Chapter 14

Screening for Diabetes in Family Practice: A Case Study in Ontario, Canada

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Additional information is available at the end of the chapter

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1. Introduction

1.1. Prevalence and Incidence of Diabetes in Ontario, Canada

The scale of the problem of diabetes in family practice is described with respect to prevalence and incidence in family medicine.

Type 2 diabetes (T2DM) and prediabetes [impaired fasting glucose (IFG); impaired glucose tolerance (IGT); and / or both IFG and IGT] are common metabolic disturbances in Canada and worldwide, having long been recognized to be reaching close to epidemic proportions [1]. Indeed, the global prevalence of diabetes in 2011 was 8.3% [2]. According to the National Diabetes Surveillance System, in 2009, over 2 million Canadians were estimated to have T2DM; a prevalence of T2DM 6.4% [3]. As many as one in six people over the age of 65 years are currently estimated to have diabetes [4]. Adults from lower income groups are twice as likely to have diabetes as those in the highest income groups [4]. Estimates suggest that over 5 million Canadians had prediabetes in 2004; a prevalence of 23% for ages 40 to 74 years [5]. The prevalence of IFG is more frequent in women but both IFG and IGT increase in prevalence with age [6].

2. Predicted increase in numbers of people with diabetes

Alarmingly, diabetes prevalence is expected to increase significantly; this will be described in detail with respect to the effect on the primary care system.

The global prevalence for diabetes is predicted to be 9.9% in 2030, an increase of approximately 20% in 20 years [2]. Indeed, over time, the prevalence of Type 2 Diabetes (T2DM)

in Ontario has increased at a much faster rate than anticipated. Adult diabetes prevalence in Ontario rose by 80%, from 5% in 1995, to 9% in 2005[6], thereby exceeding the global prevalence increase of T2DM of 6.4% projected for 2030 [7]. Following that, over a 6 year period, a 31% increase in yearly incidence occurred in Canada, from 6.6 per 1,000 in 1997 to 8.2 per 1,000 in 2003 [7]. The diabetes epidemic is not restricted to Canada, as 1 in 10 adults in the USA now have diabetes [8].

Increasing numbers of people with diabetes will result in more healthcare resources being utilised [5,6,7]. Current estimates suggest that people with diabetes use five-times as many health resources as those without [9]. Therefore, developing and testing effective strategies to increase detection of diabetes in the community is an important primary care and population health issue. Furthermore, up to one third of the people with diabetes are estimated to be undiagnosed [8,10] and may be developing diabetes-related complications which may also remain undiagnosed. Not only will the utilisation of healthcare resources be restricted to diabetes-related micro and macro vascular diseases, but other conditions as well. People with diabetes or dysglycemia are at over a twofold risk of developing cardiovascular disease compared to diabetes-free individuals [11,12,13]. These factors point to the seriousness of the diabetes epidemic and its potential impact.

3. Progression of prediabetes to diabetes

The speed at which prediabetes progresses to diabetes has serious implications for adequate healthcare. The scale of this will be discussed in depth.

Individuals with prediabetes are estimated to progress to type 2 diabetes at a rate of 10-12% per year; in total up to as much as 70% will progress [14-16]. Furthermore, individuals with both IFG and IGT develop type 2 diabetes at approximately twice the rate as those who have only one of these impairments [17]. The speed at which prediabetes progresses to diabetes has serious implications for adequate healthcare provision to the adult Canadian population aged 40 and over (which represented approximately 50% of the Canadian population in the 2006 census) [18].

Since diabetes is a multi-system metabolic chronic disorder, it causes complications that affect many organs including eyes, nerves and kidneys as well as other health related consequences. Specific complications of diabetes include macrovascular (i.e. coronary artery disease), and microvascular (i.e. renal damage, nerve damage and retinal damage) [19]. Treatment for diabetes consists of dietary and lifestyle changes, oral medication and injected insulin [19]. The healthcare system will be stretched having to care for an epidemic of people with diabetic complications.

However, pharmacological and lifestyle interventions could prevent or delay T2DM and thus decrease morbidity and mortality associated with its complications if individuals at risk of developing diabetes are detected early [20]. Unfortunately, only 49% of Canadians over 40 years old report ever having a diabetes screening blood test sometime during their life [21]

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and much diabetes and prediabetes remains undiagnosed [10]. Future treatment costs could possibly be avoided by increasing prevention and screening efforts.

4. Diagnosis of diabetes

This section will outline the many tests possible and the best choices for family physicians.

Prediabetes and diabetes can be diagnosed with inexpensive fasting blood tests [either a fasting plasma glucose (FPG) level or a 75-gram oral glucose tolerance test (OGTT). The WHO 2006 diagnostic criteria provide the appropriate cut-off points for blood tests interpretation (see Table 1) [22]. The FPG test is commonly used by Canadian physicians to identify those with prediabetes and diabetes [21].

Measurement of only a FPG misses 15% or more of people with IGT [23,24]; but, using the diagnostic criteria for IFG identifies a different and smaller group of people compared to using criteria for IGT [25,26]. Although the oral glucose tolerance test (OGTT) is the diagnostic gold standard, cost and impracticality limit its use as a screening test (overnight fasting and a 2-hour laboratory wait are required). In addition glycosylated hemoglobin or A1c is already being used as a diagnostic test by many physicians. The American Diabetes Association in 2010 recommended that A1c could be used as a screening test in non-pregnant individuals, and those without chronic kidney, liver or blood disorders which can all affect the hemoglobin levels [27]. Their recommendations state that an A1c of 6.5% (47 mmol/mol) or higher indicates diabetes and an A1c of 5.7% - 6.4% (39 - 46 mmol/mol) is indicative of prediabetes.

The Canadian Diabetes Association has also followed suit and recommended that A1c be used as a screening tool with the same limitations, and diagnostic for diabetes above 6.5%, however two separate readings (two of a combination of A1c or FPG) are required for diagnosis [28]. Increasingly, there is debate concerning the use of other laboratory tests since although the OGTT is the gold standard it may not be used frequently (Ontario data shows that less than 1% of people underwent an OGTT between 1995 and 2005) [29]. An increasing number of individuals without documented diabetes in Ontario have been tested using the A1c [1]. Additionally, many Ontarians receive serum blood glucose testing, which is either random or fasting (80% of women and 66% of men) [30].

	Fasting Plasma Glucose (mmol/l)	2 hour Post 75g Glucose Load (mmol/l)
T2DM	≥7.0	≥11.1
Isolated IGT	<6.1	7.8-11.0
Isolated IFG	6.1 – 6.9	<7.8
IGT and IFG	6.1 – 6.9	7.8-11.0
Normal	<6.1	<7.8

Table 1. Diagnostic Criteria for Diabetes and Prediabetes [22,31,32]

5. Screening for diabetes

The use of risk assessment tools in general practice will be discussed with reference to the literature.

Though T2DM can often remain undiagnosed and asymptomatic in its early stages [33], once diagnosed, it can be treated with lifestyle modification and medication, and some elements of the disease process may be reversible [14,16,34]. In light of this, early T2DM detection may be beneficial to both patients and society [35]. Screening may also detect people at high risk of developing diabetes; and thereby, determine the likelihood that a person may have a positive diagnosis of diabetes.

Screening for diabetes can be approached in 3 different ways; opportunistic, risk-based or universal. Opportunistic screening occurs where a health care practitioner will screen as part of routine medical care, whether this is part of a physical examination or other arising medical interaction [36]. Risk-based screening focuses on screening individuals at high risk of developing diabetes due to a health related trait that they have, such as obesity, age, positive family history [37]. Universal screening would screen everyone irrespective of characteristics [37] or just use age and gender criteria for screening.

Since the OGTT is the gold standard, including it in any screening program for diabetes and prediabetes may therefore be an important strategy [37], though impractical for universal screening. The challenge is how to improve the overall accuracy of diabetes screening, and to incorporate OGTT at a reasonable cost, by incorporating it as part of a multi-stage screening process. This two-step approach has already been tested and proven in Finland, and is now being implemented across many European countries as an emerging best practice. Literature demonstrates that non-laboratory based questionnaires (e.g. the FINRISK) to pre-identify individuals at risk of T2DM and prediabetes can be successful [38,39]. Screening questionnaires have similar diagnostic accuracy to laboratory screening tests and are inexpensive, simple to use and can also be used as educational tools for patients undergoing screening [38,39,40]. They can be used in conjunction with laboratory testing for universal screening.

An effectively screened population will have diabetes diagnosed 5–6 years earlier than a population without an organized screening program [41], offering opportunities for delaying diabetes and related complications [16]. The current screening tests of repeated serum glucose measurements are too costly and inconvenient to be offered at a population level in the form of a screening program. Furthermore, the organization of primary care in Canada is poorly designed to cope with the initiation and management of comprehensive diabetes screening for everyone over 40 years of age [36]. Existing diabetes prevention and lifestyle programs, designed for research and not community application, have unrealistic program costs, since they require all participants to have OGTTs [42,43]. However, sequential and selective screening of high-risk groups could increase efficiency [44] and reduce workload and screening costs for the healthcare system by reducing the number of individuals requiring a 'gold standard' diagnostic test, as compared to universal screening [45,46].

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6. Role of family practitioners

This chapter will clarify what the best method of screening is for family physicians by examining the evidence and provide recommendations for current practice.

In light of the evidence for early treatment of diabetes, in the Canadian Diabetes Association (CDA) clinical practice guidelines [31,32], the recommendations are clear that individuals at high risk for developing diabetes should be screened to determine their dysglycemic status, in an attempt to be able to recommend changes to lifestyle which may prevent or delay the onset of diabetes. 'High risk' is defined as a person whose first degree relatives have diabetes, and/or who have other diabetes risk factors such as ethnic origin, obesity and dyslipidemia, and who have a FPG of 5.7-6.9 mmol/L. Though not explicitly stated, the implementation of this screening recommendation is the responsibility of family doctors, since traditionally they are the first point of access to health care in Canada. Family doctors usually have the opportunity to detect diabetes in their patients at annual health checks as long as the patient has a physical exam. However, at least 15% of the Canadian population does not have a family doctor and will not receive a physical examination [47]. Family doctors are a scarce resource and may not be able to initiate successful screening programs for all their patients. Indeed, evidence shows that they may be too busy [33], or resources too scarce to implement comprehensive screening either opportunistically or targeted, or to provide appropriate follow up to identified individuals. Therefore, opportunistic screening in this way may not be the best approach to effectively identify the individuals with diabetes. Other strategies may be more appropriate, but few have been tested or rigorously evaluated in family practice.

Rather than a universal screening program of everybody over the age of 40 years, selective screening of subgroups at high risk of having the disease may reduce the workload and the cost to the healthcare system by reducing the number of individuals who need a diagnostic test [48], while still identifying the vast majority of new cases. Involving patients themselves in the decision to attend screening may also lessen the burden on family physicians, since a consultation initiated for risk assessment alone, is likely to be more focused than one initiated for other reasons [49]. Taking into account these issues, a program utilising this philosophy, the Community Health Awareness of Diabetes program, was developed and piloted in Ontario. CHAD assessed risk of diabetes in the over 40 year old population using the Finnish Diabetes Risk Score [38] (for impaired glucose tolerance detection), the Cambridge Diabetes Risk Score [50] (for undiagnosed diabetes), fasting capillary blood glucose and a glycosylated hemoglobin level. Individuals were invited by their family doctors, for 'diabetes awareness and risk assessment' sessions delivered by specially trained community peers, in a network of local community pharmacies.

There were 588 participants in CHAD; of these, the majority that had received invitation letters were seniors and were females; 526 did not have pre-existing diabetes; and 16% of participants were identified as being at high risk for diabetes [51]. Those at high risk of diabetes had significantly more modifiable risk factors, including higher fat, fast food and salt intake, and higher systolic blood pressure. Satisfaction with the program was high. An audit of 1030 medical charts of individuals eligible to attend the CHAD program, from 28 family doctors'

practices in Grimsby, Ontario. Of these, 387 charts were of patients who had attended the CHAD program and 643 charts were of individuals who did not attend the program but who met the program eligibility criteria. Overall, the difference between the rates of diabetes diagnosis before-and-after the program was not statistically different. The difference in rate of diabetes diagnosis annually in the attendee group was 20 per 1000 and in the non-attendee group was -2 (to be interpreted as 0) per 1000. In the community, the annual rate of new diabetes diagnosis was 27 per 1000 (95% CI = 17.90 – 39.00) in the year before the introduction of the CHAD program, and 45 per 1000 (95% CI = 33.00 – 59.80) in the year after.

The attendee and non-attendee groups were significantly different demographically in that the CHAD attendees were more likely to be female, retried and older than the random sample of eligible patients drawn from the same practices. Multi-level regression modeling showed that attending CHAD did seem to have a positive effect on whether diabetes was diagnosed; however, this effect was lessened both in statistical significance and magnitude when taking in to account the physician effect (clustering), patient gender, patient employment status and patient age. If found to be effective in both case detection and cost, a targeted community diabetes screening program should be recommended to Canadian Health Policy makers. Current literature shows that screening is more cost effective in hypertensive and obese groups and the costs of screening are offset in many groups by lower treatment costs [52].

7. Conclusions

The debate for or against screening and even the method of screening in the community therefore has not been fully resolved in Canada. Currently, though the Canadian Diabetes Association recommends screening all individuals over the age of 40 [31,32], the Canadian Task Force on Preventive Health Care (CTFPHC) recommends screening only for adults with hypertension or hyperlipidemia [46]. Both guidelines are under frequent review and revision. For now, health policy makers will need to assess their own communities' needs, which may vary based on the population mix, and assess whether or not local programs for screening (whether targeted or universal) could be initiated; an example of this is the Aboriginal Diabetes Initiative [53]. Through this program, targeting the Aboriginal population increased regular screening for early diagnosis using population-based and opportunistic screening methods is supported, with the use of mobile detection programs. It is possible that diabetes screening could be increased in communities predicted by population-based algorithms to have high rates of undiagnosed diabetes [54]. Researchers have used population based data (national registries and other such data) and developed and validated an algorithm to estimate the number of individuals who will develop diabetes over a 9-year period [54]. This algorithm could be applied to existing provincial data to decide where to focus diabetes screening strategies for greatest effect.

Those reading this chapter from other countries must evaluate the need for screening for diabetes or at the very least, risk-assessment for diabetes, in the primary care setting, which is the natural setting for such activities. Given the epidemic of diabetes worldwide, it is likely

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that many other countries will be able to use the case study example posed here, as a way of evaluating the need to screen in primary care or family medicine situations elsewhere.

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