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Patterns and Outcomes of Diabetes in Canada studied using Administrative Data: The Ontario experience

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Diabetes mellitus (DM) is a serious and growing health problem. Approximately 6% of Canadian adults have been diagnosed with DM; however, with the aging of the population and growing rates of obesity, the number of people with this condition is expected to rise. Canadian researchers place the economic burden of DM at an estimated $7 billion nationwide based on 1998 figures.[1] Diabetes is a leading cause of cardiovascular disease, blindness, end-stage renal failure leading to dialysis, and amputation. The complications associated with DM contribute to a heightened risk of disability, an impaired quality of life, and premature mortality.

Until recently, few large-scale research initiatives focused on the impact of DM in Canada. The National Diabetes Surveillance System (NDSS) is an innovative strategy that will use existing administrative data sources to determine the incidence and prevalence of DM across regions and to examine the burden of DM on the health of Canadians and on the healthcare system.[2] Previous estimates of the prevalence of DM relied on self-report from national surveys and may have underestimated the true prevalence of DM by up to 40%.[3] Universal healthcare provides the opportunity to use comprehensive and systematically collected information contained in administrative data sets to study the health of the whole population in an anonymous fashion. Furthermore, the infrastructure provided by the NDSS provides a standardized approach for measuring the prevalence of DM across regions of the country, thereby allowing inter-provincial comparisons. This type of analysis can provide critical information for healthcare providers and policymakers alike.

Researchers in several provinces have used administrative data to examine DM outcomes and patterns of DM care within their jurisdictions. In this issue of *Endocrinology Rounds*, we review findings from the recently published report, *Diabetes in Ontario: An ICES Practice Atlas* produced by the Institute for Clinical Evaluative Sciences (ICES) in partnership with the Canadian Diabetes Association.[4] This research was conducted using a validated algorithm based on hospitalization and physicians' billing records to identify all adults with DM in Ontario, similar to the approach used in the NDSS. The Ontario Diabetes Database contains over 600,000 population-based cases of diabetes, making it one of the largest diabetes registries worldwide.

Diabetes prevalence and incidence

In Ontario, the prevalence of DM rose by 31% between fiscal years 1995 (April 1, 1994-March 31, 1995) and 1999, from a rate of 4.7% to 6.2% of the population.

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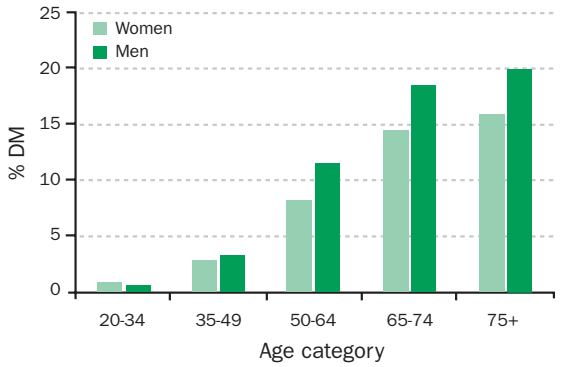
Figure 1: Prevalence of diabetes by age in Ontario, 1998-1999[3]



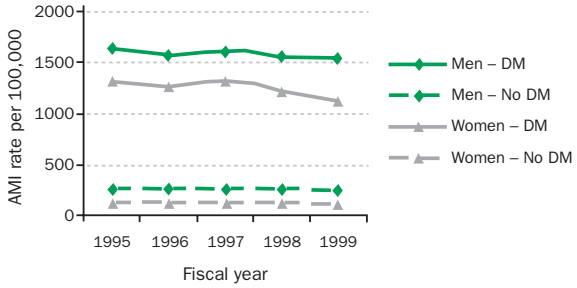
Consistent with findings in other jurisdictions, prevalence rates were higher in men than in women, and increased sharply over the middle adult years (Figure 1). By the age of 65, between 15% and 20% of the population of Ontario had been diagnosed with DM. DM prevalence was also much higher among persons living in low-income neighbourhoods, particularly among women aged 35-49, in whom the prevalence was nearly twice as high in the lowest income quintile compared to the highest income quintile. Prevalence rates varied markedly across regions of the province and followed the clustering of ethnic groups at high risk for type 2 DM. For instance, counties that have higher proportions of First Nations residents (Manitoulin, Kenora, Sudbury, and Rainy River) or south Asian immigrants (Metropolitan Toronto and Peel region) had among the highest prevalence of DM in the province.

Diabetes-related complications

Cardiovascular disease

Cardiovascular disease is the leading cause of death among persons with DM. Between fiscal 1995 and 1999, there were 104,471 hospitalizations for acute myocardial infarction (AMI) in Ontario and nearly one-third occurred in individuals with DM. Persons with DM also accounted for one-third of hospitalizations for stroke and 43% of admissions for heart failure. In general, admission rates significantly declined over the 5-year period. Among those with DM, admission rates for AMI fell by 9%, while rates of hospitalization for stroke declined by 16% and those for heart failure dropped by 24% (Figure 2). Lesser declines were evident in the non-diabetic population.

Figure 2: Rates of admissions for acute myocardial infarction (AMI) in Ontario[4]



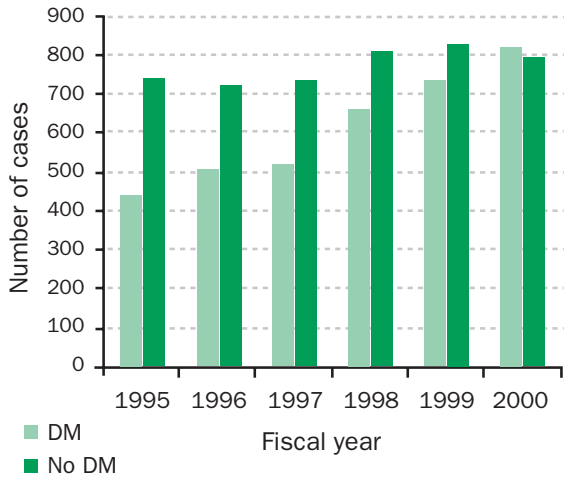
Admission rates were over 7-fold greater in persons with DM compared to those without DM. After accounting for age and gender differences, individuals with DM remained up to 3 times more likely to be admitted for AMI. Although the largest burden of disease was seen in the elderly population, the relative disparity in rates between the two populations was most pronounced in the youngest age group. Men and women with DM, aged between 20 - 34 years, had a 9- and 30-fold greater odds of suffering an AMI, respectively, than those without DM in the same age group. AMI rates among the diabetic population were comparable to those of non-diabetic individuals who were 15 to 20 years older. Individuals with DM also had longer lengths of stay and a 1.4-fold greater mortality rate one-year after admission for AMI compared to those without DM. Furthermore, one-year readmission rates for AMI, unstable angina, and heart failure were up to twice as common in the diabetic population.

Geographic patterns suggested higher rates of admission in northern and rural regions of the province. Multivariate analysis revealed several independent predictors of AMI, including increasing age, male gender, lower socio-economic status, previous MI, and the presence of other chronic diseases. Additionally, this analysis confirmed an increased risk of AMI among those living in rural areas, but also among those living in regions outside of Toronto and the Eastern planning region.

Kidney disease

Kidney failure is a serious and costly complication of diabetes. Between fiscal 1994 and 2000, 8,344 people started chronic dialysis in Ontario. Dialysis rates were approximately 12-fold higher in the diabetic population and increased only modestly over the period of study. However, rising numbers of

Figure 3: Number of new dialysis cases per year in Ontario[4]



individuals with DM in the general population led to a substantial increase in the number of persons on dialysis. The population with DM starting chronic dialysis grew at an average annual rate of 13.2%, more than 8 times the 1.6% annual increase seen in the non-diabetic population. By 2000, individuals with DM comprised over 50% of new cases starting dialysis in Ontario, compared to only 38% in 1995 (Figure 3). The largest degree of growth occurred in the population >75 years, resulting in a dialysis population that is older and more ill. Mortality rates were exceedingly high in this population. Three-year survival rates after starting dialysis were only 55% for those with DM and 68% among those without DM. Mortality differences were largely explained by underlying differences in the level of comorbidity in the 2 populations.

Amputations

Non-traumatic amputation is another important cause of morbidity among the diabetic population. Foot complications (eg, skin ulceration and infection) occur in the setting of peripheral neuropathy and lower extremity vascular disease, but are potentially preventable with appropriate foot care. In Ontario, age/sex-adjusted amputation rates are up to 20 times more common in the diabetic than the non-diabetic population. Between fiscal 1995 and 1999, minor amputations (below ankle) fell by 29% in the diabetic population, coincident with a similar drop in rates of admission for skin and soft tissue infections. Rates of major lower extremity amputations (those occurring above the ankle) were relatively stable over the period of study. After adjusting for other factors, men remained nearly twice as likely to have an amputation than women and those >65 years were 3.6 times as likely to experience this complication compared to young adults.

Socio-economic status was also strongly associated with the risk of amputation, with those in the lowest income group having rates that were nearly one-third higher than those in the highest income category. Amputation rates also varied across regions of the province with individuals living in northern communities having 50% higher levels than those living in Toronto. Regular use of outpatient services was found to protect against the need for amputation. Individuals who saw their general practitioner at least 3 times per year experienced one-third lower amputation rates over the subsequent 5 years compared to those with fewer visits.

Acute complications

Hospitalizations for diabetic emergencies are potentially avoidable with timely and effective outpatient care and thus serve as an important measure of the quality of care provided in the ambulatory setting. Between fiscal 1995 and 1999, hospital admissions for hyper- and hypoglycemia decreased in Ontario by 30% and 75%, respectively. Although bed closures and reduced hospital staffing could lead to a higher threshold for admission to hospital, emergency department visits for DM also fell by 24% over the same time period. This suggests that reduced availability of in-patient services is not the only factor leading to the observed decline.

These findings suggest an improvement in DM care delivered over the period of study. However, there was a considerable degree of variation in acute complications across regions. Emergency department visits for diabetes remained (up to 2- fold) higher in northern Ontario, suggesting a possible lack of access to outpatient services in these communities. On multivariate analysis, individuals in low income groups had 44% higher rates of acute complications compared to those in the wealthiest category. Failure to see a primary care physician during the previous year was associated subsequently with a 2-fold higher risk of acute complications. In contrast, having a regular care provider and visiting a physician more frequently appeared to be protective. Furthermore, having one or more visits to a diabetes specialist in the previous year

Figure 4: Providers of diabetes care in Ontario, 1999-2000[4]

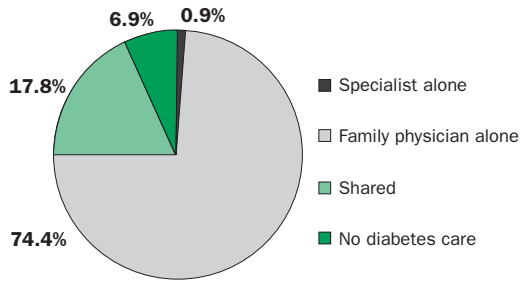
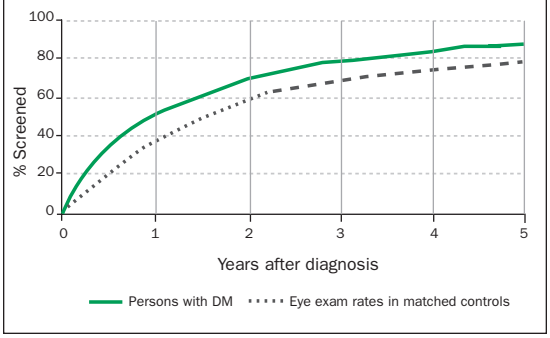


Figure 5: Rates of retinopathy screening after diagnosis of diabetes[4]



was associated with a one-third lower risk of acute complications.

Use of physician services

In Ontario, three-quarters of patients with DM receive care through their family physician alone (Figure 4). Continuity of care was quite high within primary care; that is, people with DM tended to see the same family physician for most of their ambulatory visits. Up to 7% of the diabetic population (and up to 13% of young men with DM) appear to lack visits to a primary care physician or to a DM specialist over a 2-year period. These findings may be due in part to the inability to capture visits to physicians paid through an alternative funding program. Another striking finding was that the proportion of people seeing specialists declined with advancing age. For example, between 1994 and 1996, 38.2% of people aged 20 to 34 years saw a DM specialist, while only 11.2% of people aged ≥75 years did. For all but the very elderly, women saw DM specialists more than men while, at all ages, a higher proportion of men than women saw no physician.

Persons with diabetes use twice as many physician services as patients without diabetes. Among diabetic individuals >75 years old, this translates to an average of 2 visits to a family physician, specialist, or optometrist every month. Despite physician shortages, persons with DM living in different regions appear to have reasonably equitable access to primary care. However, the use of specialty services, particularly endocrinologists, is highly contingent on physician supply. There was a direct relationship between the use of both internal medicine and endocrinology services and the local supply of these physicians. Unfortunately, there is little information available on the availability and use of diabetes education services in Ontario; however, these centres tend to be hospital-based and likely follow the distribution of endocrinology services in the province.

Eyecare visits

Diabetic retinopathy is a common complication of diabetes and the leading cause of blindness among Canadians between the ages of 30 and 70. Vision loss from diabetic retinopathy can be averted through prevention strategies and by early detection and treatment. The Canadian Diabetes Association recommends that all adults with diabetes undergo routine examinations from an experienced eyecare professional.[5] An evaluation of claims submitted to eyecare professionals in Ontario demonstrated that surveillance for diabetic retinopathy falls short of recommended levels. Only one-half of diabetic adults aged ≥30 years undergo a screening eye care exam within 1 year of diagnosis. Furthermore, eye exam rates were, in general, only minimally higher in persons with diabetes than in the non-diabetic population (Figure 5). Among those with diabetes, young adults, males, and those in lower income groups were least likely to obtain an eye examination. In fiscal 1998, the overall rate of eye examinations fell by 4.5%. This fall coincided with a restriction in the frequency of ocular examinations reimbursed by the Ontario Health Insurance Plan, a policy from which persons with diabetes were

exempt. Despite existing disparities in the distribution of eyecare services in Ontario, the average number of visits for eye care varied little between counties.

Medication use

Medication use was evaluated among persons with DM aged ≥65 years and therefore eligible for reimbursement under the province's drug benefit program. Between 1995 and 2001, as the number of elderly people taking glucose-lowering medications rose, the total costs of these medications increased by $10 million annually. However, findings suggest that these medications are still being underused. Only 57% of patients received glucose-lowering drugs within 3 years of diagnosis, despite evidence that the majority of such patients would be unable to achieve good glycemic control on diet therapy alone. Over the period of study, nearly three-quarters of newly diagnosed patients with DM were started on a sulfonylurea. After the results of the United Kingdom Progressive Diabetes Study (UKPDS) were published, the Canadian Diabetes Association revised its guidelines to recommend metformin as initial therapy for most obese patients with type 2 DM. The number of people receiving metformin nearly tripled between 1995 and 2001 and future projections suggest that metformin use will continue to increase more quickly than the use of sulfonylureas or insulin.

Randomized controlled trials have demonstrated that tight control of blood pressure and serum cholesterol, and the use of angiotensin-converting enzyme (ACE) inhibitors can reduce the risk of cardiovascular events in high-risk patients with diabetes.[6-8] While the use of cardioprotective medications appears to be increasing, levels still appear to be below those recommended by guidelines. Of those diagnosed with DM in fiscal 1999, 65% were prescribed antihypertensive medications within the next year, representing an absolute increase of 6% from 1995. The use of ACE inhibitors increased among elderly persons with DM from 25% to 37% over the same period. The most dramatic change occurred for lipid-lowering medications, which showed a 156% relative increase in prescriptions within the first year of DM diagnosis between 1995 and 1999. However, despite these improvements, by the end of the study period, only one-quarter of elderly people with DM received these drugs within one year of diagnosis.

Conclusions

Between 1995 and 1999, the prevalence of DM rose by 31% in Ontario. Future projections estimate that these rates will continue to rise. Findings from the Atlas suggest an improvement in the care delivered to persons with DM over this 5-year period.[4] Overall, complication rates associated with DM remained stable and, in some cases, declined over the period of study. Despite these findings, the actual number of hospitalizations and services used by people with DM increased. These trends are expected to continue, driven largely by increases in the number of people with DM. Thus, policy makers and planners will need to allocate sufficient resources to keep up with the increasing demands placed on the healthcare system by DM. Furthermore, public health initiatives aimed at reducing risk factors for diabetes, in particular obesity and physical inactivity, should be considered.

A number of strategies can be implemented to lower the risk of complications among individuals with DM. There is now compelling evidence from randomized trials that specific interventions such as the use of ACE inhibitors, antihypertensive medications, and lipid-lowering agents can sharply reduce the risk of complications in this population. While the use of these agents appears to be suboptimal, the observed fall in cardiac admissions points to some improvements in outpatient DM care. Tailoring educational efforts and guideline dissemination to the needs of busy family practitioners may further increase the use of appropriate medications in this population.

Findings from the Atlas highlight the importance of routine clinical care in reducing the risk of diabetic complications. Family physicians are the main providers of physician care for people with DM in Ontario. Fewer than 1 in 5 people with DM had contact with a DM specialist and this proportion appears to be decreasing. Imbalances in physician supply may contribute to the observed variation in diabetes outcomes across regions. The healthcare system needs to develop

innovative strategies to break down the barriers between specialists, generalists, nurse practitioners, diabetes educators, and other allied health professionals involved in diabetes management. Full access to diabetes services and enhanced coordination of care between providers is essential for ensuring that the best quality of care is delivered to this population. Providing care to people with diabetes will continue to be a challenge for healthcare providers in the years to come. National initiatives focusing on diabetes surveillance will provide an opportunity for policy makers and planners to design strategies on a local level that could enhance the coordination of care and, ultimately, the outcomes related to this disease.

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