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ORIGINAL ARTICLE

Glycaemic control and cardiovascular risk factor management in patients with diabetes with and without coronary artery disease: insights from the diabetes mellitus status in Canada survey

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Aims Current diabetes guidelines recommend an individualized approach to glycaemic control. There are limited data on the contemporary and comprehensive management of patients with diabetes in relation to coronary artery disease (CAD).

Methods and results The Diabetes Mellitus Status in Canada (DM-SCAN) survey included 5123 patients with type 2 diabetes seen in primary care in November 2012. Primary care physicians (PCPs) collected clinical data and specified the A1C target for each patient on standardized forms. We compared management strategies and achievement of treatment targets in patients with and without CAD. Among the 4994 patients with data on CAD history, 22.5% had CAD. Primary care physicians were more likely to select a higher A1C target for patients with CAD ($\leq$7.5 or $\leq$8.0%) versus without ($\leq$7.0%). There was no difference in median A1C or in the proportion of patients with A1C $\leq$7.0% between the two groups. Compared with the group without known CAD, patients with CAD had a higher reported prevalence of hypoglycaemia in the preceding 6 months; more frequently received aspirin, statins, ACE inhibitors, or angiotensin receptor blockers, and were more likely to achieve blood pressure and low-density lipoprotein-cholesterol targets. Only 15.4 and 12.0% of patients with and without CAD ($P = 0.002$), respectively, achieved all three guideline-recommended targets.

Conclusion Compared with patients with diabetes without CAD, those with CAD more frequently had a less stringent A1C target selected by their PCPs but achieved similar glycaemic control. Overall, risk factor management remained suboptimal in both groups. There remains an important opportunity to improve the care and outcome of patients with diabetes.

Keywords Coronary artery disease • Diabetes • Risk factors • Glycaemic control

Introduction

Type 2 diabetes is a leading cause of cardiovascular morbidity and mortality in Canada and worldwide.[1] Randomized controlled trials of intensive versus less intensive glycaemic control have shown long-term benefits on microvascular complications and with adequate follow-up, benefits on macrovascular complications.[2–4] However, one study demonstrated harm with overly intensive glycaemic control in select patients[5] and therefore, there is wide recognition that glycaemic targets should be individualized. Practice guidelines, including those of the Canadian Diabetes Association (CDA), have been updated to reflect this new evidence,[6] with higher A1C targets endorsed since 2012 by the American Diabetes Association/European Association for the Study of Diabetes for patients at increased

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clinical risk, including those with manifest cardiovascular disease.[7,8] In addition to individualization of glycaemic targets, there continues to be an emphasis on cardiovascular risk factor management.[9] There remains a paucity of real-world data to determine if these changes have been implemented in practice.

The Diabetes Mellitus Status in Canada (DM-SCAN) survey was conducted to obtain point prevalence data on patients with diabetes managed in the community in Canada.[10] This cross-sectional study aims to compare the management of glycaemia and cardiovascular risk factors, as well as the overall achievement of guideline-recommended targets, in patients with diabetes with or without coronary artery disease (CAD) in the Canadian primary care setting.

Methods

Study design

Data were obtained from the DM-SCAN survey, with the study design detailed in a previous publication.[10] Primary care physicians (PCPs) across Canada were contacted by the Canadian Heart Research Centre from September to December 2012 to invite their participation in the survey.

Physicians first completed a 10-question survey providing details of their practice and patient population, specifically their patients with type 2 diabetes. This included information regarding the topics typically discussed during patient interviews and a basic needs assessment in terms of perceived barriers to type 2 diabetes care. Physicians who completed the initial survey were asked to fill out an anonymous 1-page data collection form on patients with type 2 diabetes seen in their clinic on or around World Diabetes Day, 14 November 2012. Although patients with type 2 diabetes who did not see a PCP would be underrepresented by design, given the universal healthcare and the need for referral to consult with an endocrinologist, it is unlikely that a considerable proportion of patients with diabetes were excluded on this basis. Eligible patients were those with an established diagnosis of type 2 diabetes as defined in the 2008 CDA guidelines, namely one of either symptoms of hyperglycaemia with a random plasma glucose value $>$11.1 mmol/L, a fasting plasma glucose $>$7.0 mmol/L or A1c $>$ 6.5% (A1c(mmol/mol) = [A1c(%) − 2.15] × 10.929).[6] Additionally, in order to differentiate these patients from patients who may have type 1 diabetes, patients had to have an absence of history of ketoacidosis and no insulin use in the first 6 months following diagnosis. In terms of exclusion criteria, pregnant women and patients undergoing their first diabetes-related visit were excluded from the study.

The case report form included demographic and anthropometric data, clinical history (including CAD status), physical examination and laboratory data [e.g. last blood pressure (BP), measurement, measured A1c, most recent lipid profile], as well as medication use (including antihyperglycaemics, antihypertensives, lipid modifying medications, aspirin) and overall management strategies for type 2 diabetes and various cardiovascular risk factors. Of particular importance, along with the most recent measured A1c value, the individual patient A1c target according to the treating physician was recorded on the case report form.

OPTIMUM Clinical Research, an independent central ethics review board, reviewed and approved the study materials prior to initiation of the survey. Physicians received reimbursement for their time.[10] The Canadian Heart Research Centre developed the protocol, coordinated the study, collected and managed the data.

Data collection and analysis

Continuous variables are summarized as median with interquartile range (25th, 75th percentile), and compared by the Mann–Whitney *U* test. Discrete variables are reported as percentages or counts. Nominal variables between the CAD and no CAD groups were compared using Pearson's Chi-square test. Data analysis was carried out using SPSS version 22 (IBM).

In the study, CAD was defined and diagnosed by symptoms, past medical history, or objective test results. Symptoms include chest pain—both typical and atypical—as well as shortness of breath on exertion. The presence of a prior myocardial infarction, acute coronary syndrome, coronary artery bypass graft, or percutaneous coronary intervention was considered diagnostic of CAD. Finally, available results for either a positive stress test or evidence of $>$50% stenosis of one or more coronary artery on conventional angiography or CT angiography conveyed a diagnosis of CAD.

Although we recognize that there are variations in practice worldwide, optimal treatment targets were defined using the most recent CDA guidelines.[6] Optimal BP target in patients with diabetes was defined as a BP $<$ 130/80 mmHg and low-density lipoprotein-cholesterol (LDL-C) target was $\leq$2.0 mmol/L. In terms of optimal glycaemic control, the CDA recommends an individualized target based on comorbid status (including extensive CAD at high risk of ischaemic events), life expectancy, hypoglycaemia unawareness, or severe events and overall risk status of each patient. Most adult patients with type 2 diabetes have a recommended target A1c $\leq$7.0%. Some patients with type 2 diabetes who may derive greater microvascular protection from tight glycaemic control have an individualized recommended target A1c $\leq$6.5%. Patients with shortened life expectancy, frailty, extensive CAD at high risk of ischaemic events, hypoglycaemic unawareness or severe hypoglycaemic episodes, and/or a large number of severe comorbidities have a recommended target A1c 7.1–8.5%.

In the analysis of the management of cardiovascular risk factors, the achievement of all three guideline-recommended targets, namely BP $<$ 130/80 mmHg, LDL-C $\leq$2.0 mmol/L, and an A1c $\leq$7.0%, was compared between both groups.

Hypoglycaemia was defined, as per the CDA, as the presence of autonomic or neuroglycopenic symptoms, a low plasma glucose level ($<$4.0 mmol/L in patients on insulin or insulin secretagogues) and improvement of symptoms after administration of carbohydrate.[6] However, episodes of hypoglycaemia were self-reported by patients, without necessarily simultaneous verification of blood glucose measurements.

In terms of selected A1c targets, PCPs were asked to report which of five categories they placed their patients in: $\leq$6.0, $\leq$6.5, $\leq$7.0, $\leq$7.5, and $\leq$8.0%. The percentage of patients allocated to each group was compared between patients with and without CAD.

The case report forms also collected data on three different health behaviour interventions: whether the patient had been referred to a registered dietician or a certified diabetes educator in the last 12 months or prior; whether there was a nutrition and/or exercise and/or weight loss plan that had been established for the patient in the last year or earlier; and whether a smoking cessation plan had been discussed with current smokers in the last year. These three health behaviour interventions were also compared between patients with and without CAD.

Results

Patient demographics

From the original 738 PCPs who completed the initial audit form, 479 participated in the study (65% participation rate). These physicians provided data on a total of 5123 patients with type 2 diabetes mellitus cared for in their practice. Of these, CAD status was reported in 4994 patients; 1126 patients (22.5%) had known CAD

and 3868 (77.5%) did not have documented CAD (*Table 1*). Patients from across Canada were included in the study. There were 2916 patients from Ontario, 832 patients from the Atlantic Provinces (Prince Edward's Island, New Brunswick, Nova Scotia, and Newfoundland), 486 patients from the Prairies (Manitoba, Alberta, and Saskatchewan), 383 patients from Quebec and 377 from British Columbia. The highest proportion of patients with CAD was in the Prairies (27.8%), while patients in British Columbia had the highest likelihood (59%) of achievement of A1c $< 7.0\%$.

The age of patients with vs. without CAD was significantly higher (median 71 vs. 62 years) and there were fewer women in the CAD group when compared with the group without CAD. There was no difference between the groups for prevalent smoking and body mass index.

Notably, patients in the CAD group were more likely to have a longer duration of diabetes, with a median of 10 years compared with 7 years in patients without CAD ($P < 0.001$). Patients with CAD were also significantly more likely to have other macrovascular (stroke, peripheral vascular disease) or microvascular (retinopathy, neuropathy, and nephropathy) complications of diabetes.

Glycaemic management

Patients with type 2 diabetes with CAD were less likely to have diabetes management with diet alone, relative to those without CAD, although this did not reach statistical significance. Both groups had a median of two anti-hyperglycaemic medications prescribed, with no difference in insulin use between the groups. In terms of specific oral anti-hyperglycaemic agents, there was no difference between the groups for metformin use. Patients with vs. without CAD were more likely to be on a sulfonylurea (28.7 vs. 20.4%, respectively; $P < 0.001$), as well as an α-glucosidase inhibitor (3.1 vs. 1.9%, respectively; $P = 0.02$), but were less likely to have been prescribed a DPP-4 inhibitor (21.0 vs. 25.5%, respectively; $P = 0.002$) (*Table 2*).

In terms of individual patient target A1c goals chosen by PCPs, patients with CAD were more likely to have a higher chosen A1c target (≤ 7.5 or $\leq 8.0\%$), when compared with patients without CAD (*Figure 1A*). However, there was no statistically significant difference in the actual A1c measurements between the two groups (*Figure 1B*). The median achieved A1c was not different for those with vs. without CAD (7.1 vs. 7.0%, respectively; $P = 0.18$). Patients with vs. without CAD were significantly more likely to have reported a hypoglycaemic episode in the prior 6 months (12.3 vs. 6.5%, respectively; $P < 0.001$). They were also significantly more likely to have reported a severe hypoglycaemic episode, defined as hypoglycaemia requiring assistance by another person, in that same time period (2.1 vs. 0.9%, respectively; $P = 0.003$) (*Table 2*).

Table 1 Demographics and medical history

	No known CAD ($N = 3868$)	CAD ($N = 1126$)	*P*-value
Age (years)[a]	62 (54, 71)	71 (64, 78)	<0.001
Male (%)	50.4	66.3	<0.001
Ethnic groups (%)			<0.001
Caucasian	57.6	70.5	
East/Southeast Asian	19.6	10.8	
South Asian	11.0	9.8	
Aboriginal Canadian, Black, Hispanic, other	11.9	8.9	
Current smoker (%)	11.5	10.1	0.23
BMI (kg/m^2)[a]	29.1 (25.7, 33.7)	29.4 (26.0, 33.4)	0.34
Duration of diabetes (years)[a]	7 (4, 12)	10 (6, 15)	<0.001
Macrovascular complications (%)			
Stroke[b]	3.1	11.9	<0.001
Peripheral artery disease	3.6	21.4	<0.001
Microvascular complications (%)			
Retinopathy	5.7	16.2	<0.001
Neuropathy	8.5	21.3	<0.001
Nephropathy	11.4	27.1	<0.001

BMI, body mass index.
[a]Median (25th percentile, 75th percentile).
[b]Data on previous stroke only recorded on paper case report form and available in 2221 patients.

Cardiovascular risk factor control and management

In comparing the management of BP in patients with or without CAD, there was no significant difference in systolic BP (SBP), with a median SBP of 128 mmHg in both groups. However, there was a significant difference in diastolic BP (DBP), with a lower median DBP in patients with than without CAD (*Table 3*). Patients with vs. without CAD were treated with a greater number of antihypertensive medications (median 2 vs. 1, respectively; $P < 0.001$). Patients with vs. without CAD were also significantly more likely to be taking an angiotensin-converting enzyme inhibitor and/or angiotensin receptor blocker (ARB) (89 vs. 73.8%, respectively), a β-blocker (46.9 vs. 12.8%, respectively), a calcium channel blocker (37.6 vs 24.7%, respectively) and a diuretic (40.7 vs 31.2%, respectively; all $P < 0.001$) (*Table 3*). Patients with vs. without CAD had a significantly lower LDL-C level on their last measurement (1.8 vs. 1.9 mmol/L, respectively). Patients with CAD were also more likely to have been prescribed a statin (88.1 vs. 75.7%, respectively; $P < 0.001$) and aspirin (67 vs. 45%, respectively; $P < 0.001$) (*Table 3*).

Achievement of guideline-recommended targets

There was no significant difference in the proportion of patients having achieved the recommended A1c $\leq 7.0\%$ in groups with or without CAD (48.5 vs. 50.5%, respectively; $P = 0.24$; *Figure 2*). Patients with vs. without CAD were significantly more likely to achieve the guideline-recommended BP target (39.1 vs. 35.8%, $P = 0.045$), and more likely to have achieved an LDL-C ≤ 2.0 mmol/L (66.0 vs. 54.5%, respectively; $P < 0.001$).

Overall, using an A1C target of $\leq 7.0\%$, patients with CAD were more likely to achieve all three recommended targets than their counterparts without CAD (15.4 vs. 12.0%, respectively; $P = 0.002$) (*Figure 2*).

Table 2 Management of type 2 diabetes

	No known CAD (*N* = 3868)	CAD (*N* = 1126)	*P*-value
Haemoglobin A1c (%)[a]	7.0 (6.5, 7.9)	7.1 (6.5, 7.9)	0.18
Fasting plasma glucose (mmol/L)[a]	7.2 (6.2, 8.6)	7.3 (6.3, 8.7)	0.57
Hypoglycaemia (%)	6.5	12.3	<0.001
Severe hypoglycaemia (%)	0.9	2.1	0.003
Diet (%)	16.1	13.9	0.07
Number of anti-hyperglycaemics (%)			0.02
1	34.7	34.9	
2	34.5	38.0	
≥3	17.2	16.6	
Number of anti-hyperglycaemic medications[a]	2 (1, 2)	2 (1, 2)	0.09
Insulin therapy (%)	50.5	51.4	0.60
Oral anti-hyperglycaemics (%)			
Metformin	50.8	50.3	0.74
Sulfonylurea	20.4	28.7	<0.001
DPP-4 inhibitor	25.5	21.0	0.002
α-Glucosidase inhibitor	1.9	3.1	0.02
GLP-1 agonist	3.3	2.8	0.35
Thiazolidinedione	3.5	3.6	0.89
Meglitinide	1.4	1.9	0.29

To convert from % to mmol/mol, A1c(mmol/mol) = [A1c(%) − 2.15] × 10.929.
DPP-4, dipeptidyl peptidase-4; GLP-1, glucagon-like peptide-1.
[a]Median (25th percentile, 75th percentile).

Health behaviour interventions

Patients with vs. without CAD were significantly more likely to have been referred to a registered dietician or a certified diabetes educator in the last 12 months or prior (*Figure 3*). Similarly, patients with vs. without CAD were more likely to have had a formal nutrition/exercise/weight loss plan documented by their practitioners, both in the last year or prior. There was no significant difference between the two groups in the proportion of current smokers who had a discussion about smoking cessation plan, an intervention documented frequently in both groups.

Discussion

This cross-sectional study demonstrates that patients with diabetes and CAD were more likely to have a less stringent A1c target selected by their PCPs than patients without CAD. However, glycaemic control achieved did not differ for patients with and without CAD. Overall use of metformin and insulin did not differ, but there was greater use of sulfonylureas and α-glucosidase inhibitors in the CAD group, and greater use of diet alone in the group without CAD. Patients with CAD were prescribed more antihypertensive medications than their counterparts without CAD, and were more likely to be on other cardioprotective medications. The patients with CAD were also more likely to have been prescribed a statin and had lower LDL-C levels. Overall, patients with CAD were more likely to have achieved all three guideline-recommended targets, though the absolute numbers remained low with only 15.4% of patients with CAD and 12% of patients without CAD actually achieving all three targets.

The short- and long-term microvascular benefits of glycaemic control are well established. Macrovascular benefits in type 2 diabetes have also been demonstrated but have required a longer duration of follow-up and all-cause mortality has not been consistently reduced. In addition, the ACCORD trial demonstrated increased harm with intensive glycaemic control (target ≤6%) in the short term in certain patients.[5] Therefore, clinical practice guidelines have recommended individualization of glycaemic targets.[6,11] However, there continues to be a strong priority placed on vascular protection and optimization of cardiovascular risk factors, extending beyond glucose control to include intensive BP and LDL-C management, aspirin for patients with CAD, and therapeutic lifestyle interventions.[6]

Our study examined how patients were treated in the community and whether these guidelines translated into actual practice. We found that patients with CAD were more likely to have been set a higher A1c target by their physicians than patients without. This corresponds to the CDA-recommended approach of individualization given that the CAD patients were significantly older and more likely to have other factors that could favour a less stringent A1c target. However, the patients' actual achieved A1c was not significantly different between the patients with and without CAD, with groups similarly likely to achieve an A1c ≤7.0%.

Several studies have identified patients with extensive CAD as being at increased risk for hypoglycaemic events. Hypoglycaemia has been hypothesized to trigger a cascade of pathophysiologic effects, which induce adrenergic activation, oxidative stress, and may lead to

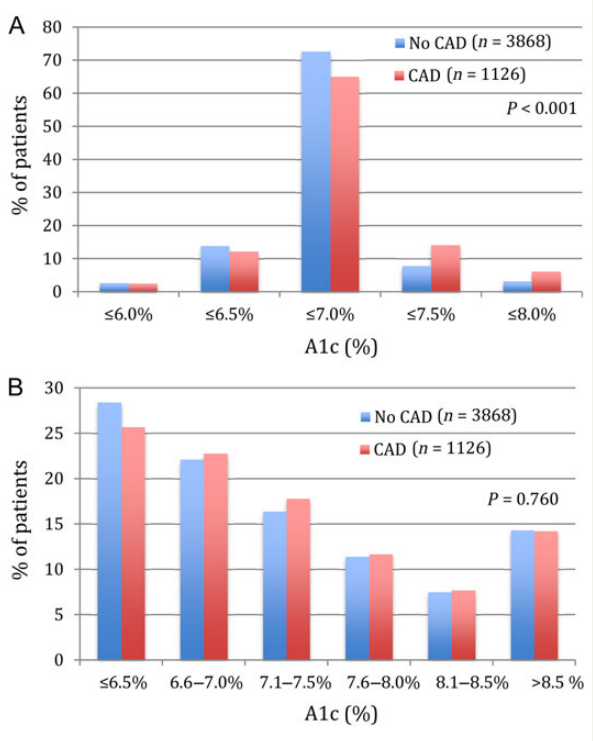

Figure 1 Targeted and achieved A1c values in patients with or without coronary artery disease. (*A*) Distribution of physician-specified A1c targets in patients with or without coronary artery disease. (*B*) Distribution of achieved A1c values in patients with or without coronary artery disease. To convert from % to mmol/mol, A1c (mmol/mol) = [A1c(%) − 2.15] × 10.929.

worsening of the cardiovascular risk profile, increase the risk of cardiac arrhythmias, and may contribute to sudden death and ischaemic cerebral damage.[12,13] The greater prevalence of hypoglycaemic events in patients with CAD was similarly illustrated in our study. Despite their similar glycaemic achievement, they were more likely to have had one or more hypoglycaemic events in the last 6 months.

Of note, patients with CAD were more likely to have been prescribed a sulfonylurea, which is known to have greater potential to induce hypoglycaemia and other adverse events.[14] Moreover, patients with CAD in our study had a significantly longer duration of diabetes. In fact, these patients were likely at higher risk of hypoglycaemia unawareness based on their duration of diabetes and rates of hypoglycaemia might have even been underreported. Prolonged use of both sulfonylureas and insulin may significantly contribute to this greater incidence of hypoglycaemic events in this patient population. However, this may also support the notion that patients with CAD have a greater predilection for glycaemic fluctuations than their counterparts without CAD.[15]

Patients with CAD in our study were more likely to have been prescribed a β-adrenergic antagonist. These medications have been hypothesized to have deleterious glycaemic effects and have been found in some patients to increase the incidence of hypoglycaemia.[16] Another concerning feature of the mechanism of action of β-blockers is the potential for blunting of the adrenergic response to hypoglycaemia. Moreover, there is biological plausibility for delayed return to euglycaemia after hypoglycaemia has occurred.[17] Although these have not been conclusively demonstrated in patients with type 2 diabetes, they remain important plausible explanations for why our patients with CAD might have had a higher prevalence of hypoglycaemic events.

In terms of comorbidities, it has been previously posited and subsequently demonstrated that patients with renal disease have higher incidence of hypoglycaemia. In fact, studies have shown that patients with chronic kidney disease with or without diabetes are at higher risk of hypoglycaemic events.[18] Patients with diabetes and CAD in our study were found to be more likely to also have nephropathy. Along with intrinsic predispositions, the use of oral hypoglycaemic agents and a higher prevalence of β-blocker use, the higher prevalence of renal failure contributes to the high-risk protoplasm of patients with diabetes and CAD in terms of risk of hypoglycaemic events.

In this study, 3.6% of patients with CAD were treated with a thiazolidinedione. This is surprising in light of the findings that these medications predispose to heart failure, particularly in patients with underlying heart disease, as summarized by the American Heart Association and American Diabetes Association along with recommendations.[19] It is possible that several of these patients had been previously treated with thiazolidinediones with good glycaemic control and the decision was made, weighing risks and benefits, to continue therapy. However, the case report form did not collect data regarding rationale for the management of these patients.

Hypertension and dyslipidaemia have been shown to be strong independent cardiovascular risk factors in patients with diabetes.[20] An important randomized controlled trial, STENO-2, showed that a multifactorial intervention targeting glycaemic control as well as management of cardiovascular risk factors, had sustained benefits in terms of cardiovascular events and risk of death.[21] In patients with type 2 diabetes and microalbuminuria at study entry. Likewise, an observational study published in 2013 showed that patients with type 2 diabetes who had uncontrolled BP, LDL-C and A1c or with only their A1c at target, were at greatest risk of hospitalization for cardiovascular disease, whereas those with all three risk factors controlled or with BP and LDL-C at target had lower rates of adverse cardiovascular events.[22] Moreover, patients with diabetes who have suffered an acute coronary syndrome have been shown in a recent Canadian study[23] as well as in prior publications,[24] to have higher adjusted in-hospital mortality. Among others, these studies highlight the importance of cardiovascular risk factor management in patients with diabetes.

Our study has shown that in Canadian patients with diabetes currently managed in the community, patients with CAD were found to be better treated for their cardiovascular risk factors than patients without CAD. For instance, these patients had an overall greater number of antihypertensive medications prescribed relative to those without CAD. They were also more likely to have been prescribed a statin. This highlights that PCPs recognize the importance of implementing vascular protective measures for these patients. Moreover, it is possible that the high-risk status of these patients—marked by a higher prevalence of macro- and microvascular complications in addition to their known CAD—may have prompted a more aggressive treatment approach by their PCPs. It is possible

Table 3 Management of cardiovascular risk factors

	No known CAD (*N* = 3868)	CAD (*N* = 1126)	*P*-value
Management of blood pressure			
SBP (mmHg)[a]	128 (120, 135)	128 (120, 136)	0.12
DBP (mmHg)[a]	78 (70, 80)	75 (69, 80)	<0.001
Number of antihypertensives (%)			<0.001
1	35.3	22.8	
2	26.8	35.0	
3	14.4	29.9	
4	2.8	8.1	
5	0.1	0.5	
Number of antihypertensives[a]	1 (1, 2)	2 (1, 3)	<0.001
ACEi/ARB (%)	73.8	89.0	<0.001
β-blocker (%)	12.8	46.9	<0.001
CCB (%)	24.7	37.6	<0.001
Diuretic (%)	31.2	40.7	<0.001
Direct renin inhibitor (%)	0.6	0.5	0.74
Management of dyslipidaemia			
LDL-C (mmol/L)[a]	1.9 (1.5, 2.6)	1.8 (1.4, 2.3)	<0.001
Statin (%)	75.7	88.1	<0.001
Other cardiovascular interventions			
ASA (%)	45.0	67.0	<0.001
Smoking cessation plan for current smokers, *n* = 535 (%)	87.9	93.5	0.095

ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CCB, calcium channel blocker; LDL-C, low-density lipoprotein-cholesterol; ASA, acetylsalicylic acid.
[a]Median (25th percentile, 75th percentile).

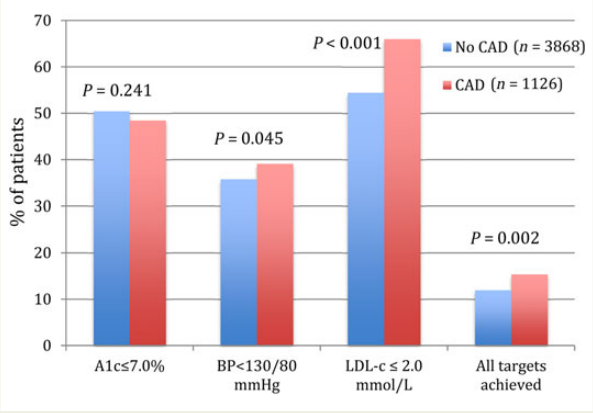

Figure 2 Achievement of guideline recommended targets in relation to coronary artery disease status. A1c, haemoglobin A1c; BP, blood pressure; LDL-C, low-density lipoprotein-cholesterol. To convert from % to mmol/mol, A1c(mmol/mol) = [A1c(%) − 2.15] × 10.929.

that patients with CAD and other comorbidities were more likely to have been followed by specialists. Closer follow-up and more involved care might have played a role in patients with CAD being more likely to achieve guideline-recommended targets in terms of their cardiovascular risk factors.

There is evidence that non-pharmacologic interventions are beneficial in terms of improving glycaemic control and cardiovascular risk factors in patients with diabetes. A recent meta-analysis showed that aerobic exercise alone or combined with resistance training improved glycaemic control as well as BP and dyslipidaemia in patients with diabetes.[25] These findings are echoed in the CDA recommendations.[6] In terms of nutritional counselling, there is evidence that specific diets as well as input from a dietician or diabetes educator improve cardiovascular risk factors as well as glycaemic control in patients with diabetes.[26,27]

Patients with diabetes and CAD in the DM-SCAN survey were more likely to have been referred to a registered dietician or a certified diabetes educator, as well as to have had a nutrition and/or exercise and/or weight loss plan established for them by their primary care provider. This denotes a more comprehensive care approach and attention to aggressive management of all cardiovascular risk factors, which remains a fundamental aspect of diabetes care.

We found that patients with CAD were more likely to achieve CDA-recommended BP and lipid targets, though still fewer than 50% of patients in both groups were able to achieve the BP target. Patients with CAD had a better chance of achieving the combination of all three targets (haemoglobin A1c, BP, LDL-C); however, absolute numbers remained low, with only 15.4% of the CAD group and 12.0% of patients without CAD achieving all three targets. Overall, cardiovascular risk factor management was found to be suboptimal in both groups and this highlights a substantial and persistent care

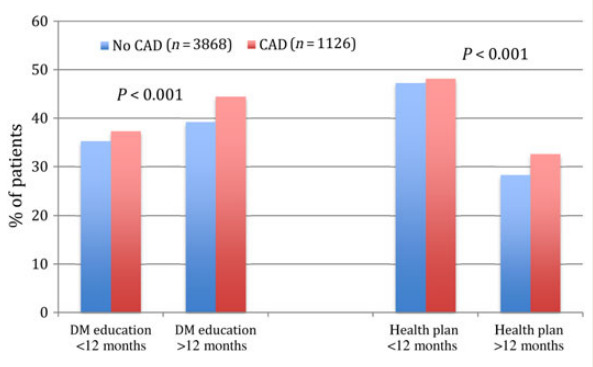

Figure 3 Health behaviour interventions in relation to coronary artery disease. *DM education*, referral to certified diabetes educator or registered dietician within specified time period; *health plan*, establishment of exercise and/or nutrition and/or weight loss plan within specified time period.

gap in the real world.[28] Patient-individualized strategies to help practitioners manage glycaemia and cardiovascular risk factors in patients with diabetes are needed to bridge the remaining care gaps. Longitudinal studies, with hard outcomes and long-term assessments of risk factors would help answer some of the remaining outstanding questions in real-world management of diabetes.[29]

The DM-SCAN survey does have several limitations. As a cross-sectional observational study, it can provide insight into point prevalence data about diabetes care; however, results can only be used to illustrate association and not infer causality. The survey was not population based, and the recruitment strategies for the physicians might have selectively included physicians who were more likely to be up to date with evidence-based management, which might have actually overestimated the achievement of guideline-recommended targets in Canadian patients. Moreover, patients with better-controlled diabetes and risk factors may visit their physicians more frequently and thus have been more likely to be included in the study. Patients with type 2 diabetes, especially those with a greater number of comorbidities including CAD, may also be cared for by specialists along with their PCP. The case report form in DM-SCAN did not collect data regarding other physicians' involvement in the patients' care, nor did it permit PCPs to justify various treatment decisions.

Data were abstracted from medical records by physicians and were not verified independently. Similarly, we could not determine medication adherence. Other self-reported data included episodes of hypoglycaemia. Along with an absence of objective findings to correlate with the information reported by patients, the DM-SCAN form did not collect detailed information regarding these episodes, nor did we have information regarding hypoglycaemia awareness. We acknowledge that this information may have had in certain cases a substantial influence on designated A1c targets. Finally, we recognize that although the concepts and concerns relating to the care of patients with type 2 diabetes in the community are quite generalizable, the findings in this national cross-sectional study may not be representative of practice patterns in other countries.

This study has several strengths, most importantly the multifaceted data collected, from a large number of PCPs from varied settings across the country. There were few patient inclusions or exclusion criteria, which allowed for inclusion of a broad spectrum of patients with type 2 diabetes and a more accurate representation of their comprehensive care at that time point. Physicians were encouraged to survey patients in a consecutive fashion on or around World Diabetes Day to minimize selection bias. Finally, there were few missing data with regards to A1c, LDL-C, and BP, suggesting that calculated rates of achievement of targets were likely accurate. Overall, our study provides new information on the care of patients with diabetes and CAD managed in primary care in Canada.

In conclusion, patients with diabetes and CAD were older and had a longer duration of diabetes compared with those without CAD. Although PCPs set individualized and less stringent glycaemic targets for these patients with CAD, their achieved glycaemic control was similar to their counterparts without CAD. Moreover, patients with CAD were more aggressively managed in terms of their other cardiovascular risk factors, and were more likely to achieve guideline-recommended targets, though the absolute proportions achieving these targets remain suboptimal. There remain important gaps in the care of patients with diabetes, both with and without CAD, in terms of their cardiovascular risk factors as well as glycaemic management. Further studies are required to devise strategies to overcome these on-going barriers and improve clinical outcomes.

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