-443.

(257) Shields M. Measured Obesity. Overweight Canadian children and adolescents. In: Nutrition: Findings from the Canadian Community Health Survey; Issue no. 1. Ottawa: Statistics Canada, 2005.

(258) Statistics Canada. Food Statistics, 2006. Ottawa: Statistics Canada, 2007.

(259) Tjepkema M. Measured Obesity. Adult obesity in Canada: Measured height and weight. In: Nutrition: Findings from the Canadian Community Health Survey; Issue no. 1. Ottawa: Statistics Canada 2005.

(260) Wang Y, Beydoun MA. The obesity epidemic in the United States—gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. Epidemiol Rev 2007;29:6-28.

(261) Leiter LA, Barr A, Bélanger A, Lubin S, Ross SA, Tildesley HD, et al. Diabetes screening in Canada (DIASCAN) study: prevalence of undiagnosed diabetes and glucose intolerance in family physician offices. Diabetes Care 2001;24(6):1038-1043.

(262) Chan B, Harju M. Chapter 14: Supply and utilization of health care services for diabetes. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(263) Davis WA, Norman PE, Bruce DG, Davis TM. Predictors, consequences and costs of diabetes-related lower extremity amputation complicating type 2 diabetes: the Fremantle Diabetes Study. Diabetologia 2006;49(11):2634-2641.

(264) Health Canada. Smoking. A National Strategy. Accessed August 13, 2010 at http://www.hc-sc.gc.ca/hc-ps/pubs/tobac-tabac/ns-sn/preface-eng.php.

(265) Diez Roux AV, Merkin SS, Arnett D, Chambless L, Massing M, Nieto FJ, et al. Neighborhood of residence and incidence of coronary heart disease. N Engl J Med 2001;345(2):99-106.

(266) Hawker GA, Badley EM, Jaglal S, Dunn S, Croxford R, Ko B, et al. Musculoskeletal Conditions. In: Bierman AS, editor. Project for an Ontario Women's Health Evidence-Based Report, 2010.

(267) Hux JE, Tang M. Chapter 1: Patterns of prevalence a nd incidence of diabetes. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(268) Chan BTB, Klomp H, Cascagnette P. Quality of diabetes management in Saskatchewan. Saskatoon: Health Quality Council, 2006.

(269) Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, et al. The effectiveness of interventions to increase physical activity. A systematic review. Am J Prev Med 2002;22(4 Suppl):73-107.

(270) Sallis JF, Bauman A, Pratt M. Environmental and policy interventions to promote physical activity. Am J Prev Med 1998;15(4):379-397.

(271) Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating healthy food and eating environments: policy and environmental approaches. Annu Rev Public Health 2008;29:253-272.

(272) Yancey AK, Kumanyika SK, Ponce NA, McCarthy WJ, Fielding JE, Leslie JP, et al. Population-based interventions engaging communities of color in healthy eating and active living: a review. Prev Chronic Dis 2004;1(1):A09.

(273) Glazier RH, Booth GL, Gozdyra P, Creatore MI, Tynan A-M. Neighbourhood environments and resources for healthy living: a focus on diabetes in Toronto. Toronto: Institute for Clinical Evaluative Sciences, 2008.

(274) Papas MA, Alberg AJ, Ewing R, Helzlsouer KJ, Gary TL, Klassen AC. The built environment and obesity. Epidemiol Rev 2007;29(1):129-143.

(275) Raine K, Spence JC, Church J, Boulé N, Slater L, Marko J, et al. State of the evidence review on urban health and healthy weights. Ottawa: The Canadian Institute for Health Information, 2008.

(276) White House Task Force on Childhood Obesity. Report to the President. Solving the problem of childhood obesity within a generation. Available at http://www.letsmove.gov/obesitytaskforce.php, May 2010.

(277) UK Prospective Diabetes Study Group. Efficacy of atenolol and captopril in reducing risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 39. UK Prospective Diabetes Study Group. BMJ 1998;317(7160):713-720.

(278) Battersby MW. Health reform through coordinated care: SA HealthPlus. BMJ 2005;330(7492):662-665.

(279) Wagner EH, Austin BT, Von Korff M. Organizing care for patients with chronic illness. Milbank Q 1996;74(4):511-544.

(280) Norris SL, Lau J, Smith SJ, Schmid CH, Engelgau MM. Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. Diabetes Care 2002;25(7):1159-1171.

(281) Shojania KG, Ranji SR, McDonald KM, Grimshaw JM, Sundaram V, Rushakoff RJ, et al. Effects of quality improvement strategies for type 2 diabetes on glycemic control: a meta-regression analysis. JAMA 2006;296(4):427-440.

(282) Meigs JB, Cagliero E, Dubey A, Murphy-Sheehy P, Gildesgame C, Chueh H, et al. A controlled trial of web-based diabetes disease management: the MGH diabetes primary care improvement project. Diabetes Care 2003;26(3):750-757.

(283) Shea S, Weinstock RS, Teresi JA, Palmas W, Starren J, Cimino JJ, et al. A randomized trial comparing telemedicine case management with usual care in older, ethnically diverse, medically underserved patients with diabetes mellitus: 5 year results of the IDEATel study. J Am Med Inform Assoc 2009;16(4):446-456.

(284) Duke SA, Colagiuri S, Colagiuri R. Individual patient education for people with type 2 diabetes mellitus. Cochrane Database Syst Rev 2009(1):CD005268.

(285) Hawthorne K, Robles Y, Cannings-John R, Edwards AG. Culturally appropriate health education for Type 2 diabetes in ethnic minority groups: a systematic and narrative review of randomized controlled trials. Diabet Med;27(6):613-623.

(286) Health Canada. Responding to the challenge of diabetes in Canada: first report of the National Diabetes Surveillance System (NDSS) 2003. Ottawa: Health Canada, 2003.

(287) Center for Chronic Disease Prevention and Control, Population and Public Health Branch, Health Canada. Diabetes in Canada. 2nd ed. Ottawa: Health Canada, 2002.

(288) Association of Public Health Epidemiologists in Ontario (APHEO). Core indicators for public health in Ontario. Last accessed August 26, 2010 at http://www.apheo.ca/index.php?pid=55.

(289) Mathers C, Vos T, Stevenson C. The burden of disease and injury in Australia. Canberra: Australian Institute of Health and Welfare, 1999.

(290) Statistics Canada. Comparable health indicators—Canada, provinces and territories, November 2004. Last accessed May 18, 2010 at http://www.statcan.gc.ca/pub/82-401-x/2002000/index-eng.htm.

(291) Kessler RC, Andrews G, Mroczek D, Ustun B, Wittchen HU. The World Health Organization Composite International Diagnostic Interview Short-Form (CIDI-SF). Int J Methods Psychiatr Res 1998;7(4):171-185.

(292) The National Quality Measures Clearinghouse. Diabetes Mellitus. Last accessed May 18, 2010 at http://www.qualitymeasures.ahrq.gov/.

(293) Health Resources and Services Administration, U.S. Department of Health and Human Services. Health Disparities Collaboratives: Diabetes Collaborative. Last Accessed August 31, 2010 at http://www.healthdisparities.net/hdc/html/collaboratives.topics.diabetes.aspx.

(294) National Committee for Quality Assurance (NCQA). HEDIS and quality measurement. Last accessed August 31, 2010 at http://www.ncqa.org/tabid/59/Default.aspx.

(295) Johnson I, Goettler F, Goral A, Leffley A, Lueske B, Lee-Han H, et al. Report on the health status of the residents of Ontario. Ontario: Public Health Research, Education & Development Program, February 2000.

(296) Institute of Health Economics. Alberta Diabetes Atlas 2007. Alberta: Institute of Health Economics, 2007.

(297) Majumdar SR, Johnson JA, Bowker SL, Booth GL, Dolovich L, Ghali W, et al. A Canadian consensus for the standardized evaluation of quality improvement interventions in type 2 diabetes. Can J Diabetes 2005;29(3):220-229.

(298) U.S. Department of Health and Human Services. Healthy People 2010. 2nd ed. With understanding and improving health and objectives for improving health. 2 vols. Washington, D.C: U.S. Government Printing Office, November 2000.

(299) Buhrmann R, Assaad D, Hux JE, Tang M, Sykora K. Chapter 10: Diabetes and the eye. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(300) Booth G, Fang J. Chapter 2: Acute complications of diabetes. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(301) Agency for Healthcare Research and Quality. Prevention Quality Indicators. Last accessed August 31, 2010 at http://www.qualityindicators.ahrq.gov/pqi_overview.htm.

(302) Booth GL, Rothwell DM, Fung K, Tu JV. Chapter 5: Diabetes and cardiac disease. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(303) Oliver MJ, Lok CE, Shi J, Rothwell DM. Chapter 8: Dialysis therapy for people with diabetes. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(304) Feig DS, Kopp A, Anderson GM. Chapter 11: Pregnancy in women with diabetes. In: Hux JE, Booth GL, Slaughter PM, Laupacis A, editors. Diabetes in Ontario: Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, 2003.

(305) Shiller SK, Bierman AS. Introduction to the POWER Study. In: Bierman AS, editor. Project for an Ontario Women's Health Evidence-Based Report: Volume 1. Toronto: St.Michael's Hospital and the Institute for Clinical Evaluative Sciences, 2009.

(306) Clark JP, Bierman AS. The POWER Study Framework. In: Bierman AS, editor. Project for an Ontario Women's Health Evidence-Based Report: Volume 1. Toronto: St.Michael's Hospital and the Institute for Clinical Evaluative Sciences, 2009.

(307) Thomas S. Combining cycles of the Canadian Community Health Survey. Proceedings of Statistics Canada Symposium 2006: Methodological Issues in Measuring Population Health. Ottawa, 2006.

(308) Iron K, Zagorski BM, Sykora K, Manuel DG. Living and dying in Ontario: an opportunity for improved health information. ICES Investigative Report. Toronto: Institute for Clinical Evaluative Sciences, 2008.

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