Original Research

Process Evaluation of the Diabetes Canada Guidelines Dissemination Strategy Using the Reach Effectiveness Adoption Implementation Maintenance (RE-AIM) Framework

Catherine H. Yu MHSc [a,b,c,d,*]; Carolyn Gall Casey BASc [e]; Calvin Ke MD [c]; Gerald Lebovic PhD [b,f,g]; Sharon E. Straus MS [a,b,c,f]

[a] Department of Medicine, St. Michael's Hospital, Toronto, Ontario, Canada
[b] Li Ka Shing Knowledge Institute of St. Michael's Hospital, Toronto, Ontario, Canada
[c] Department of Medicine, Faculty of Medicine, University of Toronto, Ontario, Canada
[d] Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada
[e] Diabetes Canada, Toronto, Ontario, Canada
[f] Department of Health Policy Management and Evaluation, University of Toronto, Toronto, Ontario, Canada
[g] Applied Health Research Centre, St. Michael's Hospital, Toronto, Ontario, Canada

Key Messages

- Using the Reach Effectiveness Adoption Implementation Maintenance (RE-AIM) framework, our study provides macrolevel insights regarding the reach, implementation and adoption of Diabetes Canada 2013 guideline strategies.
- Our interactive tools were repeatedly accessed, signifying their relevance to problems in clinical care.
- Our synthesized analyses indicate that the guidelines website is resource intensive with a wide reach and the potential to change outcomes.

ARTICLE INFO

ABSTRACT

Objectives: Our purpose was to disseminate and implement the Diabetes Canada (formerly the Canadian Diabetes Association) 2013 Clinical Practice Guidelines and evaluate the impact of the dissemination and implementation strategy on process outcomes (reach, adoption, implementation and maintenance).
Methods: Our patient- and provider-directed strategy consisted of a guidelines website, electronic point-of-care decision-support tools, mobile applications, electronic medical record templates, laboratory prompts, continuing professional development modules, a communications campaign and printed education materials. We used the Reach Effectiveness Adoption Implementation Maintenance (RE-AIM) framework to assess process-level outcomes. We report on the reach, adoption, implementation and organizational maintenance by using mixed methods and multiple data sources (communications reports, mailing lists, website-usage statistics, accreditation logs, session-evaluation forms, budgets).
Results: A total of 1,786,910 contacts were made with health-care professionals, the majority of whom were nurses. The greatest reach was through the website. A total of 35,573,154 contacts were made with the general population; the greatest reach occurred through media channels. We contacted 149 and collaborated with 18 governmental, professional and health advocacy organizations about activities such as distributing resources and implementing team-based care initiatives and screening policies. Most website users were young women, with use occurring during working hours. Interactive clinical decision-support tools were most commonly accessed. Website use increased with time. The institutionalization of guidelines occurred in a few areas such as the use of an adapted screening policy in the Northwest Territories.
Conclusions: Our interactive tools were repeatedly accessed, signifying their relevance to problems in clinical care. Our synthesized analyses indicate that the guidelines website is resource intensive, with a wide reach and the potential to change outcomes.

© 2018 Canadian Diabetes Association.

* Address for correspondence: Catherine H. Yu, MHSc, St. Michael's Hospital, 30 Bond Street, Toronto, Ontario M5B 1W8, Canada.
E-mail address: yuca@smh.ca

R É S U M É

Mots clés :
perfectionnement professionnel continu
diabète sucré
lignes directrices
mise en œuvre
diffusion d'informations
cadre RE-AIM

Objectifs : Notre objectif était de diffuser et de mettre en œuvre les lignes directrices de pratique clinique 2013 de l'Association canadienne du diabète, et d'évaluer les répercussions de la diffusion et de la mise en œuvre de la stratégie sur les résultats du processus (portée, adoption, mise en œuvre et maintien).
Méthodes : Notre stratégie axée sur les patients et les prestataires consistait en un site Web sur les lignes directrices, des outils d'aide à la décision au chevet des patients, des applications mobiles, des modèles de dossiers médicaux électroniques, des invites de laboratoires, des modules de perfectionnement professionnel continu, une campagne de communication et du matériel éducatif en format imprimé. Nous avons utilisé le cadre RE-AIM (*Reach, Effectiveness, Adoption, Implementation and Maintenance*, c.-à-d. la portée, l'efficacité, l'adoption, la mise en œuvre et le maintien) pour évaluer les résultats par processus. Nous traitons de la portée, de l'adoption, de la mise en œuvre et du maintien au niveau organisationnel en utilisant des méthodes mixtes et des sources de données multiples (comptes rendus des communications, listes de diffusion, statistiques sur la consultation du site Web, les registres d'agrément, les formulaires d'évaluation de la séance).
Résultats : Un total de 1 786 910 contacts ont été établis avec les professionnels de la santé, dont la plupart étaient des infirmiers et des infirmières. Le site Web avait une meilleure portée. Un total de 35 573 154 contacts ont été établis avec la population générale; la portée des canaux médiatiques s'est révélée la meilleure. Parmi les 149 organisations gouvernementales, professionnelles et d'action de sensibilisation aux questions de santé avec lesquelles nous sommes entrés en contact au sujet des activités telles que la distribution des ressources et la mise en œuvre d'initiatives de soins en équipe et de politiques de dépistage, 18 d'entre elles nous ont offert leur collaboration. Le site Web était la plupart du temps consulté par de jeunes femmes durant leurs heures de travail. Les outils interactifs d'aide à la décision clinique étaient les plus fréquemment utilisés. La consultation du site Web a augmenté au fil du temps. L'institutionnalisation des lignes directrices s'est effectuée dans quelques régions. Par exemple, les Territoires du Nord-Ouest ont utilisé une politique de dépistage adaptée à leur région.
Conclusions : L'utilisation répétée de nos outils interactifs a permis de démontrer leur pertinence en ce qui concerne les problèmes liés aux soins cliniques. La synthèse de nos analyses montre que le site Web sur les lignes directrices exige beaucoup de ressources, mais qu'il a une grande portée et le potentiel de changer les résultats.

© 2018 Canadian Diabetes Association.

Introduction

Evidence-to-practice gaps are well documented in diabetes care (1). In a Canada-wide chart audit of 479 primary care physicians and 5,123 patients with type 2 diabetes (1), 50% of patients achieved the guideline-recommended glycated hemoglobin (A1C) levels of <7.0%; 36% of patients achieved blood pressure levels of <130/80 mmHg; and 57% of patients achieved low-density lipoprotein levels of ≤2.0 mmol/L (2). Multifactorial risk-reduction strategies, with tight glucose regulation and the use of renin-angiotensin system blockers, aspirin and lipid-lowering agents, have been demonstrated to reduce the development of complications in patients with diabetes (3). Because of these care gaps, cardiovascular disease continues to be a major cause of morbidity and mortality (4) in patients with diabetes.

The Diabetes Canada (formerly the Canadian Diabetes Association) 2013 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada (CPGs) (5) is a rigorously developed knowledge tool (5).

A randomized controlled trial of the dissemination of the CPGs in 2008, evaluating the impact of a cardiovascular toolkit mailed to primary care providers, demonstrated no difference in processes of care (e.g. electrocardiograms), outcomes (e.g. myocardial infarctions) or drug prescriptions (e.g. lipid-lowering agents) (6). Qualitative exploration using individual interviews identified that potential reasons for this lack of impact were multiple demands for their attention (many guidelines, competing diseases); lack of integration into care; and time constraints.

We sought to bridge this evidence-to-practice gap by developing a dissemination and implementation strategy (7) and reporting on its implementation, reach and usage. In this study, we used the Knowledge-to-Action framework (7) as a process model to guide the development of our dissemination and implementation strategy. However, in order to assess implementation success, we used the Reach Effectiveness Adoption Implementation Maintenance (RE-AIM) framework (8) as an evaluation framework (9).

Methods

Overview

Implementation theories, models and frameworks serve various purposes; in this study, we used the Knowledge-to-Action framework as a process model to guide the development of our dissemination and implementation strategy. We designed a 5-year strategy to enhance uptake of the 2013 CPGs (5) by health-care professionals (HCPs) and patients across Canada, using the Knowledge-to-Action framework (10) (Supplementary Table 1). We report on our intervention using the Template for Intervention Description and Replication checklist (11) (Supplementary Appendix 1). Finally, we used the RE-AIM framework to evaluate the impact of our strategy.

Intervention

Briefly, based on a literature review and a national on-line survey of dietitians, nurses, pharmacists, family physicians, nurse practitioners and general internists, we selected 6 areas to target for dissemination activities: screening/diagnosis, glucose-lowering, vascular protection, team care/organization of care, self-management and individualization of care (Supplementary Table 1). Our literature review and survey identified barriers to guideline uptake as well as preferred strategies for dissemination (Supplementary Table 2). Specifically, barriers to guideline implementation included systems-related barriers (such as lack of team coordination and information management); provider-related barriers (such as lack of medical or technical knowledge); and patient-related barriers, such as patient education (Supplementary Table 2). Facilitators of diabetes care and guideline uptake were guideline related (such as guideline summaries); systems related (case management supported by protocols and medical directives); provider related (opportunities for further education); and patient related (such as hard-copy patient education and self-management resources) (Supplementary Table 2). Based on our literature search and survey, we selected strategies and interventions to

target these barriers, and we incorporated these facilitators into our dissemination and implementation strategies (Supplementary Table 2). As a result, our patient- and provider-directed strategies aimed to provide knowledge and promotion of team-based care and self-management centred around the individual (Supplementary Table 3). It consisted of interventions targeting the following: 1) who provides care: role expansion (e.g. interprofessional workshops) and self-management (e.g. professional and patient resources to promote self-management); 2) coordination of care: communication between providers and patients (e.g. team logs) and disease management (e.g. flowsheets); 3) information and communication technology: electronic point-of-care decision-support tools, mobile applications and electronic medical record templates; and 4) health-care organizations: educational materials (e.g. reference guides summarizing CPG key messages), educational meetings (e.g. conferences, rounds, webinars, interprofessional workshops), patient-mediated interventions (e.g. patient tools, such as printed educational materials, interactive decision support, explanatory videos) (12). We conducted usability assessments of our guideline website through iterative cycles (13) of testing and improvement.

Design

We used the RE-AIM framework to evaluate the impact of our strategy (8,14). This framework recognizes the importance of reach, adoption, implementation and maintenance in quantifying the impact of an intervention at the public health level. It acknowledges the importance of the individual-level and organizational-level impacts. We adopted a pragmatic hybrid approach for applying the RE-AIM framework to accommodate the multifaceted nature of our intervention (15). We used an additive approach for assessing reach, adoption, implementation and maintenance so as to facilitate a broad perspective, while using an activity-specific approach to assess effectiveness, given the heterogeneity of activities and outcomes. We operationalized RE-AIM to fit our intervention and context; definitions, activities, data sources and measures for each dimension are provided in Supplementary Table 4. We defined *reach* as the number of HCPs and members of the public who were aware of the CPGs. Effectiveness (at the individual level) referred to the impacts of various strategies on HCP knowledge and practice-behaviour change and on patients' clinical outcomes relevant to the CPGs' recommendations. *Adoption* (at the organizational level) was defined as the number of organizations that were aware of and collaborated to disseminate the CPGs. *Implementation* was defined as the extent to which various strategy activities were implemented as intended, as well as the time involved and the costs of each activity. *Organizational maintenance* was defined as the extent to which guidelines and guideline activities had become a routine part of operational activities. *Individual maintenance* was defined as the impact of activities on HCP practice behaviours and patients' outcomes after 6 or more months.

In this article, we report on process-level outcomes (16,17), specifically, reach, adoption, implementation and organizational maintenance. Effectiveness is addressed in other publications (18,19).

Data sources

We used quantitative and qualitative methods and multiple data sources.

Media communications and analysis report

This report was compiled annually for the first 2 years following the launch of the CPGs (2013 to 2014) and included the air date, outlet/station name, city/reach boundary, province/region, type of communication and reach for each media event. An HCP-targeted

report was prepared for 2015 and included the type of communication and reach, based on distribution lists of communications and publications, website traffic data for digital ads and social media.

Mailing lists and stakeholder communications

Because we used mailing lists to contact individuals regarding the guidelines, we reviewed mailing lists for existing Diabetes Canada contacts (e.g. membership, conference attendees, etc.) as well as those of external organizations. External organizations included national and provincial professional associations (medical, dietetic, nursing, podiatric, occupational and physical therapy), ministries of health (national and provincial), disease-advocacy organizations (e.g. Kidney Foundation of Canada), electronic medical record vendors and diagnostic testing centres.

Website usage statistics

We assessed website usage, user characteristics and patterns of tool use (Supplementary Table 5). We used Google Analytics (20) to collect data from April 8, 2013 (launch date of the dissemination strategy), to July 4, 2016. Traffic from Internet protocol ranges corresponding to Diabetes Canada employees was excluded. Demographic characteristics (age, gender, device) were collected from sessions and users when available. More detailed data, including age and gender, were collected after April 2014, when a tracking code was installed on the guidelines website. Thus, the sampling proportion was expressed as a percentage of total sessions or users.

Mobile application downloads

We collected this information from iTunes and the GooglePlay store from May 29, 2014 (launch date of mobile application), to June 2016.

Accreditation logs and session evaluation forms

We conducted a variety of continuing professional sessions, including lectures, interprofessional workshops and webinars. For lectures, interprofessional workshops and webinars, we collected attendance records, including number of attendees, type of health-care professional and province.

Annual budgets

Annual budgets were obtained from the Diabetes Canada's financial statements, with assistance from the comptroller.

Outcomes

Reach

We categorized our assessment of reach by HCPs and the public. We collated the number of HCPs who were aware of the CPGs, defined them as contacts, and categorized them (when possible) by type of HCP and province. Similarly, we summed the number of the population who were aware of the CPGs and defined them as contacts. Data sources are indicated in Supplementary Table 6.

Adoption

We assessed the total number of organizations that we contacted about disseminating the CPGs as well as those with whom we collaborated. For example, we contacted professional organizations to ask them to include information about the CPGs in communications with their members. We defined collaboration as any action by the organization that promoted the CPGs or their messaging, such as inclusion in organizational communications or tools, integration into electronic medical records, and joint initiatives and knowledge-exchange events (e.g. interprofessional workshops and conference presentations).

Implementation

Implementation outcomes included website use and total number of continuing professional development (CPD) sessions conducted;

for the latter, we included sessions implemented by the committee and sessions conducted by others (e.g. conference sessions). We assessed implementation costs by activity.

Maintenance (organizational)

We assessed time trends for website use and number of CPD sessions over time. We also collected examples of CPG institutionalization (where the CPGs became a routine part of operational activities) in other organizations.

Analysis

We used descriptive statistics to report reach, adoption, implementation and maintenance.

Specific to website usage, we used descriptive statistics to analyze frequency of use, user characteristics, source of traffic and patterns of website use. We used chi-square tests to compare proportions (%) of interest and assess their significance. To compare means, we conducted parametric t tests for comparisons of 2 categories and 1-way analyses of variance (ANOVA) for comparisons involving more than 2 categories. A quasi-Poisson model with a population offset was used to examine discrete outcomes that were overdispersed. Rate ratios were obtained from the model.

Time trends were analyzed using the autoregressive integrated moving average (ARIMA) approach to address autocorrelation and nonstationarity. We hypothesized that increases in website usage would occur in conjunction with communications and launches; the ARIMA approach would estimate the extent to which a significant level of change occurs before and after communications and launches. The multiple measurement points are necessary for the ARIMA analysis to distinguish between treatment effects and secular trends. The ARIMA approach accounts for 3 major sources of error that may confound the analysis: trend, seasonality and random error (21). Model checking of the ARIMA involved ensuring that the autocorrelation function and partial autocorrelation function plots indicated model appropriateness. Augmented Dickey-Fuller tests were used to assess for stationarity. White noise was assessed by examining the autocorrelation at various lags and was tested using the Ljung-Box chi-square test.

Results

Reach: HCPs

A total of 1,786,910 contacts were made with HCPs regarding the CPGs, the majority of whom were nurses (Supplementary Table 7). The greatest reach occurred through the guidelines website, detailed below. The mobile application was downloaded 9,390 times in a 25-month period (from May 29, 2014, to June 2016). Although direct and indirect communications may include duplications or repeated contacts with the same HCP, the number of mobile application downloads does represent single users.

Website usage and user characteristics

Number of users

The total number of users was 1,098,116 (April 2013 to June 2016 inclusive), with 1,952,432 sessions and 6,734,512 unique page views. However, due to a coding error that occurred between March 8, 2015, and April 11, 2015, there was a double counting of some visitors (data censored in all results).

Age

Age sampling data were available for 45.3% of sessions (see caveat in Table 1), and most sessions represented people in the 25- to 34-year-old age range (Table 1). The majority of users (70.2%)

Table 1
Demographic characteristics and access-point characteristics of website users nationwide across Canada between April 2014 and July 2016

Characteristics	Users (n=822,931)	Sampled (%)
Age category (%)		
18—24 years	14.4	45.3
25—34 years	35.8	
35—44 years	14.2	
45—54 years	14.7	
55—64 years	11.9	
≥65 years	8.9	
Female (%)	70.2	49.4
Country of origin		
Canada	68.1	84.3
United States	8.9	
India	3.6	
United Kingdom	1.9	
Malaysia	1.5	
Australia	1.1	
Other	14.9	
Province or territory of origin (Canadian only; n=476,791)		
Ontario	48.4	100
British Columbia	13.1	
Alberta	12.4	
Quebec	11.7	
Manitoba	3.8	
Saskatchewan	3.5	
Nova Scotia	2.9	
New Brunswick	1.9	
Newfoundland and Labrador	1.4	
Prince Edward Island	0.5	
Northwest Territories	0.2	
Yukon Territory	0.2	
Nunavut	0.1	

Note: Sampling represents the percentage of users or sessions during the entire study period when detailed statistics were accessible. Detailed statistics were not activated until April 2014 during the study period.

were female. Geographic analysis showed that most users were Canadian (68.1%), followed by users in the United States and India (Table 1). Most Canadian users were from Ontario (48.4%), British Columbia (13.1%), Alberta (12.4%) and Quebec (11.7%), which was roughly comparable to the national geographic distribution of HCPs (22) (34.9%, 11.1%, 11.8% and 24.5%, respectively), with a slight overrepresentation of Ontario HCPs and a slight under-representation of Quebec HCPs.

Source of traffic

Traffic from mobile devices consisted of 13.1% of all sessions. The most common referral source for traffic was Google (60.0%), followed by direct entry (24.7%) ($p < 0.001$). The source of traffic was not significantly affected by gender or age.

Reach: Public

A total of 35,573,154 contacts were made with the public regarding the CPGs, with the greatest reach occurring through indirect communication via media channels (Supplementary Table 8).

Adoption

We contacted 149 organizations (79 professional organizations, 20 ministries of health, 31 disease advocacy organizations and 19 electronic medical record vendors) to inform them about our guidelines' release and to direct them to our website for further information.

We collaborated with 18 governmental, professional and heath advocacy organizations on a variety of activities, ranging from distribution of resources to implementation of team-based care initiatives and screening policies (Supplementary Table 9).

Table 2
Most popular tools by descending order of page views and users nationwide across Canada between April 2013 and July 2016

Tool name (web extension to guidelines.diabetes.ca)	Type	Page views (n=3,574 379; %)	Users (n=822,931; %)
Screening and Diagnosis (/ScreeningAndDiagnosis/Screening)	Interactive	2.76%	11.77%
Pharmacotherapy of DM2 (/BloodGlucoseLowering/PharmacologyT2)	Interactive	1.97%	8.57%
A1C Target (/BloodGlucoseLowering/A1Ctarget)	Interactive	1.40%	6.63%
Risk Assessment (/VascularProtection/RiskAssessment)	Interactive	0.97%	4.59%
Quick Reference Guide: Screening & Diagnosis (/ScreeningAndDiagnosis/RefGuide)	Static	0.81%	4.12%
Quick Reference Guide for All Patients with Diabetes: ABCDEs (/VascularProtection/ABCDEs)	Static	0.70%	2.99%
Patient Care Flow Sheet (/OrganizingCare/PatientCareFlowSheet)	Static	0.66%	3.15%
Appendix B: Examples of Insulin Initiation and Titration Regimens in People with Type 2 Diabetes (/Browse/Appendices/AppendixB)	Static	0.56%	3.00%
Framework, Tools and Resources (/SelfManagementEducation/SMETools)	Static	0.54%	2.49%
Blood Glucose-Lowering Therapies (/BloodGlucoseLowering/TherapiesRefGuide)	Static	0.40%	2.10%

Note: URLs for the tools on diabetes.ca may have changed since the Diabetes Canada 2018 clinical practice guidelines were released.

Implementation

### Website usage and patterns of use

The guideline chapters were the most frequently accessed pages (58%), followed by interactive tools (23%) (Supplementary Figure 1). The most popular tools were 4 interactive tools (Screening and Diagnosis, Pharmacotherapy, A1C Target, Cardiovascular Risk Assessment), followed by static tools (2 Quick Reference Guides: Screening & Diagnosis, ABCDEs) (Table 2). The most popular chapters were 3 (Diagnosis of Diabetes, Prediabetes and Metabolic Syndrome; 1.9% of page views); 13 (Pharmacologic Management of Type 2 Diabetes; 1.7% of page views); and 36 (Diabetes and Pregnancy; 1.5% of page views).

Users spent an average of 3 minutes on each session, with an average of 1 minute and 1 second spent on each page. An average of 2.94 pages were visited per session.

Patterns of use

The website was used significantly more frequently on weekdays than on weekends (mean: 1,826 vs. 1,021 users; p<0.001) (Figure 1). Accordingly, the number of weekend users was 60% that of weekday users. However, of the weekend users, a larger proportion of them were <35 of age and female. The rate ratios were as follows: age 35 to 54 compared to <35 years of age: 0.56 (95% CI 0.51 to 0.62); age >55 compared to <35 years of age: 0.31 (95% CI 0.27 to 0.35); male compared to female: 0.42 (95% CI 0.38 to .46; all p<0.001).
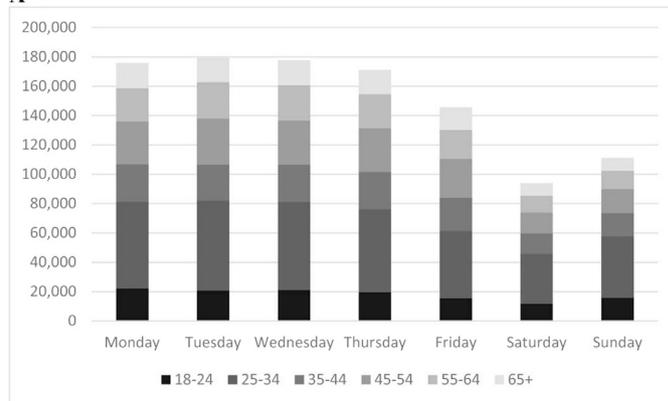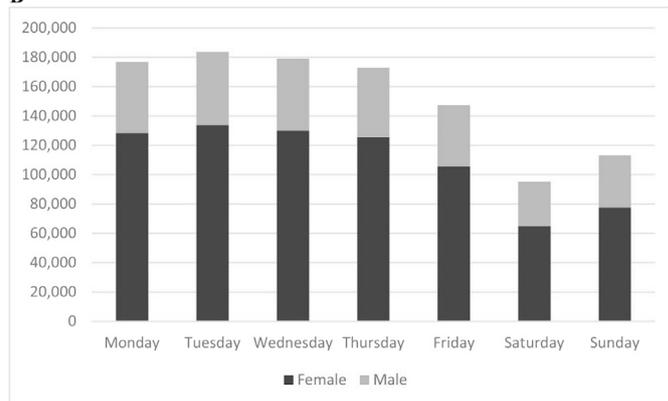

Figure 1. Website usage by day of week and by age (A) and gender (B), nationwide across Canada between April 2014 and July 2016.

Usage was greatest during the day (Figure 2) compared to night and evening (p<0.001). Time-of-day usage differed by age (p<0.001) and sex (p<0.001), with more women <35 of age using it at night (Figure 2).

Total number of CPD sessions conducted

A total of 292 CPD sessions were conducted, with the majority in Ontario (66%), followed by British Columbia (10%) and Alberta (5%).

Implementation costs

Annual budgets for 2012 to 2015 are indicated in Supplementary Table 10. Total costs over the 4 years, including overhead, were $1,459,459 (CAN), with the largest proportion attributed to website and mobile application development and maintenance and to communications. This estimate is not inclusive of investments of in-kind resources from professional volunteer committees that generated the strategy, content development and ongoing expert consultation over 4 years, estimated at over 10,000 hours.

Maintenance (organizational)

Website usage over time

Time trends were analyzed on a weekly basis, excluding March 8 to April 15, 2015, for the reason noted above. Regarding website usage over time, a linear regression model had a parameter estimate of 38.053 (95% CI 30.193 to 45.913; p<0.0001), with return users comprising 53% of all users. Regarding website usage relative to interventions, an ARIMA (1,1,0) model indicated a nonsignificant drop of 1,047 website uses in the week after a marketing
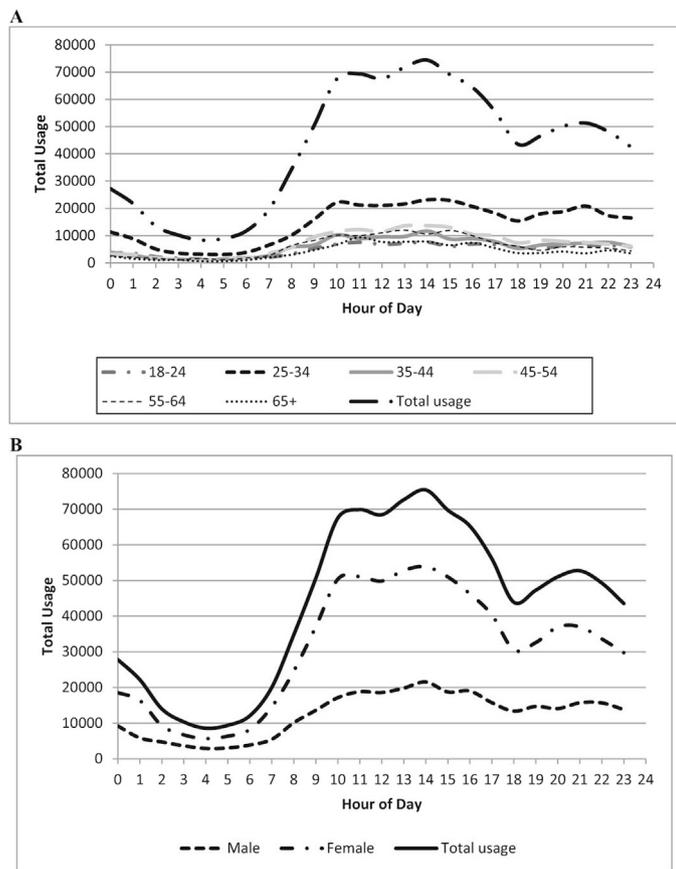
A

B

Figure 2. Website usage by time of day and by age (A) and gender (B), nationwide across Canada between April 2014 and July 2016.

intervention (May 29 to June 14, 2014) (p=0.27) (Figure 3); then, there was no subsequent change.

CPD sessions conducted over time

In the first year after launch, 178 CPD sessions were conducted. In the second year, 106 sessions were conducted. In the third year, through June 23, 2015, 8 sessions were held. There were no subsequent sessions because we did not renew accreditation.

Institutionalization of CPGs

Examples included provincewide integration of guidelines into electronic medical records in Saskatchewan; dissemination and use of an adapted diabetes screening policy in the Northwest Territories; development and implementation of provincial interprofessional workshop series by the Ministry of Health in Ontario; development and dissemination of an insulin-prescription tool with the Ontario College of Family Physicians; and annual requests for guidelines highlights in publications (e.g. Medical Post) and conferences (e.g. Primary Care Today).

Discussion

We report on process-level outcomes—specifically, reach, adoption, implementation and maintenance—of Diabetes Canada's 2013 CPG dissemination strategy by using a variety of data sources, including communications reports, website usage statistics, accreditation logs, session evaluation forms and annual budgets. We found that the greatest reach to HCPs occurred through the website and that the greatest reach to the public was through

media channels. Our reach was also facilitated by engaging with adopting organizations who further disseminated the guidelines to their membership. Examination of website implementation yielded valuable information regarding user characteristics and patterns of use, detailed further below. Regarding maintenance, although website usage increased with time, CPD sessions decreased with time. The institutionalization of guidelines occurred at a few sites, most notably that of provincewide electronic medical record integration in Saskatchewan. We demonstrated successful dissemination of the CDA guidelines website across Canada and internationally, established baseline demographic and access-point characteristics and demonstrated a positive linear trend in the number of users in the context of popular interactive tools.

Website usage

Given the website's dominant impact on reach and data regarding user characteristics and use, we focus our discussion on this aspect of the strategy. Although Internet-based dissemination of CPGs is recognized as an important tool (23), the literature regarding Internet-based guideline dissemination has focused primarily on single-modality interventions rather than a multifaceted suite of tools, as in our dissemination strategy. For example, online problem-based learning modules (24), CPD modules (25) and clinical-decision support (26) have been used as stand-alone interventions and have been demonstrated to result in improved knowledge (24), self-reported practice changes (24,25) and improved scores on simulated clinical scenarios (26). Other dimensions of RE-AIM (e.g. reach, adoption, implementation, maintenance) have not been explicitly evaluated.

Users' website browsing patterns (session duration, time per page, pages per visit) suggest that users entered the website to use a specific resource or to answer a specific clinical question. They were able to locate the resource required quickly, answer the clinical question, then access and review related resources. This is corroborated by the most frequently accessed pages' being chapters, then interactive tools.

Demographically, we observed a predominance of female users. This is consistent with interprofessional gender trends across Canada (92% of registered nurses, 91% of dietitians, 65% of pharmacists, 50% of general practitioners are female) and reflects the interprofessional nature of diabetes care in Canada (22). The increased use by young age groups (25 to 34 years) suggests increased adoption of Internet-based medical information by trainees and recent professional graduates, although interpretations of this finding should be tempered by the limitations of methods of demographic data capture. Future improvements of guidelines dissemination could include exploring reasons for decreased use among older health-care providers.

Interactive tools were highly and repeatedly accessed, confirming the relevance of these tools that address common problems in clinical care, i.e. screening and diagnosis, pharmacotherapy, A1C target and risk assessment. Unexpectedly, we discovered a highly accessed static tool in Supplementary Appendix 2 (Examples of Insulin Initiation and Titration Regimens). This was not originally identified as a priority for interactive tool development, but the data from our analysis was used to prioritize the development of such a tool. Overall, our analysis suggests that although textual guidelines are necessary, it is even more important to responsively develop the efficient, interactive and relevant tools identified by the stakeholder group.

Limited use of mobile application

Use of mobile applications by HCPs is prevalent; in a survey of 65 medical students, 65 residents and 41 faculty members, 85%
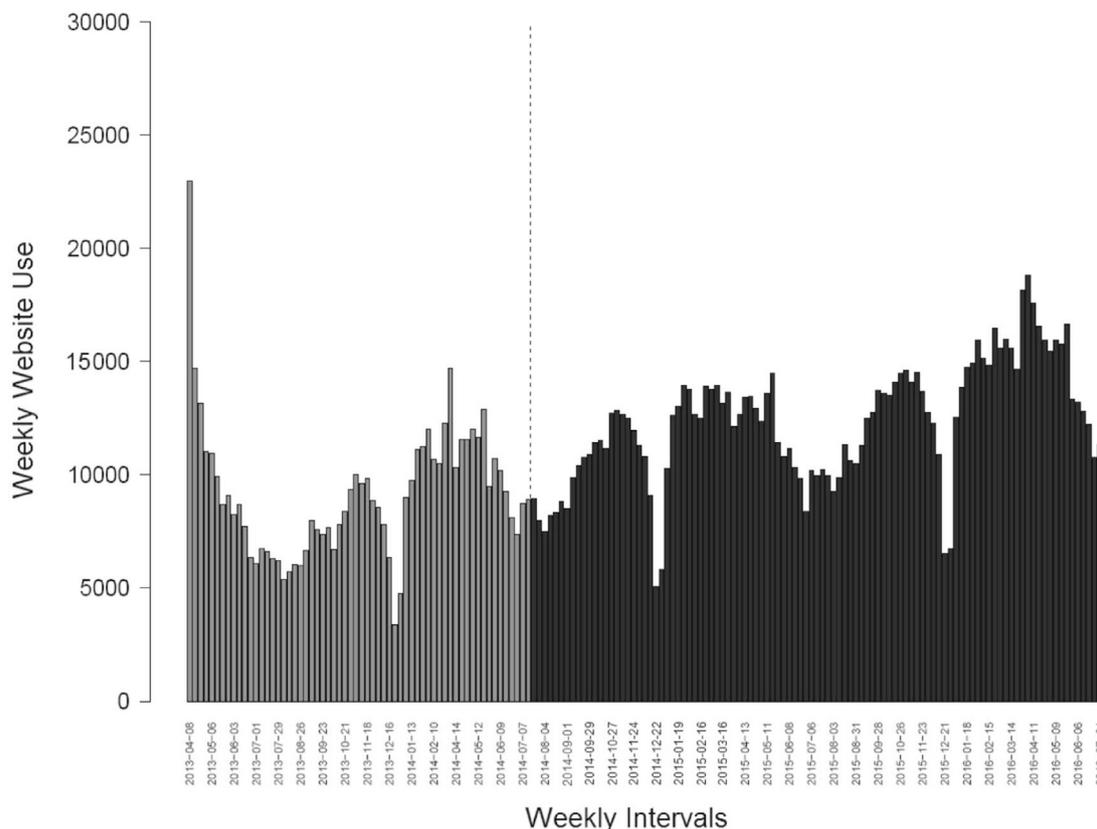
Figure 3. Time trends in website usage by week, according to the number of users nationwide across Canada between April 2013 and July 2016.

reported using their mobile device at least once a day for clinical reasons (27). Furthermore, a systematic review of handheld computers in clinical practice found greater knowledge acquisition, guideline adherence and appropriate diagnostic decisions with the use of handheld computers compared to paper resources (28). Despite these compelling reasons, and despite being highly ranked as a useful tool in our needs assessment, there were fewer than 10,000 downloads in the 19-month period of study. Potential barriers to use may include cost (priced at $0.99 USD), lack of awareness, limited use of medical applications in general and usability (29). Cost may be the primary barrier, given users' preferences for free applications (30), particularly in light of the availability of a free guidelines website that was optimized for mobile viewing and, indeed, was accessed through mobile devices by 13.1% of users. Further exploration of this in interviews or subsequent needs assessments will help to elucidate the causes of limited use and provide guidance regarding ongoing use or refinement.

Insights from synthesizing the process outcomes of RE-AIM

The RE-AIM framework provides a broad perspective on the relative merits of various dissemination interventions, considering not only their efficacy but also their reach and implementation costs. For example, the communications strategy resulted in a large reach. On the other end of the spectrum, the interprofessional workshop series were resource intensive and had very limited reach, yet they resulted in changes in the organization of care and, in 1 case, the development of their own interprofessional workshop program. Midway in the spectrum, the guidelines website was resource intensive and had a wide reach, with the potential to change outcomes.

These results are congruent with the current literature regarding the effectiveness of guideline-dissemination strategies. A synthesis of communication and dissemination strategies to facilitate the use of health-related evidence (31) identified 38 studies and divided strategies into those focusing on reach, ability or motivation. There was insufficient evidence when comparing the relative effectiveness of each of these strategies. However, although the strength of evidence was low, it found that interventions that used a multicomponent approach focusing on increasing HCPs' reach, ability or motivation were most effective in improving guideline adherence and, to a lesser degree, clinical outcomes. The effectiveness of our dissemination strategy, in comparison to those previously reported, may be attributed to our multipronged approach, which attempted to target previously reported barriers to guideline uptake (such as competing demands, time constraints, limited integration into care) as well as reach, ability and motivation. We created relevant, easily accessible and usable tools that were quick to use at the point of care, and we used an extensive communications strategy to make users aware of the existence and usefulness of these tools. Guideline uptake can be optimized by considering the applicability of the guideline recommendations. Specifically, during the guideline-development process, developers should ensure that the guidelines describe facilitators and barriers to their application, provide advice on how the recommendations can be put into practice and consider the potential resource implications of applying the recommendations (32). Adhering to these measures may increase HCPs' ability and motivation to integrate the guidelines into practice, further increasing uptake.

Limitations

Limitations of the study include the opportunistic nature of the data collection from some of our data sources; for example, although we maintained meticulous records of CPD sessions conducted, undoubtedly, other guideline sessions were held that we

were not aware of, resulting in an underestimate. Conversely, our multipronged communications campaign may have reached some individuals more than once, resulting in an overestimate of reach. However, we were careful in our interpretation of these estimates; in addition, we were able to obtain precise estimates through website usage statistics. Limitations in our website statistics methodology are related to the Google Analytics platform, including the risk of overcounting users, sampling bias and the lack of individual-level data. In addition, it is possible that older healthcare providers are less likely to have registered for Google accounts and, therefore, may appear less well represented in the sample. However, comparison with gender trends in Canada are consistent with our observations.

Supplementary Material

To access the supplementary material accompanying this article, visit the online version of the *Canadian Journal of Diabetes* at www.canadianjournalofdiabetes.com.

Author Disclosures

Conflicts of interest: None.

Author Contributions

CHY conceived of and designed the study, contributed to data acquisition, analysis, interpretation, and critical revision of important intellectual content; SES contributed to the design of the study and critical revision of important intellectual content; CGC and CK acquired data; GL conducted data analysis and interpretation. All authors took part in drafting, revising and providing final approval of the manuscript published and agreed to be accountable for all aspects of the work.

References

1. Leiter LA, Berard L, Bowering CK, et al. Type 2 diabetes mellitus management in Canada: Is it improving? Can J Diabetes 2013;37:82–9.
2. Bennett WL, Odelola OA, Wilson LM, et al. Evaluation of guideline recommendations on oral medications for type 2 diabetes mellitus. Ann Intern Med 2012;156:27–36.
3. Gaede P, Oellgaard J, Carstensen B, et al. Years of life gained by multifactorial intervention in patients with type 2 diabetes mellitus and microalbuminuria: 21 years' follow-up on the Steno-2 randomised trial. Diabetologia 2016;59:2298–307.
4. Booth GL, Kapral MK, Fung K, et al. Relation between age and cardiovascular disease in men and women with diabetes compared with non-diabetic people: A population-based retrospective cohort study. Lancet 2006;368:29–36.
5. Canadian Diabetes Association Clinical Practice Guideline Expert Committee. Canadian Diabetes Association 2013 clinical practice guidelines for the prevention and management of diabetes in Canada. Can J Diabetes 2013;37:S1–212.
6. Shah BR, Bhattacharyya O, Yu C, et al. Evaluation of a toolkit to improve cardiovascular disease screening and treatment for people with type 2 diabetes: Protocol for a cluster-randomized pragmatic trial. Trials 2010;11:44.
7. Nielsen J. Iterative user-interface design. IEEE Computer 1993;26:32–41.
8. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: The RE-AIM framework. Am J Public Health 1999;89:1322–7.
9. Nilsen P. Making sense of implementation theories, models and frameworks. Implement Sci 2015;10:53.
10. Graham ID, Logan J, Harrison MB, et al. Lost in knowledge translation: Time for a map? J Contin Educ Health Prof 2006;26:13–24.
11. Hoffmann TC, Glasziou PP, Boutron I, et al. Better reporting of interventions: Template for intervention description and replication (TIDieR) checklist and guide. BMJ 2014;348:1687.
12. Effective Practice and Organisation of Care (EPOC). EPOC Taxonomy; 2015. https://epoc.cochrane.org/epoc-taxonomy. Accessed October 2, 2018
13. Yu CH, Ke C, Gall-Casey C. Disseminating the Canadian Diabetes Association 2013 clinical practice guidelines: Guidelines.diabetes.ca in Action. Can J Diabetes 2014;38:S72–3.
14. Glasgow RE, McKay HG, Piette JD, Reynolds KD. The RE-AIM framework for evaluating interventions: What can it tell us about approaches to chronic illness management? Patient Educ Couns 2001;44:119–27.
15. Glasgow RE. What does it mean to be pragmatic? Pragmatic methods, measures, and models to facilitate research translation. Health Educ Behav 2013;40:257–65.
16. Straus S, Tetroe J, Graham ID, editors. Knowledge translation in health care: Moving from evidence to practice. Hoboken (NJ): Wiley; 2011. p. 336.
17. Grant A, Treweek S, Dreischulte T, Foy R, Guthrie B. Process evaluations for cluster-randomised trials of complex interventions: A proposed framework for design and reporting. Trials 2013;14:1.
18. Yu CH, Lillie E, Mascarenhas-Johnson A, Gall Casey C, Straus SE. Impact of the Canadian Diabetes Association guideline dissemination strategy on clinician knowledge and behaviour change outcomes. Diabetes Res Clin Pract 2018;140:314–23.
19. Rigobon AV, Kalia S, Nichols J, et al. Impact of the Diabetes Canada guideline dissemination strategy on the prescription of vascular protective medications: a retrospective cohort study, 2010-2015. Diabetes Care; 2018:dc180935.
20. Oliffe JL, Han CS, Lohan M, Bottorff JL. Repackaging prostate cancer support group research findings: An e-KT case study. Am J Mens Health 2014;9:53–63.
21. McDowall D, McCleary R, Meidinger E, Hay RA. Interrupted time series analysis: Quantitative applications in the social sciences. Thousand Oaks: California: University Press; 1980.
22. Canadian Institute for Health Information. Canada's Health Care Providers—1997 to 2011: A reference guide, vol. 40. Ottawa (Ontario, Canada): Canadian Institute for Health Information; 2013.
23. Jeannot J-G, Scherer F, Pittet V, Burnand B, Vader JP. Use of the world wide web to implement clinical practice guidelines: A feasibility study. J Med Internet Res 2003;5:e12.
24. Robson J. Web-based learning strategies in combination with published guidelines to change practice of primary care professionals. Br J Gen Pract 2009;59:104–9.
25. Vollmar HC, Schürer-Maly CC, Frahne J, Lelgemann M, Butzlaff M. An e-learning platform for guideline implementation: Evidence- and case-based knowledge translation via the Internet. Methods Inf Med 2006;45:389–96.
26. Thomas KW, Dayton CS, Peterson MW. Evaluation of internet-based clinical decision support systems. J Med Internet Res 1999;1:E6.
27. Wallace S, Clark M, White J. "It's on my iPhone": Attitudes to the use of mobile computing devices in medical education, a mixed-methods study. BMJ Open 2012;2:e001099.
28. Mickan S, Atherton H, Roberts NW, Heneghan C, Tilson JK. Use of handheld computers in clinical practice: A systematic review. BMC Med Inform Decis Mak 2014;14:56.
29. Tahamtan I, Sedghi S. Perceived benefits and barriers of handheld computers in clinical practice. Health Scope 2014;3:e20999.
30. Murfin M. Know your apps: An evidence-based approach to evaluation of mobile clinical applications. J Physician Assist Educ 2013;24:38–40.
31. McCormack L, Sheridan S, Lewis M, et al. Communication and dissemination strategies to facilitate the use of health-related evidence. Evidence Report/Technology Assessment No. 213. AHRQ Publication No. 13(14)-E003-EF. Rockville, MD: Agency for Healthcare Research and Quality; November 2013. https://doi.org/10.23970/AHRQEPCERTA213.
32. Brouwers MC, Kho ME, Browman GP, et al. AGREE II: Advancing guideline development, reporting and evaluation in health care. CMAJ 2010;182:E839–42.

Supplementary Material

Supplementary Table 1
The Knowledge-to-Action framework, used to design our dissemination strategy

	Study component
Knowledge synthesis	Literature review • Identification of Diabetes Canada's *2013 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada* as a rigorous knowledge tool (1) (described in Introduction)
Identify problem: identify, review, select knowledge	Literature review • Identification of clinical care gaps in diabetes care (2) • Identification of barriers and facilitators to guideline implementation in diabetes care (3,4) (See Table 2) (described in Introduction, Methods)
Adapt knowledge to local context; assess barriers to knowledge use	A national cross-sectional survey of nurses, dietitians and pharmacists, family physicians and general internists was conducted to determine at which steps guideline attrition occurs, key messages, barriers to and facilitators of dissemination and preferred formats. The survey included the following sections: 1) demographic and practice characteristics (including resources used for patient care); 2) key topics and content areas; 3) intention to adopt guideline recommendations based on the theoretical domains framework; 4) barriers to and facilitators of guideline uptake; 5) current tools and resources used, as well as ideal tools and resources. The survey was disseminated between September 24, 2012, and October 21, 2012, through national and provincial professional and governmental organization communications (e.g. e-mail, newsletters), Diabetes Canada distribution lists and networks of committee members. Of 1,389 total respondents, 865 completed the survey. In addition, participants were asked to rank key topic areas and were asked about their intention to adopt only their top-3-ranked topics. Thus, denominators vary for each question. Briefly, respondents were primarily dietitians (32%), nurses (27%), pharmacists (21%) and a minority of family physicians or nurse practitioners (11%). Of the respondents, 65% used electronic medical records. The top 5 topics were: individualization of diabetes care, self-management education, diagnosis and screening for diabetes, glucose lowering and vascular protection. Barriers and facilitators are shown in Supplementary Table 2. The full results are available in Appendix 2. (described in Methods, Intervention)
Select, tailor, implement intervention	Based on the above, we created a patient- and provider-directed strategy that aimed not only to provide knowledge, but also to promote team-based care and self-management centred around the individual. We selected 6 key areas of focus (based on care gap, value, strength of recommendation, feasibility): screening/diagnosis, glucose lowering, vascular protection, team and organization of care, self-management and individualization of care. We then selected strategies targeting barriers and facilitators identified in the literature and in our needs assessment. These are described in Supplementary Table 3. (described in Methods, Intervention)
Monitor knowledge use	We used the following methods to determine how health-care providers were using our guideline tools: 1. Guideline website usage statistics (Supplementary Table 5) 2. E-mail requests to guidelines website 3. National online survey 4. Individual interviews (described in Methods, Intervention)
Evaluate outcomes a) Process level	Outcomes assessed: 1. Recruitment and reach to individuals 2. Intervention delivery to individuals Methods used/data collected: 1. Communications reports 2. Website usage statistics (Supplementary Table 5), user e-mails 3. Demographic and practice characteristics of participants in continuing professional development session and interprofessional workshop series (described in Methods, Results)
b) Outcome level	Outcomes assessed: 1. Knowledge 2. Confidence 3. Change in practice Methods used/data collected: 1. Evaluation forms from continuing professional development session and interprofessional workshop series participants 2. Online national survey of health-care professionals 3. Individual interviews with health-care professionals (described in companion report)
Sustain knowledge use	Continue to engage and build on relationships with target audience, stakeholders and partners.

Supplementary Table 2
Identified barriers to and facilitators of optimal diabetes care and guideline uptake derived from the literature and online surveys

	Barriers to optimal diabetes care	Barriers to guideline uptake	Facilitators of diabetes care and guideline uptake	Strategies targeting identified barriers and facilitators
Guideline-related			• Guideline summaries • Hard and electronic copies of guidelines • Online accredited continuing professional development sessions • Decision support	• Inclusion of these facilitators in our dissemination strategy
Systems-related	• Lack of team coordination and information management (5) • Limited human resources • Limited time, remuneration and funding (5) • Financial burden of diabetes • Delay in accessing specialty care	• Lack of team coordination and information management (5) • Limited human resources • Limited time, remuneration and funding (5) • Ineffective organization of care (for example, no follow-up protocol, no referral criteria) (7,8)	• Use of novel care strategies (comanagement, shared care, case management supported by protocols or medical directives) (6) • Access and ability to use communication mediums (5) • Availability of interprofessional expertise (5)	• Selection of team care as a key message • Interprofessional workshop series • Patient resources to enable team care
Provider-related	• Lack of medical or technical knowledge (for example, insulin) (6,9) • Lack of time • Competing comorbidities	• Lack of medical or technical knowledge (for example, insulin) (6,9) • Lack of time • Limited opportunities for continuing education (5,10–12) • Limited knowledge regarding interprofessional roles and responsibilities (5,10,12) • Lack of interest in or willingness to collaborate, impingement on professional autonomy (5,8,10) • Lack of communication • Duplication of services (5)	• Opportunities for further education (7) • Role clarity (6) • Interest in and willingness to collaborate (5) • Clear communication	• Educational slides and videos • Continuing professional development sessions • Interprofessional workshop series • Communication tools
Patient-related	• Patient compliance • Patient education (7) • Patient complexity		• Adoption of self-management strategies (13) • Patient receptiveness • Hard-copy patient education and self-management resources	• Selection of team care as a key message • HCP education, including interactive case studies • HCP and patient resources to enable self-management

HCP, health-care professional.

Supplementary Table 3
Content and format of dissemination strategy

Content		
Key messages selected	**Description**	**Relevant Guideline chapter**
Screening/diagnosis	Appropriate identification of individuals: whom to screen, selection and interpretation of appropriate screening tests	3, 4, 5, Appendix 1
Glucose lowering	Individualization of glycemic targets and antihyperglycemic-agent selection	8−17
Vascular protection	Individualized selection of appropriate vascular protective strategies	10−11, 22−25
Team and organization of care	Promotion of quality diabetes care delivery through interprofessional collaboration and systems-based interventions	6, Appendix 2
Self-management	Provision of knowledge, skills and resources to help HCPs promote patient self-management	8−11, 18
Individualization of care	Individualization of guideline recommendations based on patient characteristics	28−29, 34−35, 36−38

Format					
Step of guideline adherence targeted	**Intervention**	**Description**	**Materials, procedures**	**Provider**	**Mode of delivery, location**	**Tailoring, modification, fidelity**
Awareness	Communications campaign	Consisted of: 1. Mass communication (television, radio, newspapers, Internet) 2. HCP-targeted communication (e.g. Medical Post) 3. Indirect communication (professional organizations) 4. Direct communication (mailing lists, primary care)	Press releases, newsletters, announcements, articles, radio and television interviews, executive summaries	Not applicable	Mail, e-mail, Internet, newspapers, radio, television National, provincial, local	Messages were tailored to focus on aspects relevant to the target audience
Agreement	Slide decks	42 slide sets, 1 for each guideline document chapter, as well as 4 summarizing essentials and key changes. Available online for download for self-study or CPD	Developed and reviewed by endocrinology trainees and dissemination committee members	Not applicable	Available online from guideline website and mobile application	Slide decks are standardized Modification discouraged to ensure fidelity
	Practical tips	Text box within relevant chapters included to help implement recommendations into practice	Created by chapter authors	Not applicable	Available in hard copy and online from guideline website and mobile application	Standardized Unable to modify to ensure fidelity
	Key messages, highlights of revisions (executive summary)	Summarizes key messages and changes in guidelines compared to previous guidelines Included for each chapter	Created by chapter authors	Not applicable	Available in hard copy and online from guideline website and mobile application	Standardized Unable to modify to ensure fidelity
	Video lectures	42 narrated videos, 1 for each guideline document chapter, as well as 4 summarizing essentials and key changes Available online for download for self-study or CPD	Developed, reviewed and narrated by endocrinology trainees and dissemination committee members	Not applicable	Available online from guideline website, mobile application and YouTube	Standardized Unable to modify to ensure fidelity
	Continuing medical education	1- to 2-hour sessions were conducted using accredited slide decks created by members of the dissemination team and were delivered by key opinion leaders to their peers Instructions on how to deliver the slide deck were provided in a training video	Developed and reviewed by an interprofessional team with expertise in continuing professional development Evaluated by self-reported confidence and practice change before and after session	Delivered by endocrinologists and internists with clinical expertise in diabetes care Instructions on how to deliver the slide deck were provided in a training video.	Face-to-face small-group learning National, provincial, local	Standardized Unable to modify for accreditation purposes and to ensure fidelity

Supplementary Table 3 (continued)

	Format					
Step of guideline adherence targeted	Intervention	Description	Materials, procedures	Provider	Mode of delivery, location	Tailoring, modification, fidelity
Adoption	Website	Easily searchable guidelines, point-of-care decision support, access to videos, slide sets, patient resources	Guidelines.diabetes.ca	Not applicable	Available online	Standardized Unable to modify for accreditation purposes and to ensure fidelity
	Order sets	Consisted of: 1. Background document on in-hospital organization of diabetes care 2. Order set implementation manual 3. Sample order sets	Developed and reviewed by an interprofessional team with expertise in in-hospital diabetes management	Not applicable	Available in hard copy and online from guideline website	Standardized Designed for user adaption to local setting
	Interprofessional workshops	Consisted of a half-day workshop series of 2 to 3 workshops employing role clarification activities, case-based exercises designed to enable interprofessional collaboration at individual and organizational levels	PowerPoint slide set, activity worksheets (e.g. team action planning), hard copy resources	Delivered by an interprofessional team of diabetes experts (nurse, dietitian, pharmacist, endocrinologist) with expertise in interprofessional collaboration and care	Face-to-face (teleconference for remote locations) at practice Ontario, Newfoundland	Adapted to local needs based on input from local stakeholders and needs assessment survey of participants
	Patient reports and resources	Electronic and hard copy resources to support patient self-management and team-based care	Interactive and static tools and videos: e.g. interactive blood glucose self-monitoring recommendation tool, "Understanding your A1C" video, "ABCDEs," "Targets, goals and results" flowsheet, "My Action Plan"	Not applicable	Available in hard copy and online from guideline website, linked to Diabetes Canada website and YouTube	Standardized Unable to modify to ensure fidelity
Adherence	Integration into electronic medical record	Inclusion of guideline recommendations and tools into electronic medical records Includes prompts and reminders, chronic disease flowsheet, visit template, links to interactive guideline tools, reports	Led by a committee member in partnership with the Saskatchewan provincial Ministry of Health and 2 electronic medical record vendors	Not applicable	Electronic medical record interface	Standardized tools Unable to modify to ensure consistent reporting
	Tools to promote organization of care and interprofessional collaboration	Diabetes care flowsheets, reference guide, facilitated relay, communication logs	Diabetes care flowsheets, reference guide, facilitated relay, communication logs		Available in hard copy and online from guideline website	Static Unable to modify to ensure fidelity
	Laboratory prompts	Guideline-based statements to assist in the interpretation A1C, glucose, lipid and albumin to creatinine ratio	Developed and reviewed by committee members, then sent to identified laboratories		Available on laboratory result sheet under patient's own result	At laboratory's discretion, but feedback provided if uncertainties arose

A1C, glycated hemoglobin; *CPD,* continuing professional development.

Supplementary Table 4
Definition, activity, measures and data sources for each RE-AIM dimension

RE-AIM dimension	Definition	Activity	Measure	Data source
Reach (individual level)				
HCPs	Number, proportion and representativeness of HCPs who are aware of CPGs	• Mass communication (television, radio, newspapers, Internet) • HCP-targeted: medical post, hospital news • Indirect communication (professional organizations) • Direct communication (mail/e-mail for needs assessment, resources, survey) • Education (guidelines website, continuing professional development sessions, interprofessional workshops, conferences, webinars) • Electronic medical records	• Number of HCPs who are aware of CPGs, subdivided by: • Type of HCP • Province	• Communications report • Mailing lists (organizational, HCP) • Needs assessment, survey, individual interviews • Website usage statistics • App downloads • Accreditation logs/attendance records
Public		• Mass communication (television, radio, newspapers, Internet) • Direct communication (mail/e-mail of resources) • Education (webinars, expos)	• Number of media impressions • Number of patients who are aware of CPGs	• Communications report • Mailing lists • Attendance records
Efficacy/effectiveness (individual level)*				
HCP Knowledge	Impact of various strategy activities on HCP knowledge of CPGs recommendations	• Guidelines website • CPD sessions (lecture series, interprofessional workshop series, conferences, webinars)	Change in confidence Knowledge scores	• Session evaluation forms • National survey • Individual interviews
Practice behaviour change	Impact of various strategy activities on HCP practice behaviours relevant to CPGs recommendations	• Guidelines website • CPD sessions (lecture series, interprofessional workshop series, conferences, webinars) • Electronic medical records	• Change in self-reported practice behaviour change for each of key messages • Change in practice behaviour change: • Use of A1C for diagnosis • Individualization of glucose-lowering agents • Use of vascular-protective drugs • Individualization of blood glucose self-monitoring	• Session evaluation forms • National survey • Individual interviews • Administrative databases
Patient Clinical outcomes	Impact of various strategy activities on patients' clinical outcomes relevant to CPG recommendations		• Change in clinical outcomes: • LDL cholesterol in target • Blood pressure in target • Blood glucose test-strip use	Administrative databases
Adoption (organizational level)				
	Number, proportion and representativeness of organizations (nongovernment, government) who are aware of CPGs	Direct communication	Total number of organizations contacted	Stakeholder list
	Number, proportion and representativeness of organizations (nongovernment, government) who have collaborated with dissemination efforts	Direct communication	Total number of organizations with collaborations	Stakeholder communications
Implementation (organizational level)				
	The extent to which various strategy activities were implemented as intended	• Guidelines website • CPD sessions (lecture series, interprofessional workshop series, conferences, webinars) • Electronic medical records	• Total number of website users • Website use and usability • Total number of sessions conducted	• Website usage statistics and usability study • Accreditation logs/attendance records
	Time and cost for each strategy activity	• Guidelines website • CPD sessions (lecture series, interprofessional workshop series, conference, webinars) • Electronic medical records	• Total cost for each activity • Number of personnel hours (paid and volunteer) for each activity	• Annual budget • Personnel time logs
Maintenance (organizational and individual* levels)				
Organizational level	The extent to which guideline and guideline activities have become institutionalized	• Guidelines website • CPD sessions (lecture series, interprofessional workshop series, conferences, webinars) • Screening tool • Electronic medical records	• Time trends for use • Number of CPD sessions over time • Number of interprofessional workshop series • Screening tool usage	• Website usage statistics and usability study • Accreditation logs/attendance records • Stakeholder communications
Individual level HCP	Impact of various strategy activities on HCP practice behaviours relevant to CPG recommendations after 6 or more months	• Guidelines website • CPD sessions (lecture series, interprofessional workshop series, conference, webinars) • Electronic medical records	• Change in practice behaviour change: • Use of A1C for diagnosis • Individualization of glucose-lowering agents • Use of vascular-protective drugs • Individualization of blood glucose self-monitoring	Administrative databases
Patient	Impact of various strategy activities on patient clinical outcomes relevant to CPG recommendations after 6 or more months		• Change in clinical outcomes: • LDL cholesterol in target • Blood pressure in target	Administrative databases

A1C, glycated hemoglobin; *CPD*, continuing professional development; *CPGs*, clinical practice guidelines; *HCP*, health-care professional; *LDL*, low-density lipoprotein; *RE-AIM*, Reach Effectiveness Adoption Implementation Maintenance.
* Assessed in companion and future reports.

Supplementary Table 5
Website usage outcomes

Outcome		Description
Usage	Number of users	Total number of users to site
	Number of sessions	Total number of sessions
	Unique page views	Total number of unique page views
	Geographic distribution	Total number of users by country
		Total number of users by province
	Use by day of week	By day: Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday
		Weekday: Monday to Friday
		Weekend: Saturday, Sunday
	Use by time of day	By hour
		Morning: 9 AM to 5 PM
		Evening: 5 PM to 12 AM
		Night: 12 AM to 9 AM
User characteristics	Age distribution	Proportion of users in the following age groups: 18—24, 25—34, 35—44, 45—54, 55—64, 65+ years
		In the Poisson models, groups were combined into 3 categories: <35, 35—54, 55+ years)
	Gender	Male, female
	Country of origin	
	Province or territory of origin	
	Device category	Desktop, mobile, laptop
	Referral source	Google, direct, Bing, Diabetes.ca, etc.
Patterns of use	Frequency of use of each tool type (as proportion of total number of visits)	Interactive tools, static tools, slides/videos, chapters, patient tools
	Most frequently used tools	Top 10 tools; Top 5 interactive tools,
		Top 5 static tools, Top 5 patient tools,
		Top 5 slides/videos, Top 5 chapters
	Average session duration	Amount of time spent by users during 1 session
	Average time spent on page	Amount of time spent by users on a page
	Site penetration	Pages visited per session

Supplementary Table 6
Characteristics of user access points according to the proportion of total sessions (data includes 100% of sessions)

Characteristics		Sessions
Device category (%)		
	Desktop	76.2
	Mobile	13.1
	Tablet	10.7
Referral source (%)		
	Google search	60.0
	Direct (no referral)	24.7
	Bing	3.0
	Diabetes.ca	1.5
	Google cost-per-click advertising	1.3
	Other	2.9

Supplementary Table 7
Reach: Number of health-care professionals who were aware of clinical practice guidelines

Activity	Specific data source	Number of HCPs contacted (distribution list)
Indirect communication		
Print publication	*Hospital News*	50,000
	Canadian Nurse	151,049
	Infirmiere Canadienne	3,283
	Canadian Medical Association Journal	80,740
	Canadian Pharmacists Association Journal	4,600
	Medical Post	47,000
	The Diabetes Communicator	2,500
	Canadian Journal of Diabetes	5,000
Digital/online	*Canadian Medical Association Journal*	40,000
	Canadian Family Physician	40,000
	Canadian Nurses Association	40,000
Direct/e-newsletter	Canadian Healthcare Network	
	Physicians (English-speaking)	10,000
	Physicians (French-speaking)	3,700
	Pharmacists (English-speaking)	31,500
	Pharmacists (French-speaking)	10,800
	Health-care managers (English-speaking)	8,000
	Canadian Family Physician (Mainpro)	30,000
	Canadian Nurses Association	40,000
	Dietitians of Canada	6,000
	Physician Networks	500
	Ministry of Health Primary Care Networks of Ontario	12,000
Social media	LinkedIn	12,205
Direct communication	Diabetes Canada professional membership	3,400
	Conference delegate lists	4,000
	Diabetes Canada-CSEM-Vascular	14,500
	American Diabetes Association	3,100
	Primary Care Today	4,000
	Family Medicine Forum	1,500
	Diabetes Canada-CSEM Conference	15,000
	American Diabetes Association	
Guidelines website	Google analytics	1,098,116
Mobile application	App downloads (as of January 25, 2016)	9,390
Continuing professional development		
Lecture series	Attendance records	4,000
Interprofessional workshops	Attendance records	194
Webinar	Attendance records	368
Electronic medical record	College of Physicians and Surgeons of Saskatchewan Public Register	465
Total		1,786,910

CSEM, Canadian Society of Endocrinology and Metabolism; *HCPs*, health-care professionals.

Supplementary Table 8
Reach: Number of lay persons who were aware of the CPGs

Activity	Specific data source	Total number
Indirect communication	Media communications and analysis report	34,877,465
	Online	585,214
	Diabetes Canada print publication	90,000
Direct communication	Mailing list	3,159
Expos	Attendance records	1,945
Webinar	Attendance records	15,371

CPGs, clinical practice guidelines.

Supplementary Table 9
Adoption: Number of collaborating organizations and collaborating activities

| Organization type/name	Activity
Government	
Ministry of Health, Saskatchewan	Integration of the CPGs into electronic medical records provincewide
Government of the Northwest Territories	Individualization and launch of a revised screening policy territorywide for routinized use by public health nurses
Department of Health and Community Services, Newfoundland & Labrador	Implementation of team-based care initiatives
Ministry of Health and Long-Term Care of Ontario	Implementation of team-based care initiatives
Ministry of Health and Long Term Care, Primary Care Networks	Distribution of needs assessment, resources and evaluation survey
Ontario MD	Integration of the CPGs into electronic medical records provincewide (ongoing)
Professional	
Canadian Pharmacists Association	Distribution of needs assessment, resources and evaluation survey
Canadian Nurses Association	Distribution of needs assessment, resources and evaluation survey
Dietitians of Canada	Distribution of needs assessment, resources and evaluation survey
Community Health Nurses	Development of a conference program
Ontario College of Family Physicians	Development of an insulin prescription tool
Saskatchewan Registered Nurses Association	Distribution of guideline resources, development of education program
Health Advocacy	
Canadian Association for Wound Care	Development, review and dissemination of diabetes foot-care tools
Hypertension Canada	Development and review of hypertension and diabetes tools
C-CHANGE	Development and review of hypertension and diabetes tools
Ontario Stroke Network	Development of a vascular health strategy and integration into electronic medical records
Thrombosis Canada	Development and implementation of facilitated quality improvement program
Other	
Diagnostic laboratories	Integration of guideline recommendations into result report

CPGs, clinical practice guidelines.

Supplementary Table 10
Annual budgets for years 2012 to 2015

	2012	2013	2014	2015	Activity totals	Proportion of total budget
Health-care provider needs assessment		$2,109	$83,695	$13,000	$98,804	6.8%
Executive summary		$145,597		$9	$145,606	10.0%
Website and application development and maintenance		$152,829	$135,923	$154,774	$443,526	30.4%
Pocket cards		$15,348	$4,214	$13,305	$32,867	2.3%
Communications (includes conference dissemination)		$71,034	$225,499	$135,258	$431,791	29.6%
Online CME (development, accreditation and deployment)		$27,232	$51,632	$27,856	$106,720	7.3%
Interprofessional workshop (development, accreditation and deployment)		$28	$28,532	$81,353	$109,913	7.5%
Electronic medical records		$793			$793	0.1%
Dissemination committee meetings	$4,203	$44,600	$23,038	$17,598	$89,439	6.1%
Year totals	$4,203	$459,570	$552,533	$443,153	$1,459,459	100.0%

CME, continuing medical education.
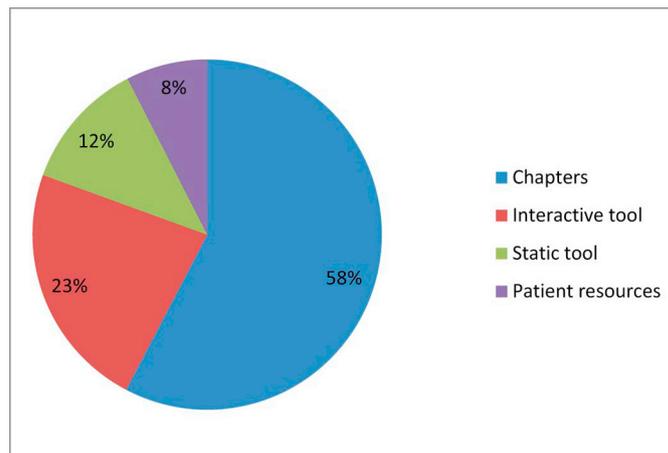
Supplementary Figure 1. Frequency of use for each tool type (as a proportion of total number of visits).

References

1. Canadian Diabetes Association Clinical Practice Guideline Expert Committee. Canadian Diabetes Association 2013 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. Can J Diabetes 2013;37: S1–212.
2. Leiter LA, Berard L, Bowering CK, et al. Type 2 diabetes mellitus management in Canada: Is it improving? Can J Diabetes 2013;37:82–9.
3. Goderis G, Borgermans L, Mathieu C, et al. Barriers and facilitators to evidence-based care of type 2 diabetes patients: Experiences of general practitioners participating in a quality improvement program. Implement Sci 2009;4:41.
4. Raaijmakers LG, Hamers FJ, Martens MK, et al. Perceived facilitators and barriers in diabetes care: A qualitative study among health care professionals in the Netherlands. BMC Fam Pract 2013;14:1.
5. Murray S, Silver I, Patel D, et al. Community group practices in Canada: Are they ready to reform their practice? J Contin Educ Health Profes 2008;28: 73–8.
6. Shojania KG, Ranjii SR, McDonald KM. Effects of quality improvement strategies for type 2 diabetes on glycemic control: A meta-regression analysis. JAMA 2006;296:427–40.
7. Renders CM, Valk GD, Griffin S, et al. Interventions to improve the management of diabetes mellitus in primary care, outpatient and community settings (Cochrane Rev). Cochrane Library 2001;3.
8. Forrest CB, Nutting PA, von Schrader S, et al. Primary care physician specialty referral decision making: Patient, physician, and health care system determinants. Med Decis Mak 2006;26:76–85.
9. Harris S, Yale JF, Dempsey E, Gerstein H. Can family physicians help patients initiate basal insulin therapy successfully? Randomized trial of patient-titrated insulin glargine compared with standard oral therapy: Lessons for family practice from the Canadian INSIGHT trial. Can Fam Phys 2008;54:550–8.
10. Retchin SM. A conceptual framework for interprofessional and co-managed care. Academ Med 2008;83:929–33.
11. Davis DA, Taylor-Vaisey A. Translating guidelines into practice: A systematic review of theoretic concepts, practical experience and research evidence in the adoption of clinical practice guidelines. Can Med Assoc J 1997;157:408–16.
12. Nasmith L, Coté B, Cox J, et al. The challenge of promoting integration: Conceptualization, implementation, and assessment of a pilot care delivery model for patients with type 2 diabetes. Fam Med 2004;36:40.
13. Norris SL, Engelgau MM, Narayan KM. Effectiveness of self-management training in type 2 diabetes: A systematic review of randomized controlled trials. Diabetes Care 2001;24:561–87.