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Original Research

Exploring Clinical Care Among Adults With Diabetes Mellitus: Alignment With Recommended Statin and Sulfonylureas Treatment

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Key Messages

- Diabetes care does not always align with evidence-based recommendations.
- Some provider's characteristics were associated with implementation of evidence-based practice, which can guide future targeted medical education.

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ABSTRACT

Objectives: The care of patients with diabetes mellitus (DM), compiled in the 2008 Canadian Diabetes Association clinical practice guidelines and in recommendations from the Choosing Wisely Canada program, is informed by a large body of evidence. This study sought to assess to what extent primary care providers (PCPs) incorporate recommended statin and sulfonylureas treatment in their care of patients with DM, and to identify the association between use of recommended care and PCP characteristics.
Methods: This retrospective cohort study (2007–2017) used electronic medical records of 21,149 patients with DM receiving care from 240 PCPs participating in the Manitoba Primary Care Research Network.
Results: PCPs prescribed statins to patients newly diagnosed with DM who were ≥40 years of age 41% of the time, with 45% of the prescriptions occurring ≤180 days after a new diagnosis (early treatment). PCPs least likely to prescribe recommended statin treatment had higher odds of being older (adjusted odds ratio [aOR], 1.05; 95% confidence interval [CI], 1.01 to 1.09) and fee-for-service funded (aOR, 4.36; 95% CI, 1.47 to 12.91). In addition, older PCPs (aOR, 1.06; 95% CI, 1.02 to 1.10) and women (aOR, 2.42; 95% CI, 1.11 to 5.28) were less likely to prescribe statin treatment early. Seventy-four percent of PCPs prescribed sulfonylureas to adults ≥65 years of age. No PCP characteristics were associated with prescription of sulfonylureas in the lower implementation quartile in the fully adjusted model.
Conclusions: Results suggest that PCPs' practice does not always align with current evidence-based clinical guidelines or Choosing Wisely Canada recommendations for patients with DM. Some PCP's characteristics were associated with lower implementation of recommended evidence-based care. This information can help guide future targeted medical education.

Mots clés :
lignes directrices de pratique clinique
pratique fondée sur des données probantes
soins primaires
statines
sulfonylurées

RÉSUMÉ

Objectifs : Les soins aux patients atteints de diabète sucré (DS), compilés dans les lignes directrices de pratique clinique de l'Association canadienne du diabète (2008) et les recommandations du programme Choisir avec soin, sont fondés sur de nombreuses données probantes. La présente étude visait à évaluer dans quelle mesure les prestataires de soins primaires (PSP) intègrent les recommandations de traitement par statines et par sulfonylurées dans leurs soins aux patients atteints de DS, et à établir l'association entre le recours aux soins recommandés et les caractéristiques des PSP.

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Méthodes : La présente étude de cohorte rétrospective (2007–2017) portait sur les dossiers médicaux électroniques de 21 149 patients atteints du DS qui avaient reçu des soins de 240 PSP du Réseau de recherche en soins primaires du Manitoba.
Résultats : Les PSP prescrivaient des statines aux patients qui avaient récemment reçu un diagnostic de DS et qui étaient âgés ≥40 ans 41 % du temps, et 45 % de ces ordonnances étaient émises ≤180 jours après un récent diagnostic (traitement précoce). Il était plus probable que les PSP les moins susceptibles de prescrire le traitement par statines recommandé étaient plus âgés (risque relatif approché ajusté [RRAa], 1,05; intervalle de confiance [IC] à 95 %, de 1,01 à 1,09) et qu'ils recevaient une rémunération à l'acte (RRAa, 4,36; IC à 95 %, de 1,47 à 12,91). De plus, les PSP plus âgés (RRAa, 1,06; IC à 95 %, de 1,02 à 1,10) et les femmes (RIA, 2,42; IC à 95 %, de 1,11 à 5,28) étaient moins susceptibles de prescrire de manière précoce le traitement par statines. Soixante-quatorze pour cent des PSPs prescrivaient les sulfonylurées aux adultes ≥65 ans. Aucune caractéristique des PSP n'était associée à l'ordonnance des sulfonylurées dans le quartile inférieur de mise en œuvre du modèle entièrement ajusté.
Conclusions : Les résultats montrent que la pratique des PSP ne s'harmonise pas toujours avec les lignes directrices actuelles fondées sur des données probantes ou avec les recommandations du programme Choisir avec soin destinées aux patients atteints de DS. Certaines caractéristiques des PSP étaient associées à une plus faible mise en œuvre des soins recommandés fondés sur des données probantes. Ces informations peuvent contribuer à orienter les futurs programmes de formation médicale ciblés.

Introduction

Approximately 3.6 million people in Canada (1) and 131,000 people in Manitoba (2) have been diagnosed with diabetes. Diabetes mellitus (DM) is associated with a higher risk of medical complications and premature death. In 2008–2009 (fiscal year), 1 in 10 deaths in Canadian adults was attributable to diabetes (3). Individuals with DM are >3 times more likely to be hospitalized because of cardiovascular disease (CVD) (4).

To improve quality of care and avoid harm among patients with diabetes, professional associations, groups of clinicians and academics have compiled evidence into guidelines and recommendations. Evidence has demonstrated a reduction of CVD in patients with diabetes treated with statin medication (5,6). Previous research has linked the use of sulfonylureas, especially older ones (i.e. glyburide, glibenclamide), to a greater prevalence of hypoglycemia and CVD in adults with DM ≥65 years of age (7,8). Consequently, in 2008, the Canadian Diabetes Association (now, Diabetes Canada) clinical practice guidelines recommended statin (HMG-CoA [3-hydroxy-3-methyl-glutaryl-coenzyme A] reductase inhibitor) medications for primary prevention of CVD in patients with DM (type 1 or type 2) ≥40 years of age regardless of lipid levels (grade A, Level 1) (4,9). Similarly, Choosing Wisely (CW) Canada, a program aimed at reducing unnecessary tests and treatments in health care, recommends avoiding the use of medications known to cause hypoglycemia (sulfonylureas) in adults ≥65 years of age (grade D, level 4) (10).

Previous research has found that the proportion of patients with diabetes who received prescribed statins varies from 25% to 68% in different countries (11–15). In Ontario, three-quarters of patients ≥65 years of age received a sulfonylurea either as the primary medication or as one of a combination of medications between 1995 and 2001 (16), and another Canadian study indicated that >50% of the patients with diabetes who were exposed to a sulfonylurea were >65 years of age in 2013 (17). Some studies have explored the use of individual clinical practice recommendations; however, the level of evidence-based care provided to patients with DM by primary care providers (PCPs) still needs to be determined. Furthermore, the association between PCP characteristics and implementation of evidence-based diabetes treatment has not been studied. Therefore, the objectives of this study were 1) to assess to what extent PCPs in Manitoba incorporate recommended statin and sulfonylureas treatment in their care of patients with DM, and 2) to identify the association between the implementation of recommended care practices and practitioners' characteristics.

Methods

This retrospective study used electronic medical records (EMR) from Manitoba physicians participating in the Manitoba Primary Care Research Network (MaPCReN). The MaPCReN contains information extracted from 48 primary care offices, representing >255 providers and >288,000 patients in Manitoba. The MaPCReN is part of the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) database. The CPCSSN is a pan-Canadian network that extracts data from consenting family physicians' EMRs. The CPCSSN has developed and validated methods for capturing information about patients with several chronic diseases including diabetes. This study was approved by the Health Research Ethics Board of the University of Manitoba (HS21376).

Study setting

Manitoba is one of the 3 prairie provinces of Canada with a population of 1,356,961 (57% in Winnipeg) in 2017 (18). Canada maintains a universal, publicly funded health-care system that provides Manitobans access to health-care services. The provincial Pharmacare program will cover the cost of some prescribed medications for Manitoba residents who spend a large amount of their income on medications, after payment of the income-based deductible. In 2017, approximately 1,648 PCPs (178 nurse practitioners [11%] and 1,470 family physicians [89%]) were registered in Manitoba.

Study population

The data were extracted from the MaPCReN repository (second quartile 2017) for the years 2007–2017. Patients with diagnoses of DM (type 1 and type 2) were identified using the validated CPCSSN case definition (19) based on the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) code 250.^, Anatomical Therapeutic Chemical (ATC) codes for diabetes medicine (A10^) or glycated hemoglobin ≥7. Patients were excluded if they had a diabetes medication and an ICD-9-CM code for gestational diabetes (648.8), chemical-induced (secular) diabetes (249), neonatal diabetes (775.1), polycystic ovarian syndrome (256.4), hyperglycemia not otherwise specified (790.29). More information about the DM case definition (19) is available online (http://www.cpcssn.ca/research-resources/case-definitions). Prescriptions written for statins (C01AA^ or C01B-) and sulfonylureas (A10BB^)

among specific groups of patients with DM were identified using the ATC system.

Outcomes measures

Prescription of statins was explored among patients newly diagnosed with DM who were ≥40 years of age (2007–2017) without record of CVD (ICD-9-CM code 429.2 or *International Classification of Diseases, Ninth Revision* code for atrial fibrillation/flutter [427.3, 427.31, 427.32] or valvular disease [394.x, 395.x, 396.x, 424.0/V43.3]) or previous statin treatment (ATC codes C10AA^ or C10B^) using the following 2 time frames: 1) any time after diagnosis and 2) ≤180 days after diagnosis (early treatment). To decrease any potential bias caused by administrative processing of the medical records, statin prescriptions were counted if they occurred up to a week before the date of diabetes diagnoses. Prescriptions of sulfonylureas (ATC code A10BB^) among patients with DM who were ≥65 years of age were identified in 2017.

Provider characteristics

Provider characteristics available in the MaPCReN and included in the study are as follows: age (years), sex (male vs female), type of provider (family physician vs nurse practitioner), location of practice (rural vs urban), type of funding (salary vs fee-for-service [FFS]), large practice (no vs yes [if ≥837 patients, which is the median practice size of the cohort]) and graduate of Canadian medical school (no vs yes).

Analysis

Descriptive statistics were used to present the characteristics of the PCP. Percentages were used for categorical variables, and means ± SDs were used for continuous variables.

PCP implementation of recommended statin and sulfonylureas treatment was calculated based on the treatment provided by each health-care provider vs treatment recommended. For example, if a PCP prescribed statin to 30 of 50 patients with DM who were ≥40 years of age under his or her care, this was interpreted as 30/50: 60% implementation of this recommendation. Subsequently, PCPs in the lower quartile of implementation were identified. Spearman correlations were used to explore the association between implementation of recommended statins and sulfonylureas treatment among PCPs. Binary ordinal logistic analyses were used to identify PCP characteristics associated with lower (lowest quartile vs other 3 quartiles) implementation of the treatment recommended, using one characteristic at a time in the unadjusted model (odds ratio [OR]). To account for potential confounding effects, all PCP characteristics were simultaneously incorporated in the fully adjusted model (adjusted odds ratio [aOR]).

Statistical significance was noted at $p<0.05$. All analyses were performed using SPSS software version 24.0 (SPSS, Chicago, Illinois, United States).

Results

Description

There were 21,149 patients diagnosed with DM who received care from one of the 240 MaPCReN providers between 2007 and 2017. Mean PCP age was 47.5±10 years, 40% were men and 84% were family physicians (Table 1).

Table 1
Health-care provider characteristics (N=240)

Provider characteristics	Value
Sex, males	96 (40)
Type of health-care provider (family physician vs nurse practitioner)	
Family physician	202 (84)
Location of practice (rural vs urban)	
Rural	81 (34)
Funding (fee-for-service vs salary)	
Fee-for-service	120 (50)
Large practice* (no vs yes)	
Yes	121 (50)
Canadian graduated (no vs yes)	
Yes	190 (79)
Age, years	47.6±10.0

Note: Values are n (%) or mean ± SD.
* Large practice ≥837 patients, which is the median practice size of the cohort.

Statin prescription

Providers (n=220) prescribed statin medications to 5,005 patients newly diagnosed with DM who were ≥40 years of age without record of CVD (mean prescription, 41.2%±17%). Forty-five percent of those prescriptions (n=2,258) occurred within 180 days after diagnoses of diabetes (early treatment). PCPs in the quartile with lower implementation of the recommended statin treatment prescribed statins to ≤30% of their patients newly diagnosed with DM who were ≥40 years at any time (mean, 19%±7.7%), and early statins to ≤10% of them (mean, 3.5%±2.5%) (Figure 1).

Binary regression analysis showed that PCPs less likely to implement the recommended statin treatment had a higher odds of being in rural locations (OR, 2.76; 95% confidence interval [CI] 1.48 to 5.16; p=0.01), FFS (OR, 4.63; 95% CI, 2.31 to 9.28; p<0.01) and in large practices (OR, 2.54; 95% CI, 1.36 to 4.73; p<0.01). In addition, older PCPs were least likely to prescribe statin at any time after DM diagnosis (OR, 1.04; 95% CI, 1.01 to 1.08; p=0.01) and within the first 180 days after diagnosis (OR, 1.05; 95% CI, 1.02 to 1.08; p<0.01). In fully adjusted models, which incorporated all the potentially relevant PCP characteristics, older age (aOR, 1.05; 95% CI, 1.01 to 1.09; p=0.01) and FFS providers (aOR, 4.36; 95% CI, 1.47 to 12.91; p=0.01) remained significantly associated with lower odds of implementing recommended statin treatments at any time after diagnoses of DM. The odds of not initiating early statin treatment increased by 1.06 times for every year increase in the age of the PCP (aOR, 1.06; 95% CI, 1.03 to 1.10; p<0.01). Additionally, female PCPs (aOR, 2.42; 95% CI, 1.11 to 5.28; p=0.03) and family physicians (aOR, 3.45; 95% CI, 1.10 to 10.88; p=0.03) had higher odds of not initiating early statin treatment compared with male PCPs and nurse practitioners (Table 2).

Sulfonylureas prescriptions

In 2017, 220 PCPs delivered care to 10,208 patients with DM who were ≥65 years of age. Twenty-six percent (n=57) of the PCPs avoided using medication known to cause hypoglycemia, such as sulfonylureas, in adults ≥65 years of age. Nevertheless, 74% (n=163) of the PCPs prescribed sulfonylureas to 1,074 patients with DM (mean, 9.8%±9.6%). PCPs in the quartile with lower implementation of the recommended treatment prescribed sulfonylureas to ≥16% of their patients with DM who were ≥65 years of age (mean, 23.6%±6.3%) (Figure 1).

Regression analysis (Table 3) showed that PCPs in rural practice (OR, 0.34; 95% CI, 0.18 to 0.64; p=0.001), FFS providers (OR, 0.42; 95% CI, 0.22 to 0.79; p=0.01) and Canadian graduated PCPs (OR, 0.47; 95% CI, 0.24 to 0.94; p=0.03) had lower odds of being in the

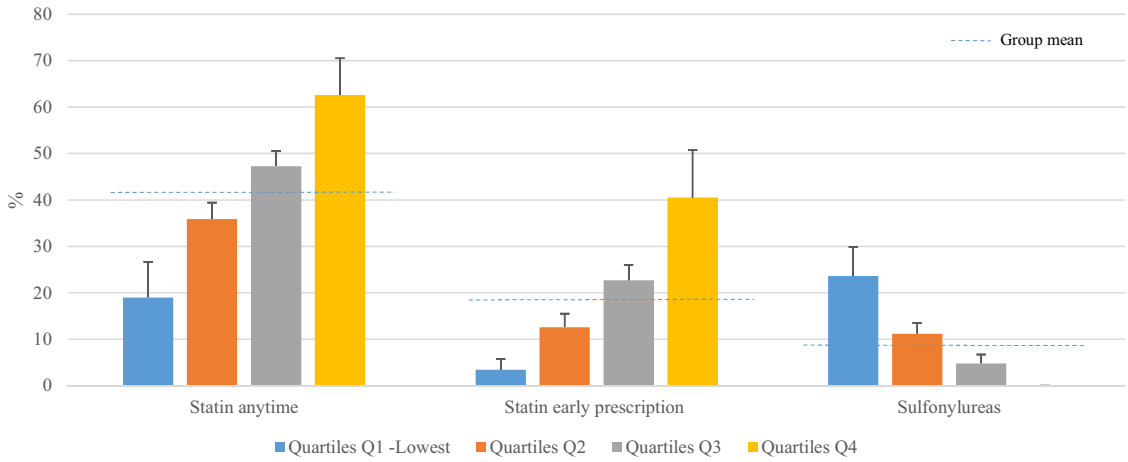

Figure 1. Implementation of recommended statin and sulfonylureas treatment to patients with diabetes mellitus among primary care providers.

quartile with lower implementation (higher proportion of prescriptions) of sulfonylureas recommended treatment to patients with DM who were ≥65 years of age. However, in the fully adjusted model, no PCP characteristics were associated with prescription of sulfonylureas to patients with DM who were ≥65 years of age in the lower implementation quartile.

PCP prescription of sulfonylureas was not significantly correlated with prescription of statins at any time (p=0.69) or early statin treatment (p=0.70).

Discussion

PCPs prescribed statin medication to patients with newly diagnosed DM only 41% of the time (45% of them within the first 180 days). These findings aligned with previous research suggesting that, despite the strong evidence supporting the effectiveness of statins treatment in primary prevention (4), statins are underprescribed to individuals with the highest risk of CVD (20–22). Lower likelihood of prescribing statins was associated with some PCP characteristics, such as older age and FFS funding model. Those results align with previous studies that found poorer patient outcomes and lower quality of care among older practitioners (23,24). Authors have suggested that it is possible that physicians further from training are less likely to adhere to evidence-based guidelines, might use newly proved treatments less often and might more often rely on clinical evidence that is not up to date (23). Regarding the funding models, it is been suggested that FFS practitioners might be more inclined to prescribe unnecessary treatments and to treat a higher volume of patients in a shorter period of time compared with physicians reimbursed by other funding models (25,26), which could potentially translate into a lower quality of care. PCP sex did not associate with overall prescribing of recommended statins to patients with DM ≥40 years of age; however, female PCPs had lower odds of prescribing statins

Table 2
Association between provider characteristics and initiation of statin treatment after diagnosis of diabetes mellitus

	Statin treatment (lower implementation quartile yes/no)						Early statin treatment* (lower implementation quartile yes/no)					
	Unadjusted			Adjusted			Unadjusted			Adjusted		
	Exp (B)	95% CI	p value	Exp (B)	95% CI	p value	Exp (B)	95% CI	p value	Exp (B)	95% CI	p value
Provider age, years	1.04	1.01–1.08	0.01	1.05	1.01–1.09	0.01	1.05	1.02–1.08	<0.01	1.06	1.02–1.10	<0.01
Sex												
Male	1			1			1			1		
Female	0.64	0.35–1.19	0.16	1.24	0.57–2.68	0.59	1.24	0.66–2.33	0.52	2.42	1.11–5.28	0.03
Type of health-care provider												
Nurse practitioner	1			1			1			1		
Family physician	1.89	0.74–4.81	0.18	0.61	0.18–2.10	0.43	2.28	0.84–6.21	0.11	3.45	1.10–10.88	0.03
Location of practice												
Urban	1			1			1			1		
Rural	2.76	1.48–5.16	0.01	1.87	0.85–4.08	0.12	1.05	0.55–1.98	0.89	1.51	0.66–3.49	0.33
Funding												
Salary	1			1			1			1		
Fee-for-service	4.63	2.31–9.28	<0.01	4.36	1.47–12.91	0.01	1.19	0.64–2.20	0.58	0.81	0.31–2.12	0.66
Large practice												
No	1			1			1			1		
Yes	2.54	1.36–4.73	<0.01	1.03	0.46–2.35	0.94	1.58	0.85–2.94	0.15	1.30	0.57–2.99	0.53
Canadian graduated												
No	1			1			1			1		
Yes	1.71	0.85–3.43	0.13	1.25	0.55–2.83	0.59	0.75	0.34–1.64	0.48	0.54	0.23–1.29	0.16

Notes: Binary logistic analysis using lower implementation quartile (prescription of statins to a lower proportion of their patients) vs 3 higher implementation quartiles combined as outcome factor. Unadjusted model includes individual characteristics, and adjusted model includes all characteristics.
CI, Confidence interval.
* Early stating treatment if ≤180 days after diabetes mellitus diagnoses.

Table 3
Provider characteristics associated with prescription of sulfonylureas among patients with diabetes mellitus

	Sulfonylureas prescription among patients with diabetes mellitus who were ≥65 years of age (lower implementation quartile yes/no)					
	Unadjusted			Adjusted		
	Exp (B)	95% CI	p value	Exp (B)	95% CI	p value
Provider age, years	1.01	0.98–1.05	0.36	1.02	0.99–1.06	0.26
Provider sex						
Male	1			1		
Female	1.53	0.83–2.82	0.17	1.43	0.67–3.05	0.36
Type of health-care provider						
Nurse practitioner	1			1		
Family physician	0.93	0.41–2.11	0.86	1.90	0.64–5.62	0.25
Location of practice						
Urban	1			1		
Rural	0.34	0.18–0.64	<0.01	0.49	0.22–1.07	0.07
Funding						
Salary	1			1		
Fee-for-service	0.42	0.22–0.79	0.01	0.41	0.14–1.14	0.09
Large practice						
No	1			1		
Yes	1.01	0.54–1.90	0.97	2.13	0.92–4.93	0.08
Canadian graduated						
No	1			1		
Yes	0.47	0.24–0.94	0.03	0.51	0.23–1.10	0.09

Notes: Binary logistic analysis using lower implementation quartile (prescription of sulfonylureas to a higher proportion of their patients) vs 3 higher implementation quartiles combined as outcome factor. Unadjusted model includes individual characteristics, and adjusted model includes all characteristics.
CI, Confidence interval.

within the first 180 days after diagnoses of DM. No differences between physician sex and their adherence to coronary heart disease guidelines were reported previously (27). Nevertheless, it is also possible that the relationship between PCP sex and their implementation of evidence-based guidelines varies across health conditions (28); therefore, further research is needed to clarify this association. Lower odds of prescribing early statin treatment were also found among family physicians (compared with nurse practitioners), and this may be explained by a large presence of family physicians (84%) in the study group. Nevertheless, these results align with previous evidence suggesting that nurse practitioners demonstrate stricter adherence to standards of care for patients with diabetes (29,30).

Of the health-care providers, 74% prescribed sulfonylureas to patients with DM who were ≥65 years of age. Use of sulfonylureas has been associated with a greater prevalence of hypoglycemia and CVD in adults ≥65 years of age (7,8), and with other undesirable effects such as falls and cognitive impairment (31). Despite evidence that has identified potential hazards associated with the prescription of sulfonylureas in older adults (7,8), these medicines are frequently used in clinical practice, probably because of their lower cost, the possibility of monodosing and the presence of metformin in the same tablet (8). In fact, previous Canadian studies have reported that sulfonylureas are an antihyperglycemic drug class commonly used by older adults (16,17).

Previous studies identified that the lack of implementation of evidence-based guidelines might be caused by disagreement with the recommendations because of lack of applicability or lack of evidence, environmental factors such as organizational constraints, lack of knowledge of the guideline recommendations and unclear or ambiguous guideline recommendations (32). In addition, lack of adherence to CW Canada recommendations could be because of lack of knowledge. Stern et al (33) found that more than two-thirds of physicians cannot describe most recommendations targeted to their own specialty. Future studies should explore potential strategies to increase use of evidence-based recommendations among PCPs. The identification of PCP characteristics less likely to implement evidence-base care may assist in promoting targeted Continuing Medical Education/Continuing Professional Development for PCPs involved in diabetes care.

Limitations and strengths

Several limitations of this study have to be considered when interpreting the results. Although data included in this study represent a comprehensive sample of primary care appointments in Manitoba, the MaPCReN database only includes consenting PCPs in Manitoba, representing approximately 16% of Manitoba providers. It is possible that prescriptions that did not align with the clinical guidelines or CW recommendations were influenced by clinical circumstances and/or PCP knowledge of or disagreement with the recommendations. Prescribing practices may also have been influenced by specific patients' characteristics, and by provider and/or patient preferences. This study only used structured data files available within the EMR and not clinic encounter notes, which may have provided more details related to treatment decisions (e.g. clinical presentation, discussion with the patient). Finally, this study was based on EMRs that may have some gaps in terms of data completeness (34,35), but using clinical data from EMRs has been shown to be valid for use in diagnoses (36,37).

The use of good-quality EMR data from the MaPCReN database is one of the main strengths of this study. Furthermore, this is one of the first studies exploring the characteristics of the practitioners less likely to implement diabetes evidence-based clinical practice guidelines and treatment recommendations (CW). Previous studies which related to adherence with clinical guidelines have mainly focused on identifying the characteristics of the patients that are more likely to receive the recommended treatment and/or their adherence to the prescribed regimen.

Conclusions

Our results suggest that the practices of PCPs do not always align with current guidelines or CW recommendations for patients with DM. Although there are several factors that influence clinical decision-making, our results highlight some features associated with adherence to evidence-based guidelines, including PCP

characteristics. This information can serve to help guide future targeted medical education and continuing professional development programs for health-care providers involved in diabetes care. Equally, our findings could be useful in the development of effective resources to improve implementation of new campaign recommendations and/or best practice guidelines going forward.

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Author Disclosures

Conflicts of interest: None.

Author Contributions

DSR contributed to the concept and design of the study. AS and LK collaborated on data gathering. DSR completed the data preparation and analysis. All coauthors collaborated on data interpretation, preparing the manuscript and approved the final article.

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