

A Scoping Review of Foot Screening in Adults with Diabetes Mellitus across Canada

Abstract

Introduction: Regular foot screening by a knowledgeable health provider is the cornerstone of ulcer and amputation prevention in people with diabetes. However, information on foot screening practices among Canadians with diabetes remains sparse. We therefore sought to synthesize available data on the frequency and approach to diabetic foot screening across Canada.

Methods: We conducted a scoping review by searching MEDLINE and EMBASE databases, alongside a grey literature search, for both English and French language reports. Data on patient demographics, setting as well as the frequency and approach to foot screening were abstracted. Title and abstract screening, full-text review, and data abstraction were conducted in duplicate, with discrepancies resolved by a third reviewer.

Results: The search yielded 21 reports including information on diabetic foot screening practices in Canada. In a consolidated study sample of 13,388 Canadians with diabetes, 7,277 (53%) reported receiving a foot examination by a healthcare provider at least once in the past year. The majority of the reports did not provide information on the demographics of patients being screened or details on the approach to foot screening. No report mentioned the use of a triage algorithm applied to the results of foot screening.

Conclusion: This review identified limited frequency and uncertain quality of diabetic foot screening across Canada. Further research should focus on better understanding disparities and barriers to regular diabetic foot screening.

Introduction

In 2020, Diabetes Canada reported that over 11 million Canadians live with diabetes or pre-diabetes (1). For many people, a diagnosis of diabetes carries significant psychosocial distress related to new self-care demands and the potential risk of microvascular, macrovascular and other related complications (2). Every day in Canada there are on average 20 deaths attributable to diabetes-related complications (3). There are also 14 lower extremity amputations daily and, for many people with diabetes, limb loss is an outcome feared more than death (3,4). Fortunately, most amputations are preventable with regular foot screening, supported by timely interdisciplinary treatment of diabetic foot ulcers (DFU). Practice guidelines on foot screening applicable to Canada include those published in 2017 by Wounds Canada, in 2018 by Diabetes Canada and in 2019 by the International Working Group of the Diabetic Foot (5-7). In accordance with these guidelines, all individuals with diabetes require at minimum an annual foot screening examination performed by a knowledgeable health care provider. When no acute complications (e.g. wound/ulcer, gangrene or infection) are identified, the interval of follow-up screening should be dictated by risk-stratification based on the presence of: skin and nail changes, previous ulceration or amputation, neuropathy or loss of protective sensation, peripheral artery disease, foot deformities. Regular foot screening should also involve foot care treatments (e.g. callus debridement, nail care), assessment of footwear and patient education.

The 2007 Canadian Community Health Survey diabetes care module highlighted foot screening as a clear diabetes care gap (8). Only half of respondents reported having their feet checked by health care professionals in the previous year. Almost one-third of those surveyed never check their own feet. Furthermore, annual foot screening was less common than HbA1c testing, screening for diabetes kidney disease or screening for retinopathy (8). Despite updated guidelines reinforcing the need for regular foot screening in people with diabetes, and efforts in guideline dissemination, anecdotal evidence suggests that adherence to this recommendation remains suboptimal (9).

Through this review, we sought to synthesize all available data on the frequency and approach to foot screening among Canadians with diabetes. An updated understanding of the current context of diabetic foot screening across Canada is essential to inform future research and clinical practice improvements.

Methods

We conducted a scoping review following the methodological framework suggested by Arksey and O'Malley with additional recommendations from Levac et al (10,11). We used PRISMA-SR checklist for the manuscript and the research protocol has not been published elsewhere (11). We systematically searched the MEDLINE and EMBASE databases from inception until Nov 30, 2020 using a search strategy elaborated with the input of a medical librarian (Appendix – Supplemental Table 1). In addition, we searched relevant online sources by national and provincial governments, government agencies and medical societies for additional data on diabetic foot screening in Canada (Appendix – Supplemental Table 2). Two independent reviewers (JP and AZ) screened the titles and abstracts followed by a full-text screening. All reports including adults with any type of diabetes mellitus who received a foot examination were included in the study (Table 1). French report full-text and grey literature reviews were performed by two alternate independent reviewers (VB and CdeM). Discrepancies were resolved by discussion with a third independent reviewer (MS).

The data abstraction was performed in duplicate by two independent team members (JP and AZ). The data charting form, a Microsoft Excel (Microsoft Corporation) spreadsheet, was co-developed a priori by the authors and included the following elements: publication year, study design, setting (year, national or province/territory, rural or urban), study sample size and the proportion of the sample receiving a foot exam, specified patient characteristics (mean or median age, proportion of male sex, inclusion of indigenous patients, inclusion of dialysis patients), the frequency of foot screening, the provider performing the foot screen, the use of a specific screening tool (e.g. Inlow's 60-second

screening), the use of specific adjuncts to the physical exam (e.g. Ankle-brachial index), whether footwear was checked and, any specific triage or referral plan based on the results of foot screening. No appraisal for quality assessment was planned a priori since this is not a mandatory entity for scoping reviews and since different study designs would be included. Study results were stratified based on foot screening by a healthcare provider, through self-care or unspecified.

Results

Out of the 658 French and English reports retrieved from the database and grey literature searches, 21 included data on diabetic foot screening (12-32, Figure 1). Sixteen (76%) articles provided information from retrospective data and five (24%) articles collected self-reported information from patient surveys. Of the 18 (86%) articles specifying the study period, the data were obtained from 1997 to 2016 (Table 2). Two studies were pan-Canadian with 4 studies reporting data from multiple regions (all ten provinces and Yukon) (12-17), 9 from Ontario (18-26), 3 from Alberta (27-29), 1 from Quebec (31), 1 from Manitoba (30), and 1 from British Columbia (32).

Overall, the characteristics of individuals receiving foot screening were inconsistently reported (Table 2). All studies reported recruiting adults however most studies did not specify the age, sex, or if the patients were receiving dialysis for the patients undergoing foot screening (Table 2). Not all studies identified the type of diabetes for the patients but in studies which did identify, majority patients had type 2 diabetes mellitus. Most studies 14 (67%) specified the setting of recruitment: 4 from urban settings (18-20, 22), 2 from rural settings (28,30), 8 from both urban and rural settings (13-16,21,24,25,27). Two studies included Indigenous people only, however most studies did not report on ethnicity (28,30).

From a consolidated sample of 13,388 people with diabetes, only 7,277 (54%) participants were reported to have undergone a foot examination by any health care provider in the past year. From a larger sample of 21,956 patients with diabetes, 9,602 (44%) people reported having a foot care exam by a

healthcare provider, without a specific timeline mentioned. The proportion of study participants receiving a foot exam annually by a healthcare provider varied by region: 22 to 64% (Table 3).

The approach to screening was poorly characterized and variably reported across studies (Table 2). Eighteen studies specified that foot examination was conducted by either the participants themselves or by a healthcare provider (12-21, 23-26, 28, 30-32). No article reported the use of a specific screening tool. No article reported the use of a triage or referral algorithm applied to the results of foot screening.

Discussion

The current study provides the most up to date picture of diabetic foot screening practices across Canada. Unfortunately, there remains limited data on this topic with two main results to emphasize. First, approximately half of Canadians with diabetes have an annual foot exam by a healthcare professional. Second, the quality of diabetic foot screening across Canada remains uncertain, given sparse information on the approach and extent of foot screening in the identified reports.

Current national and international guidelines recommend at least annual foot screening in patients with diabetes (5-7). The low prevalence of foot screening identified in this scoping review is concerning, and the only available studies with a national sample are surveys which are already over a decade old (12, 13). The current national frequency of annual diabetic foot screening is uncertain and may well be below 50% identified in published studies. More recent regional analyses suggest no major improvement in the frequency of diabetic foot screening (13-14). Given well documented high morbidity and mortality associated with diabetic foot complications, and the role of prevention strategies to reduce those complications: annual foot screening is essential for early identification and risk stratification to deliver targeted prevention strategies. Our study data highlights that even the minimum primary care requirements are not met currently across Canada. There is clearly a need for action to address this gap.

We did not find data suggesting that any province or territory was a national leader with respect to diabetic foot screening. Numerous provinces have promising initiatives, and Alberta has a provincial

Diabetes Foot Care Clinical Pathway, which integrates regular foot care and screening (36). Other provinces such as Nova Scotia and Prince Edward Island also have provincial screening programs and Saskatchewan has published online resources and guidelines regarding diabetic foot screening and treatment (37). However, the majority of Canadians live in provinces and territories (e.g. Ontario and Québec) that lack province-wide diabetic foot screening programs. The lack of such screening programs tailored to regional needs and resources must be addressed in order to help reverse the growing number of diabetes-related amputations (38).

Looking internationally, the prevalence of foot screening in Canada is similar to that reported in Australia: approximately 50% of Australians with diabetes received a foot screen annually (39). However, recent Australian commitment to preventing diabetic foot ulcers and amputations may translate into an increase in diabetic foot screening (40-41). Canada fares worse compared to the United Kingdom and Scotland, where annual diabetic foot screening prevalence is about 70-80% (37). This is likely because diabetic foot care is a priority of the National Health System with commitments to both implementing practice guidelines and monitoring practice (e.g. National Diabetes Foot Care Audit). While Canada has practice guidelines and some government-led screening implementation efforts as previously described, our review clearly demonstrates a lack of current performance auditing. Any effort to increase diabetic foot screening must be coupled with measurement of foot screening frequency as well as ulcer prevalence and amputation rates (42). It also warrants mention that performance auditing should not be focused on the minimum necessary for low-risk patients (i.e. annual screening). High-risk patients require close monitoring and may struggle with sustained high-intensity follow-up due to financial barriers, comorbidity and social marginalization. Additionally, McGill and L Molyneux show a 55% reduction in relative risk from assessment and care by podiatrists, emphasizing the need for interdisciplinary care of patients with diabetes. The recently launched Diabetes Action Canada's National Diabetes Repository can hopefully act as a critical tool for performance auditing moving forward.

We conducted a thorough search including journal databases as well as national and provincial health agencies and organizations. However, the review has certain limitations. First, the results reflect data we were able to identify and therefore may not reflect the actual proportion of Canadians with diabetes receiving regular foot screening. Second, it is likely more data exists that have not been published or are not publicly available such as government analysis, examinations by nurse practitioners or healthcare providers. Despite these limitations, our study clearly highlights the need for more extensive understanding of foot screening practices across Canada. Future research studies or regional practice audits should capture the characteristics of patients receiving foot screening, the frequency of screening, the provider performing the screening, details of the approach to foot examination and the use of standardized objective assessment tools including monofilament test and ankle-brachial index.

In conclusion, this review identified limited frequency and uncertain quality of diabetic foot screening across Canada. Foot screening implementation is needed nationwide, and further research should focus on better understanding the disparities and barriers to regular diabetic foot screening.

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This study has not received any funding.

Author Contributions

All authors meet the 4 criteria for authorship as outlined by the International Committee of Medical Journal Editors (ICMJE).

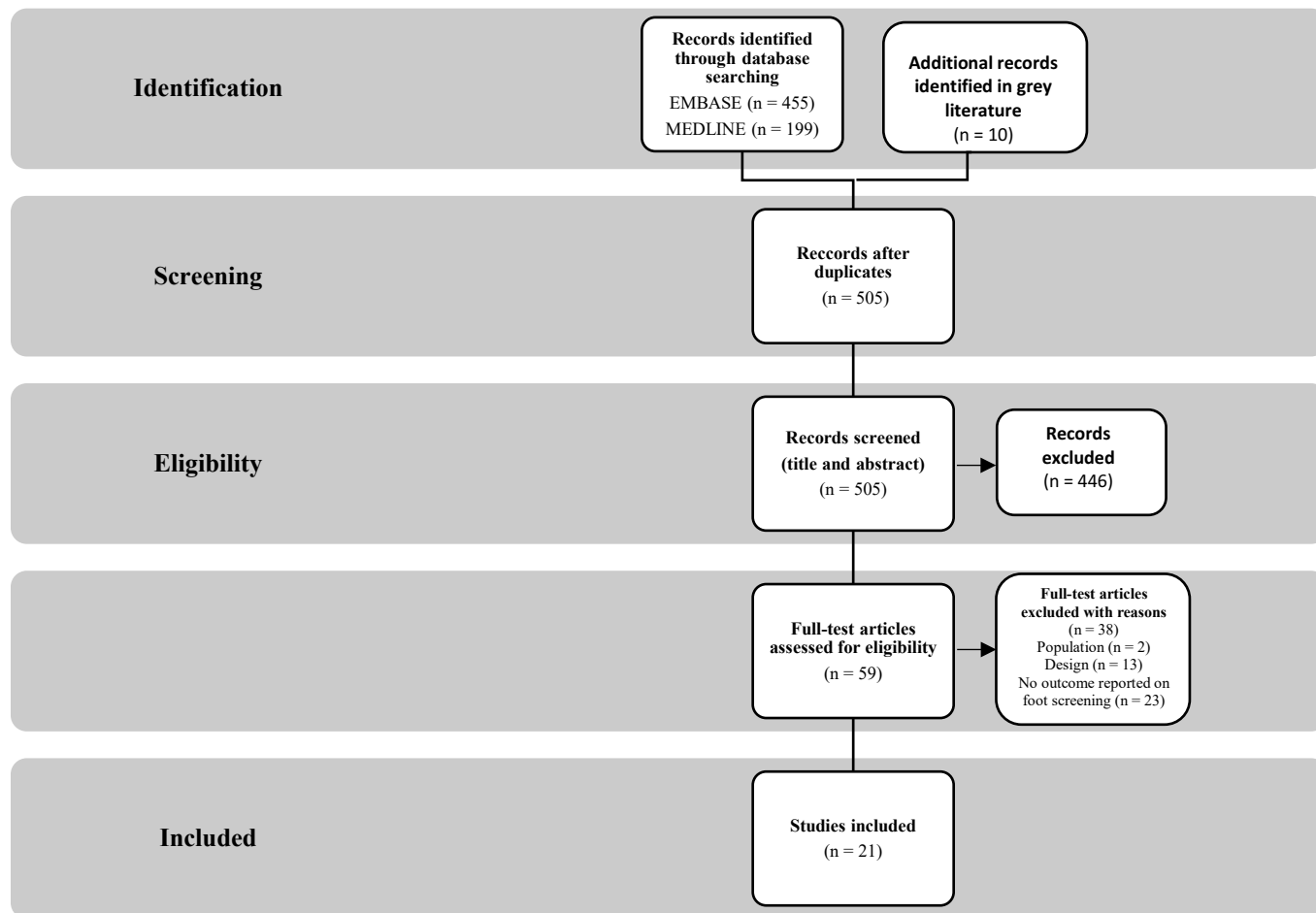


Figure 1: PRISMA flow diagram

Table 1. Study Inclusion and Exclusion Criteria for MEDLINE and EMBASE searches

Criteria	Inclusions	Exclusions
Publication year, journal and language	Any year since database inception, any indexed journal and any articles in English and French	Retracted publications
Study Subjects	Adults (at least 18 years old) with Type 1 or 2 Diabetes Mellitus	Non-human
Study setting	Any Canadian Province or Territory	
Study design	Any retrospective observational study, prospective observational study, experimental study or survey	Reviews or guidelines
Interventions discussed in article	Diabetic foot screening (frequency, approach and delivery)	Diabetic foot ulcer treatment approaches or teams without mention of foot screening

Table 2. Foot screening practices information obtained from all the studies included in the scoping review

Reference	Setting			Sample Size		Patient Characteristics			Foot Screening Details		
	Province or Territory	Urban or rural	Years	No. eligible for foot screening	No. (%) who had foot screening	No. Male Sex	Age	Does the intervention sample include indigenous patients?	Minimum frequency of foot screen	Who performed foot screen?	Use of adjuncts to physical exam
12	Canada	NS	2007	3769	1922 (51%)	NS	NS	NS	Annually	HCP	NS
13	All provinces	Both	2010-2011	2335	1086 (47%)	NS	NS	NS	Annually	HCP	NS
14	BC, AB, MB, ON, QC, NF	Both	2013-2015	2008	219 (11%)	NS	NS	Yes	NS	HCP	NS
15	NF, PEI, NB, ON, MB, YK	Both	2005	3924	1883 (48%)	923	NS	NS	Annually	HCP	NS
16	NF, QC, ON, AB	Both	1998-1999	435	112 (26%)	NS	NS	NS	Annually	HCP	NS
17	AB, NS, ON	NS	NS	500	282 (56%)	NS	NS	NS	Annually	HCP	NS
18	ON	Urban	2015-2016	833	691 (83%)	NS	NS	NS	Annually	HCP	NS
19	ON	Urban	2006	431	49 (11%)	NS	NS	NS	NS	HCP	NS
20	ON	Urban	2004-2005	417	371 (89%)	NS	NS	NS	NS	HCP	NS
21	ON	Both	1997-1999	331	49 (15%)	NS	NS	NS	Annually	HCP	NS
22	ON	Urban	NS	54	41 (76%)	45	NS	NS	Weekly	Self	NS
23	ON	NS	2009-2014	284	135 (48%)	NS	NS	NS	NS	HCP	NS
24	ON	Both	2008-2010	403	100 (25%)	NS	NS	NS	NS	HCP	NS
25	ON	Both	NS	998	341(34%)	NS	NS	NS	NS	HCP	Monofilament
26	ON	NS	2006-2011	1969	315 (16%)	NS	NS	NS	NS	HCP	NS
27	AB	Both	2011-2013	2040	1834 (90%)	1026	NS	NS	HCP-annually, Self-weekly	Both:	NS
28	AB	Rural	2003	743	156 (21%)	NS	NS	Yes	NS	HCP	NS

29	AB	NS	NS	2080	1019 (49%)	NS	NS	NS	HCP- annually, Self- weekly	Both	NS
30	MB	Rural	2003	140	31 (22%)	NS	NS	Yes	NS	HCP	NS
31	QC	NS	2008-2009	1175	608 (52%)	NS	NS	NS	NS	HCP	NS
32	BC	NS	2012	2458	1357 (55%)	NS	NS	NS	Annually	HCP	NS

NS = Not Specified, HCP = Healthcare provider

Table 3. Proportions of people undergoing a foot exam across regions of Canada			
Region	Foot exam by healthcare provider in the past year (% , reference)	Foot exam by healthcare provider, no specified timeframe (% , reference)	Foot exam by self, weekly (% , reference)
Canada	51% (12)		-
All ten provinces	47% (13)		-
Six provinces (British Columbia, Alberta, Manitoba, Ontario, Quebec, Newfoundland and Labrador)	-	11% (14)	-
Newfoundland and Labrador, Prince Edward Island, New Brunswick, Ontario, Manitoba and Yukon Territory	48% (15)	-	-
Newfoundland and Labrador, Quebec, Ontario and Alberta	26% (16)	-	-
Alberta, Nova Scotia and Ontario	56% (17)	-	-
Ontario	64% (18,21)	29% (19,20,23-26)	76% (22,27)
Alberta	-	44% (27-29)	19% (27,29)
Manitoba	-	22% (30)	-
Quebec	-	52% (31)	-
British Columbia	55% (32)	-	-

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Appendix

Supplemental Table 1- Search Strategy for MEDLINE and EMBASE databases

Sr. No.	Search Terms
#1	Diabetes Mellitus.mp. or exp Diabetes Mellitus/
#2	Diabetic Foot.mp. or exp Diabetic Foot/ or Foot/ or foot.mp. or feet.mp.
#3	(canad* or british columbia or alberta* or saskatchewan or manitoba* or ontario or quebec or (new brunswick not new jersey) or nouveau brunswick or nova scotia or nouvelle ecosse or prince edward island or newfoundland or labrador or nunavut or nwt or northwest territories or yukon or nunavik or inuvialuit).mp,jw,nw. or (Abbotsford or Airdrie or Ajax or Aurora or Barrie or Belleville or Blainville or Brampton or Brantford or Brossard or Burlington or Burnaby or Caledon or Calgary or Cape Breton or Chatham Kent or Chilliwack or Clarington or Coquitlam or Drummondville or Edmonton or Fredericton or Fort McMurray or Gatineau or Granby or Grande Prairie or Sudbury or Guelph or Halton Hills or Iqaluit or Inuvik or Kamloops or Kawartha Lakes or Kelowna or Kingston or Kitchener or Langley or Laval or Lethbridge or Levis or Longueuil or Maple Ridge or Markham or Medicine Hat or Milton or Mirabel or Mississauga or Moncton or Montreal or Nanaimo or New Westminster or Newmarket or Niagara Falls or Norfolk County or North Bay or North Vancouver or North Vancouver or Oakville or Oshawa or Ottawa or Peterborough or Pickering or Port Coquitlam or Prince George or Quebec City or Red Deer or Regina or Repentigny or Richmond or Richmond Hill or Saanich or Saguenay or Saint John or Saint-Hyacinthe or Saint-Jean-sur-Richelieu or Saint-Jerome or Sarnia or Saskatoon or Sault Ste Marie or Sherbrooke or St Albert or St Catharines or St John's or Strathcona County or Surrey or Terrebonne or Thunder Bay or Toronto or Trois-Rivieres or Vancouver or Vaughan or ((Cambridge or (Halifax or Hamilton or London or Victoria or Waterloo or Welland or Whitby or Windsor)) not (UK or Britain or United Kingdom or England or Australia)) or Whitehorse or Winnipeg or Wood Buffalo or Yellowknife).ti,ab,kw.
#4	1 and 2 and 3

Supplemental Table 2 - National and provincial websites.

Organisations	Internet address
National	
Government of Canada Publications	http://publications.gc.ca/site/eng/home.html
Statistics Canada	https://www.statcan.gc.ca/eng/start
Canadian Institute for Health Information	https://www.cihi.ca/en
Public Health Agency of Canada	https://www.canada.ca/en/public-health.html
Canadian Agency for Drugs and Technologies in Health	https://www.cadth.ca/about-cadth/what-we-do/products-services/hta
Diabetes Canada	https://www.diabetes.ca/
Wounds Canada	https://www.woundscanada.ca/
French Publications (Réseau SantéCom)	https://catalogue.santecom.qc.ca
Provincial	
British Columbia	https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/public-health-links http://www.phsa.ca/ https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/partners/health-authorities/bc-health-technology-assessment
Alberta	https://www.alberta.ca/health.aspx https://www.albertahealthservices.ca/default.aspx https://www.alberta.ca/health-evidence-reviews.aspx#toc-0
Saskatchewan	https://www.saskatchewan.ca/government/government-structure/ministries/health https://www.saskhealthauthority.ca/
Manitoba	https://www.gov.mb.ca/health/ https://www.gov.mb.ca/health/publichealth/surveillance/reports.html https://www.ices.on.ca/
Ontario	http://www.health.gov.on.ca/en/ https://www.publichealthontario.ca/ https://www.hqontario.ca/ https://www.hqontario.ca/Evidence-to-Improve-Care/Health-Technology-Assessment
Quebec	https://www.msss.gouv.qc.ca/ https://www.inspq.qc.ca/

	https://www.csbe.gouv.qc.ca/accueil.html https://www.inesss.qc.ca/en/home.html
Newfoundland and Labrador	https://www.gov.nl.ca/hcs/
New Brunswick	https://www2.gnb.ca/content/gnb/en/departments/health.html https://www2.gnb.ca/content/gnb/en/departments/ocmoh.html
Nova Scotia	https://novascotia.ca/dhw/ https://novascotia.ca/dhw/publichealth/ https://www.cdha.nshealth.ca/diabetes-care-program-nova-scotia/foot-care
Nunavut	https://www.gov.nu.ca/health
Northwest Territories	https://www.gov.nt.ca