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Canadian Journal of Diabetes

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Original Research

## Glycated Hemoglobin Level Goal Achievement in Adults With Type 2 Diabetes in Canada: Still Room for Improvement



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### Key Messages

- Type 2 diabetes imposes a significant burden in primary and specialist care.
- Primary care physicians and specialists both perceive patient factors as the main barrier to optimal management of glycemia.
- Practice audits suggest that clinician-driven therapeutic inertia is an important obstacle in achieving therapeutic goals in people with type 2 diabetes.

### ARTICLE INFO

#### Article history:

Received 12 June 2018

Received in revised form

13 August 2018

Accepted 15 October 2018

#### Keywords:

primary care

specialist

therapeutic inertia

type 2 diabetes

### ABSTRACT

**Objectives:** To describe the clinical histories and management of adults with type 2 diabetes who were not reaching their target glycated hemoglobin (A1C) levels and to identify barriers to achieving therapeutic goals.

**Methods:** Practice assessment surveys and practice audits were completed by 88 primary care physicians (PCPs) in the Diabetes Mellitus Assessment of Clinical management In Ontario (DM-ACTION) program and by 56 diabetes specialists in the Diabetes Mellitus IMproving PATient Care in our communiTies (DM-IMPACT) program. The DM-ACTION audit analyzed data from 1,173 adults with A1C levels  $\geq 7.3\%$  who were not prescribed insulin; the DM-IMPACT audit included 135 individuals with similar characteristics.

**Results:** Most PCPs (92%) and specialists (88%) stated that they typically recommend A1C levels of  $\leq 7.0\%$ ; more than 90% indicated that they adjusted antihyperglycemic therapy within 3 months if suboptimal A1C targets endured. Among the DM-ACTION patients, the median A1C level was 7.8%; the median time between the last 2 A1C tests was 5 months; 58% were taking  $\leq 2$  noninsulin antihyperglycemic agents; and adjustment of glucose-lowering therapy was noted for only 56%. The corresponding values for the DM-IMPACT patients were 8.0%, 4 months, 43% and 68%, respectively. PCPs and specialists attributed patients' factors and patients' adherence as primary causes of poor achievement of guideline-recommended targets. PCPs perceived patients' factors as the predominant barrier to optimizing care,

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<https://doi.org/10.1016/j.jcjd.2018.10.005>

but the specialists believed that therapeutic inertia stems from a wide range and a varied combination of patient-centric factors.

**Conclusions:** Type 2 diabetes remains a health-care challenge in Canada and globally. Primary care physicians and specialists attributed patients' factors as principal obstacles to optimal diabetes management. However, physician-associated therapeutic inertia may also be an important barrier to unmet therapeutic goals.

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**Mots clés :**  
soins de santé primaires  
spécialiste  
inertie thérapeutique  
diabète de type 2

## R É S U M É

**Objectifs :** Décrire les antécédents cliniques et la prise en charge des adultes atteints du diabète de type 2 qui n'avaient pas atteint leurs valeurs cibles d'hémoglobine glyquée (A1c) et déterminer les obstacles à l'atteinte des objectifs thérapeutiques.

**Méthodes :** Quatre-vingt-huit médecins en soins de santé primaires (MSSP) du programme DM-ACTION (*Diabetes Mellitus Assessment of Clinical management In Ontario*) et 56 spécialistes du diabète du programme DM-IMPACT (*Diabetes Mellitus IMproving PATient Care in our communiTies*) ont rempli les enquêtes d'évaluation des pratiques et les audits de pratique. L'audit du DM-ACTION a permis d'analyser les données de 1173 adultes qui avaient des concentrations d'A1c  $\geq 7,3$  % et qui ne s'étaient pas fait prescrire d'insuline; l'audit du DM-IMPACT portait sur 135 individus qui avaient des caractéristiques similaires.

**Résultats :** La plupart des MSSP (92 %) et des spécialistes (88 %) ont déclaré avoir habituellement recommandé des concentrations d'A1c  $\leq 7,0$  %; plus de 90 % ont indiqué avoir ajusté le traitement antihyperglycémique dans les 3 mois si les valeurs cibles sous-optimales de l'A1c s'étaient maintenues. Parmi les patients du DM-ACTION, la concentration médiane d'A1c était de 7,8 %; le temps médian entre les 2 dernières épreuves d'A1c était de 5 mois; 58 % prenaient  $\leq 2$  antihyperglycémiques non insuliques; l'ajustement du traitement hypoglycémiant a été noté chez seulement 56 % des individus. Les valeurs correspondantes chez les patients du DM-IMPACT étaient respectivement de 8,0 %, de 4 mois, de 43 % et de 68 %. Les MSSP et les spécialistes ont considéré que les facteurs liés aux patients et à l'observance des patients étaient les principales causes de la faible atteinte des valeurs cibles recommandées par les lignes directrices. Les MSSP ont perçu les facteurs liés aux patients comme l'obstacle le plus important à l'optimisation des soins, mais les spécialistes ont cru que l'inertie thérapeutique découlait d'un large éventail et d'une combinaison variée de facteurs axés sur le patient.

**Conclusions :** Le diabète de type 2 reste un problème important pour les soins de santé au Canada et dans le monde entier. Les MSSP et les spécialistes ont considéré que les principaux obstacles à la prise en charge optimale du diabète étaient attribuables aux facteurs liés aux patients. Toutefois, l'inertie thérapeutique des médecins peut également être un obstacle important à la non-atteinte des objectifs thérapeutiques.

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## Introduction

The eighth edition of the International Diabetes Federation Atlas has projected that the global prevalence of diabetes will grow by 48%, from 425 million in 2017 to 629 million in 2045 (1). Perhaps more concerning, given the time frame, the Canadian Diabetes Cost Model has estimated that in the absence of proactive measures, the prevalence of diabetes in Canada will show a 44% increase from 3.4 million in 2015 to 5 million in 2025 (2). This unwavering diabetes trajectory corresponds with escalating socioeconomic burdens, given that a significant proportion of people continue to live with inadequately managed type 2 diabetes (3–5), a phenomenon that, in part, stems from the absence of or delay in initiating and modifying antihyperglycemic therapies (3,6–23).

The persistent manifestation of therapeutic inertia is perplexing on several counts. First, there is strong evidence that tight glycemic control early in the disease trajectory can yield significant benefits in terms of morbidity and mortality (24–27), and these findings form the basis upon which international clinical practice guidelines are aligned in endorsing early pharmacologic intervention and timely adjustments to slow the progression of diabetes and its associated complications (28–31). Second, therapeutic inertia has been associated with an increased risk for diabetes complications. In a study from the United Kingdom, a 1-year delay in modifying the ongoing antihyperglycemic regimen among individuals with glycated hemoglobin (A1C) levels of 7.0% or higher was associated with meaningful increases in risk for stroke (51%), heart failure (64%), myocardial infarction (67%) and a composite of the 3

outcomes (62%; all  $p < 0.01$ ) vs. those with A1C levels below 7.0%) (16). In a smaller study from Thailand, delayed initiation of insulin was associated with a shorter median time to progression of diabetic retinopathy (log rank test  $p = 0.02$ ) and a higher incidence rate of diabetic retinopathy progression (10 vs. 2.2 cases per 1,000 person-months;  $p = 0.003$ ). Third, barring access, cost and coverage considerations, a wide range of glucose-lowering agents are now available, with excellent efficacy and safety profiles and potential additional benefits (e.g. cardiac and renal protection).

The Diabetes Mellitus Assessment of Clinical management In Ontario (DM-ACTION) and Diabetes Mellitus IMproving PATient Care in our communiTies (DM-IMPACT) programs were designed to gather insight into the management of adults with type 2 diabetes who had not achieved their target A1C levels. The DM-ACTION patient cohort included adults under the care of primary care physicians (PCPs), and the DM-IMPACT group included those under the care of diabetes specialists. The overarching goal of both programs was to evaluate the prevalence of therapeutic inertia, identify the perceptions of treatment modification and ascertain the barriers physicians believe contribute to the continual suboptimal achievement of glycemic targets.

## Methods

### Study design and conduct

The DM-ACTION and DM-IMPACT programs as well as their study documents were developed in consultation with clinicians

who were members of the steering committee of 1 or both programs. The Canadian Heart Research Centre, a federally incorporated, not-for-profit academic research organization, was responsible for combining the databases and conducting the analyses.

Potential physician participants were invited via electronic mail, facsimile, telephone calls and visits from the sponsor's representatives. A total of 430 PCPs whose clinics are located within Ontario were contacted between August 2016 and November 2016 (inclusive). A total of 261 community diabetes specialists from across Canada were approached between August 2016 and December 2016 (inclusive). The physicians were asked to complete electronic practice assessment surveys that allowed the investigators to summarize the respondents' demographic information and practice settings as well as their current perceptions of and priorities for diabetes management. The respondents were also asked to complete electronic practice audit forms. Physicians participating in the DM-ACTION and DM-IMPACT programs were asked to submit details about the clinical history and diabetes management strategies for 10 and 3 individuals, respectively, in their practices who fulfilled the criteria below. Patient-related information was anonymized for analysis.

Individuals with the following characteristics qualified for inclusion in the DM-ACTION practice audit: adults (>18 years) with confirmed diagnoses of type 2 diabetes per the 2013 Diabetes Canada guidelines (32); a most recent A1C level of  $\geq 7.3\%$  (chosen to provide a slight margin from the general target of  $< 7.0\%$ ) and managed with lifestyle only or lifestyle plus noninsulin antihyperglycemic agents. In addition to fulfilling these criteria, DM-IMPACT-eligible people had to have been referred to the participating diabetes specialists within the past 12 to 18 months. The following served as exclusion criteria: limited life expectancy, a high level of functional dependency, extensive coronary artery disease at high risk for ischemic events, multiple comorbidities, a history of recurrent severe hypoglycemia or currently using insulin.

#### Ethics review

The DM-ACTION program together with its study-associated materials were reviewed and approved prior to study initiation by OPTIMUM Clinical Research (Salt Lake City, Utah, United States). The DM-IMPACT program and its study-associated materials were reviewed and approved prior to study initiation by the Institutional Review Board Services (<https://www.irbervices.com>).

#### Statistical analyses

The data were analyzed by SAS software v. 9.4 (SAS Institute, Cary, North Carolina, United States). Descriptive values are shown as counts (percentages); continuous variables are presented as medians with interquartile ranges (IQRs). Categorical variables between groups were compared using the chi-square or Fisher's exact test, where appropriate, and the Wilcoxon test was used for the continuous variables.

## Results

#### Results from the DM-ACTION physician survey and practice assessment

Of the 88 PCPs who completed the DM-ACTION practice survey, 33% were women and 72% practiced in urban/suburban communities. Clinic settings included group practices (42%), solo practices (38%) and family health teams (20%). Each week, on average, 56% of the PCPs saw 20 or more individuals with diabetes, of whom >75% had type 2 diabetes. The baseline characteristics of

the 1,173 patients submitted through the practice audit portal are detailed in Table 1. Women made up 40% of the patient cohort. The median age was 61 years, and the median duration of living with type 2 diabetes was 8 years. Of note, per guideline recommendations, 89% of the patients were taking metformin therapy, either alone or in combination with other antihyperglycemic agents.

Although 50% to 70% of the DM-ACTION physician respondents had ready access to diabetes specialists, diabetes nurses, dietitians, eye specialists and podiatrists in the community, the practice audits revealed that only 39% of the patients were comanaged with a diabetes educator, cardiologist, endocrinologist, general internist or nephrologist. Notably, however, 81% of the patients had undergone eye assessments and 79% foot examinations within the past 12 months.

Over one-third (35%) of the PCPs reported that all their patients with diabetes had planned visits that included regular assessments, preventive interventions and attention to self-management support, while 39% indicated that they used checklists and flow sheets, in addition to other tools, to ensure that key elements of care are provided. Nearly two-thirds indicated that they equally favour getting glycemia, blood pressure and low-density lipoprotein cholesterol (LDL-C) to target (Figure 1). When asked

**Table 1**  
Demographics of individuals included in the patient population

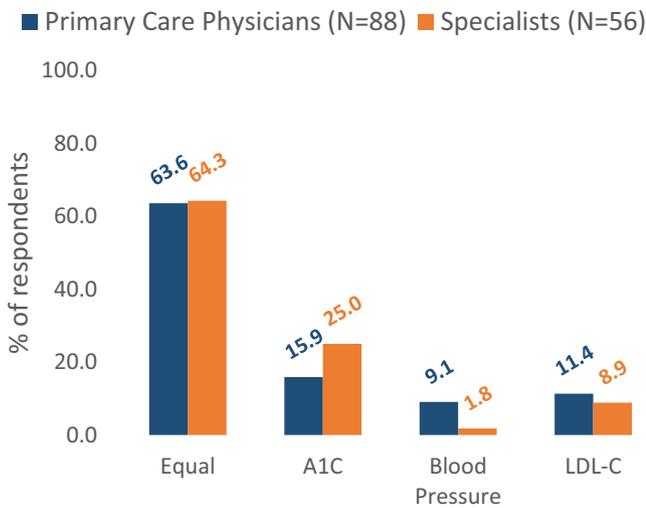
	DM-ACTION (N=1,173)	DM-IMPACT (N=135)
Female	468 (39.9)	48 (35.6)
Age (years)	61 (53, 68)	58 (52, 66)
Caucasian/white	613 (52.3)	82 (60.7)
Duration of type 2 diabetes (years)	8 (5, 12)	7 (4, 12)
Body mass index (kg/m <sup>2</sup> )	30.6 (26.8, 34.7)	31.1 (26.4, 35.2)
Hypertension	772 (65.8)	100 (74.1)
Dyslipidemia	812 (69.2)	106 (78.5)
Macrovascular history		
Coronary artery disease	121 (10.3)	24 (17.8)
Cerebrovascular disease	26 (2.2)	5 (3.7)
Abdominal aortic aneurysm	3 (0.3)	1 (0.7)
Peripheral arterial disease	16 (1.4)	6 (4.4)
Microvascular history		
eGFR <60 mL/min/1.73m <sup>2</sup>	117/1153 (10.1)	20/104 (19.2)
Albumin-creatinine ratio <2 mg/mmol	701/1039 (67.5)	86/113 (76.1)
Microalbuminuria	184 (15.7)	29 (21.5)
Retinopathy	26 (2.2)	14 (10.4)
Neuropathy	45 (3.8)	23 (17.0)
Current smoker	154 (13.1)	21 (15.6)
Erectile dysfunction (male only)	118 (16.7)	11 (12.6)
Depression	143 (12.2)	14 (10.4)
Select vascular protection medications		
Metformin (alone and in fixed-dose combinations)	1043 (88.9)	125 (92.6)
ACEi/ARB (mono- and combination therapy)	869 (74.1)	104 (77.0)
Lipid-lowering agent	992 (84.6)	120 (88.9)
A1C (%)	7.8 (7.4, 8.5)	8.0 (7.6, 8.7)
Blood pressure (mmHg)		
Systolic	126 (120, 132)	Not collected
Diastolic	78 (70, 80)	Not collected
LDL-C (mmol/L)	1.9 (1.4, 2.6)	Not collected
Medication coverage		
None	179 (15.3)	19 (14.1)
Provincial/federal	500 (42.6)	62 (45.9)
Private	421 (35.9)	43 (31.9)
Provincial/federal and private	73 (6.2)	11 (8.1)

ACEi, angiotensin-converting enzyme inhibitor; A1C, glycated hemoglobin; ARB, angiotensin receptor blocker; DM-ACTION, Diabetes Mellitus Assessment of Clinical management In Ontario; DM-IMPACT, Diabetes Mellitus IMProving PATient Care in our communiTies; eGFR, estimated glomerular filtration rate; LDL-C, low-density lipoprotein cholesterol.

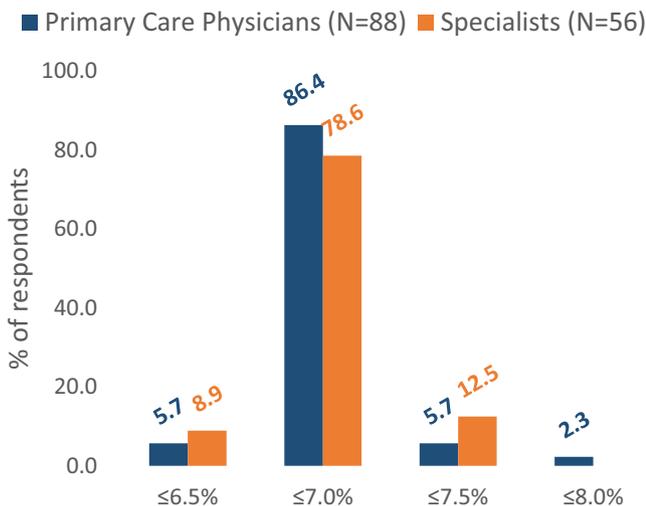
Note: Data are presented as median (interquartile range) or n (%).

when, on average, they would initiate antihyperglycemic therapy in drug-naïve individuals who were not at their target A1C levels, 44% responded “right away” and 52% said “within 3 months.” In response to being asked when they would introduce new antihyperglycemic therapies to people who were not meeting their A1C goals with current glucose-lowering regimens, 49% indicated “right away” and 49% said “within 3 months.” When asked about their patients’ blood pressure targets, 86% indicated <130 mmHg for systolic blood pressure, and 84% selected the <80 mmHg option for diastolic blood pressure. The majority (87%) indicated an LDL-C level of  $\leq 2.0$  mmol/L as the typically recommended therapeutic goal. Less than half (44%) of the DM-ACTION patients, however, had documented blood pressure of <130/80 mmHg, whereas 57% had LDL-C values that were 2.0 mmol/L or lower. Of note, only 28% met both the blood pressure <130/80 mmHg and LDL-C  $\leq 2.0$  mmol/L goals.

**A Prioritization of vascular protection therapeutic goals**



**B Most commonly recommended A1C goal**



**Figure 1.** Prioritization of vascular protection therapeutic goals: physicians’ vascular protection management strategies. A, Physicians were asked how they typically prioritize the management of glucose, blood pressure and low-density lipoprotein cholesterol (LDL-C) levels. B, Physicians were asked what their most commonly recommended glycated hemoglobin (A1C) goal is. The DM-IMPACT specialists were provided with only 3 response options.

Most of the PCPs (92%) considered an A1C level of 7.0% or less the most common glycemic target they recommended, and 53% believed that >75% of their patients with diabetes were at their glycemic goals. Although, as mentioned above, 98% responded that they would adjust pharmacotherapy within 3 months if the A1C goal were not met with the current regimen, the practice audits revealed that the mean (standard deviation) of the most recent A1C measurements was 8.2% (1.3%) and that the median time between the last 2 A1C tests was 5 (IQR 3 to 7) months. Furthermore, modification of antihyperglycemic regimens in response to higher-than-recommended A1C levels at the last visit was recorded for only 56% of the patient cohort. Of note, between the last 2 clinic visits, 21% of the patients had achieved a  $\geq 0.5\%$  A1C decrease, 17% showed a <0.5% reduction, 8% remained stable, 20% recorded a <0.5% elevation and 34% registered a  $\geq 0.5\%$  increase. Interestingly, even though the cohort’s median type 2 diabetes duration was 8 years, 58% were taking 2 or fewer noninsulin antihyperglycemic agents (5%, 21% and 32% on 0, 1 and 2 agents, respectively).

Implementation of healthful behavioural changes was the only therapeutic recommendation provided to 38% of the DM-ACTION patients, and status quo was reported for 6%. The reasons for not modifying pharmacotherapy in the latter group of patients were patient factors limiting the incorporation of changes (70%); physicians’ decisions about appropriateness of the current strategy (66%); medical constraints such as comorbidities; side effects associated with glucose-lowering therapies; age (22%); and insufficient resources (18%).

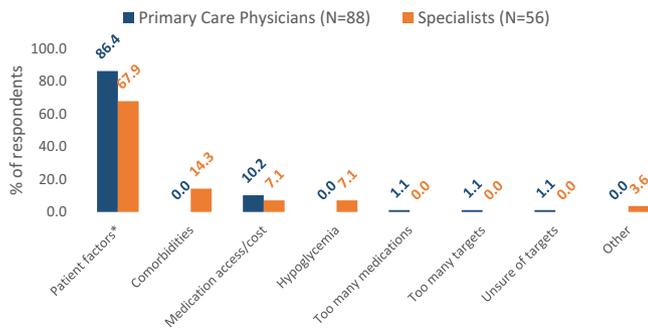
The majority (86%) of the PCPs reported patient factors and patient adherence as the most common causes for their patients’ not achieving guideline-recommended targets (Figure 2A). The top 3 perceived barriers for optimizing the management of high-risk patients were patient factors, comorbidities and treatment-related adverse events (Figure 2B). More than half of the DM-ACTION PCPs believed that nonadherence, with prescribed behavioural changes and medications, was a significant patient-related barrier. Medication costs, although technically a consideration that falls within the jurisdiction of the health organization, were also deemed by the PCPs to be a significant patient-related barrier (Figure 2C). It should be noted that adherence was estimated primarily through patient- or caregiver-directed queries (76%) and much less frequently through pharmacy renewal records (22%).

*Results from the DM-IMPACT physician survey and practice assessment*

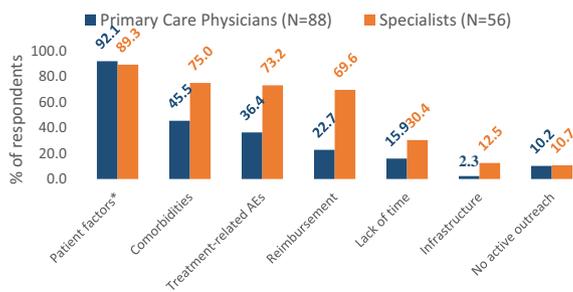
The DM-IMPACT practice survey was completed by 56 community specialists, 43% of whom were from Ontario, 28.6% from Québec and 28.6% from western Canadian provinces. Most (73%) were in private practice, and 89% reported seeing more than 20 patients with diabetes each week. The summary profile of the 135 patients reported on in the DM-IMPACT practice audit is shown in Table 1. Nearly two-fifths (36%) were women. The median age was 58 years, and the median duration of type 2 diabetes was 7 years. Notably, metformin therapy, either on its own or as a part of a combination regimen, was documented for 93% of the patient cohort. Relative to the DM-ACTION patient cohort, the DM-IMPACT patient group had significantly more cases of dyslipidemia and higher incidences of macro- and microvascular complications.

Almost half (48%) the DM-IMPACT physicians were in practices that did not have any form of performance feedback for diabetes care. Access to diabetes nurse educators, dietitians, eye specialists, cardiologists and nephrologists was generally high (>80% in all cases). Within the practice or community, there was less access to mental health professionals (64%) and social workers (63%) and very low access to foot-care specialists (34%). Most of the

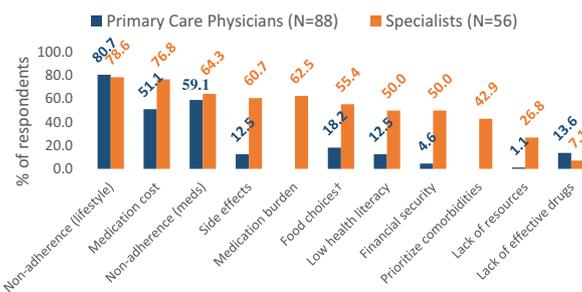
### A Perceived reasons for patients' suboptimal meeting of guideline-recommended targets



### B Perceived barriers for optimizing care



### C Perceived patient-related barriers



**Figure 2.** Factors contributing to poor achievement of guideline-recommended targets and therapeutic inertia. Physicians' perceived barriers for A, patients meeting type 2 diabetes guideline-recommended targets; B, optimizing management of people at high cardiovascular risk; C, physicians' perceived patient-associated barriers that contribute to therapeutic inertia. AEs, adverse events; meds, medications. \*Includes patient adherence. †Limited by finances.

DM-IMPACT patients had, over the past 12 months, undergone eye examinations (74%) and comprehensive foot assessments (74%).

Elevated A1C levels were cited as the most common (79%) reason for referrals to diabetes specialist clinics; the need to initiate insulin was second (41%). More than half (55%) responded that their patients with type 2 diabetes are typically seen every 3 months, although 23% indicated that 6-month intervals were the norm. As shown in Figure 1, 64% of the DM-IMPACT diabetes specialists reported that they placed equal priority on getting glycemia, blood pressure and LDL-C under control. Notably, despite recent demonstrations that some of the newer antihyperglycemic agents may offer cardiovascular and renal benefits, the DM-IMPACT physicians cited glycemic efficacy as the most important factor when selecting a glucose-lowering therapy.

Most (88%) of the diabetes specialists responded that they generally recommend an A1C target of  $\leq 7.0\%$ , and 91% indicated that they suggest A1C testing every 3 months for those not at target A1C levels. In contrast, the practice audit revealed that the median interval between consecutive A1C testing for these individuals was 4 (IQR 3 to 6) months. Almost all the DM-IMPACT physicians (98%)

responded that they initiated antihyperglycemic pharmacotherapy within 3 months when A1C goals were not met, and 96% reported adjusting pharmacotherapy within 3 months if A1C levels remained suboptimal. However, the practice audits revealed that only 70% of the patients had their glucose-lowering therapies modified in response to higher-than-recommended A1C levels at the last visit. Notably, 43% of the DM-IMPACT patient cohort was taking 2 or fewer noninsulin antihyperglycemic agents (29%, 13% and 1% on 2, 1 and 0 drugs, respectively), either as individual pills/injections or fixed-dose combinations. Of interest too, between the last 2 clinic visits, 30% of the patient cohort had recorded A1C decreases of  $\geq 0.5\%$ , 22% had A1C reductions of  $< 0.5\%$ , 8% remained stable, 18% had A1C elevations of  $< 0.5\%$ , and 22% had A1C increases of  $\geq 0.5\%$ .

Like the DM-ACTION PCPs, the DM-IMPACT diabetes specialists considered patient factors and patient adherence to be the predominant reasons for suboptimal attainment of guideline-recommended targets (Figure 2A). As shown in Figure 2B, a significantly greater proportion of the DM-IMPACT physicians, relative to that of the DM-ACTION physician group, perceived comorbidities, treatment-related adverse events, reimbursement, lack of time and infrastructure to be hurdles impeding optimal care. According to the DM-IMPACT practice assessment survey results, although proportionally more physicians considered nonadherence (79% for behavioral changes and 64% for medications) and medication costs (77%) as significant drivers of therapeutic inertia, the group in general believed that there is no dominant patient-associated barrier and that, in fact, therapeutic inertia stems from a wide range and a varied combination of patient-centric factors (Figure 2C).

## Discussion

More than 3 million people in Canada have diabetes, and nearly 6 million are estimated to be living with prediabetes (2). Of concern, the national cross-sectional Diabetes Mellitus Status in Canada (DM-SCAN) survey, conducted in 2013, found that only 50% of individuals included in the survey had A1C levels that were at target, and only 13% met the recommended combined target of A1C  $\leq 7.0\%$ , blood pressure  $< 130/80$  mmHg and LDL-C  $\leq 2.0$  mmol/L goals (3). The persistence of suboptimal vascular-protection goal achievements by individuals with type 2 diabetes is not unique to Canada. The most recent national audit data from the United Kingdom revealed that although 67% of those with type 2 diabetes had A1C levels  $\leq 7.5\%$ , only 41% met the national triple target of A1C  $\leq 7.0\%$ , blood pressure  $\leq 140/80$  mmHg and total cholesterol  $< 5$  mmol/L (4). Likewise, a United States study showed that only 53% of people with diabetes had documented A1C levels of  $< 7.0\%$ , 51% had blood pressures of  $< 130/80$  mmHg and 56% had LDL-C levels of  $< 2.6$  mmol/L; 19% achieved all 3 goals (5).

According to the DM-ACTION and DM-IMPACT practice assessment surveys, the participating PCPs and diabetes specialists indicated that timely attainment of glycemic control is fundamental in diabetes management, and most considered the meeting of glycemic, blood pressure and LDL-C control equally important. It is, thus, noteworthy that despite having A1C levels that were above the entry criterion of  $> 7.3\%$ , 44% of the DM-ACTION patient cohort had well-managed blood pressure, and 57% had guideline-recommended LDL-C levels. Clinical practice guidelines increasingly underscore the importance of individualizing glycemic goals and long-term commitment to treatment adjustments (28–31). Interestingly, the Global Partnership for Effective Diabetes Management (7) recently concluded that the percentage of individuals with optimal A1C levels in published audits may actually be higher than reported, given the move toward more relaxed A1C goals in certain patient populations (33,34). However,

the Diabetes Collaborative Registry, through enumeration of 7 nontherapeutic goal-based diabetes-related quality metrics, noted that only 19% of the 574,972 patients from 259 primary care and specialist practices across 39 American states had their glycemic status under control (35).

Perhaps not surprisingly, the DM-ACTION and DM-IMPACT practice audits demonstrated that individuals under the care of diabetes specialists tended to have more complex conditions and present with more comorbidities. Accordingly, the DM-IMPACT patients may have been more challenging to manage optimally and may warrant having higher A1C targets. Regardless, diabetes is a complex, chronic disease, and optimal management requires a multidisciplinary approach with a united goal of improving patient well-being and limiting unwanted side effects. It is reassuring that as per Canadian guideline recommendations (36,37), a significant proportion of the DM-ACTION and DM-IMPACT patient cohorts had had their eyes and feet checked within the past 12 months. However, diabetes is well established as a major risk factor for cardiovascular and renal diseases, and the results herein emphasize that the availability of and access to specialists in the endocrinology, cardiology or nephrology fields remain a challenge. To add to the complexity, diabetes distress and mental health issues related to diabetes have recently emerged as critical care factors (38). Both the DM-ACTION PCPs and the DM-IMPACT specialists reported that approximately 10% of their patients experience depression and that their clinics have poor access to colleagues in the mental health and social work areas. Although we acknowledge that this is an important care gap that merits being addressed, a full discussion is beyond the scope of the current body of work.

Therapeutic inertia stems from a complex mosaic of prescriber, patient and health organization factors (14,17,22,39). It is, therefore, interesting that the DM-ACTION PCPs and DM-IMPACT diabetes specialists were very much aligned in attributing therapeutic inertia and suboptimal A1C goal achievements predominantly to patient-imposed barriers and poor patient adherence. Both physician groups very noticeably underestimated the A1C threshold and length of time they would normally take to check glycemic status and modify antihyperglycemic therapy and, in turn, how these behaviours would promote therapeutic inertia. Then again, it is plausible that even though physicians may subscribe to follow-up intervals of 3 months, the pressures of their practices may prevent them from routinely seeing their patients with diabetes at this frequency. Additionally, given the many comorbidities associated with diabetes, it may be necessary, at times, to relegate glycemic management to a position lower on the list of concerns to be addressed. Regardless, our findings that consecutive A1C tests tend to occur beyond the recommended 3-month window and that therapeutic adjustments to higher-than-ideal A1C readings are often delayed very much mirror those reported around the globe (9,12,13,16,21), where median time to first modification has been reported to range from 3.6 to 35.3 months (10,13–16). It is notable that even though the median type 2 diabetes duration for the 2 patient cohorts was in the 7- to 8-year range, 58% of the DM-ACTION patients and 43% of the DM-IMPACT patients were being managed with 2 or fewer noninsulin antihyperglycemic agents, with 1 more than likely being metformin. Indeed, among these individuals, the option to add at least 1 more noninsulin glucose-lowering agent from another class was clearly viable, but it is not known whether the missed opportunities were resultant of patient-, physician- or organization-driven therapeutic inertia. Our results further support and extend earlier observations that physicians tend not to be cognisant of their role in perpetuating therapeutic inertia (vs. patient and organization factors) and that this is prevalent at both the primary care (3,8,14–17,22,40) and specialist care (6,15,18,20,23) levels.

The entire type 2 diabetes continuum is prone to therapeutic inertia, and this becomes increasingly evident further along the spectrum (10,11,14). Given that those with A1C levels closer to the recommended goals are more likely to be earlier in their diabetes journeys and perhaps more motivated to get their diabetes under control, it makes sense to immediately introduce and modify glucose-lowering strategies in these individuals so as to mitigate downstream complications. On the other hand, when peoples' health becomes more complex, regardless of whether it is related to the underlying diabetes, de-escalation may be the appropriate move, and any delay in doing so may also be considered therapeutic inertia (24).

Until recently, many international diabetes guidelines were in favour of a stepwise approach, which typically began with metformin monotherapy and progressively evolved into diverse oral and injectable combinations. The growing number of available antihyperglycemic agents, with their individual considerations, may have complicated the therapy-modification process for some and likely helped fuel therapeutic inertia. However, many of the recently updated guidelines now incorporate more specific guidance and should help to alleviate therapeutic inertia (28–31). That said, the enriched focus on the cardiovascular benefits observed with some of the newer antihyperglycemic agents may unintentionally draw attention away from other reasons for lowering A1C levels and, as a result, propagate a new phase of therapeutic inertia in glucose management. Regardless, it is noteworthy that the latest international guidelines endorse the notion of initial combination therapy (2 oral antihyperglycemic agents or an oral plus an injectable antihyperglycemic agent) for certain populations, thereby underscoring the importance of tailoring therapy to the individual (28–31). The diabetes management toolbox now also includes an increasing variety of fixed-dose and fixed-ratio combinations that offer opportunities to reduce complexity, improve adherence and potentially overcome therapeutic inertia (19,41,42), barring any cost, coverage or access issues.

Therapeutic inertia in type 2 diabetes is unlikely to be easily, swiftly and totally eradicated. The more realistic goals would, therefore, be to identify and design innovative ways to gradually overcome the phenomenon. There is limited hard evidence, but it is conceivable that physicians are less inclined to recommend treatment changes to individuals who have nonadherent histories (43). Shared decision making that considers the realm of patient factors (e.g. race, culture, socioeconomic status) between the patient and the diabetes health-care team is encouraged (44) because the trust built and the goals shared within the entire network can appreciably motivate patients and improve adherence (45). In line with this, improved exchange concerning the treatment regimens, medication benefits, adverse events and costs within the primary care and diabetes clinic may promote patient buy-in and self-management and, in turn, encourage adherence and relieve therapeutic inertia (46,47).

The DM-ACTION and DM-IMPACT practice audits have several strengths and limitations. Collectively, the 2 practice audits provide critical insights into what physicians at the primary care and specialist levels perceive as hurdles contributing to therapeutic inertia and suboptimal achievement of recommended therapeutic targets. However, given that all the patient data used for the DM-ACTION analysis and most of the data for the DM-IMPACT evaluation were derived from Ontario, the results reported may not reflect national practices and outcomes because there are distinct differences in medical coverage, access to specialists, referral practices and socioeconomic status across the Canadian provinces and territories. Indeed, it is plausible that the somewhat broader public formulary coverage in Ontario relative to some other Canadian provinces and territories may have contributed to better

target achievement than would be seen elsewhere in Canada. Perhaps more noteworthy is the finding that despite generally better coverage in Ontario relative to most other Canadian provinces and territories, medication costs were ranked, by more than 50% of the respondents, within the top 3 perceived patient-related factors that contribute to suboptimal achievement of guideline-recommended therapeutic targets, highlighting the importance of medication access and coverage as barriers to improved glycemic control. It is of additional interest that a recent analysis using data from a US commercial claims database found that initiation and adjustments of antihyperglycemic therapy occurred not only more often with more frequent clinic visits but also with lower generic drug copayments (43). Finally, although the focus of the study was not to determine the extent of therapeutic inertia but to tease out the factors that may be contributing to suboptimal therapeutic goal achievements, the therapeutic inertia described herein at the primary care level may be less evident than that in the real world; the physicians who responded to the DM-ACTION invitation may have a greater interest in and emphasis on diabetes management (17).

We have opted, in this manuscript, to avoid nouns such as *intensification* and *escalation* as well as their associated verbs and have, instead, used words such as *modification* and *adjustment* because the former terms may suggest to some health-care providers and patients an overly aggressive approach. Rather, we wish to emphasize that we now have an increasing number of safe and effective therapies to manage type 2 diabetes, and that it is important that our focus should be turned to administering “appropriate and personalized care” in conjunction with each patient’s personal preferences, clinical history and risk profile.

## Conclusions

The results from the DM-ACTION and DM-IMPACT programs reiterate that there is still much room for improvement with regard to the management of type 2 diabetes in Canada at both the primary care and the specialist levels. The results of the DM-ACTION and DM-IMPACT programs extend those of previous investigations by underscoring the impact therapeutic inertia has on perpetuating suboptimal diabetes care. The findings further demonstrate that although most physicians are aligned in attributing patient- and organization-associated factors as the predominant factors underlying therapeutic inertia, they appear to be less aware of how significantly their own perceived barriers and management practices can also drive therapeutic inertia. A change in mindset is clearly warranted, so it is time for physicians and all stakeholders involved in type 2 diabetes management to become proactive in promoting diabetes education and reinforcing good diabetes management practices to help abate the continual therapeutic inertia.

## Acknowledgments

The Scientific Committee thanks the individual investigators for their participation in the DM-ACTION and DM-IMPACT programs. The DM-IMPACT program was coordinated and managed by MedPlan Communications Inc. Hwee Teoh, PhD, of HTaq Biomedical Editorial and Education Services Inc. is acknowledged for writing and editorial support in the preparation of this manuscript.

## Funding

The DM-ACTION and DM-IMPACT programs were supported by Merck Canada Inc., Kirkland, Quebec, Canada.

## Author Disclosures

Dr. Leiter has received honoraria and/or research grants from AstraZeneca, Boehringer Ingelheim, Eli Lilly, GSK, Janssen, MSD, Novo Nordisk, Sanofi and Servier. Dr. Cheng has received honoraria for speaking or consulting from Abbott, AstraZeneca, Boehringer Ingelheim, Eli Lilly, Janssen, MSD, Novo Nordisk, Sanofi, Servier and Takeda. Dr. Ekoé has received honoraria and research grants from Boehringer Ingelheim, Bristol-Myers Squibb, Eli Lilly, Janssen, MSD, Novo Nordisk, Sanofi and Takeda. Dr. Goldenberg has received honoraria and research grants from Abbott, AstraZeneca, Boehringer Ingelheim, Eli Lilly, GlaxoSmithKline, Janssen, Medtronic, MSD, Novartis, Novo Nordisk, Roche, Sanofi and Takeda. Dr. Harris has received honoraria from AstraZeneca, Eli Lilly, Janssen, MSD, Novo Nordisk and Sanofi. Dr. Hramiak has received honoraria and/or research grants from AstraZeneca/Bristol-Myers Squibb, Eli Lilly, GlaxoSmithKline, Insulet Corp, Janssen Pharmaceuticals, Lexicon Pharmaceuticals, Medtronic, MSD, Novo Nordisk, Roche Pharma, Sanofi and Takeda. Dr. Khunti has received honoraria and research grants from AstraZeneca, Boehringer Ingelheim, Janssen, Lilly, MSD, Novartis, Novo Nordisk, Roche, Sanofi-Aventis, Takeda, Bristol-Myers Squibb and Unilever; he also acknowledges the support of the National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care—East Midlands and the National Institute of Health Research Leicester Biomedical Research Centre. Dr. Lin has received honoraria from AstraZeneca, Boehringer Ingelheim and MSD. Mr. Richard is an employee of MSD. Dr. Senior has received consulting fees and honoraria for delivery of accredited educational programs from Abbott, AstraZeneca, Boehringer Ingelheim, Eli Lilly, Janssen, MSD, Novo Nordisk and Sanofi. His institution has received grant support from AstraZeneca, Novo Nordisk and Sanofi. Dr. Senior is co-chair of the Professional Section of Diabetes Canada and a member of the Diabetes Canada Clinical Practice Guidelines steering committee. The opinions expressed in this manuscript are his own and not those of Diabetes Canada. Dr. Yale has received honoraria and research grants from Abbott, AstraZeneca, Bayer, Boehringer Ingelheim, Eli Lilly, Janssen, Medtronic, MSD, Mylan, Novo Nordisk, Sanofi and Takeda. Ms. Goldin has no disclosures. Ms. Tan has no disclosures. Dr. Langer is Chair of the Canadian Heart Research Centre, which received the grant from MSD to coordinate and manage the DM-ACTION program.

## Author Contributions

LAL contributed to the design of the study, analysis of the data and the drafting and editing of the manuscript; MKT contributed to the analysis of the data and the editing of the manuscript; all other authors contributed to the design of the study, the analysis of the data and the editing of the manuscript.

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