Attainment of Canadian Diabetes Association recommended targets in patients with type 2 diabetes

A study of primary care practices in St John's, Nfld

Farah McCrate MSc   Marshall Godwin MD MSc CCFP   Laura Murphy MSc

ABSTRACT

OBJECTIVE To examine the degree to which targets for diabetes (blood pressure [BP], glycated hemoglobin [HbA_{1c}], and low-density lipoprotein cholesterol [LDL-C]) are achieved in family practices and how these results compare with family physicians' perceptions of how well targets are being achieved.

DESIGN Chart audit and physician survey.

SETTING Newfoundland and Labrador.

PARTICIPANTS Patients with type 2 diabetes and their family physicians.

INTERVENTIONS The charts of 20 patients with type 2 diabetes were randomly chosen from each of 8 family physician practices in St John's, Nfld, and data were abstracted. All family physicians in the province were surveyed using a modified Dillman method.

MAIN OUTCOME MEASURES The most recent HbA_{1c}, LDL-C, and BP measurements listed in each audited chart; surveyed family physicians' knowledge of the recommended targets for HbA_{1c}, LDL-C, and BP and their estimates of what percentage of their patients were at those recommended targets.

RESULTS The chart audit revealed that 20.6% of patients were at the recommended target for BP, 48.1% were at the recommended target for HbA_{1c}, and 17.5% were at the recommended target for LDL-C. When targets were examined collectively, only 2.5% of patients were achieving targets in all 3 areas. The survey found that most family physicians were aware of the recommended targets for BP, LDL-C, and HbA_{1c}. However, their estimates of the percentages of patients in their practices achieving these targets appeared high (59.3% for BP, 58.2% for HbA_{1c}, and 48.4% for LDL-C) compared with the results of the chart audit.

CONCLUSION The findings of the chart audit are consistent with other published reports, which have illustrated that a large majority of patients with diabetes fall short of reaching recommended targets for BP, blood glucose, and lipid levels. Although family physicians are knowledgeable about recommended targets, there is a gap between knowledge and clinical outcomes. The reasons for this are likely multifactorial. Further investigation is needed to better understand this phenomenon as well as to understand the foundation for physicians' optimistic estimates of how many of their patients with diabetes were reaching target values.

EDITOR'S KEY POINTS

- It is likely that most Canadian physicians are aware of the Canadian Diabetes Association guidelines for management of type 2 diabetes and that they have a vested interest in delivering the best care possible to their patients. However, practice audits repeatedly find that most patients are not achieving the targets recommended in the guidelines. What is the reason for this, if it is not lack of awareness or lack of caring? Why does a gap exist in the translation of knowledge to practice?

- In this study, the authors confirmed that most family physicians surveyed in Newfoundland and Labrador were aware of the recommended targets for their patients with diabetes, but that many seemed to overestimate the degree to which their patients were achieving these targets. Further qualitative analysis is planned to uncover the reasons for these overly optimistic estimates.

Atteinte des valeurs cibles recommandées pour les diabétiques de type 2 par l'Association canadienne du diabète

Étude d'établissements de soins primaires à St-Jean, Terre-Neuve

Farah McCrate MSc   Marshall Godwin MD MSc CCFP   Laura Murphy MSc

RÉSUMÉ

OBJECTIF Établir à quel point les cibles pour le diabète (tension artérielle [TA], hémoglobine glycosylée [HbA_{1c}] et cholestérol des lipoprotéines de basse densité [LDL-C]) sont atteintes en pratique familiale et comment ces résultats se comparent aux perceptions des médecins de famille concernant l'atteinte de ces cibles.

TYPE D'ÉTUDE Revue de dossiers et enquête auprès de médecins.

CONTEXTE Terre-Neuve et Labrador.

PARTICIPANTS Diabétiques de type 2 et leurs médecins de famille.

INTERVENTIONS On a choisi au hasard les dossiers de 20 diabétiques de type 2 dans les bureaux de 8 médecins de famille de St-Jean, TN, pour en extraite les données pertinentes. Par ailleurs, tous les médecins de la province ont fait l'objet d'une enquête par une méthode de Dillman modifiée.

PRINCIPAUX PARAMÈTRES ÉTUDIÉS Les plus récentes valeurs de HbA_{1c}, LDL-C et de TA inscrites dans chaque dossier révisé; connaissances des médecins de famille sondés sur les valeurs cibles recommandées pour ces paramètres et leur estimation du pourcentage de leurs patients qui atteignent les cibles recommandées.

RÉSULTATS La révision des dossiers a révélé que le pourcentage des patients qui atteignaient les cibles recommandées était de 20,6% pour la TA, de 48,1% pour l'HbA_{1c} et de 17,5% pour le HDL-C. Seulement 2,5% des patients avaient atteint les cibles pour les 3 paramètres. L'enquête a montré que la plupart des médecins de famille connaissaient les cibles recommandées pour les 3 paramètres. Toutefois, leur estimation du pourcentage des patients de leur clientèle ayant atteint ces cibles était plutôt élevée (59,3% pour la TA, 58,2% pour l'HbA_{1c} et 48,4% pour le HDL-C) par rapport aux résultats de la révision des dossiers.

CONCLUSION Les observations de la révision des dossiers confirment des études antérieures qui ont montré qu'une très vaste majorité de diabétiques n'atteignent pas les cibles recommandées pour la TA, la glycémie et les niveaux de lipides. Même si les médecins connaissent bien ces cibles, il existe un écart entre connaissances et réalité clinique. Plusieurs facteurs sont sans doute responsables de cela. Il faudra d'autres études pour mieux cerner ce phénomène et pour comprendre l'origine des estimations optimistes des médecins quant au pourcentage de leurs patients qui atteignent les valeurs cibles.

POINTS DE REPÈRE DU RÉDACTEUR

- Il semble que la plupart des médecins canadiens connaissent les directives de l'Association canadienne du diabète pour le traitement du diabète de type 2, et savent qu'ils ont tout intérêt à prodiguer les meilleurs soins possibles à leurs patients. Toutefois, les vérifications de la qualité de pratique montrent constamment que la plupart des patients n'atteignent pas les cibles recommandées par ces directives. S'il ne manque ni de connaissances ni de bons soins, comment cela peut-il s'expliquer? Pourquoi y a-t-il un écart entre connaissances et application pratique?

- Les auteurs de cette étude ont confirmé le fait que la plupart des médecins de famille de Terre-Neuve et du Labrador participant à l'enquête connaissaient les cibles recommandées pour leurs patients diabétiques, mais qu'un bon nombre semblaient surestimer le niveau d'atteinte de ces cibles par leurs patients. Une étude quantitative additionnelle est prévue pour découvrir les raisons de ces estimations beaucoup trop optimistes.

The most recent Canadian guidelines on the diagnosis, prevention, and management of diabetes were published in 2008 by the Canadian Diabetes Association (CDA). These are generally considered the criterion standard of care for patients with diabetes in Canada.[1] The main message of these recommendations is clear: tight control of blood glucose, lipid levels, and blood pressure (BP) will decrease the likelihood of diabetic and cardiovascular complications.

Current statistics show that more than 2 million Canadians have diabetes, 90% of whom have type 2 diabetes. By the end of the decade, this number is expected to rise to 3 million.[2] Further, the prevalence of diabetes in Newfoundland and Labrador is higher than for any other province (5.8% of the population in 2000 to 2001).[3]

According to the CDA guidelines, a person with type 2 diabetes mellitus should have a BP level below 130/80 mm Hg, a glycated hemoglobin (HbA_{1c}) level of 7.0% or lower, and a low-density lipoprotein cholesterol (LDL-C) level of 2.0 mmol/L or lower. These targets are well publicized during continuing medical education events and are circulated to practitioners by the various societies that developed them.

It is likely that most physicians are aware of the guidelines and have a vested interest in delivering the best care possible to their patients. However, audits of family practitioners' patient records repeatedly find that most patients are not achieving the targets for BP, HbA_{1c}, or LDL-C.[4-7] What is the reason for this, if it is not lack of awareness or lack of caring? Why does a gap exist in the translation of knowledge to practice?

Possible barriers to successful guideline adherence have also been posited in other studies[8-10]; complex interactions between family physicians, patients, and the external environment likely play a considerable role. Factors such as patients' value systems, beliefs, socioeconomic status, available resources, level of education, adherence, side effects, and cost of medications and treatments are but a few possible barriers. However, evidence has shown that patients with diabetes are more likely to have better health outcomes and be more satisfied with their health care if guidelines are followed.[11,12]

In this paper, which reports on parts 1 and 2 of our study, we document physicians' knowledge of the CDA recommended targets for HbA_{1c}, BP, and LDL-C in the province of Newfoundland and Labrador, and the degree to which these targets were achieved in 8 family practices in St John's, Nfld.

Part 3 is a qualitative study involving focus groups of physicians and patients, which will be reported separately.

METHODS

Part 1. Chart audit

Eight physicians who are members of the Atlantic Practice Based Research Network were recruited to participate in the study. Of the 8 physicians, 3 practised in academic family medicine clinics, 1 had primarily geriatric patients, 1 practised in an area of the city where most patients had low socioeconomic status, 2 practised in suburban areas, and 1 practised in the downtown core.

In each practice, all patients with type 2 diabetes were identified by office staff through billing records or day sheets. Charts for 20 of those patients from each practice were chosen randomly and were reviewed by the research assistant to confirm the diagnosis of diabetes; collect demographic data; and determine the length of time the patients had had diabetes, which medications they were taking for their diabetes, when the 3 target measurements (BP, HbA_{1c}, LDL-C) were last taken, and what those measurements had been. Whether patients were taking angiotensin-converting enzyme inhibitors or statins was also recorded.

Part 2. Physician survey

All family physicians in Newfoundland and Labrador were surveyed. The sampling frame was developed from 2 sources: the database of the Office of Continuing Medical Education in the Faculty of Medicine at Memorial University of Newfoundland and the database of the College of Physicians and Surgeons of Newfoundland and Labrador. A short questionnaire was developed, which asked participants to provide their age, sex, and date of graduation, as well as which medical school they graduated from, their current practice setting (rural or urban), what the recommended targets for patients with diabetes were for BP, HbA_{1c}, and LDL-C, and what percentage of patients with diabetes in their practice they believed had reached those recommended targets.

A modified Dillman method[13] was used to enhance the response rate to the survey. All 3 components of this project were reviewed and given ethics approval by the Human Investigation Committee of Memorial University of Newfoundland.

RESULTS

Part 1. Chart audit

The demographic and clinical data for the 160 patients whose charts were audited are summarized in **Table 1**. There were roughly equal numbers of men (47.5%) and women (52.5%) included in the chart audit, and the average age of patients was 62.4 years.

The degree to which the different targets were achieved is presented in **Table 2**. In this table achievement of the ideal level of BP control is presented (<130/80 mm Hg), as is the percentage of patients who achieved a BP of 130/80 mm Hg or lower. Because a

Table 1. Demographic and clinical data for the 160 audited patients with diabetes: *A) Sex, treatments, and comorbidities; B) Age, BP, LDL-C, and HbA₁c.*

A)

PATIENT CHARACTERISTICS	N (%)
Sex	
• Female	84 (52.5)
• Male	76 (47.5)
Treatment	
• Metformin	76 (47.5)
• Glyburide	132 (82.5)
• Other oral	38 (23.8)
• Any oral	146 (91.3)
• Insulin	30 (18.8)
• Neither oral nor insulin	14 (8.8)
• Taking ACEI or ARB	105 (65.6)
Comorbidity	
• Hypertension	94 (58.8)
• IHD	34 (21.3)
• CVA	9 (5.6)
• CABG	12 (7.5)

B)

CHARACTERISTIC	MEAN (SD)
Age, y	62.4 (14.4)
Systolic BP, mm Hg	132 (13)
Diastolic BP, mm Hg	78 (13)
LDL-C, mmol/L	2.8 (1.0)
HbA₁c, %	7.3 (1.6)

ACEI—angiotensin-converting enzyme inhibitor; ARB—angiotensin receptor blocker, BP—blood pressure, CABG—coronary artery bypass graph, CVA—cerebrovascular accident, HbA₁c—glycated hemoglobin, IHD—ischemic heart disease, LDL-C—low-density lipoprotein cholesterol.

Table 2. Achievement of targets among the 160 audited patients with type 2 diabetes

TARGET	N (%) AT TARGET
Systolic BP <130 mm Hg	63 (39.4)
Diastolic BP <80 mm Hg	67 (41.9)
Systolic BP ≤130 mm Hg	80 (50.0)
Diastolic BP ≤80 mm Hg	109 (68.1)
Full BP <130/80 mm Hg	33 (20.6)
Full BP ≤130/80 mm Hg	63 (39.4)
HbA₁c ≤7.0%	77 (48.1)
LDL-C ≤2.5 mmol/L	64 (40.0)
LDL-C ≤2.0 mmol/L	28 (17.5)
All targets met (BP <130/80 mm Hg, HbA₁c ≤7.0%, and LDL-C ≤2.0 mmol/L)	4 (2.5)

BP—blood pressure, HbA₁c—glycated hemoglobin, LDL-C—low-density lipoprotein cholesterol.

previous guideline had set the target level for LDL-C at 2.5 mmol/L or lower, we also present 2 results for LDL-C: the percentage of patients who achieved LDL-C levels of 2.5 mmol/L or lower, as well as those who achieved levels of 2.0 mmol/L or lower. In general, the individual targets were met in less than half the patients, and all of the targets collectively (strict criteria) were met in only 2.5% of patients.

Limited subgroup analysis was done using logistic regression. Younger patients (≤60 years) were more likely to achieve systolic BP control (<130 mm Hg) than older patients were (odds ratio [OR] 3.0; 95% confidence interval [CI] 1.5 to 6.1; $P=.002$). Neither age nor sex of patient or physician was related to achievement of lipid targets. For the HbA₁c target, the only relationship detected was with whether or not the patient was taking insulin. Patients taking insulin (n=30) were less likely to have HbA₁c levels of 7.0% or less (OR 0.23; 95% CI 0.08 to 0.65; $P=.006$).

Part 2. Physician survey
In total, 284 (58.0%) of the 490 family physicians who were sent questionnaires responded. **Table 3** describes some of the demographic characteristics of the respondent group. By far most physicians were aware of the recommended targets for BP, HbA₁c, and LDL-C levels in patients with type 2 diabetes. Only 14.8% of physicians listed the target BP level as being higher than 130/80 mm Hg; 1.1% listed a target HbA₁c higher than

Table 3. Demographics of the physicians responding to the survey: *Mean age of physicians was 47.5 years (range 29-69 years); N = 284.*

CHARACTERISTIC	N (%)*
Sex	
• Female	109 (38)
• Male	170 (59)
Practice location	
• Urban	140 (49)
• Rural	134 (47)
• Other (both or missing)	10 (4)
Medical school of graduation	
• Memorial University	155 (55)
• Other Canadian medical school	40 (14)
• Outside of Canada	89 (31)
Years since graduation*	
• 0–10	65 (23)
• 11–20	74 (26)
• 21–30	79 (28)
• >30	62 (22)

BP—blood pressure, HbA₁c—glycated hemoglobin, LDL-C—low-density lipoprotein cholesterol.
*Percentages might not add to 100% owing to missing data.

7.0%; and 5.6% said the target for LDL-C was higher than 2.5 mmol/L. It seems that the message is out that BP, HbA$_{1c}$, and LDL-C should be treated to low targets for patients with diabetes. However, when asked to estimate what percentage of their patients were reaching these targets, physicians generally estimated that about half of their patients with diabetes were meeting the targets: 59.3% for BP, 58.2% for HbA$_{1c}$, and 48.4% for LDL-C (**Table 4**). These estimates are, in fact, optimistic when compared with the findings of the chart audit. In the audit, 48.1% of patients were at target for HbA$_{1c}$, 20.6% were at target for BP (<130/80 mm Hg), and only 17.5% were at the new LDL-C target of 2.0 mmol/L or lower, even though this target was correctly identified by 65.1% of physicians who estimated that 48.4% of their patients were at target.

DISCUSSION

About one-fifth of patients (20.6%) whose charts were audited had BP measurements below 130/80 mm Hg, nearly half (48.1%) achieved the HbA$_{1c}$ target level of 7.0% or lower, and only 17.5% had LDL-C levels of 2 mmol/L or lower. The number of patients reaching target for all 3 factors collectively was very low at 2.5%. Younger patients were significantly more likely to achieve systolic BP control ($P=.002$), and patients taking insulin were less likely to reach target values for HbA$_{1c}$ ($P=.006$). The finding that less than 50% of patients were at targets for each of BP, HbA$_{1c}$, and LDL-C is comparable with other published reports.[4-7] Better control of systolic BP in younger patients might reflect that the

walls of aging arteries are more likely to be stiffer from atherosclerosis, as this hardening of the arterial walls plays a considerable role in elevating systolic pressure. Those who were taking insulin were less likely to achieve HbA$_{1c}$ targets; this might be because patients with more severe diabetes or who are less compliant with treatment are the ones prescribed insulin to help them achieve glycemic control.

Most family physicians surveyed in Newfoundland and Labrador were aware of the recommended targets for BP, HbA$_{1c}$, and LDL-C levels in patients with diabetes. However, many seemed to overestimate the degree to which their patients were achieving these targets, compared with the reality of the chart audit. It should be noted, though, that because we received survey responses from 284 physicians and only audited 8 physician practices, we cannot be certain that the audit reflects the practices of the physicians who responded to the survey. However, if we assume that the practices of the audited physicians are likely to be similar to those of other physicians in the same province, it would seem that knowledge of recommended targets does not necessarily translate into achievement of these targets. Successful treatment of disease, chronic or otherwise, is contingent upon many factors—accurate physician knowledge is just one. The relatively low level of adherence to targets in this study is likely the result of various factors—physician and patient attributes as well as environmental and socioeconomic factors. It is possible that a more detailed exploration of the low levels of adherence to targets in this study would reveal reasons, barriers, and challenges that are similar to those found in other studies.[8-10]

Table 4. Physicians' knowledge of targets and estimation of achievement of targets in their practices: $N=284$.

STATED TARGET	PHYSICIAN STATING THIS AS THE RECOMMENDED TARGET, N (%)	PHYSICIANS' ESTIMATION OF THE PERCENTAGE OF PATIENTS IN THEIR PRACTICES WHO WERE AT TARGET, AS THEY UNDERSTOOD THE TARGET, MEAN (SD)
BP		59.3 (20)
• Correct (< 130/80 mm Hg)	71 (25.0)	
• Almost correct (130/80 or ≤130/80)	98 (34.5)	
• Values below recommended target threshold	67 (23.6)	
• Values higher than recommended target threshold	42 (14.8)	
HbA$_{1c}$		58.2 (20.4)
• Correct (< 7.0, 7.0, or ≤7.0)	210 (74.0)	
• Values below recommended target threshold	66 (23.2)	
• Values higher than recommended target threshold	3 (1.1)	
LDL-C		48.4 (23.1)
• Correct at older 2.5-mmol/L level (< 2.5, 2.5, or ≤2.5)	65 (22.9)	
• Correct according to most recent guideline (< 2.0, 2.0, or ≤2.0)	185 (65.1)	
• Values below recommended target threshold	15 (5.3)	
• Values higher than recommended target threshold	16 (5.6)	

BP—blood pressure, HbA$_{1c}$—glycated hemoglobin, LDL-C—low-density lipoprotein cholesterol.

Our study appears to be the first in Canada to report on the attainment of 3 key treatment targets—HbA_{1c}, BP, and LDL-C—in patients with type 2 diabetes. Harris et al[14] reported on a similar family practice audit in southwestern Ontario in 2003. However, it was primarily a process audit looking at whether BP and lipid measurements, foot examination, and other recommended procedures for patients with diabetes were being done. They did not report on achievement of targets, except for HbA_{1c} levels. They also did not report on physicians' knowledge of the guidelines. As in our study, Harris et al found that approximately 50% of patients were achieving HbA_{1c} targets. A Canada-wide study, also by Harris and colleagues (2005),[15] found that 51% of patients with type 2 diabetes were at target for HbA_{1c} (<7.0%). They did not report on attainment of BP or lipid targets.

Limitations

The findings of the chart audit are based on charts extracted from 8 family physicians' practices in St John's. The College of Physicians and Surgeons of Newfoundland and Labrador database lists 187 general practitioners working in St John's. While the sample was chosen to reflect a range of practice types in the city, it might not be representative of all family practices and does not include any rural practices. Only an audit using a larger sample, or indeed an audit of all practices in the province, could confirm the results conclusively. That the results of this audit are comparable to other published reports, however, is encouraging—especially the nearly identical results for attainment of HbA_{1c} targets from 2 other Canadian studies.[14,15] The survey, which attempted to reach all family physicians in Newfoundland and Labrador, achieved a response rate of 58%, which is respectable; however, the ideal would have been a 100% response rate. While the survey revealed valuable information about physicians' knowledge of targets and estimates of patients achieving target, the premise upon which these estimates are based is still unknown. It was not possible in the scope of a quantitative survey such as this one to elicit this information from the physician respondents.

Future research should focus on further examination of the reasons for the physicians' optimistic estimates of patients reaching targets and a deeper exploration of the reasons for low levels of achievement of recommended targets. In fact, focus groups, which will be reported on separately, have been conducted as part of this study in an attempt to get a better understanding of this matter. Another important possibility for future research would be to look at "getting close to target." Physicians and patients might have worked very hard to get systolic BP levels from 160 to 135 mm Hg, LDL-C levels from 4.3 to 2.7 mmol/L, and HbA_{1c} levels from 9.0% to 7.5%; yet they would receive no credit in our study, or in most other studies on this topic. That only 2.5% of patients had achieved all 3 targets in our study might not reflect what is actually happening.

More to learn

Finally, 2 recent studies, which were published in the *New England Journal of Medicine* after the completion of this study, should be discussed in relation to our results.[16,17] Gerstein et al reported on a randomized trial of type 2 diabetes, the ACCORD (Action to Control Cardiovascular Risk in Diabetes) study,[16] which compared patients receiving intensive therapy aimed at decreasing HbA_{1c} levels to less than 6.0%, with a group in which the goal was to keep HbA_{1c} levels between 7.0% and 7.9%. An average HbA_{1c} level of 6.4% was achieved in the intensive group compared with 7.5% in the less intensive group; however, all-cause mortality increased in the intensive treatment group, as did rates of hypoglycemia, weight gain, and fluid retention. It is apparent that there is more to learn about what constitutes ideal targets for treatment in type 2 diabetes. Perhaps it is fortunate that only 48% of patients in our study had HbA_{1c} levels of 7.0% or lower. The ACCORD study probably only tells us that there is a lower limit to what we should be trying to achieve. It does not necessarily mean we should not be striving to lower HbA_{1c} levels toward 7.0%. This was made particularly clear by the second study, the Steno-2 trial,[17] which showed the lasting benefits of intensive therapy (both medication and lifestyle changes). This trial had intensive and conventional therapy arms that lasted an average of 7.8 years. At that point there were significant differences in triglyceride ($P<.05$), cholesterol, BP, and HbA_{1c} ($P<.01$) levels between the groups. When they followed the groups for a further 5.5 years (average 13.3 years from start of study), the differences in the people in the 2 arms with respect to the achieved levels of lipids, BP, and HbA_{1c} were no longer present; however—and this is the very important result—cardiac events, cardiovascular death, and all-cause mortality were significantly lower in those who had been in the intensive treatment arm ($P \leq .04$). The reduction was not only statistically significant but clinically significant, with a relative reduction of 59% and an absolute reduction of 29%.

Conclusion

The evidence seems clear: intensive treatment to recommended targets in people with type 2 diabetes mellitus saves lives. It is also clear, from our study and others, that recommended targets are not being achieved in people with type 2 diabetes mellitus.

Ms McCrate is an Aging and Seniors Consultant in the Office for Aging and Seniors of the Department of Health and Community Services for the province of Newfoundland and Labrador in St John's. **Dr Godwin** is a Professor of Family Medicine at the Primary Healthcare Research Unit at Memorial University in St John's. **Ms Murphy** is a second-year medical student at Memorial University.

Correspondence
Dr Marshall Godwin, Primary Healthcare Research Centre, Room 1776, Health Sciences Centre, 300 Prince Philip Dr, St John's, NL A1B 3V6; telephone 709 777-8373; fax 709 777-6118; e-mail **godwinm@mun.ca**

References
1. 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):S1-151. Available from: **www.diabetes.ca**. Accessed 2009 Nov 23.
2. Canadian Diabetes Association. *The prevalence and costs of diabetes.* Toronto, ON: Canadian Diabetes Association; 2008. Available from: **www.diabetes. ca/Section_About/prevalence.asp**. Accessed 2009 Nov 23.
3. Statistics Canada. *Diabetes by sex, provinces and territories.* Ottawa, ON: Statistics Canada; 2006. Available from: **www40.statcan.ca/l01/cst01/ health54a.htm?sdi=diabetes**. Accessed 2006 Mar 25.
4. Edge JA, Swift PGF, Anderson W, Turner B; Youth and Family Advisory Committee of Diabetes UK. Diabetes services in the UK: fourth national survey; are we meeting NSF standards and NICE guidelines? *Arch Dis Child* 2005;90(10):1005-9. Epub 2005 Jun 7.
5. Lindberg M, Lind M, Petersson S, Wilhelmsson S. The use of clinical guidelines for asthma, diabetes, and hypertension in primary health care. *Int J Qual Health Care* 2005;17(3):217-20. Epub 2005 Mar 2.
6. Putzer G, Roetzheim R, Ramirez AM, Sneed K, Brownlee HJ Jr, Campbell RJ. Compliance with recommendations for lipid management among patients with type 2 diabetes in an academic family practice. *J Am Board Fam Pract* 2004;17(2):101-7.
7. Eliasson B, Cederholm J, Nilsson P, Gudbjörnsdóttir S; Steering Committee of the Swedish National Diabetes Register. The gap between guidelines and reality: type 2 diabetes in a national diabetes register 1996-2003. *Diabet Med* 2005;22(10):1420-6.
8. Lesho EP, Myers CP, Ott M, Winslow C, Brown JE. Do clinical practice guidelines improve processes or outcomes in primary care? *Mil Med* 2005;170(3):243-6.
9. Gabbay J, le May A. Evidence based guidelines or collectively constructed "mindlines?" Ethnographic study of knowledge management in primary care. *BMJ* 2004;329(7473):1013.
10. Larme AC, Pugh JA. Evidence-based guidelines meet the real world: the case of diabetes care. *Diabetes Care* 2001;24(10):1728-33.
11. Kirkman MS, Caffrey HH, Williams SR, Marrero DG. Impact of a program to improve adherence to diabetes guidelines by primary care physicians. *Diabetes Care* 2002;25(11):1946-51.
12. Gross R, Tabenkin H, Porath A, Heymann A, Greenstein M, Porter B, et al. The relationship between primary care physicians' adherence to guidelines for the treatment of diabetes and patient satisfaction: findings from a pilot study. *Fam Pract* 2003;20(5):563-9.
13. Dillman DA. *Mail and Internet surveys: the tailored design method.* New York, NY: Wiley; 1999.
14. Harris SB, Stewart M, Brown JB, Wetmore S, Faulds C, Webster-Bogaert S, et al. Type 2 diabetes in family practice. Room for improvement. *Can Fam Physician* 2003;49:778-85.
15. Harris SB, Ekoe JM, Zdanowicz Y, Webster-Bogaert S. Glycemic control and morbidity in the Canadian primary care setting (results of the diabetes in Canada evaluation study). *Diabetes Res Clin Pract* 2005;70(1):90-7.
16. Action to Control Cardiovascular Risk in Diabetes (ACCORD) Study Group; Gerstein HC, Miller ME, Byington RP, Goff DC Jr, Bigger JT, et al. Effects of intensive glucose lowering in type 2 diabetes. *N Engl J Med* 2008;358(24):2545-59. Epub 2008 Jun 6.
17. 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):580-91.

———✳✳✳———