

# Diabetes Screening Among High-risk Participants in the Quebec Health Survey

Stéphanie Couture<sup>1</sup> MSc, Jean-François Yale<sup>2</sup> MD, Robert Marchand<sup>3</sup> MD, Nahla Aris-Jilwan<sup>4</sup> MD, François Champagne<sup>5</sup> PhD, Irene Strychar<sup>1,4,5</sup> RD EdD

<sup>1</sup>Research Centre, Hôpital Notre-Dame du Centre Hospitalier de l'Université de Montréal (CHUM), and the Department of Nutrition, Faculté de Médecine, Université de Montréal, Montreal, Quebec, Canada

<sup>2</sup>Nutrition and Food Science Centre, Royal Victoria Hospital, McGill University Hospital Centre (MUHC), Montreal, Quebec, Canada

<sup>3</sup>Family Practice Clinic, Verdun Hospital, Montreal, Quebec, Canada

<sup>4</sup>Division of Endocrinology, Hôpital Notre-Dame du CHUM, Montreal, Quebec, Canada

<sup>5</sup>Groupe de recherche interdisciplinaire en santé (GRIS), Université de Montréal, Montreal, Quebec, Canada

## A B S T R A C T

### OBJECTIVES

To determine to what extent participants in the Quebec Health Survey who had 2 or more risk factors for diabetes were screened by their physician and what type of advice they received when diagnosed with prediabetes.

### METHOD

Of the participants in the Quebec Health Survey, 4555 were identified from the databank as having 2 or more risk factors for diabetes. These individuals were contacted; 541 (12%) completed a telephone interview and 258 (48%) of their treating physicians provided information from their chart and medical practice profile.

### RESULTS

Seventy-nine percent (427/541) of subjects with 2 or more risk factors self-reported having a blood test to measure blood glucose (BG) levels, while 99% (256/258) of their responding physicians reported screening with a blood test. Among subjects who reported that their physician told them

## R É S U M É

### OBJECTIFS

Déterminer dans quelle mesure les personnes qui avaient participé au sondage et qui présentaient au moins 2 facteurs de risque de diabète ont été évaluées par leur médecin et quel type de conseils elles ont reçu lorsqu'un diagnostic de prédiabète a été posé.

### MÉTHODE

D'après la banque de données, 4555 des participants présentaient au moins 2 facteurs de risque de diabète. On a communiqué avec ces personnes ; 541 (12 %) ont été interviewées par téléphone et 258 (48 %) des médecins traitants ont fourni des renseignements à partir de leur dossier médical et de leur profil clinique.

### RÉSULTATS

Soixante-dix-neuf pour cent (427/541) des sujets présentant au moins 2 facteurs de risque ont dit avoir eu une analyse de sang pour mesurer leur glycémie, tandis que 99 % des médecins ont dit avoir fait des épreuves sanguines de dépistage (256/258). Parmi les sujets qui ont signalé que leur médecin leur avait dit que leur glycémie était élevée mais qu'ils n'étaient pas atteints de diabète, 98 % (57/58) ont dit ne pas avoir reçu de conseils concernant leur mode de vie, tandis que 48 % des médecins (16/33) ont dit avoir donné des conseils.

### CONCLUSION

Presque tous les médecins qui ont fourni des renseignements au sondage ont mesuré la glycémie chez leurs patients et environ la moitié d'entre eux ont recommandé un traitement non pharmacologique ou des modifications du mode de vie en présence de prédiabète. Il faudrait examiner la communication médecin-patient en présence de prédiabète.

*Address for correspondence:*

*Irene Strychar*

*Hôpital Notre-Dame du CHUM*

*1560 Sherbrooke West*

*Pavillon Mailloux, K-6244*

*Montreal, Quebec*

*H2L 4M1 Canada*

*Telephone: (514) 890-8000, ext. 28039*

*Fax: (514) 412-7603*

*E-mail: irene.strychar@umontreal.ca*

**Keywords:** diabetes prevention, physician practices, prediabetes, screening

they had high BG levels but no diabetes, 98% (57/58) reported receiving no advice regarding lifestyle recommendations, whereas 48% of their responding physicians (16/33) reported providing advice.

## CONCLUSION

Almost all responding physicians tested their patients' BG levels, and approximately one-half of physicians recommended nonpharmacologic/lifestyle treatment for prediabetes. Communication between physician and patient in prediabetes should be examined further.

## INTRODUCTION

Diabetes mellitus is a serious health threat, and its medical, social and economic burden will increase dramatically in the 21st century. Combining diagnosed and undiagnosed diabetes, the prevalence of diabetes is estimated to be over 8%, with higher rates occurring in older and high-risk ethnic populations (1). The presence of microvascular complications is common at the time of diagnosis of type 2 diabetes mellitus and ranges from approximately 3 to 30% (2-4). Also, prediabetes (impaired fasting glucose [IFG] and impaired glucose tolerance [IGT]) is associated with a substantially higher risk for cardiovascular disease (5-9). Lowering blood glucose (BG) levels has been shown to prevent or delay the progression of the disease (10-16). Identifying individuals in the early stages of the disease would permit them to take action to lower and control BG levels. Screening is an important initial step in dealing with this problem.

There is no consensus on diabetes screening guidelines among professional associations. The United States (US) Preventive Services Task Force states that there is insufficient evidence to recommend for or against routine screening for type 2 diabetes, IGT or IFG for asymptomatic adults. However, they do advise screening adults with hypertension or hyperlipidemia (17,18). The American Diabetes Association emphasizes screening among individuals with a body mass index (BMI)  $\geq 25$  kg/m<sup>2</sup> (11,19). The Canadian Diabetes Association (CDA) recommends that adults  $\geq 40$  years of age be screened for diabetes at 3-year intervals and that screening be considered at a younger age or done more frequently in those individuals with additional risk factors (12,20).

Diabetes screening guidelines are divergent and may result in ambiguities for physicians in their clinical practice patterns (17-22). To investigate the situation in Quebec, participants in the Quebec Health and Social Survey with risk factors for diabetes (older age, high BMI, hypertension, hyperlipidemia, heart disease/cardiovascular disease, high-risk ethnic population and gestational diabetes) were contacted to determine the following: 1) whether or not those with 2 or more risk factors for diabetes reported being screened for the disease and what differentiated those who were screened from those who were not; 2) physicians' perceptions regarding diabetes screening

and what characteristics were associated with positive perceptions toward screening; and 3) physician self-reported practice patterns regarding the level of fasting plasma glucose (FPG) at which they usually make a diagnosis of diabetes and initiate nonpharmacologic treatment.

Based on the literature of physician practices (23-29), we hypothesized that patients with a greater number of risk factors, smokers, women, urban inhabitants and those with a higher level of education would more likely be screened for diabetes. Physicians with more positive perceptions toward diabetes screening would be more likely to have a hospital-based practice, specialty training, more years of experience and a higher caseload of patients with diabetes.

## METHODS

Complete details regarding the sampling procedures and data collection of participants in the 1998 Quebec Health and Social Survey are described in Santé Québec's report (30). Interviews were conducted in 11 986 households, and 30 386 individuals were surveyed. This sample was representative of 97% of the Quebec population, excluding institutionalized individuals and those on Aboriginal reserves. An interview was conducted with 1 household member, who answered questions about the health status of all household members. In addition, household members over 15 years of age were asked to complete a self-administered questionnaire that contained additional information about their health and lifestyle behaviours; 20 773 individuals completed this self-administered questionnaire. Information from the interviews and the self-administered questionnaires was used to identify those with 2 or more risk factors for diabetes. Risk factors identified from this databank included older age, high BMI, hypertension, hyperlipidemia, heart disease/cardiovascular disease and high-risk ethnic population (i.e. African, Asian, Hispanic, Aboriginal). Limitations of the databank were as follows: 1) there was no question regarding family history of diabetes; 2) gestational diabetes was reported only during the interview period; and 3) Aboriginal communities were excluded from the sampling framework.

Individuals identified from the databank as having 2 or more risk factors for diabetes were contacted by mail by

<b>Table 1. Reported screening of patients according to their characteristics</b>				
<b>Characteristics</b>	<b>All cases (N=541) (%)</b>	<b>Patient report</b>		<b>p value</b>
		<b>Screened (n=429), n (%)</b>	<b>Not screened (n=112), n (%)</b>	
<b>Risk factors</b>				
<i>Age</i>				
<39	27 (5.0)	20 (4.6)	7 (6.3)	0.837
40–54	238 (44.0)	190 (44.3)	48 (42.9)	
55–64	162 (29.9)	127 (29.6)	35 (31.2)	
65–74	86 (15.9)	71 (16.6)	15 (13.4)	
≥75	28 (5.2)	21 (4.9)	7 (6.3)	
<i>Family history</i>				
Yes	247 (45.7)	205 (47.8)	42 (37.5)	0.052
No	294 (54.3)	224 (52.2)	70 (62.5)	
<i>High-risk ethnic population</i>				
Yes	11 (2.0)	7 (1.6)	4 (3.6)	0.195
No	530 (98.0)	422 (98.4)	108 (96.4)	
<i>GDM</i>				
Yes	54 (10)	45 (10.5)	9 (8.0)	0.440
No	487 (90)	384 (89.5)	103 (92.0)	
<i>Hypertension</i>				
Yes	264 (48.8)	215 (50.1)	49 (43.8)	0.230
No	277 (51.2)	214 (49.9)	63 (56.2)	
<i>Hyperlipidemia</i>				
Yes	289 (53.4)	231 (53.8)	58 (51.8)	0.697
No	252 (46.6)	198 (46.2)	54 (48.2)	
<i>Heart disease/CVD</i>				
Yes	138 (25.5)	111 (25.9)	27 (24.1)	0.702
No	403 (74.5)	318 (74.1)	85 (75.9)	
<b>Demographic factors</b>				
<i>Gender</i>				
Male	256 (47.3)	204 (47.6)	52 (46.4)	0.832
Female	285 (52.7)	225 (52.4)	60 (53.6)	
<i>Education</i>				
Primary (≤7 years)	174 (32.2)	143 (33.3)	31 (27.7)	0.001
Secondary (8–11 years)	163 (30.1)	113 (26.4)	50 (44.6)	
Postsecondary (≥12 years)	204 (37.7)	173 (40.3)	31 (27.7)	
<b>Lifestyle factors</b>				
<i>Physical activity</i>				
Active*	344 (63.6)	275 (64.1)	69 (61.6)	0.625
Not active	197 (36.4)	154 (35.9)	43 (38.4)	
<i>Smoking status</i>				
Smoker (current)	63 (11.6)	56 (13.1)	7 (6.3)	0.046
Nonsmoker	478 (88.4)	373 (86.9)	105 (93.7)	
<i>Alcohol consumption</i>				
Yes (current)	261 (48.2)	222 (51.7)	58 (51.8)	0.994
No	280 (51.8)	207 (48.3)	54 (48.2)	

\*Active is defined as exercising ≥1 times per week

p = significance of differences between those screened (429) and those not screened (112)

CVD = cardiovascular disease

GDM = gestational diabetes mellitus

Santé Québec to request their written permission to receive a letter of explanation from the research team. Those who gave signed consent were sent a letter describing the project, which consisted of having subjects do the following: 1) complete a 15-min telephone interview; 2) provide the name and address of their physician; and 3) provide written permission to contact their physician and obtain information from their medical chart. Physicians received 2 questionnaires: 1 pertaining to their patient's diabetes risk factors and the other to their practice profile and perceptions toward screening. The ethics committees of the Centre Hospitalier de l'Université de Montréal and Santé Québec approved the study, as well as the Quebec Collège des médecins du Québec. Physicians were informed that individual treatment practices would not be transmitted to the college of physicians and that results would be reported as a summary of all physician responses. Data for this study were collected in 2000 and 2002, and were validated and analyzed in 2003 and 2004.

During the telephone interview, subjects were asked whether their physician had tested their BG levels and whether 1) they had been told that they had a high BG level and given treatment/advice, or 2) that they had diabetes, hypertension, hyperlipidemia and/or heart disease. Subjects were also asked about their family history of diabetes,

gestational diabetes mellitus (GDM), ethnicity, alcohol and tobacco use, and physical activity. Physicians were asked similar questions about their patient's diabetes risk-factor profile. Physicians were also asked to respond to questions regarding their medical practice profile, including the following: type of practice; practice setting; percentage of time spent on clinical duties, research or teaching; caseload of patients with diabetes; number of years since graduation; gender; and location of practice. In addition, physicians were asked the following: 1) at which FPG level they usually diagnosed diabetes and initiated nonpharmacologic (i.e. lifestyle) treatment; and 2) to rate, on a Likert scale ranging from 1 to 7 (strongly disagree to strongly agree), their perceptions of diabetes screening.

The SPSS program was used to conduct analyses (SPSS Statistical Analysis, Chicago, Illinois, US). Descriptive statistics were used to describe patient and physician characteristics. Chi-square analyses (for categorical variables) and Student's t-tests (for continuous variables) were used to determine the significance of differences between respondents and nonrespondents and between individuals who reported being screened and those who did not. A diabetes screening perception measure was developed for this study, and the Cronbach coefficient alpha (31), a measure of internal consistency reliability, was 0.71. Student's t-tests were used to determine differences in physician practice profile characteristics and their scores on the screening perception measures.

## RESULTS

### Participation rate

In the Santé Québec databank, 4555 of 20 773 individuals were identified as having 2 or more risk factors for diabetes. Of those, 35% (1595/4555) gave permission to be contacted by the research team: 14% (656) consented to participate, and 12% (541) actually completed the telephone interview (79 could not be reached after 3 calls, 24 refused and 12 gave wrong numbers). Denominalized data for nonrespondents were available from the Quebec Health Survey databank provided by Santé Québec to the research team. There were no differences between the respondents and nonrespondents in total number of risk factors and gender; however, respondents were more likely to be younger (<65 years), nonsmokers, drinkers, active, dyslipidemic, more educated, from rural areas and small cities, and not from a high-risk ethnic population ( $p < 0.05$ ).

A total of 447 physicians were sent questionnaires by mail (70 physicians had >1 patient). Of these, 258 physicians responded and provided information from their patient's medical chart, and 214 provided information on their practice profile.

### Subject and physician characteristics

Subject characteristics (N=541) are outlined in Table 1: 73.9% were between 40 and 64 years of age; 52.7% were female;

<b>Table 2. Physicians' characteristics</b>	
<b>Characteristics</b>	<b>Cases (N=214) n (%)</b>
<b>Gender</b>	
Female	124 (57.9)
Male	90 (42.1)
<b>Specialty</b>	
General/family medicine	205 (95.8)
Specialist	9 (4.2)
<b>Years since graduation</b>	
>20	106 (49.5)
≤20	108 (50.5)
<b>Type of practice</b>	
Clinic only	162 (75.7)
Clinic, teaching and/or research	52 (24.3)
<b>Practice setting</b>	
Hospital clinic	65 (30.4)
Private or community health clinic*	149 (69.6)
<b>Number of patients with diabetes</b>	
>10 per week	116 (54.2)
≤10 per week	97 (45.3)
<b>Practice location</b>	
Urban	114 (53.3)
Rural	100 (46.7)

\*Community health clinic = centres locaux de services communautaires (CLSC)

37.7% had postsecondary education; 53.4% had high blood lipid levels; 48.8% had hypertension; 45.7% had a family history of diabetes; 25.5% had heart/cardiovascular disease; and only 2.0% were from a high-risk ethnic population.

Physicians' characteristics (n=214) are outlined in Table 2: 95.8% were general practitioners; 57.9% were women; 45.3% had a diabetes caseload of >10 patients/week; 30.4% practiced in a hospital setting; and 75.7% spent all their practice time performing clinical duties.

### Screening for diabetes and advice for high BG

Seventy-nine percent (429/541) of subjects reported that they had had a blood test to measure their BG levels. Those who had had their BG tested were more likely to smoke

( $p=0.046$ ), have either primary or postsecondary education ( $p=0.001$ ), or have a family history of diabetes ( $p=0.052$ ) (Table 1).

In contrast, 99% of responding physicians (256/258) reported that they had tested their patients' BG levels. The discrepancy between subject and physician reporting was examined (79% vs. 99%).

Of the 112 subjects who reported not being screened, 43 patient profiles were received from the physician, and 42 physicians (98%) reported having screened the patient. In cases where the physician and patient were in disagreement regarding the occurrence of screening, patients were less likely to have had a family history of diabetes (31% vs. 47%,  $p=0.053$ ) and more likely to be men (75% vs. 54%,  $p=0.03$ ).

Questionnaire statements	Percentage of physicians						
	Disagree strongly	Disagree moderately	Disagree a little	Neutral	Agree a little	Agree moderately	Agree strongly
According to the CDA's clinical practice guidelines, screening for diabetes (FPG testing) should be performed every 3 years among individuals >45 years of age and ...	2	3	5	1	6	30	53
... more frequent testing or earlier testing should be conducted among individuals with additional risk factors, including a first-degree relative with diabetes, member of a high-risk population (Aboriginal, Hispanic, Asian, African descent), obesity (BMI >27 kg/m <sup>2</sup> ), low HDL-C ( $\leq 0.9$ mmol/L), or elevated triglyceride level ( $\geq 2.8$ mmol/L).	1	1	1	0	4	12	81
According to the Canadian Diabetes Association Clinical Practice Guidelines, annual testing should be considered for any one of the following risk factors: history of IGT or IFG, presence of complications, history of gestational diabetes or having a baby with a birth weight >4 kg, hypertension or coronary artery disease.	1	0	1	0	5	17	76
Screening for diabetes as part of routine medical care should be done for patients with $\geq 2$ risk factors.	2	1	1	1	5	28	62
Screening all high-risk patients for diabetes is feasible in a day-to-day medical practice.	1	0	0	2	5	17	75
Screening all high-risk patients for diabetes is cost-beneficial.	1	0	0	8	5	20	66
Early screening of patients for diabetes will reduce complications in the long term.	1	0	0	1	5	15	78
Early treatment of patients with IFG will reduce complications in the long term.	0.5	0	0.5	3	4	21	71

BMI = body mass index

CDA = Canadian Diabetes Association

FPG = fasting plasma glucose

HDL-C = high-density lipoprotein cholesterol

IFG = impaired fasting glucose

IGT = impaired glucose tolerance

Among the 429 subjects who reported being screened, 215 patient profiles were received from the physicians and 214 physicians reported that they had screened the patient.

Among subjects who reported that their physician had tested their BG levels ( $n=429$ ), 315 reported being told that they had normal BG levels, 58 that they had high BG levels but no diabetes, 30 that they had diabetes and 26 that they did not know the results. Among subjects who reported that their physician had told them they had high BG levels but no diabetes, 98% (57/58) subjects reported receiving no treatment advice. Of these patients, 33 patient profiles were received from physicians, and 16 physicians (48%) reported having provided treatment/advice. In cases in which physician and patient were in disagreement regarding the provision of treatment/advice, patients were more likely to be women (75% vs. 41% in cases in which there was agreement,  $p=0.05$ ) and were less likely to have seen the physician in a hospital clinic (13% vs. 57%,  $p=0.01$ ).

### Physicians' views

When physicians were asked at what FPG level they usually made a diagnosis of diabetes, only 47% stated 7.0 mmol/L (46% provided a level between 7.1 and 7.7 mmol/L, 5% responded  $\geq 7.8$  mmol/L and 2% provided other responses). When physicians were asked at what FPG level they usually initiated nonpharmacologic treatment (i.e. lifestyle), only 37% reported initiating it at 6.1 mmol/L, as recommended by the CDA (12).

Table 3 contains the results pertaining to physician perceptions regarding screening. Fifty-three percent of physicians agreed strongly with the CDA statement about screening patients over 45 years of age every 3 years, compared with 81% who agreed strongly with the CDA statement about screening patients with additional risk factors more frequently. Physicians with higher scores on the diabetes perception measure were more likely to have a greater patient caseload for diabetes and to spend all their practice time in clinical duties ( $p<0.05$ ).

## DISCUSSION

In this study, a high percentage of physicians in Quebec screen for diabetes when 2 or more risk factors are present. Almost all responding physicians (99%) reported screening, and as such we were not able to compare physicians who screened with those who did not. Fewer patients reported that their physician had tested their BG levels (79%). One can only speculate about this difference between physician and patient responses: 1) physicians may not report to their patients the details of all tests they conduct; 2) patients may have forgotten to report that they were screened. It is interesting to note that patients who reported being screened were more likely to have a high or low degree of education and to be smokers. It may be that patients with higher levels of education report more screening because their physician

better explains the tests being conducted or because subjects ask about tests being conducted. Similarly, smokers and those with lower levels of education are at higher risk, possibly prompting the physician to provide the test results.

Our survey results indicate that only 75% of physicians agreed strongly that screening all high-risk patients is feasible in day-to-day medical practice; 66% agreed strongly that screening all high-risk patients is cost-beneficial; 78% agreed strongly that early screening would reduce complications in the long term; and 71% agreed strongly that treatment of IFG would reduce complications in the long term. Physicians who reported a more positive perception of screening were more likely to have a higher caseload of diabetes and spend more time on clinical duties. It may be that these physicians are seeing the consequences of the screening more frequently, so that their perception is based on what they observe in their practice.

Among subjects who reported being screened for diabetes, all but 1 of the 58 individuals who were told by their physician that they had a high BG level but no diabetes reported receiving no treatment advice. In contrast, 16 of 32 physicians reported the opposite. This discrepancy may be due to the fact that some patients may have forgotten the treatment advice they had received because the message given by their physician may not have been strong enough. Further research is needed with respect to the dynamics of communication between physician and patient in prediabetes.

Approximately half of responding physicians reported providing treatment advice for prediabetes. Similar results were found by Edelman and colleagues (32), who examined diabetes treatment practices in patients with newly diagnosed diabetes. Furthermore, in our study, when physicians were asked at what FPG level they usually initiate nonpharmacologic treatment (i.e. lifestyle), only 37% reported initiating it at 6.1 mmol/L, as recommended (12). Treatment rates that include lifestyle modification for prediabetes are low in the office-based setting and, as such, a more aggressive approach for prediabetes may be warranted.

The low percentage of physicians providing treatment advice for prediabetes may reflect the divergent practice recommendations by various medical organizations. Furthermore, the CDA recommends that treatment for prediabetes should include a structured program of lifestyle modification (20) conducted by health professionals that emphasizes intensive behavioural and skill development. Communication between physicians and patients is but one step in addressing this complex and multifactorial problem.

The low participation rate by respondents to the Quebec Health Survey and by physicians is a limitation of the study. The profile of physicians who responded to the questionnaire may be different from that of nonrespondents, and this may have affected screening rates (23-29). Furthermore, diabetes screening was defined for the purposes of this study as "a blood test to measure BG levels."

## CONCLUSION

Almost all responding physicians tested their patients' BG levels, and approximately 50% of physicians reported providing treatment advice for prediabetes according to the CDA guidelines (20). However, our study shows that screening for diabetes involves different perceptions by patients and physicians concerning the practice itself and the implications for treatment. We recommend that physician-patient communication strategies in prediabetes be further examined. Having physicians encourage patients to take preventive action may be an important component in dealing with this multifactorial problem.

## ACKNOWLEDGEMENTS

The project was funded by the CDA. A portion of this paper formed the Master's degree thesis of Stéphanie Couture. A portion of this paper was presented as an abstract at the 2003 Canadian Diabetes Association Professional Conference (*Can J Diabetes*. 2003;27:329. Abstract 122).

## AUTHOR DISCLOSURES

No duality of interest declared.

## REFERENCES

- Harris MI, Flegal KM, Cowie CC, et al. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults. The Third National Health and Nutrition Examination Survey, 1988-1994. *Diabetes Care*. 1998;21:518-524.
- Harris MI, Klein R, Welborn TA, et al. Onset of NIDDM occurs at least 4-7 yr before clinical diagnosis. *Diabetes Care*. 1992;15:815-819.
- Schellhase KG, Koepsell TD, Weiss NS, et al. Glucose screening and the risk of complications in type 2 diabetes mellitus. *J Clin Epidemiol*. 2003;56:75-80.
- Rajala U, Laakso M, Qiao Q, et al. Prevalence of retinopathy in people with diabetes, impaired glucose tolerance, and normal glucose tolerance. *Diabetes Care*. 1998;21:1664-1669.
- Fisman EZ, Motro M, Tenenbaum A, et al. Impaired fasting glucose concentrations in nondiabetic patients with ischemic heart disease: a marker for worse prognosis. *Am Heart J*. 2001;141:485-490.
- Meigs JB, Nathan DM, Wilson PW, et al. Metabolic risk factors worsen continuously across the spectrum of nondiabetic glucose tolerance. The Framingham Offspring Study. *Ann Intern Med*. 1998;128:524-533.
- Haffner SM. Can reducing peaks prevent type 2 diabetes: implication from recent diabetes prevention trials. *Int J Clin Pract Suppl*. 2002;129:33-39.
- Hanefeld M. Postprandial hyperglycemia: noxious effects on the vessel wall. *Int J Clin Pract Suppl*. 2002;129:45-50.
- Keebler ME, McGuire DK. Subclinical diabetes mellitus: is it really "subclinical"? *Am Heart J*. 2003;146:210-212.
- UK Prospective Diabetes Study Investigators. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. *Lancet*. 1998;352:837-853.
- Sherwin RS, Anderson RM, Buse JB, et al; American Diabetes Association. The prevention or delay of type 2 diabetes. *Diabetes Care*. 2003;26(suppl 1):S62-S69.
- Meltzer S, Leiter L, Daneman D, et al. 1998 clinical practice guidelines for the management of diabetes in Canada. Canadian Diabetes Association. *CMAJ*. 1998;159(suppl 8):S1-S29.
- Knowler WC, Barrett-Connor E, Fowler SE, et al; Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346:393-403.
- Tuomilehto J, Lindström J, Eriksson JG, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med*. 2001;344:1343-1350.
- Pan XR, Li GW, Hu YH, et al. Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance. The Da Qing IGT and Diabetes Study. *Diabetes Care*. 1997;20:537-544.
- Eriksson KF, Lindgärde F. Prevention of type 2 (non-insulin-dependent) diabetes mellitus by diet and physical exercise. The 6-year Malmö feasibility study. *Diabetologia*. 1991;34:891-898.
- Harris R, Donahue K, Rathore SS, et al. Screening adults for type 2 diabetes: a review of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2003;138:215-229.
- United States Preventive Services Task Force. Screening for type 2 diabetes mellitus in adults: recommendations and rationale. *Ann Intern Med*. 2003;138:212-214.
- American Diabetes Association. Screening for type 2 diabetes. *Diabetes Care*. 2003;26(suppl 1):S21-S24.
- Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2003 clinical practice guidelines for the prevention and management of diabetes in Canada. *Can J Diabetes*. 2003;27(suppl 2):S1-S152.
- Buchanan TA. Prevention of type 2 diabetes: What is it really? *Diabetes Care*. 2003;26:1306-1308.
- Expert Committee on the Classification of Diabetes Mellitus. Report of the Expert Committee on the diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2003;26(suppl 1):S5-S20.
- Massing MW, Henly NS, Carter-Edwards L, et al. Lipid testing among patients with diabetes who receive diabetes care from primary care physicians. *Diabetes Care*. 2003;26:1369-1373.
- Streja DA, Rabkin SW. Factors associated with implementation of preventive care measures in patients with diabetes mellitus. *Arch Intern Med*. 1999;159:294-302.
- Fontana SA, Baumann LC, Helberg C, et al. The delivery of preventive services in primary care practices according to chronic disease status. *Am J Public Health*. 1997;87:1190-1196.
- Zoorob RJ, Mainous AG 3rd. Practice patterns of rural family physicians based on the American Diabetes Association standards of care. *J Community Health*. 1996;21:175-182.

27. Weiner JP, Parente ST, Garnick DW, et al. Variation in office-based quality. A claims-based profile of care provided to Medicare patients with diabetes. *JAMA*. 1995;273:1503-1508.
28. Cowie CC, Harris MI, Eberhardt MS. Frequency of determinants of screening for diabetes in the U.S. *Diabetes Care*. 1994;17:1158-1163.
29. Kenny SJ, Smith PJ, Goldschmid MG, et al. Survey of physician practice behaviors related to diabetes mellitus in the U.S. Physician adherence to consensus recommendations. *Diabetes Care*. 1993;16:1507-1510.
30. Institut de la Statistique du Québec (under the direction of Daveluy C, Pica L, Audet N, et al). *Enquête sociale et de santé 1998, Collection la santé et le bien-être (1998 Social and Health Survey, Health and Well-Being Collection)*. Quebec, QC: Les Publications du Québec; 2000.
31. McDowell I, Newell C. *Measuring Health: A Guide to Rating Scales and Questionnaires*. New York, NY: Oxford University Press; 1987.
32. Edelman D, Olsen MK, Dudley TK, et al. Quality of care for patients diagnosed with diabetes at screening. *Diabetes Care*. 2003;26:367-371.