Clinical Resources for Diabetic Foot Health: Applying the Wounds Canada Foot Health Pathway in Newfoundland and Labrador

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Abstract

Background: Newfoundland and Labrador (NL) has one of the highest incidences of diabetes and diabetes-related lower-limb amputations (LLAs) in the country, which has long-term implications for patients, families, health care providers (HCPs) and health systems. Despite the widespread prevalence of LLAs in NL, an organizational-level approach to address diabetic foot management is lacking. The aim of this practicum project was to develop a comprehensive clinical resource for HCPs to reduce diabetic foot complications and improve outcomes for patients living with diabetes in NL. **Methods:** Integrated literature review, consultations with key informants, environmental scan to determine existing resources, and development of a joint clinical resource for diabetic foot health. **Results:** The literature supported that diabetic foot ulceration (DFU) and LLA is a problem with negative implications for patients, HCPs and health systems and provided evidence in support of clinical pathways (CPWs) as an organizational level strategy to address DFU. The environmental scan illuminated the widespread availability of CPWs in jurisdictions outside of NL and highlighted the usefulness of the CPW developed by Wounds Canada in directing the provision of care. The consultation phase shed light on the complexity of diabetic foot management and allowed for the identification of specific needs of HCPs within a local context. Cumulatively, these findings informed the development of a clinical resource for the diabetic foot that aligns with evidence-based practice and the local needs of providers. An infographic was developed for local HCPs to support the application of the Wounds Canada (2022) Foot Health Pathway for People Living with Diabetes. The Wounds Canada CPW is designed to assist HCPs to systematically prevent, screen, detect, and treat diabetic foot concerns

based on assessment of risk. A custom button was also developed as a secondary strategy to improve foot screening on an individual-level. **Conclusion:** A joint organizational and individual level strategy consisting of an infographic tailored to the local context of NL and a custom button for providers may be effective in assisting HCPs with application of the Wounds Canada CPW and in turn, improve diabetes outcomes in the NL.

*Key terms***:** Diabetes, diabetic foot ulcers, lower-limb amputations, care pathway, health care provider, management, organizational-level, individual-level, quality improvement, infographic, button.

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I began the Master of Nursing program when my oldest son was a month old. Five years later and I am now a mother of two boys, Derrick (age 5) and Teddy (age 2). Balancing the demands of parenting with the demands of school and full-time work has not been easy, especially during the pandemic. I recognize that achieving this milestone would not have been possible without the love and support of so many important people in my life.

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Global projections from the International Diabetes Federation (IDF, 2022) indicate that 1 in 10 adults live with a diagnosis of diabetes and an even greater proportion of affected adults remain undiagnosed. On a provincial level, Newfoundland and Labrador (NL) has one of the highest incidences of diabetes in the country with an estimated prevalence of 34% for diabetes and prediabetes combined (Diabetes Canada, 2021; Lukewich et al., 2020). To reduce the burden of the disease, prominent health agencies endorse the widespread implementation of strategies and resources to strengthen diabetes management (Diabetes Canada, 2021; IDF, 2021; World Health Organization [WHO], 2020). Despite the call to action, diabetes remains a leading cause of blindness, heart disease, stroke, renal failure, lower-limb ischemia, and death (IDF, 2022; WHO, 2020). Diabetic foot ulceration (DFU) in particular is one complication of poorly controlled diabetes that has far-reaching implications for patients, families, health care providers (HCPs), and health systems. Diabetes Canada (n.d.) estimates that approximately 70% of non-traumatic lower limb amputations (LLAs) performed in Canada are related to complications from diabetes. Currently, NL has one of the highest incidences of LLAs in the country with an estimated 37.9 amputations per 100,000 individuals (Imam et al., 2017). Despite the widespread prevalence of diabetes and LLAs in NL, a standardized approach to addressing diabetic foot concerns is lacking (Diabetes Canada, 2020).

While many interventions are needed to reduce the burden of diabetes and diabetes complications within the province, the purpose of this practicum project was to develop a comprehensive clinical resource to support providers in the provision of diabetic foot care. Prior to clinical resource development, several preliminary steps were completed to understand the problem and contributing factors associated with DFU, identify effective solutions to address the problem, and determine content and mode of delivery for the clinical resources developed. The

specific research methods that were used during the practicum included a literature review, environmental scan, and consultations. The findings of these methods informed the development of joint organizational and individual-level strategies for the diabetic foot that aligns with evidence-based practice and local needs of HCPs. The joint organizational and individual-level strategy that was developed consists of an infographic to support the application of the Wounds Canada (2022) Foot Health Clinical Pathway (CPW) and a custom button to encourage dialogue between patients and providers and enhance foot screening. A copy of these clinical resources are included in Appendix B. CPWs are approaches to care that facilitate the systematic management of a clinical condition by providing standardized guidance and evidence-based provisions to support clinical decision-making (Centre for Policy on Ageing, 2014; Lawal et al., 2019; Meza-Torres et al., 2021). The CPW developed by Wounds Canada (2022) was designed to assist providers to systematically prevent, screen, detect, and treat diabetic foot concerns based on risk for complications. Once implemented, it is hoped that these resources will improve uptake of the CPW by local providers and in turn, improve outcomes for patients with diabetic foot concerns.

In this practicum report, an overview of the practicum project goals and objectives, research methods, and findings are presented. Cumulatively, the findings of the literature review, environmental scan and consultations informed the development of two complementary clinical resources to support providers with the application of the Wounds Canada (2022) Foot Health Pathway for People Living with Diabetes. A copy of the Wounds Canada Foot Health Pathway is depicted in Appendix A. A summary of the joint organizational and individual level strategy is presented in this report followed by an overview of the plan for implementation and evaluation of the clinical resources. To conclude the report, a reflection of lessons learned throughout the

practicum process and a discussion of Advanced Nursing Practice (ANP) competencies is presented.

Background and Overview

Diabetes mellitus is a complex chronic condition with widespread prevalence and impacts worldwide. Living with DFU and LLA greatly impacts all aspects of a person's physical, psychological, and social wellbeing, as well as impacts their families and caregivers. A well-conducted qualitative study by Crocker et al. (2021) in the United States described the immense burden placed on family members and caregivers of patients with DFU in relation to coordinating appointments, arranging transportation and attending to patients' ever-increasing care needs. Participants in this phenomenological study perceived the role reversal and shifting of responsibilities that occurred as a result of DFU and LLA to be a considerable family adjustment. According to Crocker et al. (2021), the complexity associated with DFU management is a source of emotional and physical stress for families and caregivers.

Local contributing factors unique to NL also play a leading role in the progression of diabetes and diabetes-related complications across the province. According to a high-quality cross-sectional study by Lukewich et al. (2020), only half of the people living with diabetes in NL were achieving glycemic targets of Hemoglobin A1C less than or equal to seven percent with diabetes more prevalent in rural regions of the province compared to urban regions (Lukewich et al., 2020). Glycemic control was particularly poor in these rural regions with a mean Hemoglobin A1C value of 7.41% (SD 1.49) compared to 7.26% (SD 1.50) in urban regions (Lukewich et al., 2020). The aging demographic of the population also poses distinctive challenges for proper self-management, given that the incidence of diabetes and comorbid complications increase with age (Diabetes Canada, 2018; Lukewich et al., 2020; Qin et al.,

2020). According to Statistics Canada (2022), the proportion of the population of NL aged 65 years and older was 23.6% in 2021 with a percentage point change of +4.2 from 2016 to 2021. The combined effect of poor glycemic control, rural disposition, limited access to services, low support, rising cost of supplies, and advanced age may greatly impede self-management for patients.

Detailed data collection and analysis of the literature, environmental scan results, and consultations revealed a gap in organizational-level strategies to address diabetic foot management and a need for a clinical resource to assist local providers in the provision of diabetic foot care. It was clear from these findings that the management of diabetes and diabetic foot complications is complex and influenced by a multitude of patient, provider, and health system factors and the relationships among them. Given the extensive occurrence and profound impact of diabetes and DFU within the province, reducing diabetic foot complications and improving patient, provider, and health system outcomes must be prioritized. Thus, an organizational and individual-level strategy tailored to the local needs of providers is presented in this practicum report as a means to address the problem.

Goals and Objectives

The overall goal of the practicum was to develop a comprehensive clinical resource to reduce diabetic foot complications and improve outcomes for patients living with diabetes in NL. The key practicum objectives included:

1. Describe the impact of diabetes on foot health.
2. Describe existing evidence related to interventions to be used by healthcare providers that support foot health management for patients with diabetes by conducting an integrative review of the literature.

3. Describe the extent of the available resources for diabetic foot care by conducting an environmental scan and engaging in consultations with key stakeholders to determine what resources exists and where improvements can be made.
4. Identify the needs of healthcare providers in Eastern Health in relation to diabetes and foot health management.
5. Identify barriers and drivers to optimizing diabetic foot care through a review of the literature and consultations with key stakeholders from inpatient and outpatient settings.
6. Develop a resource for health care providers to facilitate systematic diabetic foot care across inpatient and outpatient settings. This resource may be a clinical pathway, a portion of a clinical pathway, or a resource to support a clinical pathway.
7. Demonstrate advanced nursing practice core competencies throughout the practicum.

Theoretical Underpinnings

The Donabedian Model of Quality of Care (1997) and Knowles Theory of Andragogy (1984) provided the theoretical foundation for the practicum project activities and subsequent clinical resource development. Together, these theoretical models provided conceptual direction for the literature review, environmental scan, and consultations, while also informing the design, content and mode of delivery of the organizational and individual-level strategy developed.

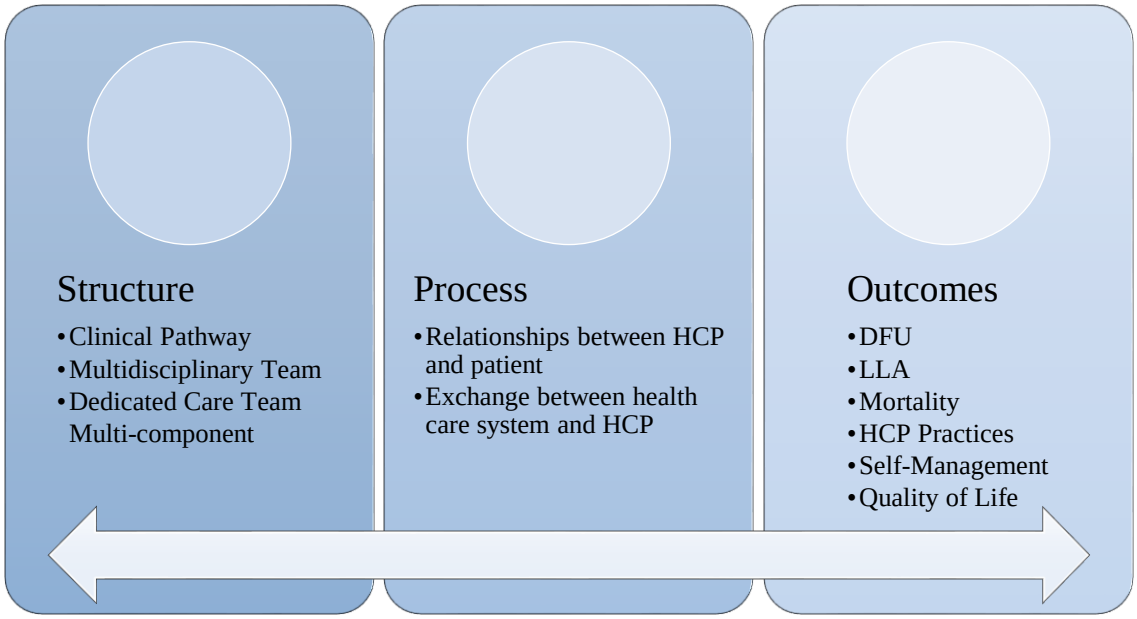
According to the Donabedian model, the assessment of quality of care encompasses three dimensions: structure, process, and outcome; where *structure* refers to the organizational or health system resources and facilities, *process* refers to the care that is provided and received in the exchange between patient, provider, and system, and *outcome* refers to the effects of the care on the patient, provider, and the system (Donabedian, 1997; Harrison & Graham, 2021). Based on this notion, implementing changes at the structure level to address diabetic foot health is

thought to produce changes at the process and outcome level to mitigate the impact of DFU as depicted in Figure 1 below (Donabedian, 1997; Harrison & Graham, 2021).

Knowles Theory of Andragogy (1984) provided the conceptual direction needed to ensure clinical resource development remained consistent with needs of adult learners. The Theory of Andragogy considers six assumptions related to the adult learner: self-concept, experience, readiness to learn, orientation to learning, motivation to learn, and need to know. Given that the target audience is likely to have previous experience with managing diabetes and diabetes-related foot concerns, it is conceivable that they will be receptive to expanding their knowledge on the topic to enhance their understanding and improve the level of care their patients receive. Likewise, Knowles' theory emphasizes that adults are most interested in learning when it is problem-centered and has immediate relevance and impact to their careers and day-to-day lives. Given the substantial burden of diabetes and diabetes related complications across the province, it is highly likely that the target audience will be motivated to utilize a clinical resource that was developed with a purpose of improving diabetes-related outcomes (Knowles et al., 2015). While the target audience encompasses primary HCPs such as family physicians, nurse practitioners, registered nurses, nurse educators, endocrinologists and internal medicine specialists from varied backgrounds and experiences, all providers share a common goal of promoting health and wellness among their patients. Taking both these theories into consideration, an infographic and accompanying button was selected as promising organizational-level and individual-level strategies to address diabetic foot management among local primary HCPs.

Figure 1

Donabedian Model of Care for the Diabetic Foot



Overview of Methods and Results

In order to develop a comprehensive clinical resource that was based on the best available evidence and representative of the needs of providers on a local level, data was collected using three distinct methods: a literature review, environmental scan, and consultations with key stakeholders. While each method was conducted in sequence, the process was iterative with multiple drafts completed for each component. Each of the components provided valuable information related to issues to address and content to include that was considered essential to the development of the resource. In total, four drafts of the literature review, two drafts of the consultation report, and two drafts of the environmental scan report were completed. The integrated review of the literature provided moderate evidence in support of CPWs and multidisciplinary teams (MDTs) as an organizational-level strategy to address DFU. The environmental scan illuminated the widespread availability of CPWs and MDTs in jurisdictions

outside of NL, while drawing attention to the lack of organizational-level approaches within the province. The consultations shed light on the complexity of diabetic foot management and allowed for the identification of specific needs of HCPs within a local context. A summary of the results of each method is presented below.

Summary of Literature Review

An integrative review of the literature was conducted to elicit a deeper understanding of the problem of DFU as well as to identify the solutions available to address the problem (see Appendix C). A broad search of the databases CINAHL, PubMed, Cochrane Library, and Google Scholar was conducted to gain insight into the occurrence and impact of DFUs and the contributing factors associated with its onset and management. Key questions used to guide the review were:

1. What is the occurrence of DFUs?
2. What are the contributing factors associated with DFUs?
3. What is the effectiveness of organizational-level strategies that address diabetic foot health?

Titles and abstracts of the articles retrieved were reviewed to determine relevance to the key questions and inclusion criteria. The reference lists of applicable articles were also reviewed as a secondary search strategy. The Public Health Agency of Canada's (PHAC, 2014) critical appraisal toolkit was used to guide the critical analysis of the quantitative articles selected, while the Critical Appraisal Skills Programme (CASP, 2018) qualitative checklist was used to guide the critique of the qualitative literature. The Donabedian Model (1997) and Knowles (1984) Theory of Adult Learning provided the conceptual direction for this paper and assisted with the interpretation of the evidence. Inclusion in the review was limited to English-language peer-

reviewed journal articles published within the last five years. Following an in-depth screening of the full-text versions of relevant articles, a total of five studies describing organizational-level strategies for HCPs to address DFUs were selected (Chan et al., 2020; Meza-Torres et al., 2021; Mullan et al., 2021; Musuuza et al., 2020; Thanh et al., 2020). A high-quality systematic review and meta-analysis of 57 descriptive and analytic studies from all over the world formed the basis of the evidence included in the integrated review (Meza-Torres et al., 2021). The remaining studies included in this paper consisted of a systematic review (Musuuza et al., 2020), two cross-sectional (Chan et al., 2020; Thanh et al., 2020), and one qualitative (Mullan et al., 2021) study.

The systematic review and meta-analysis conducted by Meza-Torres et al. (2021) was high-quality and methodologically sound. Over half (n=30) of the studies were descriptive in nature and utilized weak designs such as cross-sectional and retrospective cohort designs. Critical appraisal of the remaining four studies included in the integrative review revealed limited high-quality evidence produced in the years since the systematic review by Meza-Torres et al. (2021) was published. Apart from one other high-quality systematic review (Musuuza et al., 2020), the remainder of the studies (Chan et al., 2020; Thanh et al., 2020) included in the literature review utilized weak cross-sectional designs and yielded medium quality evidence. The systematic review by Musuuza et al. (2020) of 33 descriptive and analytic studies provided evidence to support the effectiveness of the MDT approach. Consistent with Meza-Torres et al. (2021), studies included in this review were predominantly descriptive with the majority of studies utilizing cross-sectional and cohort designs. Methodological shortcomings in the remaining cross-sectional studies by Chan et al. (2020) and Thanh et al. (2020) included low response rate, convenience sampling, inadequate control of confounding variables, and selection

bias. The phenomenological qualitative study by Mullan et al. (2021) was methodologically sound, strengthened by detailed thematic analysis and inductive process methodology.

The integrative review of the literature revealed four prominent organizational care processes to address DFU, including dedicated care teams (DCTs), CPWs, MDTs and approaches that combine CPWs and MDTs. A critical analysis of the studies using the PHAC (2014) and CASP (2018) criteria demonstrated moderate evidence to support the effectiveness of CPWs and MDTs in reducing LLAs in patients with DFU yet inconclusive and contradictory evidence to support the effectiveness of multi-component interventions, and insufficient evidence to support the effectiveness of DCT interventions. Information obtained from this review was used to direct the environmental scan and consultation phase of the project and inform the development of a joint organizational and individual-level strategy to assist HCPs with application of the Wounds Canada (2022) CPW for the diabetic foot. Evidence from the literature related to these four approaches is summarized in the paragraphs below.

DCTs have been identified in the literature as a strategy to strengthen diabetic foot services. The effectiveness of DCTs was examined in two studies: one uncontrolled before-after (UCBA) study (Spanos et al., 2017) and one cross-sectional study (Chan et al., 2020) conducted. The systematic review and meta-analysis conducted by Meza-Torres et al. (2021) provided evidence of only one study (Spanos et al., 2017) that utilized this approach with positive results. Given the paucity of literature, there was insufficient evidence to support the effectiveness of DCTs in DFU management. Although the DCT approach seemed to be a promising organizational-level strategy for the management of diabetic foot care, a conclusion could not be drawn about its effectiveness in mitigating DFU based on the available evidence. Given the limited number of studies and their methodological limitations, further research using rigourous

well-conducted longitudinal study designs is needed to substantiate a claim that DCTs are effective in mitigating DFU and LLA.

CPWs have been gaining momentum in the literature as effective tools to promote the uptake of best practice recommendations across health care institutions (Lawal et al., 2019). Twenty of the 57 studies included in the systematic review (Meza-Torres et al., 2021) focused specifically on CPWs, while an additional 21 studies described the combined impact of CPWs and other organizational-level approaches. Despite the abundance of literature on CPWs, there was variability in the composition and focus of the pathways, quality of the studies, and in the consistency of the results. CPWs also differed in multidisciplinary involvement as well as in the level of provider contact, duration, and length of the intervention. Of the 18 studies included in the systematic review in favour of the CPW approach, half (n=9) yielded strong evidence and half (n=9) yielded low to moderate evidence in support of the effectiveness of CPWs in the reduction of DFU and LLA. Despite the lack of strong study designs, there was sufficient evidence from studies included in the systematic review to support the effectiveness of CPWs in reducing LLA. While rigorous study designs were lacking, there was moderate evidence from medium and high quality NRCTs (n=1), UCBAs, (n=2), cohorts (n=6), and cross-sectional (n=9) studies in the systematic review (Meza-Torres et al., 2021) to illustrate the effectiveness of CPWs in reducing LLA. In addition, qualitative findings from the study by Mullan et al. (2021) illuminated the perspectives of key stakeholders regarding the need for CPWs to enhance diabetic foot care delivery and communication among HCPs.

Despite the growing body of evidence to support the effectiveness of CPWs, further research using robust study designs such as NRCTs and RCTs is needed to strengthen the existing evidence base and determine the most effective attributes to include within a CPW to

optimize diabetic foot health. Nonetheless, CPWs are a promising intervention to target diabetic foot health. As complications of diabetes develop over time, future research priorities should include longitudinal trend analyses to determine the effectiveness of CPW in preventing DFU and LLA in the long term.

The implementation of MDTs is a popular organizational-level strategy identified in the literature to improve diabetic foot health, however there was remarkable heterogeneity in MDT composition, function, contact time and level of involvement between studies. Consistent with the CPW approach, studies examining the effectiveness of MDTs involved predominantly weak and moderate study designs and yielded medium to high quality evidence. Nonetheless, there was sufficient evidence from two high quality systematic reviews (Meza-Torres et al., 2021; Musuuza et al., 2020) to support the effectiveness of the MDT approach in the reduction of LLA. All 15 relevant studies included in the systematic review by Meza-Torres et al. (2021) and 31 of the 33 studies included in the systematic review by Musuuza et al. (2020) showed improvements in LLA following implementation of MDTs. Despite the favourable results, both systematic reviews reported considerable heterogeneity in the composition and function of the MDTs examined. While the majority of studies included both medical and surgical specialty representatives, there were variations in patient contact time, follow-up, level of coordinated care, and setting. Although there was sufficient evidence from the literature to support the effectiveness of MDTs in reducing DFU-related amputation, stronger study designs such as NRCTs and RCTs are needed.

Multi-component interventions involving the joint implementation of CPWs and MDTs are on the rise. Twenty-one of the 57 studies included in the systematic review by Meza-Torres et al. (2021) focused on the effectiveness of combined interventions and four of those studies met

criteria for inclusion in the meta-analysis. The systematic review and meta-analysis by Meza-Torres et al. (2014) provided evidence from predominantly weak (n=9 cross-sectional) and moderate (n=6 cohort, and n=1 UCBA) design studies of medium and high quality to support the effectiveness of multi-component interventions in reducing LLA. Although four systematic reviews and one RCT contributed to this body of literature, inconclusive (n=5) and contradictory evidence (n=2) from these systematic reviews and additional cross-sectional studies impeded the strength of the evidence. While the longitudinal nature of the four studies included in the meta-analysis provided insight into trends in LLA incidence and prevalence overtime, strong study designs with more robust control of confounding and longer follow-up periods are needed to gain a true sense of the effects of the intervention on diabetic foot outcomes. Given the considerable variability in strength of the evidence and in the consistency of the results, further research is needed to determine the effectiveness of the combined MDT and CPW approach in diabetic foot management.

Summary of Environmental Scan

An environmental scan was performed to elicit existing knowledge from established internal and external databases and published guidelines to gain insight into the management of diabetic foot complications on a provincial and national scale (see Appendix D). The specific objectives for the environmental scan were:

1. Determine the extent of the available clinical resources used by providers to direct management of the diabetic foot within the four regional health authorities (RHAs) in NL.
2. Determine the extent of the available clinical resources for diabetic foot management used by providers across Canada.

3. Identify tools recommended by leading national and international professional associations to assist providers with diabetic foot management.

Sources of information for the environmental scan included provincial, national, and international clinical resources for diabetic foot management. On a provincial level, clinical practice guidelines (CPGs) and policies for diabetic foot management were obtained from four of the RHAs within the province through review of publicly accessible websites and internal databases. On a national level, sources of information were restricted to the provinces of Alberta (AB), British Columbia (BC), New Brunswick (NB), Nova Scotia (NS) and Ontario (ON) to ensure the amount of information in the environmental scan was manageable for analysis. On an international level, clinical resources published by leading national and international associations were reviewed for relevancy to the key questions including Diabetes Canada (2018), Wounds Canada (2022), International Working Group on the Diabetic Foot (IWGDF, 2019), and the National Institute for Health and Care Excellence (NICE, 2022).

Data for the environmental scan was collected primarily through review of professional organization websites and published guidelines. For the purpose of the environmental scan, clinical resource referred to any resource or tool specifically targeted toward HCPs to aid in the management of diabetic foot concerns. To ensure consistency, standard questions were applied to the review process and emphasis was placed on identifying CPWs and MDTs. Other examples of clinical resources included DCTs, care maps, and decision support tools. Only tools with a specific focus on diabetic foot health were included in the environmental scan. All data were managed and analyzed by me through use of an Excel spreadsheet. Descriptive analysis involved organizing meanings found in the data, identifying patterns between sources, and establishing themes (Sundler et al., 2019). Two tables depicting key results were included in the Appendix of

the environmental scan with content categorized according to RHA and province. All data were stored on a password protected personal computer accessed only by me in a locked office space.

An extensive review of the diabetes services in the province of NL revealed a lack of clinical resources to guide HCPs in the provision of diabetic foot care. Despite recommendations from Diabetes Canada (2019, 2022) to adopt a provincial diabetes strategy, services for patients with diabetes in the province remained especially limited. While a variety of services were offered for patients with diabetes at the Diabetes Centre located in St. John's, a broad review of policies and procedures available on the EH intranet website provided no evidence of formal pathways or foot care teams dedicated to the diabetic foot. Although not specific to the diabetic foot, EH offered a specialized wound care clinic comprised of wound care experts from disciplines of nursing, dermatology, plastics, and orthopedic specialties. A major limitation of that service, however, was that it was only accessible to patients via consultation from a physician or an NP.

A review of the available resources within CH, WH, and LGH proved that organizational-level strategies within these regions were also limited. CH offered a diabetes management program that involved the targeted assessment, screening, referral and treatment of patients with diabetes as well as the facilitation of supportive education to improve self-management, but services varied according to site (Central Health, n.d.). CH also offered free foot care clinics for patients with diabetes, whereby RNs performed comprehensive foot assessments and provided tailored education to patients with diabetic foot concerns (Central Health, n.d.). Unfortunately, such foot care services were only offered at two of the main general hospitals in Gander and Grand Falls, which may not have been accessible to all patients in the region. Within WH, self-management and supportive education by nurses and diabetes educators

was available upon referral, but there were no specific diabetic foot care programs or pathways in place to direct care priorities (Western Health, n.d.). A review of the external database and discussion with a nurse from LGH also revealed a lack of clinical resources for HCPs within the region that were specific to the diabetic foot. Other than diabetic education services which were primarily focused on newly diagnosed patients, there were no programs explicitly dedicated to diabetic foot health (Labrador Grenfell Health, n.d.). Advanced foot care services by nurses were available upon referral but were not sufficient to meet the current demand of the population. Across all RHAs, a consistent finding among providers was the use of Diabetes Canada CPGs to inform diabetes management.

An environmental scan of resources to guide the provision of diabetic foot care shed light on the paucity of organizational-level strategies for diabetic foot care in the province of NL. In contrast to other provinces in Canada, NL was clearly lagging behind in the systematic management of the diabetic foot. A review of the available resources implemented in the provinces of AB, BC, NS, NB, and ON highlighted the widespread use of CPGs, CPWs, and MDTs by these provinces to improve management of the diabetic foot. Although there were differences in composition, function, and target areas, CPWs for providers to assist in diabetic foot management were evident in all of these provinces.

A review of resources developed by Diabetes Canada, Wounds Canada, IWGDF (2019), and NICE (2022) revealed a number of informative resources and tools for HCPs to guide the provision of foot care. On a national level, Diabetes Canada and Wounds Canada provided detailed guidance for HCPs in the form of CPGs (Diabetes Canada, 2018) and CPWs (Wounds Canada, 2022). Diabetes Canada's website provided links to accessible resources such as a PowerPoint presentation and a Smartphone application for ease of knowledge sharing on a

variety of topics related to DFU prevention, screening, assessment, treatment, and patient education. Consistent with Diabetes Canada, Wounds Canada (2022) has developed a number of valuable resources for diabetes care including the most recent development of an integrated CPW. On an international level, IWGDF (2019), and NICE (2022) continued to lead diabetes care with the development of tools and resources to guide management, advance knowledge, and improve patient care. The findings of the environmental scan were used to inform the nature of the questions asked during the consultations and used in conjunction with the other methods to inform clinical resource content and delivery.

Summary of Consultations

Consultations were conducted with ten key informants from diverse backgrounds and experiences in the realm of diabetes (see Appendix E). In total, nine consultations that consisted of semi-structured telephone and email-based interviews were conducted to gain insight into available resources for diabetic foot management in the province and to identify the priority needs of providers on a local level. Participants consisted primarily of representatives from the nursing profession, including one LPN, six RNs, and one NP. The LPN that was interviewed specialized in advanced foot care and provided private services in a remote region of the province. The NP that was interviewed was a practitioner who specialized in vascular surgery. The RNs interviewed included a vascular surgery nurse, a research nurse coordinator, a diabetes nurse educator, two wound care nurse consultants, and a community health nurse. Consultations were also conducted with an endocrinologist, who expressed a keen interest in diabetic foot care, as well as a local podiatrist. All data was managed, analyzed, and properly secured on my personal computer. No identifiable information was kept beyond sharing with my practicum supervisor to protect the anonymity of the participants. Consistent with the environmental scan,

descriptive analysis was performed to analyze the data collected during the consultations and a table was created to depict the results (Sundler et al., 2019).

The need for a clinical resource to improve the management of the diabetic foot in NL became abundantly clear during the consultations with local providers. On an organizational level, a lack of standardized resources was a consistent finding that emerged from the consultations. Namely, a lack of standardized programs to assist providers with diabetic foot management. Other themes identified included: a lack of funding to cover services such as podiatry and advanced foot care; lack of fiscal and human resources to meet the demands of the population in terms of diabetic foot needs; long wait times to see primary care providers and specialists; and ineffective lines of communication between private and public sectors to optimize the coordination of care for patients with diabetic foot needs.

On a provider level, inconsistencies in provider practices and in the advice given to patients was the most notable finding that emerged from the consultations. Other important themes identified included a critical need for provider education and standardized resources targeted towards prevention and screening. On a patient-level, many of the factors impacting provider management of the diabetic foot were related to socioeconomic factors such as: soaring costs of supplies; lack of resources due to low-income and limited means to afford services; lack of knowledge regarding preventative care and maintenance; and noncompliance with self-care recommendations. Providers also acknowledged the increasing medical complexity of many of their patients as a major factor impacting management of the diabetic foot.

Summary of Results of Methods

An integrative review of the literature provided insight into the best available evidence on strategies to enhance diabetic foot management. The environmental scan shed light on available

resources that have been implemented in jurisdictions across the country with varying levels of success, while also revealing the lack of resources within the province to support providers in the provision of diabetic foot care. Consultations with key stakeholders within the province of NL provided a unique understanding of the local context, which was fundamental to customizing the best available evidence to the local context. It was clear from the findings of the literature review, environmental scan, and consultations that diabetic foot management was influenced by a number of organizational-level, provider-level, and patient-level factors. To address the problem on an individual and organizational level, a decision was made to develop two complementary resources to enhance diabetic foot management: an infographic and a custom button. A second round of consultations were conducted with previous informants during the second semester of the practicum to gather input on resource content and delivery. A publishable draft of a journal article for the *Canadian Journal of Diabetes* was also completed as part of the practicum project, but is not included in this report. A summary of clinical resource development is described in the next section.

Summary of Clinical Resources

Overview of the Literature

The Wounds Canada (2022) Foot Health Pathway for People Living with Diabetes was identified during the environmental scan as a comprehensive, high-quality, and clinically useful resource that was representative of current best practices as outlined by the IWGDF (2019) and Diabetes Canada (2018). Despite the many strengths of the Wounds Canada pathway, it became clear during the consultations that further guidance was needed to enhance application within a local context. For this reason, a decision was made to develop an infographic to assist local providers with the application of the pathway. Copyright permission to use the pathway was

granted by Wounds Canada for this specific purpose. A copy of the email correspondence from Wounds Canada is included in Appendix F. An infographic was chosen as the most suitable mode of delivery to achieve the identified goal largely due to its ability to reach a large audience in an efficient manner (Ginzburg et al., 2021). While little is known about the effectiveness of the infographic as a medium to convey health information with HCPs, there is a growing body of research supporting its use as a visual communication tool in a wide range of education, marketing, and health care settings (Arcia et al., 2016; Dunlap & Lowenthal, 2016; Lankow et al., 2012). The PHAC (2014) toolkit was used to appraise the quantitative studies while the CASP (2018) criteria were used to critique the qualitative study by Arcia et al. (2016). The Mixed Methods Appraisal Tool (MMAT) was used to appraise the mixed-methods study by Ginsburg et al. (Hong et al., 2018). An overview of the studies and critical appraisal is described below.

Ginzburg et al. (2021) conducted a medium-quality mixed-methods study using surveys, interviews, and a focus group to evaluate an infographic designed for environmental health. In this study, a total of 74 participants were recruited via convenience sampling using community partnerships from two urban neighbourhoods in Massachusetts. Although recruitment for the focus groups (n=8) was not as high as the authors had anticipated, they reported achieving data saturation through the interviews (n=4). The tool that was developed by the authors for evaluation of the infographic was not previously validated, which limited the quality of the evidence. Nonetheless, detailed coding and thematic analysis strengthened study rigour. While 95.9% of participants reported that the purpose of the infographic was clear, data from the questionnaire, focus group, and interviews were used to revise the infographic to improve overall clarity, visual appeal, and context. Based on their positive findings, the authors concluded that

infographics were a useful communication tool for health promotion. However, the results should be interpreted in context of the study population which included largely immigrant and non-English speaking participants.

A well-conducted action research qualitative study by Arcia et al. (2016) used a participatory design approach to gain a deeper understanding of the role of infographics in supporting comprehension of health information among a purposefully sampled population (n=102) from a large urban neighbourhood in New York. Arcia et al. (2016) facilitated 21 participatory design sessions with participants in groups of one to fifteen to elicit their perspectives on infographic content, clarity, likeability, meaning, and preferences. Study rigour was strengthened through iterative data collection and analysis using both audio-recordings and detailed note-taking processes. Preliminary findings from the study reiterated the importance of the infographic design characteristics in motivating health-related behavioural changes among participants. The infographics that were preferred by participants were those they considered easy to understand and information-rich. Participants indicated that infographics that provided context, made comparisons, and used symbols and analogies were most effective in conveying their intended message. Similar to Ginzburg et al. (2021), generalizability may be limited due to the predominantly Hispanic and female population of the participants. Nonetheless, the findings demonstrate support for infographics in facilitating comprehension and promoting engagement.

Dunlap and Lowenthal (2016) conducted an inquiry of 20 popular infographics to determine the design characteristics that were most notable in an effective infographic. While their review was meant to be exploratory rather than scientific, the asesthetic learning experience framework provided conceptual direction for data collection and analysis and supported instrument development. Using the tool they had developed to analyze the characteristics of

infographics, Dunlap and Lowenthal (2016) noticed many inconsistencies among the designs in relation to common features such as structure, clarity, visual appeal, and relatability. Despite the inconsistencies, clarity and succinctness were identified as common features across all of the infographics evaluated. This literature review provided a foundation to inform future research on the systematic analysis of infographics. Cumulatively, these findings support the growing body of literature that highlights the value of infographics as useful visual tools for communicating information to vast populations in a clear, concise, and compact manner (Arcia et al., 2016; Dunlap & Lowenthal, 2016; Lankow et al., 2012).

A custom button was also developed as an individual-level strategy to encourage open dialogue between patients and providers about how to keep feet well. The button was developed with the intention of targeting diabetic foot management by promoting discussion of foot health. While research on the effectiveness is limited, custom buttons have been used in health care settings for decades as a cost-effective visual cue to promote handwashing and vaccination uptake (Chamberlain et al., 2015; Michaelsen et al., 2013). Chamberlain et al. (2015) conducted a high-quality cluster RCT to examine the effectiveness of a vaccine promotion package in improving vaccination uptake among pregnant women. In this study, a custom lapel pin was included within the package for providers to wear as a means to encourage vaccination. While no statistically significant differences were detected in vaccine uptake among those involved in this study, clinically significant improvements in vaccination uptake were evident. Specifically, women in the intervention group received more vaccinations than women in the control group with risk differences of 3.6% (95% CI: -4.0, 11.2, p=0.38) for influenza and 1.3% (95% CI: -10.7, 13.2, p=0.85) for Tdap. Furthermore, women in the intervention group were 50% more likely to receive a Tdap vaccine than women in the control group (RR =1.47, 95% CI: 0.70, 3.12,

p=0.27)). While these results were not statistically significant, they do suggest a clinical benefit of the health promotion materials on vaccination uptake among pregnant women. In addition to Chamberlain et al. (2015), Michaelsen et al. (2013) conducted a high-quality cross-sectional study of 250 medical-surgical inpatients at a large teaching hospital to assess patient's perspectives of handwashing compliance among providers. While the study did not evaluate the effectiveness of a button specifically, one of the findings that emerged from the study was a reluctance to engage in discussions with providers about their handwashing practices. Specifically, participants reported that they would be more likely to initiate conversations with providers if the provider wore a button or an electronic alert pin to prompt patients. While further research is needed to determine the effectiveness of the custom pin as a knowledge translation strategy, the literature suggests that it may be a useful visual aid to promote engagement (Chamberlain et al., 2015; Michaelsen et al., 2013).

Clinical Resource Development

Education is not the only intervention needed to evoke change, but it is a principal step in the knowledge translation process and fundamental to enhancing uptake of best practices among HCPs (Harrison & Graham, 2021). According to Harrison and Graham (2021), developing materials to support an innovation makes it easier for stakeholders to learn about the innovation and deliver the innovation. The principles of adult learning were taken into consideration to ensure that design, content, and mode of delivery of the clinical resources aligned with the needs of the target audience as identified in the consultation phase of data collection (Knowles, 1984).

During planning stages of the practicum, the visual elements of the infographic were carefully deliberated to enhance visual simplicity, establish logical flow, and promote effective communication of the health information depicted within the pathway (Arcia et al., 2016; Dunlap

& Lowenthal, 2016; Matrix & Hodson, 2014). In their book titled *Infographics: The Power of Storytelling,* Lankow et al. (2012) emphasized the importance of tailoring infographic design to achieve optimal balance between appeal and clarity. With this in mind, the colour palette and language selected for the infographic were designed to parallel that of the Wounds Canada pathway (Arcia et al., 2016; Ginzburg et al., 2021; Dunlap & Lowenthal, 2016; Lankow et al., 2012; Matrix & Hodson, 2014). To gauge relevance and acceptability of the infographic among target audience members, a series of consultations were held with a local wound care nurse and an endocrinologist to review content and visual appeal. Based on the feedback received from the consultations and discussions with my supervisor, the infographic was revised to optimize clinical usefulness, readability, relevance, and visual appeal among the target audience. For example, one consultant (endocrinologist) suggested to include a reminder to use the Miller Centre Orthotics referral form which was available on the intranet.

The infographic was developed not only with the intention of conveying the information depicted in the Wounds Canada Pathway but also to serve as a means to connect providers to local resources and materials such as the local Diabetes Education Centre and local Diabetes Canada chapter. For this reason, a quick response (QR) code was added to the infographic as a way to connect providers directly to the latest Diabetes Canada Guidelines via their Smart Phone. According to a well-conducted scoping review by Karia et al. (2019), the use of QR codes in health care education is gaining momentum as way to communicate information quickly and efficiently. A copy of the infographic is included in Appendix B.

Efforts to coordinate the custom button with the infographic were also initiated to promote consistency and clarity of content. To enhance visual appeal, the custom button was outlined in blue with an image of feet depicted in the background of the button. The phrase “If

you have diabetes, ask me about keeping your feet well" was included on the button with the words "ask me" in bold to emphasize the readiness of the provider to engage in discussion about the topic. Through use of word choice that promotes open dialogue, it is hoped that the button will encourage engagement between providers and patients and enhance the application of the Wounds Canada pathway. Consistent with the infographic, a QR code was also added to the button to provide quick access to Diabetes Canada patient information about foot self-care. During the second half of the practicum project, multiple drafts of each of the resources were submitted to my supervisor for feedback until a final draft of each resource was approved. A copy of the custom button is also depicted in Appendix B of this report. I am hopeful that the collective use of the button and the infographic will improve diabetic foot outcomes for patients, providers and health care systems in the province of NL.

Overview of Next Steps

Now that evidence has been compiled and analyzed, the clinical resources have been developed, and a draft journal article describing the resources has been written and approved by my supervisor, the next step in the knowledge translation process involves establishing a working group and planning implementation and evaluation. The development of an implementation and evaluation plan that entails specific timelines and methods of assessing key indicators of success is critical to the successful integration of a knowledge translation initiative (Harrison & Graham, 2021; Kurt, 2016).

As a preliminary step in the implementation plan, copies of the resources were provided to former consultants for review and feedback. The feedback obtained from the consultants, who included two wound care nurses, a nurse educator and a local endocrinologist, was incorporated into the final revisions of the resources. Now that a final version of each of the resources has

been developed, approval will need to be obtained from appropriate decision makers and stakeholders to promote implementation locally and across other regions of the province. To improve uptake of the resources, a virtual education session will need to be held for all HCPs to provide education about the resources prior to their distribution in clinical areas. Once implemented, ongoing evaluation will need to be initiated to determine acceptance, relevance, and usefulness of the resources among the target audience. To do so, a comprehensive evaluation and sustainability plan will need to be developed to determine whether the resources are feasible, appropriate, and affordable (Harrison & Graham, 2021). According to Harrison and Graham (2021), ongoing support from key stakeholders, leaders, and end users is instrumental to the success of a knowledge translation initiative.

A comprehensive evaluation is tri-fold and includes assessment of process, outcome, and impact measures (Centre for Disease Control and Prevention [CDC], n.d.). Evaluating process involves gauging provider perspectives of the usefulness, acceptability, and understanding of the content and intention of the initiative (Harrison & Graham, 2021). Process evaluation could be evaluated through the distribution of an electronic Likert-style questionnaire to gain insight into preliminary thoughts about the clarity, placement, appropriateness, relevance, and acceptability of the clinical resources (Kurt, 2016). For example, the electronic questionnaire could be emailed to providers one month following implementation to elicit responses from providers about their knowledge, understanding, and comprehension in relation to resource content, mode of delivery, and meaning. Conducting a baseline assessment may aid in evaluation of process by identifying resources and practices used by providers pre-implementation related to diabetic foot management (CDC, n.d.).

To evaluate outcome, it would be necessary to determine whether the resources have been successful in achieving their intended purpose (Harrison & Graham, 2021). As the intended purpose is to support providers in applying the Wounds Canada pathway and improve screening and assessment of diabetic foot concerns, evaluation of outcome measures would need to include assessment of provider perspectives regarding whether the resources have supported their practice. For example, an anonymous electronic poll could be emailed to providers' one-month post-implementation of the resources to assess outcome. Changes could be made to the resources if any issues were identified and a follow-up evaluation could be conducted one-month after the revised resources are implemented. Additional measures to evaluate outcome include assessing the frequency of foot assessments and the number of referrals to health professionals as outlined in the pathway. Evaluation of these measures could be accomplished through chart reviews and analysis of metrics related to the number of referrals to health professionals such as community health, podiatry, wound management clinic, and vascular surgery three months post-implementation (CDC, n.d.). An anonymous electronic poll could also be emailed to providers to measure self-report on foot screening and referral frequency between one- and three-months post-implementation of the resources. To determine whether or not the custom button is achieving its intended purpose of encouraging discussion between patients and providers, a patient experience survey could be emailed or mailed by post to patients to seek information about their experience with their providers. The survey could include questions about the custom button and whether or not patients received foot examinations, education on self-care, or referrals to other providers. Depending on the responses received from participants, modifications may be needed to maximize the acceptability and use of the button.

In keeping with the process-outcome-impact nature of a comprehensive evaluation plan, evaluation of impact would need to measure indicators such as incidence and prevalence of LLAs, admissions to hospital for diabetic foot concerns, and indicators of glycemic control such as Hemoglobin A1C. Impact evaluation could be evaluated through chart audits and surveillance of local data related to the diabetes population available in databases maintained by the Newfoundland and Labrador Centre for Health Information (NLCHI, 2018). Semi-structured interviews with providers and health authority officials could also be initiated to provide data related to the impact of the resources on the health system. As the impact of the clinical resources would not be apparent immediately post-implementation, impact measures should be evaluated at least six months following implementation and again at pre-determined intervals (e.g., every 12 months).

To evaluate sustainability, ongoing assessment of barriers and drivers of implementation must be considered (Harrison & Graham, 2021). For this particular initiative, potential barriers that will need to be assessed include provider readiness, time, and acceptance of the clinical resources. Likewise, support for the initiative on an organizational-level will need to be closely evaluated as it is a critical driver of success (Harrison & Graham, 2021). For example, an e-questionnaire could be emailed to providers to assess use of the resources three months, six months, and twelve months post implementation. Semi-structured interviews with a sample of providers from the target audience could also be initiated on a quarterly basis and an informal visit to the clinical areas by the evaluation team could be planned to monitor acceptability and usability of the resources.

Based on the feedback received from the evaluations, there may be a need to revise or expand the clinical resources to best meet the fluid needs of providers, patients, and the health

care system. Communicating insights gained from the evaluation may inform future initiatives and raise awareness of areas in need of improvement. Future steps in knowledge translation could also include collaboration with NLCHI to incorporate the infographic and associated Wounds Canada (2022) pathway into the provincial electronic medical record as well as collaboration with key stakeholders to conduct educational events such as lunch and learn sessions and virtual webinars to increase awareness and support for the resources among providers. While this overview provided some foresight into next steps, the development of an in-depth implementation and evaluation plan is needed to determine whether or not such a partnership is feasible and acceptable given local needs of providers and available resources. Thus, future steps in the knowledge translation process should include establishing a steering committee consisting of representatives from the target audience, patient population, health authority, and government to spearhead the implementation and evaluation process.

Reflection

Reflecting on the experience of completing this practicum has allowed me to appreciate the level of personal and professional growth that I have demonstrated throughout the process. The journey towards meeting the required objectives of the practicum has not been a smooth one, but rather one that has had its share of obstacles along the way. Over the course of NURS 6660 and 6661, there were many times when Covid-19, recurrent isolations, household sickness, and child care issues inhibited my ability to complete the practicum components in a timely manner. As a result, I had to request extensions from my supervisor and alter deadlines to complete necessary assignments. Despite these challenges and the stress caused by the delays, I regard this experience positively and I feel inspired to continue my nursing education at a doctorate level in the future. I am proud of the improvements I have made in my writing and feel that I have

demonstrated an above average understanding of diabetic foot health. Immersing myself in the literature came naturally to me and allowed me to gain a deeper understanding of the problem of DFU, the contributing factors associated with the problem and the strategies available to address the problem. In the early stage of completing the literature review, however, I found myself feeling overwhelmed by the sheer volume of literature at my disposal. Synthesizing the evidence in a concise and thoughtful manner was difficult and often required revisiting Donabedian's (1997) framework as well as the theoretical underpinnings of Sundler et al. (2019) to ensure data collection, abstraction, management, and analysis were in keeping with the underlying principles. During times when I struggled with content organization, I found comfort in the scheduled meetings I had with my supervisor and reveled in the guidance and direction I received. While I feel there is always room for growth, I have gained invaluable skills that will serve me well in my current role as a Research Nurse Coordinator and as well as in my future academic pursuits.

Unlike the literature review, the environmental scan and consultations were novel experiences for me. The clear directions provided by my supervisor in the outlines of these components were immensely helpful and allowed me to remain focused and succinct in my writing. Initially when completing the environmental scan, it was difficult to resist the urge to delve into the array of resources available across the country with abandon. After meeting with my supervisor in the early stages of completing the scan, however, I was reminded of the need to keep the level of information manageable and so together, we decided to limit the search to five additional provinces outside of NL. In the end, I was grateful for my supervisor's foresight, given that there was ample data obtained from a review of resources within the chosen provinces to achieve the desired outcome.

Reflecting on the consultations, I find myself feeling pleased with this phase of the practicum project. Engaging with providers from various backgrounds and experiences allowed me to gain insight into the immediate needs of HCPs within the local setting of EH. During the discussions, I was grateful for the semi-structured questionnaire I developed to guide the interview as there were many times when the conversation veered from the original topic. While the consultations were successful, I had made attempts to contact a family physician, dietician, and nurse educator via email correspondence that were not returned. As the majority of the consultants occurred during summer months, it is plausible that these providers were out of office at the time. While I have questioned whether I should have conducted the consultations at the same time as the environmental scan to maximize response rate, the results of the environmental scan shaped the consultations, so the timing of the environmental scan proved fitting. Sufficient data were conducted from those interviewed to understand the local needs of providers as well as the complexity of diabetic foot management.

Developing the clinical resources was a positive learning experience that proved more tedious than I had anticipated. Using the Visme software to create the infographic required a great deal of time, patience, and creativity. For inspiration, I frequently revisited Knowles (1984) Adult Learning Theory and watched Visme tutorials on YouTube to ensure the infographic and custom button were in keeping with the learning needs of adult learners. The use of QR codes was a new experience for me that proved to be much easier than I anticipated. I plan to utilize the QR feature again in future projects to promote quick access to resources on the internet. Overall, developing the infographic and designing the button were valuable learning experiences that I hope to build on in the future.

Discussion of Advanced Practice Nursing Competencies

Throughout the practicum project, I have had the opportunity to demonstrate several of the core competencies for APN as outlined by the Canadian Nurses Association (CNA, 2019). In pursuit of the practicum goals, I have exhibited education, leadership, research, consultation and collaboration, and optimizing health systems competencies.

Education

APNs demonstrate a commitment to lifelong learning and continuing education. The importance of engaging in and promoting the uptake of educational and learning opportunities has been emphasized by CNA (2019). The educational competency: *identify the learning needs of nurses and other members of the healthcare team and find or develop programs and resources to meet those needs* has been demonstrated through all stages of the practicum. Completion of the literature review, environmental scan, and consultations informed the clinical resource and the article development. Through the literature review, I was able to gain insight into contributing factors associated with diabetic foot management that have been shown to impact providers and use that information to guide the environmental scan, and consultations. The accumulated evidence from the literature review, environmental scan and consultations were then used to develop a joint organizational and individual-level strategy tailored to the best available evidence and local needs of providers. Through the development of a draft journal article for the *Canadian Journal of Diabetes,* I also effectively demonstrated the education competency: *dissemination of new knowledge* (CNA, 2019).

Leadership

Leadership is a core competency of all nurses and integral to the professional growth of APNs within the organizations and communities where they work (CNA, 2019). The leadership

competency: *identify problems and initiate change to address challenges at the clinical, organizational or system level* has been partially demonstrated throughout the practicum. While the clinical resources I developed have yet to be implemented, the consultations with local providers held during the practicum allowed me to identify the problems that needed to be addressed and ultimately shaped the nature of the resources developed. It is hoped that these resources will be approved for implementation by decision makers and contribute to real changes at the individual and organizational level to improve patient, provider, and system outcomes as it relates to diabetic foot health.

Research

According to CNA (2019), research competencies can be exhibited in many ways and may include generating, synthesizing, critiquing, and applying research evidence. Through completion of the literature review, environmental scan, consultations, draft journal article, and clinical resource development, I have effectively demonstrated the research competency: *identify, appraise and apply research, practice guidelines and current best practice.* Through the literature review, I was able to synthesize and critically analyze the available evidence and apply the knowledge gained to the environmental scan and consultations. By applying the definitions of terms to rate evidence and the criteria for rating evidence as outlined in the PHAC toolkit (2014) as well as the CASP (2018) criteria, I effectively demonstrated critical appraisal of research. During the environmental scan and consultations, I was able to generate my own data regarding what is happening locally, provincially, nationally, and internationally in the management of the diabetic foot. I was also able to synthesize current best practice recommendations by leading public health organizations including Diabetes Canada, Wounds Canada, IWGDF, and NICE. The data collected and analyzed through the literature review and

environmental scan helped shape the questions asked during the consultations, which ultimately led to the identification of a need for a CPW resource for the diabetic foot among local providers.

Research competencies were also demonstrated through the astute application of an iterative approach to data collection, synthesis, and analysis. The evidence collected and analyzed was then used to inform the development of a joint organizational and individual-level strategy for the diabetic foot. The research competency was also evident in the writing of a publishable draft journal article developed with the intention of dissemination through the *Canadian Journal of Diabetes*.

Optimizing Health Systems

Contributing to the effective functioning of health systems is an integral role of APNs (CNA, 2019). Through the research methods and subsequent development of an infographic to assist providers with the application of the Wounds Canada CPW and a custom button to promote foot screening, I have effectively exhibited the competency: *identify gaps in the health system and develop strategies to facilitate and manage change.* It is hoped that the resources will eventually be implemented and thus further support the optimization of the health care system.

Consultation and Collaboration

Effective consultation and communication are critical aspects of advanced nursing practice and involve timely communication at the patient, provider, and system level (CNA, 2019). The consultation and collaboration competencies: *engage clients and other team members in resolving issues at the individual and organizational levels* and *consult and collaborate with members of the health-care team and stakeholders whose services impact the key determinants of health to develop quality-improvement and risk-management strategies* have been consistently demonstrated throughout the practicum. Formal consultations with providers and personal

communication with my supervisor provided ample opportunities for constructive discussions about the problem of diabetic foot management and the identification of thoughtful solutions to address the problem. The significance of the problem and the complexity of the issue was clearly conveyed through the consultations with all parties in agreement that collaborative efforts are needed to evoke change. Consultation and collaboration were further demonstrated in NURS 6661 as I conducted additional consultations to seek feedback from past consultants about the clinical resources developed. I hope to continue to collaborate with providers, stakeholders and decisions makers to assist with the implementation and evaluation of these resources in the clinical setting.

Conclusion

Diabetes is a devastating chronic condition with widespread prevalence and impacts across Canada and around the world. DFU is one complication of diabetes that has far-reaching implications for patients, providers, and health care systems. NL is exceptionally burdened by diabetes and diabetic foot disease and is in dire need of a solution to address the problem. This paper provided a report of the methods that have been conducted in fulfillment of the objectives of the practicum project titled: *Clinical Resources for Diabetic Foot Care: Applying the Wounds Canada Foot Health Pathway in Newfoundland and Labrador* for the Master of Nursing program at Memorial University. An integrative review of the literature, an environmental scan of existing resources, and consultations with key stakeholders were conducted concurrently to inform the development of clinical resources for providers to aid in diabetic foot care. Knowles Theory of Andragogy and the Donabedian Model of Quality of Care provided the conceptual direction for practicum activities.

This practicum report described the development of a joint organizational and individual level strategy to improve diabetic foot management in NL. Specifically, an infographic was developed to guide the use of the Wounds Canada (2022) Foot Health Pathway for People Living with Diabetes in the context of NL. A custom button was also developed as an individual-level strategy to encourage dialogue about foot care between patient and provider and enhance foot screening. In this report, the goals, objectives and methods of the practicum project were described. A summary of the clinical resources was provided with a copy of the resources included in Appendix B. An introduction to the next steps in the knowledge translation process and a reflection on the process and lessons learned throughout the practicum were also outlined. To conclude the report, a discussion of the APN competencies education, research, leadership, optimization of health systems, and consultation and collaboration was presented.

While these clinical resources have yet to be implemented within the local RHA, next steps in the knowledge translation process include seeking approval for adoption by designated stakeholders within the province and developing a comprehensive evaluation plan. Once implemented through an education initiative, ongoing evaluation of process, outcome, and impact measures will be needed to promote sustainability and facilitate successful integration of the resources.

References

Arica, A., Suero-Tejeda, N., Bales, M. E., Merrill, J. A., Yoon, S., Woollen, J., & Bakken, S. (2016). Sometimes more is more: Iterative participatory design of infographics for engagement of community members with varying levels of health literacy. *Journal of the American Medical Informatics Association: JAMIA*, *23*(1), 174-183. https://doi.org/10.1093/jamia/ocv079

Canadian Nurses Association (2019). *Advanced nursing practice: A pan Canadian framework*. https://www.cna-aiic.ca/en/nursing/advanced-nursing-practice

Central Health. (n.d.). *Diabetes care program*. https://www.centralhealth.nl.ca/diabetescare

Centre for Disease Control and Prevention. (n.d.). *Types of evaluation.* https://www.cdc.gov/std/program/pupestd/types%20of%20evaluation.pdf

Centre for Policy on Ageing. (2014). *Rapid review of care pathways.* http://www.cpa.org.uk/information/reviews/CPA-Rapid-Review-Effectiveness-of-care-pathways.pdf

Chamberlain, A., Seib, K., Ault, K., Rosenberg, E., Frew, P., Cortés, M., Whitney, E., A., Berkelman, R., Orenstein, W., & Omer, S. (2015). Improving influenza and Tdap vaccination during pregnancy: A cluster-randomized trial of a multi-component antenatal vaccine promotion package in late influenza season. *Vaccine*, *33*(30), 3571–3579. https://doi.org/10.1016/j.vaccine.2015.05.048

Chan, C. B., Dmytruk, K., Labbie, M., & O'Connell, P. (2020). Organizational

changes in diabetic foot care practices for patients at low and moderate risk after implementing a comprehensive foot care program in Alberta, Canada. *Journal of Foot and Ankle Research*, *13*(1), 1-15. https://doi.org/10.1186/s13047-020-00393-0

Critical Appraisal Skills Programme (2018). *CASP qualitative checklist [online]*. https://casp-uk.b-cdn.net/wp-content/uploads/2018/03/CASP-Qualitative-Checklist-2018_fillable_form.pdf

Crocker, R. M., Palmer, K. N. B., Marrero, D. G., & Tan, T.-W. (2021). Patient perspectives on the physical, psycho-social, and financial impacts of diabetic foot ulceration and amputation. *Journal of Diabetes & Its Complications*, *35*(8), 1-5. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.jdiacomp.2021.107960

Diabetes Canada. (2018). Clinical practice guidelines for the prevention and management of diabetes in Canada. *Canadian Journal of Diabetes*, *42*(1), S1-S325. https://guidelines.diabetes.ca/cpg

Diabetes Canada. (2019). *Diabetes in Newfoundland and Labrador: Backgrounder.* https://www.diabetes.ca/DiabetesCanadaWebsite/media/About-Diabetes/Diabetes%20Charter/2019-Backgrounder-Newfoundland-and-Labrador.pdf

Diabetes Canada. (2020). *Diabetes in Newfoundland and Labrador: Backgrounder*. https://diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2020_Backgrounder_Newfoundland_FINAL.pdf

Diabetes Canada. (2021). *Diabetes in Canada: Backgrounder.* https://diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2021_Backgrounder_Canada_English_FINAL_MAR.pdf

Diabetes Canada. (2022). *Diabetes in Newfoundland and Labrador: Backgrounder.*

https://www.diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2022_Backgrounder_Newfoundland.pdf

Diabetes Canada. (no date.). *Amputation prevention*. https://www.diabetes.ca/advocacy--policies/our-policy-positions/amputation-prevention

Donabedian, A. (1997). Special article: The quality of care: How can it be assessed? *Archives of Pathology & Laboratory Medicine, 121*(11), 1145-1150. https://qe2a-proxy.mun.ca/login?url?url=https://www-proquest-com.qe2a-proxy.mun.ca/scholarly-journals/special-article-quality-care-how-can-be-assessed/docview/211957437/se-2?accountid=12378

Dunlap, J. C., & Lowenthal, P. R. (2016). Getting graphic about infographics: Design Lessons learned from popular infographics. *Journal of Visual Literacy*, *35*(1), 42–59. https://doi.org/10.1080/1051144X.2016.1205832

Ginzburg, S., Botana Martinez, P., Reisner, E., Chappell, S., Brugge, D., & Kurtz-Rossi, S. (2021). An evaluation of an environmental health infographic in community settings. *Inquiry (Chicago)*, *58*, 469580211059290–469580211059290. https://doi.org/10.1177/00469580211059290

Harrison, M. B., & Graham, I. D. (2021). *Knowledge translation in nursing and healthcare: A roadmap to evidence-informed practice*. John Wiley & Sons, Inc.

Hong, Q. N., Pluye, P., Fabregues, S., Bartlett., G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M-P., Griffiths, F., Nicolau, B., O'Cathain, A., Rousseau, M-C., & Vedel., I. (2018). *Mixed methods appraisal tool (MMAT) version 2018: User guide.*

http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/fetch/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf

Imam, B., Miller, W. C., Finlayson, H. C., Eng, J. J., & Jarus, T. (2017). Incidence of lower limb amputation in Canada. *Canadian Journal of Public Health*, *108*(4), e374–e380. https://doi-org.qe2a-proxy.mun.ca/10.17269/CJPH.108.6093

International Diabetes Federation. (2021). *IDF Diabetes Atlas*. https://diabetesatlas.org

International Diabetes Federation. (2022). *About Diabetes.* https://idf.org/aboutdiabetes/what-is-diabetes.html

International Working Group on the Diabetic Foot. (2019). *IWGDF practical guidelines on the prevention and management of diabetic foot disease.* https://iwgdfguidelines.org/wp-content/uploads/2021/03/IWGDF-2019-final.pdf

Karia, C. T., Hughes, A., & Carr, S. (2019). Uses of quick response codes in healthcare education: A scoping review. *BMC Medical Education*, *19*(1), 456–456. https://doi.org/10.1186/s12909-019-1876-4

Knowles, M. (1984). *The modern practice of adult education: From pedagogy to androgogy.* Chicago, IL: Associated Press, Follett Publishing Company. https://pdfs.semanticscholar.org/8948/296248bbf58415cbd21b36a3e4b37b9c08b1 .pdf

Knowles, M. S., Holton, E. F., III, & Swanson, R. A. (2015). *The adult learner: The definitive classic in adult education and human resource development (8th ed.).* Elsevier

Kurt, S. (2016). "Kirkpatrick model: Four levels of learning evaluation", *Educational Technology*. https://educationaltechnology.net/kirkpatrick-model-four-levels-learning-evaluation/

Labrador-Grenfell Health. (n.d.). *Regional diabetes education.* https://www.lghealth.ca/your-health/programs-and-services/population-health/regional-diabetes-education/

Lankow, J., Ritchie, J., & Crooks, R. (2012). *Infographics: The power of visual storytelling*. John Wiley & Sons, Inc.

Lawal, A. K., Groot, G., Goodridge, D., Scott, S., & Kinsman, L. (2019). Development of a program theory for clinical pathways in hospitals: protocol for a realist review. *Systematic Reviews, 8*(1), 1-7. https://doi.org/10.1186/s13643-019-1046-0

Lukewich, J., Buote, R., Asghari, S., Aubrey-Bassler, K., Knight, J., & Mathews, M. (2020). Adults with diabetes mellitus in Newfoundland and Labrador: A population-based, cross-sectional analysis. *CMAJ Open, 8*(4). E895–E901. https://doi.org/10.9778/cmajo.20190233

Matrix, S., & Hodson, J. (2014). Teaching with infographics: practicing new digital competencies and visual literacies. *Journal of Pedagogic Development*. 4(2), 18-27. https://uobrep.openrepository.com/handle/10547/335892

Meza-Torres, B., Carinci, F., Heiss, C., Joy, M., & de Lusignan, S. (2021). Health service organisation impact on lower extremity amputations in people with type 2 diabetes with foot ulcers: Systematic review and meta-analysis. *Acta Diabetologica*, *58*(6), 735–747. https://doi.org/10.1007/s00592-020-01662-x

Michaelsen, K., Sanders, J., Zimmer, S., & Bump, G. (2013). Overcoming patient

barriers to discussing physician hand hygiene: Do patients prefer electronic reminders to other methods? *Infection Control & Hospital Epidemiology, 34*(9), 929-934. doi:10.1086/671727

Mullan, L., Wynter, K., Driscoll, A., & Rasmussen, B. (2021). Barriers and enablers to providing preventative and early intervention diabetes-related foot care: A qualitative study of primary care healthcare professionals' perceptions. *Australian journal of primary health*, *27*(4), 319–327. https://doi.org/10.1071/PY20235

Musuuza, J., Sutherland, B. L., Kurter, S., Balasubramanian, P., Bartels, C. M., & Brennan, M. B. (2020). A systematic review of multidisciplinary teams to reduce major amputations for patients with diabetic foot ulcers. *Journal of Vascular Surgery*, *71*(4), 1433–1446.e3. https://doi.org/10.1016/j.jvs.2019.08.244

National Institute for Health and Care Excellence. (2022). *Diabetic foot problems: Prevention and management*. https://www.nice.org.uk/guidance/ng19/resources/diabetic-foot-problems-prevention-and-management-pdf-1837279828933

Newfoundland and Labrador Centre for Health Information (2018, February). *eHealth Report.* https://www.nlchi.nl.ca/images/FINAL_NLCHI_-_eHealth_Report_-_Feb_2018.pdf

Public Health Agency of Canada. (2014). *Infection prevention and control guidelines: Critical appraisal tool kit.* http://publications.gc.ca/collections/collection_2014/aspc-phac/HP40-119-2014-eng.pdf

Qin, W., Blanchette, J. E., & Yoon, M. (2020). Self-Efficacy and diabetes self

management in middle-aged and older adults in the United States: A systematic review. *Diabetes Spectrum, 33*(4), 315–323. https://doi-org.qe2a-proxy.mun.ca/10.2337/ds19-0051

Statistics Canada. (2022). *The populations of the Atlantic provinces are aging quickly*. https://www150.statcan.gc.ca/n1/daily-quotidien/220427/mc-a004-eng.htm

Sundler, A. J., Lindberg, E., Nilsson, C., & Palmér, L. (2019). Qualitative thematic analysis based on descriptive phenomenology. *Nursing Open,* 6(3), 733–739. https://doi-org.qe2a-proxy.mun.ca/10.1002/nop2.275

Thanh, N. X., Dmytruk, K., O'Connell, P., Rogers, E., Fillier, D., MacRae, J. M., Thomas, C., Rennie, C., Eitzenberger, C., Newman, C., Match, B., Thompson, C., Nhan, J., & Wasylak, T. (2020). Return on investment of the diabetes foot care clinical pathway implementation in Alberta, Canada. *Diabetes Research and Clinical Practice, 165*, 108241–108248. https://doi.org/10.1016/j.diabres.2020.108241

Western Health. (n.d). *Diabetes education*. https://westernhealth.nl.ca/diabetes/

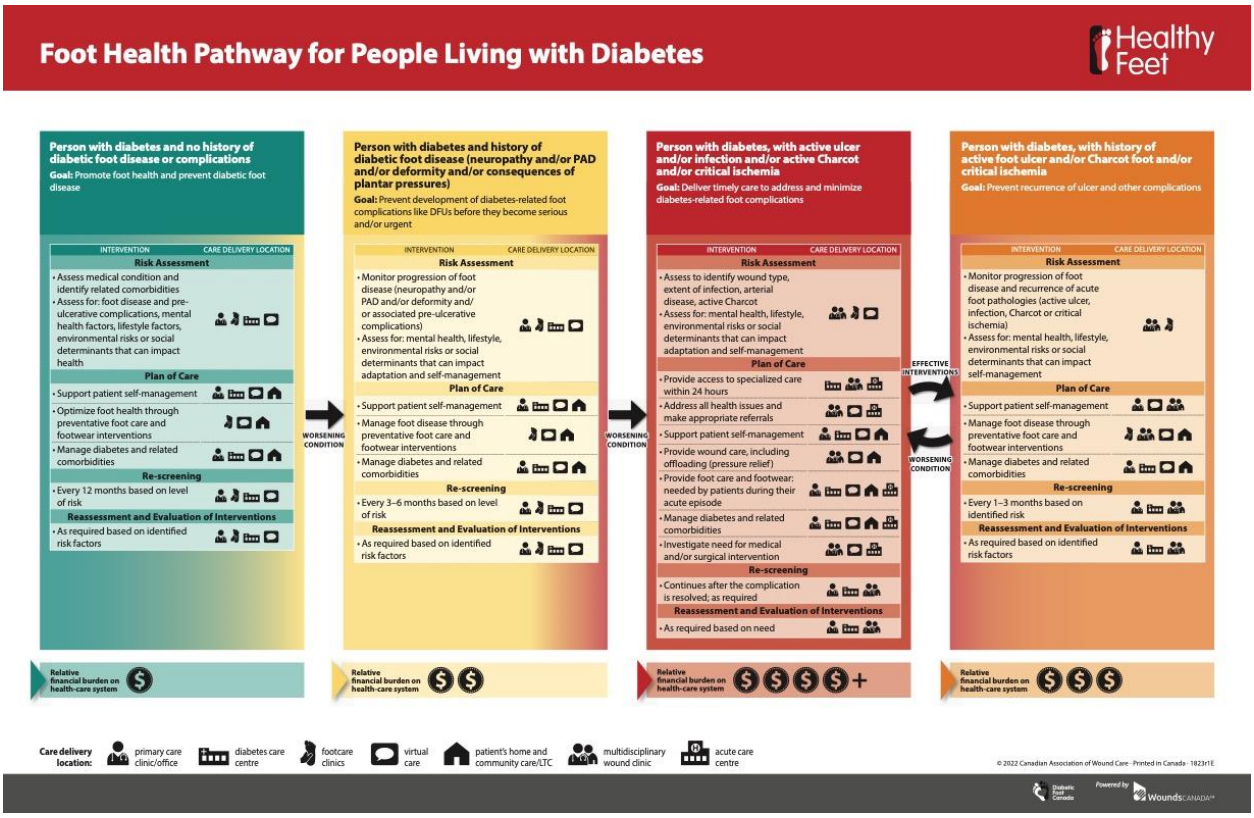
World Health Organization. (2020, December 9). *The top 10 causes of death.* https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

Wounds Canada. (2022). *Foot health pathway for people living with diabetes.* https://www.woundscanada.ca/docman/public/1829-diabetic-foot-complications-a-tab-1823e-final/file

Appendix A

Figure 1

Wounds Canada (2022) Foot Health Pathway for People Living with Diabetes



Appendix B

Clinical Resources for Diabetic Foot Health

Figure 1

Clinical Resource for Diabetic Foot Health

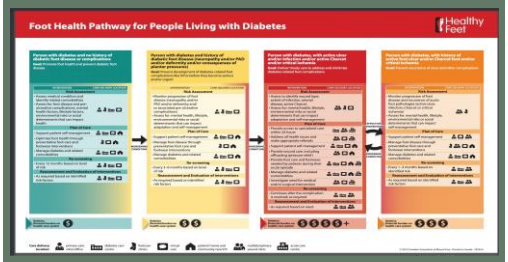
Custom Button.

Figure 2

Infographic

CLINICAL RESOURCES FOR DIABETIC FOOT HEALTH

Applying the WOUNDS CANADA FOOT HEALTH PATHWAY FOR PEOPLE WITH DIABETES IN NEWFOUNDLAND AND LABRADOR



RISK ASSESSMENT AND SCREENING

GREEN LOW RISK	Person with diabetes and no history of diabetic foot disease or complications
YELLOW MODERATE RISK	Person with diabetes with foot disease (neuropathy, PAD, deformity, plantar pressure)
RED URGENT RISK	Person with diabetes with active ulcer, infection, Charcot or critical ischemia in need of acute care
ORANGE VERY HIGH RISK	Person with diabetes who has a history of an active foot ulcer, Charcot foot or critical ischemia

PLAN OF CARE

At every visit

Assess [illegible] for foot disease

- Identify [illegible]

Monitor [illegible] for signs of foot disease or progression [illegible]

- Identify [illegible], risk of progression, [illegible] foot changes

Educate [illegible]

- Identify [illegible] and provide education [illegible]

Educate patient and support persons on what to look for and when to seek help

- Provide [illegible] Foot Care Handbook [illegible]

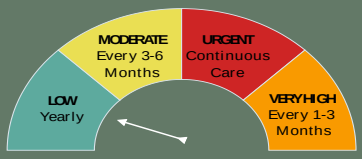
Optimize preventive foot care

- Encourage [illegible] with appropriate [illegible]
- Ask [illegible]

Refer [illegible] to appropriate health professionals

- Refer to [illegible]
- Refer to [illegible] Education Centre, [illegible] or [illegible]
- Refer to the NL Federation of Podiatric Medicine for [illegible]
- Refer to Wound Care Clinics [illegible]
- Refer to Community Health or Wound Management Clinics as needed

How often do you need to follow up?



PLAN OF CARE BASED ON RISK ASSESSMENT

GREEN

LOW

- Assess yearly
- Follow steps outlined above

yellow

MODERATE

- Assess every 3-6 months
- Follow steps outlined above

RED

URGENT

- Provide access to specialized care within 24h
- Provide wound care
- Initiate offloading
- Investigate need for immediate surgical intervention
- Consider wound care, [illegible] vascular surgery or podiatry as needed

orange

VERY HIGH

- Re-assess every 1-3 months
- Refer to [illegible] as needed
- Refer to wound care [illegible]
- Refer to [illegible]

Resources

Diabetes Education Centre
709-752-3687
Wound Care Clinic
709-752-6220
Check out *Foot Care for Diabetes* on the Intranet
Smoking Cessation Help Line
1-800-363-5864
Diabetes Canada NL Chapter
709-747-4590
Podiatrists and Foot Care Nurses
Local Yellow Pages
The NL Federation of Podiatric Medicine website

Scan the QR code to access the latest **Diabetes Canada Guidelines**

Appendix C

Clinical Resources for Diabetic Foot Care: An Integrated Literature Review

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Diabetes mellitus is a complex chronic condition with widespread prevalence and impacts worldwide. Despite efforts to reduce the global burden of disease, diabetes remains a leading cause of heart disease, stroke, kidney failure, vision loss, lower-limb amputation (LLA) and death (International Diabetes Federation [IDF], 2021; World Health Organization [WHO], 2020). Diabetic foot ulceration (DFU) is defined as an ulceration of the foot secondary to diabetes and is recognized as one of the most devastating complications of poorly controlled diabetes with far-reaching implications for patients, families, health care providers (HCPs) and health systems (IDF, 2021; International Working Group on the Diabetic Foot [IWGDF], 2019). While the etiology of DFU is influenced by multiple factors including age, gender, body mass index, smoking and the presence of comorbid conditions, it remains one of the major causes of diabetes-related morbidity and mortality (IWGDF, 2019). Without proper management, DFUs can progress to infection, ischemia, and LLA, thereby resulting in long-term sequalae for patients (Thorud et al., 2016). To reduce the burden of DFU, the integration of a systematic interdisciplinary approach to aid the prevention, screening, treatment and management of diabetic foot complications is recommended (Diabetes Canada, n.d.; IDF, 2021; Schaper et al., 2020).

The purpose of this integrative review is to determine the occurrence, impact, and contributing factors associated with DFU and to identify effective organizational-level strategies to mitigate the problem. Based on a review of the available literature, there was moderate evidence to support the effectiveness of clinical pathways (CPWs), multidisciplinary teams (MDTs) and a combination of the two approaches in the management of diabetic foot complications. The findings of the integrative review will inform the development of a

comprehensive clinical resource to assist HCPs in the systematic management of the diabetic foot.

Search Methods

An integrative review of the literature was conducted to gain a deeper understanding of the problem of DFU as well as the solutions available to address the problem. According to Russell (2005), the integrative review is the most comprehensive method of review as it allows for the broad inclusion of quantitative, qualitative, empirical, and theoretical literature. Prior to conducting the review, the target population, concept and context were defined to narrow the scope of the search and improve the success of the search efforts. The population of interest was defined as patients living with diabetic foot concerns such as DFU, the concept of interest was defined as the organizational-level clinical resources available to support diabetic foot health, and the context of interest was defined as DFU management by HCPs. Key questions used to guide the review were:

1. What is the occurrence of DFUs?
2. What are the contributing factors associated with DFUs?
3. What is the effectiveness of organizational-level strategies that address diabetic foot health?

With the above questions in mind, an extensive search of the literature was conducted to retrieve English language peer-reviewed research articles published within the last five years. The five-year time-period was selected to obtain the most relevant research based on current clinical practice guidelines for the diabetic foot (IWGDF, 2015, 2019). A broad review of the databases CINAHL, PubMed, Cochrane Library and Google Scholar was conducted to gain insight into the occurrence and impact of DFUs as well as the contributing factors associated

with DFU onset and management. A more focused search of these databases was conducted to identify organizational-level strategies available to support diabetic foot health as well as to determine the effectiveness of these strategies in mitigating DFU. Mesh terms included: diabetes, diabetic foot ulcer, impact, prevalence, occurrence, morbidity, mortality, lower limb amputations, clinical pathway, care pathway, care map, integrated pathway, critical pathway, decision pathway, resources, organizational strategy, care teams, barriers, structural changes, multidisciplinary, diabetic foot care, foot complications, health care providers, patients, health system, family and caregiver.

A librarian scientist from Eastern Health assisted in literature retrieval. Titles and abstracts of the articles retrieved were reviewed to determine relevance to the key questions and inclusion criteria. The reference lists of applicable articles were also reviewed as a secondary search strategy. The Public Health Agency of Canada's (PHAC, 2014) critical appraisal toolkit was used to guide the critical analysis of the quantitative articles selected. The Critical Appraisal Skills Programme (CASP, 2018) qualitative checklist was used to guide the critique of the qualitative literature. Consistent with the integrative review methodology, a synthesis of the literature is presented thematically in the background and intervention sections (Whittemore & Knafl, 2005). The Donabedian (1997) framework for evaluating quality of care provided the theoretical basis for interpretation and analysis of the literature review. Knowles (1984) Theory of Adult Learning provided the conceptual direction for understanding the needs of the target audience. A literature summary table depicting details of key studies is included in the Appendix. For ease of reading, the in-text citations of studies included in the literature summary table appear in bold in the body of the paper.

Background

The WHO (2020) has declared diabetes as a disease of epidemic proportions. To illustrate the extent and magnitude of the problem of diabetes and diabetic foot complications, key details related to incidence, prevalence, impact, and contributing factors will be described in the paragraphs below. Contributing factors unique to Canada and to Newfoundland and Labrador (NL) will also be presented to illuminate the local context.

Incidence and Prevalence

The extent of diabetes and diabetes-related complications is widespread. The incidence and prevalence of diabetes and DFU will be summarized in the paragraphs below.

Incidence and Prevalence of Diabetes

Global projections from the IDF (2021) indicate that 1 in 10 adults live with a diagnosis of diabetes and an even greater proportion remain undiagnosed. The trajectory in Canada echoes global estimates with a pooled national prevalence of 29% for diabetes and prediabetes combined (Diabetes Canada, 2021). According to a report derived from the Canadian Chronic Disease Surveillance System (CCDSS), as of 2019, an estimated 8.8% of Canadians were living with diabetes with approximately 549 new cases being diagnosed each day (LeBlanc et al., 2019). On a provincial level, NL has one of the highest prevalence of diabetes in the country with an estimated pooled prevalence of 34% (Diabetes Canada, 2021; Lukewich et al., 2020). Not surprisingly, the prevalence of diabetes is expected to continue to climb to accompany the exponential rate of obesity observed across the globe (Diabetes Canada, 2020; IDF, 2021; WHO, 2020). Based on an analysis of 219 data sources from 144 countries worldwide, the IDF (2021) projected that approximately 643 million people will suffer from diabetes by the year 2030, and a colossal 783 million by the year 2045. Low-to-middle income countries were disproportionately

affected by the disease, as were cultural minorities such as Indigenous populations and immigrants (Diabetes Canada, 2020; IDF, 2021; WHO, 2020). To compound the problem, it is believed that half of those living with diabetes remain unaware that they have the disease and are therefore unlikely to properly manage their condition or monitor for complications (IDF, 2021). Based on this notion, the true incidence and prevalence of diabetes is essentially unknown.

Incidence and Prevalence of DFU

The 10th Edition of the IDF Diabetes Atlas (2021) unveiled shocking statistics related to the extent and impact of diabetes and diabetes-related complications on a global front. According to the IDF's (2021) most recent projections, approximately two thirds of adults living with diabetes will develop diabetes-related complications in their lifetime and approximately one fourth will develop a DFU. A high-quality meta-analysis of 67 observational, cross-sectional, and prospective studies from 33 different countries also reported on global estimates of DFU incidence and prevalence with similar findings (Zhang et al., 2017). In this review, the global prevalence of DFU was estimated as 6.3% (95% CI: 5.4–7.3%) with the highest prevalence of 13% (95%CI: 10.0–15.9%) observed in North American countries and the lowest prevalence of 3.0% (95% CI: 0.9–5.0%) observed in Oceanian countries. Of the 33 countries analyzed, Belgium was identified as the country with the highest prevalence of DFU at 16.6% (95% CI: 10.7–22.4%), while Canada and the United States followed closely behind at 14.8% (95% CI: 9.4–20.1%) and 13.0% (95% CI: 8.3–17.7%), respectively. The extent of the DFU problem is further complicated by the staggering rate of re-occurrence observed in patients with the condition. According to recent guidelines published by the IWGDF (2019), the lifetime reoccurrence rate for DFU is estimated to be as high as 65% globally (Armstrong et al., 2017;

Bus et al., 2019). Given such alarming statistics, it is quite obvious that the incidence and prevalence of DFU is vast (Armstrong et al., 2017; Harding et al., 2019).

Impact of DFU

Diabetes is a leading cause of morbidity and mortality with DFU recognized as one of the most devastating complications of the disease (IDF, 2021). The profound impact of DFU on patients, families, HCPs and health systems will be described in the following paragraphs.

Impact on Patients

DFU has grave impacts on patient morbidity, mortality, quality of life, day-to-day functioning, and pain and discomfort.

Morbidity and Mortality. In 2019, diabetes was ranked as the ninth leading cause of death worldwide with an estimated 1.5 million deaths attributed to the disease (WHO, 2020). Recent projections from the IDF (2021) predicted an even greater impact on mortality with an estimated 6.7 million adults expected to die from diabetes and its related complications this year alone. DFU is one of the most serious complications of poorly controlled diabetes and is credited as being a significant contributor to morbidity and mortality (Diabetes Canada, 2021; IDF, 2021). The correlation between DFU and LLA is of particular concern given that there is a grim five-year survival rate associated with LLA according to recent high-quality systematic reviews (Harding et al., 2019; Thorud et al., 2016) and trend analyses (Armstrong et al., 2020). A high-quality systematic review examining five-year mortality associated with LLA discovered mortality rates ranging from 53% to 100% in their analysis of 31 medium to high quality studies from North American, European, Asian and African countries (Thorud et al., 2016). While inclusion in the review was not specific to diabetes-related LLAs, the presence of diabetes was identified as a notable risk factor for increased mortality, as was advanced age, renal disease,

proximal amputation and peripheral vascular disease. In this review, methodological rigour was enhanced by the use of broad inclusion criteria and a detailed literature search with no restrictions placed on publishing language (Thorud et al., 2016). Despite the expansive inclusion criteria, the majority of the studies selected were from European and North American countries, which could have biased results.

A recent high-quality cross-sectional study by Armstrong et al. (2020) reported equally as alarming findings about the impact of DFU and LLA on mortality. Based on their analysis of global population-based data published from 2007 to 2017, Armstrong et al. (2020) calculated comparable pooled mortality rates from DFU and LLA to those associated with cancer. The five-year mortality for DFU and minor and major LLA was reported as 30.5%, 46.2% and 56.6%, respectively, whereas the five-year pooled mortality for all-cause cancer was reported as 31.0% (Armstrong et al., 2020). It is evident from the literature that DFU and LLA profoundly impact morbidity and mortality.

Quality of Life and Daily Functioning. In addition to increasing the risk of premature death, DFU and LLA drastically impact quality of life and day-to-day functioning (IDF, 2021). A recent high-quality meta-analysis of quantitative literature revealed significantly lower health-related quality of life (HRQOL) scores among individuals with DFU (Khunkaew et al., 2018). In this review, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines and the Joanna Briggs Institute's (JBI) checklist for appraising quality were used to critique the evidence and improve methodological rigour. Efforts to minimize bias were apparent and only studies considered medium to high quality were included (N=12) in the final analysis. The studies included in this review were predominantly weak cross-sectional designs (n=10) from European countries, which is appropriate given the research question. In their

review, HRQOL was measured using the reliable and valid Short-Form 36 (SF36) tool, whereby quality of life was scored across eight domains using a scale of 0 to 100 with lower scores indicating lower quality of life. Based on their findings, HRQOL was found to be particularly poor among patients with DFU in the domains of physical functioning (mean=42.75, SE 1.5), role functioning (mean=20.61, SE 3.4), general health (mean=39.52, SE 1.7) and vitality (mean=45.73, SE 2.8), thus suggesting a lower quality of life. A well-conducted qualitative study conducted by Barg et al. (2017) also shed light on the unique lived experience of DFU and LLA. Through integrated content analysis, the authors highlighted the substantial impact of DFU and LLA on quality of life, daily functioning and independence. Common themes identified by participants in the study related to the burden of managing care needs, loss of independence, loss of employment, and financial and emotional stress due to high costs of care and feelings of helplessness. Although this study was limited to a single metropolitan region, purposeful sampling strengthened methodological rigour and contributed to the large sample size (N=39) achieved (Barg et al., 2017). It is evident from the literature that DFU and LLA negatively impact quality of life and independence.

Pain and Discomfort. Pain and discomfort in the context of DFU is often difficult to operationalize given the vast differences observed in pain perception and tolerance among patients with diabetes (Ren et al., 2019). Nonetheless, there is a growing body of evidence from recent qualitative and mixed-methods studies to support the notion that patients with DFU experience clinically significant levels of pain (Dickenson et al., 2016; Frescos, & Copnell, 2020; Ren et al., 2019). According to recent international guidelines and high-quality systematic reviews, neuropathic pain and reduced peripheral sensation contributed to a multitude of negative outcomes in patients with DFU including reductions in quality of life and in physical

and emotional wellbeing (Hicks & Selvin, 2019; IWGDF, 2019; Khunkaew et al., 2018; Ren et al., 2019). The results of a medium-quality cross-sectional study conducted by Yunus et al. (2011) of 69 outpatients at a diabetic foot clinic in a teaching hospital in the United Kingdom illuminated the variability of DFU pain symptomology. In this study, the reliable and valid self-report Leeds Assessment of Neuropathic Symptoms and Signs (s-LANSS) pain scale was used to assess the presence of painful neuropathy using a Likert scale of 1 to 12, whereby scores of 12 or more were indicative of neuropathic discomfort. The results of the study showed that s-LANSS scores were significantly greater in patients with DFU compared to those with diabetic neuropathy who did not have DFU. Specifically, 30.6% (n=11) of patients with DFU accrued scores of more than or equal to 12 as opposed to only 4.2% (n=1) of the patients in the diabetic neuropathy control group (p=0.02). Yunus et al. (2011) also found that 43.2% of subjects with DFU experienced signs and symptoms of pain, but only 18.2% of them sought treatment for the pain. Given that there was limited control of confounding variables and significant differences detected between the two groups in age and hemoglobin A1C, the potential for bias must be considered. Despite these limitations and the weak design of the study, the results support the growing assumption that pain is often under-detected and under-treated in patients with DFU (Dickenson et al., 2016; Frescos, & Copnell, 2020; Ren et al., 2019).

The findings that emerged in the literature suggest that living with DFU and LLA greatly impact all aspects of a person's physical, psychological, and social wellbeing.

Impact on Families and Caregivers

The impact of DFU on families and caregivers is substantial. Given the level of dependence patients with DFU often develop, fulfilling a caregiver role does not come without cost to family members and support persons who must undertake added emotional, physical,

social, and financial privations to meet their complex needs (IWGDF, 2019). Evidence from qualitative and quantitative literature provide insight into the financial, emotional, and physical challenges experienced by families and support persons of patients with DFU (Coffey et al., 2019; Crocker et al., 2021; Stevens et al., 2022). A medium-quality cross-sectional study examining caregiver burden among a small sample (N=105) of support persons in Turkey found that caregivers of patients with DFU experienced a moderate level of caregiver burden based on the Zarit Caregiver Burden Scale (Hancerlioglu et al., 2021). This valid and reliable instrument consists of a 22-item scale that measures caregiver burden using a 5-point Likert scale scored between 0 and 4 or "never, rarely, sometimes, quite frequently, and nearly always" (Hancerlioglu et al., 2021). Caregiver burden is calculated based on a scoring system between 0 and 88 whereby higher scores indicated a greater level of burden experienced by the caregiver. Results of the study revealed that caregiver burden was complex and influenced by multiple factors including caregiver age, family structure, education, income, hours spent caring for the patient and attitudes (Hancerlioglu et al., 2021). Caregiver burden was found to be lower in those caring for patients who had no history of amputation than in those caring for patients who had experienced LLA, however, differences were not statistically significant (M=38.04 vs. M=40.61, p=0.5). While this study was conducted at a single site in Turkey and generalizability to Canada is limited, the results illustrated that families and caregivers experience numerous physical, psychological and economic stressors while caring for patients with DFU.

A well-conducted qualitative study by Crocker et al. (2021) in the United States echoed these sentiments as participants with DFU described the immense burden placed on family members and caregivers with regards to coordinating appointments, arranging transportation and attending to patients' ever-increasing care needs. Participants in this phenomenological study

perceived the role reversal and shifting of responsibilities that occurred as a result of DFU and LLA as a considerable family adjustment. According to Crocker et al. (2021), the complexity associated with DFU management was a source of emotional and physical stress for families and caregivers. Thus, there is a growing body of literature to suggest that DFU has a negative impact not only on patients, but on their families and caregivers as well.

Impact on the Health Care System

The impact of diabetes and DFUs on the health care system is equally as dire. Globally, health systems are experiencing shortages in relation to the limited availability of skilled health professionals to respond to the ever-increasing demands of the population (Scheffler & Arnold, 2019). Not only is there an urgent need for comprehensive and timely care to manage chronic diabetic foot needs, but there is also a hefty burden placed on the system related to the management of DFU-related complications (Diabetes Canada, 2021). Diabetes Canada (n.d.) estimates that approximately 70% of the non-traumatic LLAs performed across Canada are related to complications from DFU, which equates to approximately 14 amputations each day. The high volume of LLAs observed across Canada undoubtedly creates a strain on HCPs and health care systems. With one of the highest incidences of diabetes in the country, it is not surprising that NL experiences one of the highest rates of LLA in Canada. In a high-quality cross-sectional study conducted by Imam et al. (2017) examining trends in LLA incidence across Canada, discharge records from the Canadian Institute for Health Information (CIHI) revealed that there were approximately 37.9 amputations per 100,000 individuals in NL between the years 2006 and 2012 compared to the national average of 22.9 per 100,000 individuals.

The excessive volume of LLAs observed in NL and across the country is indicative of the profound burden of DFU on the health care system and is associated with enormous health care

costs. Global health expenditures related to diabetes have been estimated to be in excess of one trillion United States Dollars (USD) with approximately 33% of the total costs attributed to diabetic foot expenses (IDF, 2021; IWGDF, 2019). The cost of managing DFU across Canada is equally as disturbing with expenditure estimates upwards to $550 million nationally based on a well-conducted cost-analysis (Hopkins et al., 2015). In this study, Hopkins et al. (2015) analyzed four national databases across Canada from 2006 to 2011 and estimated annual health care expenses related to DFU management as approximately $550 million dollars nationally or $21,371 per prevalent case. Provincial cost-analyses commissioned by Diabetes Canada (n.d.) in 2018 estimated health care expenditure related to DFU in NL as $16 to $18 million annually in direct costs and an additional $2 to $3 million annually in indirect costs.

Evidence from the literature suggests that the widespread occurrence of DFU coupled with the rising cost of patient care presents undue challenges for health care systems.

Impact on Health Care Providers

Managing the complex care needs of patients with diabetes places exceptional demands not only on health care systems, but also on HCPs who must rise to the challenge. A well-conducted meta-synthesis of qualitative literature by Holmen et al. (2020) provided evidence to support the growing concerns of HCPs in response to the management of chronic diseases such as diabetes. In this comprehensive review of 20 high quality qualitative studies, interpretive thematic coding and analysis revealed significant struggles among HCPs in relation to balancing the demands of patients with the demands of the system. Methodological rigour was enhanced by team-based review of eligible studies and detailed critical appraisal using CASP criteria. Although not specific to diabetic foot health, nine of the 20 studies included in the review explored the perspectives of HCPs such as nurses, physicians, podiatrists, pharmacists and

dieticians in relation to diabetes management. Consistent with other studies discussed in this paper, the majority of the studies included in the meta-synthesis were conducted in European and North American countries (Holmen et al., 2020). Challenges identified by HCPs in relation to the burden of chronic disease management included the inability to keep up with demanding workloads, diabetes-related burnout, anxiety and emotional fatigue due to not being able to meet the growing needs of patients, and frustrations with poor adherence to self-management practices. Roadblocks related to the health care system, such as inadequate support and limited resources, was also identified as a challenge for HCPs (Holmen et al., 2020). It is clear from the findings of this review that the complex nature of diabetes and its related complications has noteworthy impacts on HCPs. Specific factors contributing to the challenges faced by HCPs are discussed in more detail under the contributing factors section below.

Contributing Factors

A multitude of factors contribute to the onset and trajectory of DFU including patient, provider, health care system and local factors.

Patient Factors

While it is well known that routine physical activity, healthy eating, ongoing self-monitoring of blood glucose and compliance with prescribed medications preserve glycemic control and reduce the onset of complications, adhering to diabetes self-care practices is a major challenge for many patients (Diabetes Canada, 2021; IDF, 2021; WHO, 2020). Multiple well-conducted systematic reviews and cross-sectional studies highlight the plethora of factors affecting the ability of patients to practice proper diabetes self-management (Captieux et al., 2018; Degefa et al., 2020; Silva-Tinoco et al., 2021; Rasmussen et al., 2021). Knowledge, socio-economic status, comorbid illness and level of support were among the most commonly cited

factors influencing self-management in patients with diabetes according to the literature (Basu et al., 2018; Captieux et al., 2018; Coffey et al., 2019; Degefa et al., 2020; Diabetes Canada, 2021; Rasmussen et al., 2021; WHO, 2020). Demographic variables such as age, income, and geography also influence self-management practices with elderly patients living in remote areas on fixed incomes recognized as particularly vulnerable to non-adherence (Diabetes Canada, 2020; Lukewich et al., 2020; Rasmussen et al., 2021; WHO, 2021). Lack of knowledge of diabetes and its related complications has been shown to greatly hinder proper adherence, whereas adequate knowledge has been shown to promote self-management and improve glycemic control in several recent high-quality systematic reviews (Captieux et al., 2018; Beck et al., 2021; Kumah et al., 2021; WHO, 2013).

According to a qualitative meta-synthesis conducted by Coffey et al. (2019) exploring the lived experience of patients living with DFUs, inability to accurately perform foot self-assessment is a substantial barrier to DFU self-management. In this high-quality meta-synthesis, the authors conducted a thorough analysis of the qualitative literature using CASP criteria and indicated that overall quality of the 35 studies included was variable but adequate (Coffey et al., 2019). In this review, lack of awareness of diabetes-related foot complications, lack of knowledge of DFU management practices and negative attitude towards diabetes were found to greatly influence self-care practices. A well-conducted qualitative study conducted by Stevens et al. (2022) provided local evidence to support the complexity of diabetic foot self-management in NL. Consistent with Coffey et al. (2019), key themes that emerged from the study also related to level of knowledge of diabetic foot self-management, physical ability to provide proper foot care, ability to afford appropriate footwear, degree of rapport with the HCP, readiness to self-manage and level of support (Stevens et al., 2022).

It is clear from an abundance of literature that there are a multitude of barriers and facilitators to proper foot care that impact adherence to self-management and influence DFU. The combined effect of lack of knowledge, limited access to services, low support, rising cost of supplies and advanced age may greatly hinder self-management. Local contributing factors unique to NL are discussed in more detail in the respective section below.

Provider and Health System Factors

In addition to patient-related factors, provider and health system-related factors are interrelated and contribute greatly to the management of diabetes and diabetes-related complications. Diabetes Canada (2021) endorses the widespread integration of a national Diabetes 360̊ framework to support targeted action in the areas of prevention, screening, treatment and outcomes. Guidelines from the IWGDF (2019) and Diabetes Canada (2018) recommend routine screening for diabetic neuropathy and peripheral vascular disease, frequent foot examinations and targeted diabetes self-management education to improve glycemic control and optimize diabetes outcomes. Despite these recommendations, evidence from the literature indicates that multiple interrelated factors influence the ability of HCPs to implement best practice recommendations.

According to a recent scoping review conducted by Mullan et al. (2019), adherence to diabetic foot care guidelines remains largely influenced by provider knowledge, experience, available resources, time-constraints, and organizational support. In this review, in-depth analysis of eight cross-sectional (n=3), UCBA (n=1) and qualitative (n=4) studies shed light on the relationship between provider and the health system in the management of DFU. Mullan et al. (2019) identified inefficient organizational care processes including inadequate referral pathways and lack of reminder systems as a considerable barrier to proper management of the

diabetic foot. Likewise, staffing shortages, limited funding, and unclear roles and responsibilities were identified as factors impeding the ability of HCPs to provide consistent evidence-based care (Mullan et al., 2019).

According to a well-conducted qualitative meta-synthesis by Coffey et al. (2019), many individuals with diabetic foot concerns receive conflicting advice on foot health from providers and express feeling rushed during appointments. Coffey et al. (2019) also revealed that inconsistencies in the care provided by HCPs is a source of major dissatisfaction among patients with DFU and LLA. While evidence-based guidelines were available to direct HCP management of DFUs, these findings suggest that the slow uptake of best evidence into practice greatly impeded the quality and consistency of care provided by HCPs. Given the current state of the health care system across Canada and the challenges facing providers today, it is plausible that timely assessment, diagnosis, and treatment of diabetic foot concerns may be jeopardized (Holmen et al., 2020; IDF, 2021; Manu et al., 2018; Mullen et al., 2019).

It is evident from the growing body of literature that health system-related factors greatly influence the ability of providers to provide optimal care of patients with DFU.

Local Contributing Factors

The extent and magnitude of the diabetes problem in NL is gravely concerning. According to a high-quality cross-sectional study by Lukewich et al. (2020), only half of the people living with diabetes in the province were achieving glycemic targets of Hemoglobin A1C less than or equal to seven percent. The reasons for suboptimal self-management were complex and interrelated, however, several unique factors influenced the trajectory of diabetes in the province. Firstly, diabetes was more prevalent in rural regions compared to urban regions of the province with incidences of 56.3% and 43.7%, respectively (Lukewich et al., 2020). Glycemic

control was particularly poor in rural communities with data extraction by Lukewich et al. (2020) revealing a mean Hemoglobin A1C value of 7.41% (SD 1.49) compared to 7.26% (SD 1.50) in urban areas. The aging demographic and wide geographical distribution of the province also posed distinctive challenges for proper self-management, given that the incidence of diabetes and comorbid complications increase with age (Diabetes Canada, 2018; Lukewich et al., 2020; Qin et al., 2020). The rural distribution of the diabetes population in NL is important to consider as the availability of health services may be limited in rural regions of the province (Government of Newfoundland and Labrador, 2017).

Despite a call-to-action from Diabetes Canada (2021) to adopt a provincial diabetes strategy, health services for patients living with diabetes in NL remained largely divided across RHAs. While diabetic education was available to patients throughout the province, a standardized approach to facilitating diabetes self-management education was lacking (Government of Newfoundland and Labrador, 2017; Lukewich et al., 2020). Thus, the poor glycemic control and high prevalence of diabetes observed in rural areas is worrisome given that access to diabetic services such as preventative foot care may be suboptimal in these areas (Diabetes Canada, 2020; Lukewich et al., 2020; Newfoundland and Labrador Centre for Health Information, 2018; Zhang et al., 2017).

The rising cost of diabetic self-care is another substantial barrier to proper self-management impacting patients in NL and across Canada. Diabetes Canada (2020) has acknowledged the rising cost of self-management as a great deterrent to proper self-care among Canadians living with diabetes. According to recent cost analyses, out-of-pocket expenses for diabetic supplies and medications varied considerably across Canada from $1000 to $4000 annually (Diabetes Canada, n.d.; Diabetes Canada, 2020; IDF, 2021). The high costs of diabetic

self-care supplies combined with the ever-increasing cost of living imposes a considerable threat to proper self-management, especially for aging populations on fixed incomes (Diabetes Canada, 2020). So much so, seniors' advocacy groups across the province of NL have recounted the growing concerns of seniors in relation to their ability to afford basic necessities such as food, gasoline and home-heating expenses. According to an article published by the Canadian Broadcasting Corporation (2022), many NL seniors have struggled with making difficult decisions regarding how they allocate their spending and in doing so, have had to choose between their medical needs and basic needs.

A well-conducted qualitative study by Stevens et al. (2022) exploring the perspectives of patients, HCPs, and support persons in relation to diabetic foot practices provided further insight into the challenges of diabetic foot management in NL. In this study, interpretive descriptive methodology was used to gain a deeper understanding of diabetic foot self-management from the perspective of patients, HCPs and support persons. The use of detailed data analysis and verification of themes with a patient representative strengthened methodological rigour and improved accuracy of the findings (Stevens et al., 2022). Common themes identified by the participants interviewed were consistent with findings from the literature and included a lack of knowledge of self-management practices, lack of support system, and financial concerns regarding the purchasing of necessities such as footwear.

It was clear from the literature that the unique socioeconomic and demographic circumstances of patients across the province of NL greatly influenced diabetic self-management.

Conclusion

Given the occurrence and wide-reaching impact of DFU on patients, families, providers and health systems, reducing diabetic foot complications and improving patient and system outcomes is a public health priority. The management of diabetes and diabetic foot complications was greatly influenced by a multitude of patient, provider, and health system factors and the relationships among them. Local contributing factors unique to NL also played a leading role in the trajectory of diabetes and diabetes-related complications across the province. To reduce the burden of the disease, prominent health agencies endorsed the widespread implementation of strategies and resources to strengthen HCP management of DFU (Diabetes Canada, 2021; IDF, 2021; WHO, 2020). Using the Donabedian Model of Quality of Care, this integrative review of the literature aims to determine the effectiveness of organizational-level strategies in assisting HCPs in the management of DFU.

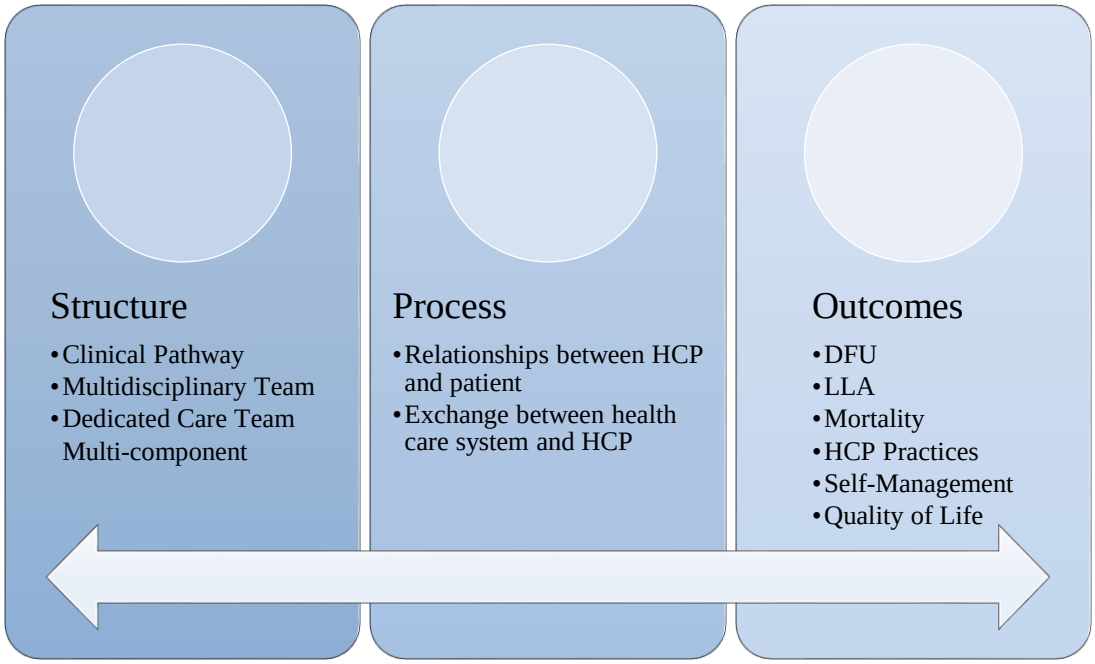
The Donabedian Model of Quality of Care

The Donabedian framework was originally published in 1966 by Avedis Donabedian to provide conceptual direction for assessing quality of healthcare systems. According to Donabedian's model, the assessment of quality encompasses three dimensions: structure, process and outcome. Within this model, *structure* refers to the organizational or health system resources and facilities, *process* refers to the care that is provided and received in the exchange between patient, provider and system, and *outcome* refers to the effects of the care on the patient, provider the system (Donabedian, 1997; Harrison & Graham, 2021). According to the Donabedian model, congruency between all three elements is critical to achieving optimal quality of care (Donabedian, 1997; Harrison & Graham, 2021). Based on this notion, implementing changes at the structure level to address diabetic foot health is thought to produce changes at the process and

outcome level to mitigate the impact of DFU. For the purpose of this integrative review, each organizational strategy, which will be defined in the next section, are presented in context of the Donabedian model triad of structure, process and outcomes as depicted in Figure 1 below.

Figure 1

Donabedian Model of Care for the Diabetic Foot



Organizational Strategies to Prevent Foot Complications Related to Diabetes

The primary objective of this review was to identify organizational strategies that could potentially support the prevention of foot complication related to diabetes. Before exploring the literature and to provide context, the definitions of the organizational strategies that fall under structure, as outlined in the Donabedian Model, will be presented. Next, an overview and critical appraisal of the body of evidence will be presented. This will be followed by a presentation of the results in relation to process and outcomes as defined by the Donabedian model.

Overview of Organizational-Level Interventions

A review of the literature provided evidence to support the implementation of four distinct organizational-level approaches to improve diabetic foot management: dedicated care teams (DCTs), CPWs, MDTs and multi-component interventions. For context and ease of reading, each structural approach is briefly defined below:

Dedicated Care Teams

DCTs are defined in the literature as specialized teams of health professionals dedicated to the care of patients with a common condition or illness (Flanagan et al., 2008; Meza-Torres et al., 2021). In comparison to MDTs, DCTs are distinguished by their focus on an explicit condition or clinical population rather than on the composition and role relationships of its team members (Flanagan et al., 2008). For the purpose of this literature review, DCTs refer to the specialized teams appointed to manage the care of patients with diabetic foot concerns.

Clinical Pathways

CPWs are defined as organizational-level care processes that facilitate the systematic management of a clinical condition by providing standardized guidance and evidence-based provisions to support clinical decision-making (Centre for Policy on Ageing, 2014; Lawal et al., 2019; Meza-Torres et al., 2021). For the purpose of this integrated review, CPWs refer to organizational care pathways designed to assist HCPs in the comprehensive management of diabetic foot concerns.

Multidisciplinary Teams

MDTs are defined in the literature as multispecialty approaches to health care that involve the purposeful coordination of two or more disciplines to provide comprehensive care to individuals with complex health needs (Abrahamyan et al., 2015; Meza-Torres et al., 2021). For the purpose of this integrative review, MDTs refer to the multispecialty teams involved in the

coordinated care of patients with diabetic foot concerns. While composition may vary, MDTs specific to the care of the diabetic foot are often comprised of disciplines such as endocrinology, podiatry, nursing, vascular, orthopedics, pharmacy and dietetics.

Multi-Component Interventions

Multi-component approaches refer to organizational-level integration of two or more of the above approaches to manage diabetic foot health. The most common combination of interventions noted in the literature for DFU management is the joint implementation of CPWs and MDTs (Meza-Torres et al., 2021). For the purpose of this integrative review, multi-component interventions refer to the joint implementation of CPWs and MDTs.

Overview of the Literature

An extensive review yielded over 600 sources of literature on organizational-level strategies for diabetic foot management. Following a review of the titles and abstracts of the articles retrieved, approximately 60 studies were selected for further review. Upon closer examination, studies (n=25) focused solely on low-resource countries were excluded, as were studies (n=4) focused on wound care models not specific to the diabetic foot and studies (n=9) published prior to the year 2017. Given that international guidelines have changed considerably over the past five to 10 years, only studies published from 2017 onward were considered relevant for inclusion (IWGDF, 2019). Five editorial pieces were also excluded. Following an in-depth screening of the full-text versions of the remaining articles, a total of five studies describing organizational-level strategies for HCPs to address DFUs were selected for the integrative review (Meza-Torres et al., 2021; Mullan et al., 2021; Musuuza et al., 2020; Chan et al., 2020; Thanh et al., 2020).

A high-quality systematic review and meta-analysis of 57 descriptive and analytic studies from all over the world formed the basis of the evidence included in the integrated review (Meza-Torres et al., 2021). The purpose of this review was to investigate the effectiveness of processes of care in the management of DFU as measured by the change in the incidence of LLA over time. Eligible study designs included in the review were limited to controlled or observational studies, either prospective or retrospective, and systematic reviews or meta-analyses. Studies included in the review were predominantly descriptive studies (n=30) that utilized retrospective cross-sectional and cohort designs, however, there were a number of analytic studies that used randomized control trial (RCT; n=2), UCBA (n=4), nonrandomized control trial (NRCT; n=2) and prospective cohort (n=4) study designs. Five systematic reviews were included in the review. A number of key studies from Meza-Torres et al. (2021) were highlighted individually to illustrate the nature of the organizational-level interventions investigated. Considering the review effectively captured evidence published between the years 1999 and 2019, the four additional articles included in this paper were dated from 2019 onward. Fifty-six studies included in the review by Meza-Torres et al. (2021) examined either MDTs, CPWs or multi-component approaches, while only one study (Spanos et al., 2017) examined DCTs.

The remaining studies included in this paper consist of a systematic review (Musuuza et al., 2020), two cross-sectional (Chan et al., 2020; Thanh et al., 2020), and one qualitative (Mullan et al., 2021) study. While there is some duplication of studies between the two systematic reviews (n=4), each review offered a distinct contribution to the cumulative evidence. Meza-Torres et al. (2021) focused on examining all four organizational strategies whereas Musuuza et al. (2020) focused solely on the effectiveness, composition and function of the MDT

approach**.** In the high-quality systematic review, Musuuza et al. (2020) examined 33 descriptive and analytic studies from national and international databases to report on the impact of MDTs on diabetic foot outcomes. Of these studies, only four were duplicated in the review by Meza-Torres et al. (2021). Thus, twenty-nine unique studies examining the impact of MDTs on DFU and LLA were evaluated (Musuuza et al., 2021). Consistent with Meza-Torres et al. (2021), the studies included in the review by Musuuza et al. (2020) were predominantly descriptive designs.

As noted above, DCTs, CPWs, MDTs, and multi-component interventions were identified in the literature as the most prominent organizational care processes to address DFUs. The research evidence related to the effectiveness of each of these strategies will be presented in relation to process and outcomes such as: DFU, LLA, mortality, coordination of care, provider assessment, referrals, cost, improved quality of life, and relationship between the patient and the HCP. Specific details related to the critical appraisal of the studies will be described in the paragraphs below, followed by a discussion of the research findings.

Critical Appraisal Summary

Each study was critically appraised to determine the strength and the usefulness of the evidence in providing support for organizational interventions to prevent DFUs. Two systematic reviews and two cross-sectional studies were analyzed using the PHAC toolkit, while the CASP criteria were used to critique the qualitative study by Mullan et al. (2021). An overview of the studies and critical appraisal is described in this section.

The systematic review and meta-analysis conducted by Meza-Torres et al. (2021) was methodologically sound and used valid and reliable tools to appraise quality and risk of bias including the Newcastle-Ottawa and Cochrane Collaboration scales. As previously noted, the purpose of this review was to investigate the effectiveness of processes of care in the

management of DFU as measured by the change in the incidence of LLA over time. The majority of the 57 studies included in the review were conducted in North American and European countries, however, there were also a number of studies conducted in Asian countries. Strengths of the review included use of detailed study selection process, independent review of eligible studies by multiple authors and use of funnel plot statistics to assess publication bias. Despite the high quality of the review, over half (n=30) of the studies were descriptive in nature and utilized weak designs such as cross-sectional and retrospective cohort designs. Studies also varied in setting, sample size, and target outcomes, but major and minor LLA were the primary outcomes explored across all studies. Conceptual incongruence in the composition of the interventions yielded considerable heterogeneity between studies thus only seven of the 57 studies qualified for meta-analysis. All seven studies included in the meta-analysis were analytic studies that were considered high quality with low risk of bias and included two RCTs, one NRCT and three cohort study designs. Furthermore, all seven studies presented results in terms of quantitative measures, such as the number of LLA cases and number of people at risk of LLA. According to the authors, methodological limitations of the studies in the review included a marginal risk of bias due to low power in two of the studies as well as low to moderate agreement between authors in relation to interpretation and classification of the study interventions. Despite these limitations, the review was high-quality and yielded sufficient evidence from medium and high-quality studies to support the role of the organizational-level strategies in the management of the diabetic foot.

Critical appraisal of the remaining four studies described in this review revealed moderate strength evidence to support the effectiveness of DCTs, CPWs, MDTs, and combination approaches. A review of recent literature revealed limited high-quality evidence

produced in the years since the systematic review by Meza-Torres et al. (2021) was published. Apart from one other high-quality systematic review (Musuuza et al., 2020), the remainder of the studies (**Chan et al., 2020;** Thanh et al., 2020) described in this paper utilized weak cross-sectional designs and yielded medium quality evidence.

As previously stated, the systematic review by Musuuza et al. (2020) of 33 descriptive and analytic studies provided evidence to support the effectiveness of the MDT approach specifically in the management of DFU. Methodological strengths of the systematic review included a detailed selection process with review of multiple databases using PRISMA guidelines with clear inclusion and exclusion criteria. Study selection and data abstraction were rigorous and involved the use of two independent reviewers and structured checklists to minimize bias. While studies published in non-English languages were excluded from the review, the use of the Systems Engineering Initiative for Patient Safety (SEIPS) model strengthened methodological rigour by providing a conceptual framework for the review that extends on the Donabedian model of structure-process-outcome (Musuuza et al., 2020). Similar to Meza-Torres et al. (2021), studies included in this review were predominantly descriptive with the majority of studies utilizing cross-sectional and cohort designs. In contrast to Meza-Torres et al. (2021), however, there were no RCTs included in this review (Musuuza et al., 2020). Quality assessment by the authors indicated that the majority of the studies included in the review were considered low risk of bias.

Methodological shortcomings in the remaining cross-sectional studies by **Chan et al. (2020)** and Thanh et al., (2020) included low response rate, convenience sampling, inadequate control of confounding variables and selection bias. The phenomenological qualitative study by

Mullan et al. (2021) was methodologically sound, strengthened by detailed thematic analysis and inductive process methodology.

A detailed discussion of the effectiveness of each strategy is presented in the next section. Specific details from a number of the key studies included within the systematic reviews are described to showcase the nature of the interventions examined.

Evidence of Effectiveness of Process and Outcome

An overview of the evidence from the literature will be presented in this section as it relates to each of the four organizational-level approaches identified: DCTs, CPWs, MDTs and multi-component interventions. In keeping with the Donabedian model, the effectiveness of each intervention is described in relation to process and outcome. While the majority of the evidence relates to the impact of the interventions on the outcomes of DFU and LLA, secondary outcomes such as mortality, quality of life, pain, cost-effectiveness, hospital admission and length of stay, HCP practices and self-management are also described. Only one qualitative study by Mullan et al. (2021) provided evidence to support process measures as is described in the CPW section.

Dedicated Care Teams

The effectiveness of DCTs was examined in two studies: one UCBA study (**Spanos et al., 2017**) conducted in Central Greece and one cross-sectional study (**Chan et al., 2020**) conducted in Alberta, Canada. The study by Spanos et al. (2017) was the only study of 57 studies included in the systematic review (Meza-Torres et al., 2021) to examine the DCT approach. Methodological strengths of the Spanos et al. (2017) study included high retention and use of sophisticated statistics such as multivariable analyses, while study limitations include single source recruitment. Likewise, methodological rigour was limited in the study by Chan et al.

(2020) by the potential for selection bias due to low participation. A description of these studies is provided below:

Description of Studies

In the high-quality study by **Spanos et al. (2017)**, the impact of a vascular surgeon-led foot care clinic on diabetic foot health was examined. During the 12-month study period, patients (n=103) attended regular clinic visits whereby they had routine history and physicals, received targeted education about self-management practices and underwent diagnostic evaluations as necessary. The authors indicated that the DCT was multidisciplinary in nature but varied depending on the patient's needs at baseline. Clinical assessment included palpation of the peripheral arteries, ankle–brachial index (ABI) measurement and ulcer evaluation. Upon entry into the study, patients were referred by the vascular surgeon to specialty services such as endocrinology, cardiology, nephrology, ophthalmology, orthopedics and neurology depending on their individual needs. Primary outcomes (wound healing and minor and major amputation) were analyzed through chart reviews, while secondary outcomes (quality of life, pain, and self-management) were measured using valid and reliable instruments at baseline and at 12 months. Reliable and valid instruments were used to collect data related to these outcomes as outlined in the literature summary table.

A DCT approach was also employed by Alberta Health Services (AHS) in 2014 as part of their provincial diabetes strategy with promising results (**Chan et al., 2020).** In a medium quality cross-sectional study conducted by **Chan et al. (2020)**, the impact of these specialty teams was evaluated. A combination of convenience and purposeful sampling was used to elicit information about foot care practices, screening, assessment and referrals prior to and post-implementation of the DCT. The DCT, described as high-risk foot care teams (HRFTs), consisted of physicians,

nurse practitioners, nurses and occupational therapists. Implementation sites included primary health care, home care and long-term care, acute and emergency care, and specialty diabetes clinics. In this study, surveys were administered online to HCPs working in these sites in 2014 and again in 2019 to gain insight about service provision and provider practices, however, respondents were not the same for both surveys. Statistical analysis was used to compare responses from both data collection periods with significant differences detected in provider assessment, screening and referral practices. While there is evidence of benefit of the approach, the majority of responses were from one HCP subgroup (nurses). Thus, it is possible that this subpopulation of HCPs was overrepresented.

Specific details related to the result of these studies are described below.

Overview of Results

Two of the studies examining DCTs that are included in this paper focused on the effectiveness of the strategy in relation to outcomes but did not measure process. Spanos et al. (2017) examined the impact of a vascular-led foot DCT on DFU healing, LLA, quality of life, pain and self-management, whereas Chan et al. (2020) examined the impact of a DCT on HCP practices such as foot assessment and referrals. Key results from these studies are summarized below under the respective outcomes.

DFU and LLA. One UCBA study included in the systematic review conducted by Meza-Torres et al. (2021) examined the impact of a DCT on DFU and LLA with promising results. During this 12-month study, 41% of participants achieved complete ulcer healing, which is clinically significant. Likewise, no patients developed new DFUs or suffered deterioration of previously healed DFUs during the study, which is also clinically significant. Despite these

positive results, the incidence of minor and major LLA remained high at 41% and 17.6%, respectively (Spanos et al., 2017).

Multivariable regression analysis revealed that limb loss was associated with several contributing factors including non-palpable popliteal artery, longer in-hospital stay, and delay in referral to the clinic. Thus, presence of non-palpable popliteal artery increased odds risk for major LLA by 5.2% (95% CI: 1.03-26, p= .045), whereas each additional day of hospital stay increased the odds risk for a major LLA by 8% (95% CI: 2%-14%, p=0.007) and each additional day of delay in referral increased the odds risk for major LLA by 3.5% (95% CI: 1%-6%, p=0.011).

Pain. In regards to the assessment of pain, all patients in the study by Spanos et al. (2017) had LANSS scores of greater than 12 which indicated a high prevalence of neuropathic pain among patients with DFU. For every increase of one unit in LANSS score, the risk for minor LLA was found to increase significantly by 43% (95% CI: 2%-100%, p= 0.040). VAS scores, which measure the impact of pain on activities of daily living (ADLs) and pain intensity on a scale from zero to ten indicated that the impact and intensity of pain decreased significantly from baseline to 12 months. Specifically, the impact of pain on ADLs decreased from 6.8 (SD 2.5) to 4.2 (SD 1.2) and the mean intensity of pain decreased from 6.3 (SD 2.2) to 2.8 (SD 1.3, p=.05).

Quality of Life. The results of the study by Spanos et al. (2017) showed that quality of life improved significantly across all domains of the DFS-SF following 12 months of the intervention compared to baseline (p<0.0001). The highest improvements were noted in domains related to leisure and negative emotions with a mean increase in quality of life of 16.5 and 18.2 from baseline to 12 months, respectively. The lowest improvements were found in domains

related to physical health, ADLs and treatment satisfaction with mean increases of 9.9, 10.9, and 12.4, respectively.

Self-Management. A significant improvement was observed in all domains of self-management in the study by Spanos et al. (2017) from baseline to 12 months as outlined in the literature summary table. The most notable improvement was observed in weekly self-examination which increased from 1.84 times per week to 8.40 times per week ($p=0.05$).

HCP Practices. The impact of DCT on provider practices was examined in one cross-sectional study by Chan et al. (2020). In this study, self-reported provider foot assessment increased significantly from 2014 to 2019 ($p<0.05$). A total of 55% ($n=36$) of respondents reported that their site provided assessment of moderate risk patients in 2019 compared to only 35% ($n=34$) in 2014 ($p<0.05$). Approximately 90% of respondents reported performing assessment of vascular problems in 2019 compared to approximately 60% in 2014 ($p<0.05$). In terms of frequency of assessment, only 18% of clinics reported not using a formalized schedule for DFU assessment in 2019 compared to 53% in 2014 ($p<0.001$). In keeping with the latest Diabetes Canada (2018) CPGs, a greater proportion of clinics utilized a 4-to-6-month reassessment schedule in 2019 than in 2014 (28% vs. 12%, respectively; $p=0.039$). According to their analysis, the number of referrals increased significantly across all sites from 2014 to 2019 ($p<0.001$). Although referral to HRFT was not a possible option in 2014, it is promising that nearly half of the sites referred patients to HRFT services in 2019. HRFT was also associated with a significantly greater assessment of pedal pulses than standard of care practices, which is encouraging ($p<0.05$).

Summary

DCTs have been identified in the literature as a strategy to strengthen diabetic foot services. Given the paucity of literature, a review of the available evidence indicated that there is insufficient evidence to support the effectiveness of DCTs in DFU management. The systematic review and meta-analysis conducted by Meza-Torres et al. (2021) provided evidence of only one study (Spanos et al., 2017) that utilized this approach with promising results. While significant improvements were noted in quality of life, pain, and self-management, no significant differences were detected in incidence of wound healing or LLA post-implementation of a DCT clinic. Nonetheless, clinically significant improvements were detected in DFU healing from baseline to 12 months. It is plausible that the lack of significant differences in LLA incidence could be attributed to the short length of follow up in this study as well as the presence of comorbid conditions. Although multiple regression analysis was used to control for confounding variables such as ulcer characteristics, the presence of comorbid factors such as peripheral arterial disease, coronary artery disease and obesity were not controlled for. Given the high prevalence of these underlying conditions (approximately 50% of the sample), it is difficult to determine the true association between the intervention and LLA outcomes.

While LLA incidence was not evaluated in the study by Chan et al. (2020), the cross-sectional study provided support for the impact of the DCT approach on HCP assessment, screening and referral practices within a Canadian context. Although the DCT approach seems to be a promising organizational-level strategy for the management of diabetic foot care, a conclusion cannot be drawn about its effectiveness in mitigating DFU at this time. Given the limited number of studies and their methodological limitations, further research using rigourous

well-conducted longitudinal study designs is needed to substantiate a claim that DCTs are effective in mitigating DFU and LLA.

Clinical Pathways

CPWs have been gaining momentum in the literature as effective tools to promote the uptake of best practice recommendations across health care institutions (Lawal et al., 2019). The role of CPWs in diabetic foot health was examined in multiple studies included in the systematic review conducted by Meza-Torres et al. (2021) as well as in a recent cross-sectional study conducted by Thanh et al. (2020) in Alberta, Canada and a recent qualitative study by Mullen et al. (2021). An overview of these studies is described below.

Description of Studies

Twenty of the 57 studies included in the systematic review (Meza-Torres et al., 2021) focused specifically on CPWs, while an additional 21 studies described the combined impact of CPWs and other organizational-level approaches. The joint initiation of CPWs with MDTs was the most common combination noted in the literature, however, tailored education was also a common adjunct to CPWs in several studies. Further analysis of the individual studies included in the systematic review revealed 11 descriptive cross-sectional study designs and 10 analytic study designs consisting of NRCT (n=1), UCBA (n=2) and cohort (n=6) studies examining CPWs. Despite the abundance of literature on CPWs, there was variability in the composition and focus of the pathways, quality of the studies, and in the consistency of the results. Several studies examined novel CPWs developed specifically for evaluation in the study, while other studies examined existing service provisions and processes within the organization and referred to these processes as pathways. CPWs also differed in multidisciplinary involvement as well as in the level of provider contact, duration, and length of the intervention. According to Meza-

Torres et al. (2021), primary care physicians, podiatrists, endocrinologists and specialized nurses were among the most commonly cited HCPs included in the pathways described.

While 18 of the studies examining CPWs demonstrated support for the approach, two medium quality cross-sectional studies provided weak evidence against the approach with non-significant findings lending to the low strength of the evidence. In these two medium quality cross-sectional studies (Gandhi et al., 2015; Lazzarini et al., 2018), the complexity associated with implementing CPWs was identified as a major factor impeding the effectiveness of the pathways in mitigating LLA. Namely, organizational barriers such as limited financial and human resources to support timely implementation and coordination of care of pathway components were identified as impeding factors to CPW success. Of the 18 studies included in the systematic review in favour of CPWs, half (n=9) yielded strong evidence and half (n=9) yielded low to moderate evidence in support of the effectiveness of CPWs in the reduction of LLA. Despite the lack of strong study designs, there was moderate evidence from studies included in the systematic review to support the effectiveness of CPWs in reducing LLA. Two of the seven studies included in the meta-analysis examined the impact of CPWs with promising results, but these studies were quite dated (Crane et al., 1999; Wrobel et al., 2003). Although these two studies used analytic study designs (NRCT and cohort), they will not be discussed in detail in this paper given that they were published approximately 20 years ago. Instead, two other studies (**Giorda et al., 2012; Paisey et al., 2018)** from the systematic review that were published within the last decade will be discussed to illustrate the nature of the CPW approach. Both of these studies yielded strong evidence in favour of CPWs and are described below.

Giorda et al. (2012) conducted a high-quality cohort analysis to examine the impact of a CPW on glycemic control and diabetes-related complications such as LLA among a large

population in Italy, while **Paisey et al. (2018**) conducted a medium-quality cross-sectional examination to examine the impact of a CPW on incidence of DFU and LLA in the United Kingdom. Both studies compared LLA incidence based on the care processes implemented. Giorda et al. (2012) compared LLA incidence and mortality among patients based on the level of care received. Cohorts consisted of primary physician only, primary physician care and specialist care, primary physician care with adherence to screening guidelines, and primary physician care and specialist care with adherence to guidelines. For the purpose of their analysis, patients receiving primary care and specialist care with compliance to screening guidelines were considered recipients of a comprehensive CPW. Paisey et al. (2018), on the contrary, compared LLA over a ten-year time period according to the number of service provisions experienced. In contrast to Giorda et al. (2012), who focused on the level of specialty care, the CPW evaluated by Paisey et al. (2018) was multidimensional, involving provisions such as tailored patient education, regular provider education, adequate podiatry staffing, multi-disciplinary diabetic foot care, administrative support, increased screening, regular vascular assessment, inclusion of orthotist as part of care team, and use of a DFU registry database. Both studies were strengthened by longitudinal data collection and strong statistical analysis with Giorda et al. (2012) using multivariate regression to assess for possible confounders. Upon analysis, only slight differences were detected in socioeconomic and clinical profiles between the four cohorts in the study by Giorda et al. (2012). Likewise, very little differences were noted between participants in the study by Paisey et al. (2018) with 95% of the population described as Caucasian. While generalizability to more ethnically diverse populations may be limited, promising results were demonstrated in both studies in relation to the impact of CPWs on incidence of DFU and LLA.

In addition to the studies included in the systematic review (Meza-Torres et al., 2021), a descriptive cohort study conducted by Thanh et al. (2020) provided insight into the Canadian context of CPW implementation in the province of Alberta. Similar to Paisey et al. (2018), this particular CPW was comprised of evidence-based guidance for screening, assessment, treatment, referrals, resources, education and ongoing support for HCPs and patients in the management of diabetic foot concerns. Health service utilization and DFU and LLA occurrence were the primary outcomes compared between the two cohorts: one group of patients with diabetes who were exposed to the CPW and a second group of patients with diabetes who were unexposed. Patients were recruited from multiple sites across Alberta with data extraction from provincial health records capturing one year of follow-up. While significant differences were detected between groups in age, sex, Hemoglobin A1C, and location, sophisticated statistical analysis using propensity matching was used to enhance study rigour. Despite the robust sample size of over 3000 patients, the short follow-up period of one year limited the strength of the evidence.

A well-conducted qualitative study conducted by Mullan et al. (2021) provided support for the CPW approach as an organizational level strategy to overcome barriers to diabetic foot care delivery. In this descriptive qualitative study, the authors utilized inductive process methodology to gain a deeper understanding of the perspectives of seven key health decision-makers in Australia. Purposeful sampling was used to obtain perspectives of these key stakeholders including health system directors, primary care clinical managers, policy advisors and health officers. Semi-structured interviews were conducted with each participant, audio recorded, and transcribed verbatim to be reviewed for accuracy by all authors. Methodological rigour was supported by independent thematic analysis as well as consensus among authors regarding coding decisions and the themes identified. While the findings of this study were not

specific to CPWs, support for such a model of care was acknowledged by participants as a formative strategy to improve diabetic foot care delivery. An overview of the results of these studies is described below.

Overview of Results

Twenty of the 57 studies included in the systematic review (Meza-Torres et al., 2021) focused specifically on CPWs, yielding strong evidence in support of the approach. The results of the systematic review are described below with specific results from two of the studies (**Giorda et al., 2012; Paisey et al., 2018**) included in the review highlighted to illuminate the role of CPWs in reducing LLA and mortality. In addition to the systematic review, results from a high-quality cross-sectional study conducted by Thanh et al. (2020) in Alberta is described to illustrate cost-effectiveness within a Canadian context as well as a qualitative study by Mullan et al. (2021) conducted in Australia to illustrate the perspectives of key decision-makers.

DFU and LLA. There is promising evidence from one NRCT, two UCBA, six cohort and nine cross-sectional studies included in the review by Meza-Torres et al. (2021) to support the effectiveness of CPWs in mitigating LLA. One high-quality cohort study by **Giorda et al. (2012)** reported an increased incidence of LLA among those receiving care from a primary care physician as opposed to a CPW with adjusted rates ratios (RRs) up to 2.03 (95% CI 1.26–3.28) in the primary care only cohort compared to 1.0 for the CPW over the four-year data collection period. The results of their analysis showed that receiving specialist care was associated with lower risk of LLA, especially when combined with adherence to screening guidelines, which was identified as a strong modifier of patient prognosis in relation to LLA.

Consistent with Giorda et al. (2012), the medium-quality cross-sectional study by **Paisey et al. (2018)** also reported statistically significant differences in DFU and LLA incidence and

prevalence with the introduction of CPW service provisions. Specifically, inverse correlations were detected in DFU incidence and LLA prevalence with increases in the number of care processes overtime. For the incidence of DFU, new ulcers decreased from 15 ulcers per 1000 with diabetes in 2005 (only 2 service provisions) to 6 ulcers per 1000 with diabetes in 2015. Statistically significant reductions in LLA prevalence were also detected with 33 LLAs per 10,000 persons with diabetes in 2005 compared to 4 LLAs per 10,000 persons with diabetes in 2015 (9 service provisions; $p=0.0115$, $z=-2,526$).

Thanh et al. (2020) also found a lower DFU and LLA incidence in the exposed group to compared to the non-exposed group at 4.6% versus 6.1% and 1.6% versus 1.2%, respectively at the one-year follow-up ($p>0.05$). While the results of this study were not statistically significant, they hold clinical significance in relation to the role of CPWs within a Canadian context (Thanh et al., 2020).

Mortality. Mortality was not one of the outcomes analyzed in the systematic review but a closer examination of the previously discussed study by **Giorda et al. (2012**) showed a significant reduction in mortality with the introduction of a CPW. In this study, patients receiving the lowest level of care (primary care only) experienced higher mortality compared to those receiving the highest level of care consistent with the CPW approach (physician, specialist and adherence to screening guidelines). Lower rates of mortality were observed among patients who received care based on the CPW compared to the alternative pathways described. All-cause mortality was calculated at 31.3 per 1000 person years for the physician only group, 19.9 per 1000 person years for the physician and adherence to screening guidelines group, 26.0 per 1000 person years for the physician and specialist group, and 19.1 per 1000 years for the CPW group that involved physician, specialist and adherence to screening guidelines (Giorda et al., 2012).

The adjusted RRs and 95% confidence intervals for each pathway are depicted in the literature summary table in the Appendix.

Cost-Savings. According to the cost-analysis calculations in the study by Thanh et al. (2020), the implementation of a CPW was shown to be cost-effective demonstrating a cost-savings of $3000 per patient each year with a return on investment of $7.40 for every invested $1.00, which is promising.

Key Stakeholder Perspective. Mullan et al. (2021) provided qualitative support for the implementation of CPWs. In this study, five of the seven key policy holders acknowledged the importance of developing models of care and referral pathways to improve diabetic foot care delivery and enhance communication between providers. Participants also acknowledged the need for collaborative CPWs that were interdisciplinary in nature to provide guidance for HCPs and promote consistent care and timely referrals.

Summary

While rigorous study designs were lacking, there was moderative evidence from medium and high quality NRCTs (n=1), UCBAs, (n=2), cohorts (n=6), and cross-sectional (n=9) studies in the systematic review (Meza-Torres et al., 2021) to illustrate the effectiveness of CPWs in reducing LLA. As demonstrated by a comparison of two of the studies (Giorda et al., 2012; Paisey et al., 2018) included in the systematic review and a critical appraisal of the cross-sectional study by Thanh et al. (2020), there were variations in CPW composition and target focus between studies. In addition to measuring LLA incidence, the study by Thanh et al. (2020) provided insight into the cost-savings benefit of CPWs within a Canadian context while the study by Giorda et al. (2012) demonstrated favourable effects of a CPW on mortality. Qualitative findings from the study by Mullan et al. (2021) illuminated the perspectives of key stakeholders

regarding the need for CPWs to improve diabetic foot care delivery and communication among HCPs. Despite the growing body of evidence to support the effectiveness of CPWs, further research using robust study designs such as NRCTs and RCTs are needed to strengthen the existing evidence base and determine the most effective attributes to include within a CPW to optimize diabetic foot health. As complications of diabetes develop over time, longitudinal trend analyses are needed to determine the effectiveness of CPW in preventing DFU and LLA in the long term.

Multidisciplinary Care Teams

Fifteen (18%) of the 57 studies included in the systematic review by Meza-Torres et al. (2021) focused on the effectiveness of MDTs in the reduction of DFU and LLA with favourable results. A high-quality systematic review by Musuuza et al. (2020) also provided evidence in support of the MDT approach. While there was some overlap noted between the two systematic reviews, Musuuza et al. (2020) examined twenty-nine independent studies not included within the review by Meza-Torres et al. (2021) and provided insight into the composition and function of MDTs. An overview of these two systematic reviews is presented below.

Description of Studies

A review of the 15 studies included in the systematic review by Meza-Torres et al. (2021) revealed predominantly cross-sectional (n=10) study designs with considerable heterogeneity in team member composition and function. Of the analytic studies examining MDTs, there were three cohort, one UCBA and one RCT. Of these studies, approximately 60% (n=9) contributed strong support and approximately 40% (n=6) contributed weak support in favour of the MDT approach. According to this review, most of the MDTs in the literature included a combination of primary care and specialist care providers such as nurses, physicians, podiatrists, vascular

surgeons and endocrinologists. Only one of the 15 studies evaluating MDTs met criteria for inclusion in the meta-analysis, however, this high quality RCT by Liang et al. (2012) conducted in China was not representative of the general DFU population in Canada due to its focus on a specific Chinese minority group. Instead, one of the medium quality cohort studies **(El-Sakka et al., 2006**) included in the systematic review that demonstrated strong support for the MDT approach will be illuminated to illustrate the role of the MDT in improving diabetic foot health.

In this medium quality cohort study by El-Sakka et al. (2006), a total of 128 diabetic patients with lower limb ischemia were recruited from hospital wards and outpatient clinics and triaged by a vascular surgeon-led MDT consisting of a diabetes consultant, a podiatrist and a radiology procedure coordinator in the United Kingdom. Based on clinical assessment using Doppler arterial waveform evaluation, ABI measurements, transcutaneous oxygen pressure, and duplex angiogram, patients were assigned to receive either active-surgical/radiological intervention (n=76), medical treatment (n=34) or palliative care (n=18). Participants assigned to the active-treatment group received further diagnostic evaluation and assessment as needed based on their individual foot care needs. While methodological shortcomings of the study included limited control of confounding, the MDT approach was found to have a favourable response on major and minor LLA ratios during the 18-month study period.

Similar to Meza-Torres et al. (2021), a high-quality systematic review by Musuuza et al. (2020) examined 33 analytic studies from reputable national and international literature databases to report on the impact of MDTs on diabetic foot outcomes. As previously indicated, methodological rigour was strengthened by an extensive search and selection process with independent reviewers performing quality and bias assessment. Of these studies, four were duplicated in the review by Meza-Torres et al. (2021). Thus, twenty-nine unique studies

examining the impact of MDTs on DFU and LLA were represented (Musuuza et al., 2020). While the review included studies of primarily weak and moderate strength designs such as cohort (n=6), UCBA (n=25), and case-control (n=2), there was sufficient evidence demonstrating a favourable impact of the MDT approach on LLA. Consistent with Meza-Torres et al. (2021), Musuuza et al. (2020) found that the majority of MDTs consisted of a combination of medical and surgical disciplines with endocrinology being the most prominent specialty represented. To exemplify the composition of the MDT approach, specific details from one of the studies included in this review **(Weck et al., 2013)** is described in the next paragraph.

Weck et al. (2013) conducted a medium-quality NRCT to examine the effects of a structured MDT program for the diabetic foot on LLA and mortality among patients admitted to hospital with DFU in Germany. Participants (n=684) in the intervention group were recruited from three large regional hospitals between the years 2000 to 2007, while participants (n=508) in the control group were recruited from a separate regional hospital between the years 2005 and 2007. Following referral to the MDT foot care ward, patients in the intervention group underwent initial diagnostic assessments including foot assessment, palpation of peripheral pulses, vibration sensation assessment, and measurement of perfusion by ABI and Doppler. In both the intervention and control groups, DFUs were graded and staged using the valid and reliable modified University of Texas Wound Classification System (UTWCS). All patients in the intervention group received proper footwear, non-weight bearing limb support, daily wound debridement and appropriate clinical monitoring. Additional treatment was initiated as needed depending on DFU grading and staging. Participants in the control hospital received usual DFU care that was not associated with a structured MDT approach. Follow-up treatment for participants in the intervention group occurred over a two-year period, but data collection for the

control group was restricted to baseline only which limited the strength of the evidence. Methodological strengths of the longitudinal NRCT included strong statistical analysis and adequate control of confounding.

Overview of Results

The effectiveness of MDTs was supported by findings of two high-quality systematic reviews (Meza-Torres et al., 2021; Musuuza et al., 2020). All 15 relevant studies included in the systematic review by Meza-Torres et al. (2021) and 31 of the 33 studies included in the systematic review by Musuuza et al. (2020) showed improvements in LLA following implementation of MDTs. Despite the favourable results, both systematic reviews revealed remarkable heterogeneity in the composition and function of the MDTs examined. While the majority of studies included both medical and surgical specialty representatives, there were variations in patient contact time, follow-up, level of coordinated care and setting (primary or specialty-based). Despite these differences and the paucity of strong study designs, there is sufficient evidence from the literature to support the effectiveness of MDTs in reducing LLA. Common target areas noted across all MDTs interventions included glycemic control, wound management, vascular disease process and infection control. Specific results from two studies **(El Sakka et al., 2006; Weck et al., 2013)** described within these systematic reviews are described below to illuminate the impacts of the MDT approach on LLA and mortality.

LLA. Ninety-four percent of the studies (31/33) examined in the systematic review by Musuuza et al. (2020) reported a reduction in LLA with results ranging from a 2% increase in LLA (odds ratio 1.14; 95% CI 0.59-2.20) to a 51% absolute or 89% relative reduction in LLA (odds ratio 0.11; 95% CI 0.05-0.25). One of the NRCTs included in the review (Weck et al., 2013) noted differences in LLA incidence following implementation of a MDT, but differences

were not significant. Following two years of follow up, overall LLA was lower in the intervention group compared to the control group at 39% and 57% respectively (OR 0.49, 95% CI 0.39-0.62 (no p-value provided). In relation to major LLA, however, age-adjusted significant differences were detected between intervention and control groups at 8% and 35%, respectively (OR 0.31, 95% CI 0.22-0.44, $p<0.0001$). The incidence of minor LLA was also marginally lower in the intervention group compared to the control group, but these differences were not significant. In terms of DFU healing, significant differences were detected between groups at discharge in terms of the proportion of patients achieving complete healing as measured by the UTCS. In the intervention group, 28.3% of participants achieved total wound healing compared to 23% in the control group, which was significant ($p=0.001$).

In the medium quality cohort study by El Sakka et al. (2006), the implementation of a vascular-led podiatry MDT team also had favourable effects on the ratio of major to minor LLAs. In this study, only three of 76 patients in the active medical-surgical treatment group required a major LLA and 35 patients required a minor LLA. As a result, the limb salvage rate for the cohort was 81% at 6 months. While results of this study are favourable, the absence of comparison group affected the ability to draw concrete conclusions about the association between intervention and outcome.

Mortality. Two of the studies (El-Sakka et al., 2006; Weck et al., 2013) included in the systematic reviews by Meza-Torres et al. (2021) and Musuuza et al. (2020) measured mortality as an outcome. Weck et al. (2013) reported on mortality in their NRCT and found that patients in the intervention group had significantly lower mortality compared to the control group at 2.5% and 9.4%, respectively ($p<0.001$). While there was no control group for comparison in the study by El-Sakka et al. (2006), mortality following implementation of the MDT approach was only

14% in the active medical-surgical treatment group, which was promising. Mortality in the palliative group was much greater at 95%, however, prognosis for this subgroup of patients was known to be poor at time of baseline assessment, so a high mortality rate was expected. Nonetheless, the results of both of these studies hold clinical significance for the potential positive impact of MDTs on mortality.

Summary

The implementation of MDT is a popular organizational-level strategy identified in the literature to improve diabetic foot health, however there was remarkable heterogeneity in MDT composition, function, contact time and level of involvement between studies. Consistent with the CPW approach, studies examining the effectiveness of MDTs involved predominantly weak and moderate study designs and yielded medium to high quality evidence. Nonetheless, there was sufficient evidence from two high quality systematic reviews (Meza-Torres et al., 2021; Musuuza et al., 2020) to support the effectiveness of the MDT approach in the reduction of LLA. Specifically, 15 of the 57 studies included in the review by Meza-Torres et all (2021) and 31 of the 33 studies included in the review by Musuuza et al. (2020) demonstrated improvements in LLA following implementation of MDTs. In addition to LLA, there was evidence from one NRCT included in the systematic review by Musuuza et al. (2020) of significant reductions in mortality following implementation of a vascular surgeon-led MDT. Mortality was also relatively low among patients who received MDT treatment in the cohort study by El-Sakka et al. (2006), but these differences were not significant.

Multi-component Interventions

There is a growing body of literature examining the impact of combined interventions that feature aspects of both MDTs and CPWs on diabetic foot outcomes. Twenty-one of the 57

studies included in the systematic review by Meza-Torres et al. (2021) focused on the effectiveness of multi-component interventions and four of those studies met criteria for inclusion in the meta-analysis. A description of the studies is presented below.

Description of Studies

Consistent with the former approaches, there was considerable variability in the composition of multi-component interventions noted in the literature, however the implementation of CPWs and MDTs was the most common combination included in the systematic review and meta-analysis (Meza-Torres et al., 2021). Of the 21 studies evaluating the impact of multi-component interventions included in the systematic review and meta-analysis, there were substantial variation in study design, results and strength of the evidence. Studies included in the systematic review consisted of systematic reviews (n=4), RCT (n=1), UCBA (n=1), cohort (n=6) and cross-sectional designs (n=9). Four studies demonstrated strong evidence in support of the approach while 10 studies demonstrated weak evidence in support of the approach. Inconclusive evidence regarding the impact of multi-component interventions on LLA was noted in five studies, three of which were systematic reviews. Likewise, contradictory evidence was presented in two studies, one of which was a systematic review. All four of the well-conducted systematic reviews included in the review by Meza-Torres et al. (2021) found inadequate high-quality evidence examining combined interventions for diabetic foot management. Nonetheless, there is some promising evidence from studies included in the meta-analysis (Meza-Torres et al., 2021) to support the effectiveness of combined interventions in reducing LLA.

All four studies included in the meta-analysis that examined multi-component interventions were high quality analytic studies with low risk of bias, however one of the studies

was limited by a small sample size and short follow-up (McMurray et al., 2002). Two of these four studies utilized cohort designs, one of the studies utilized a UCBA design and the remaining study conducted an RCT (McMurray et al., 2002). All studies examined the impact of a combined MDT and CPW approach in patients with diabetes within a hospital context, however, the composition and function of the teams and pathways was quite diverse. Diabetes case managers, nurses, physicians, vascular surgeons and dieticians were among the health disciplines represented on the MDTs in these studies. While three studies focused specifically on patients with diabetic foot concerns, the RCT by McMurray et al. (2021) focused explicitly on amputations in dialysis patients, which is why it was not discussed in detail in this paper. All studies were conducted in different countries, including the United States, Pakistan, Spain and Singapore. To exemplify the composition of the multi-component intervention approach, a closer look at one (**Martinez-Gomez et al., 2014)** of the four studies included in the meta-analysis by Meza-Torres et al. (2021) is described below.

Martinez-Gomez et al. (2014) conducted a UCBA study to examine the impact of a combined CPW and MDT approach to diabetic foot care among patients with DFU in Spain. In this high-quality study, the authors compared incidence of major and minor LLAs between patients during three distinct time-periods. The first time-period involved provider preference for care rather than the implementation of standardized guidelines, whereas the second time-period involved the introduction of an integrated CPW, and the third time-period consisted of care based on the collaboration of an integrated CPW and MDT team. Methodological strengths of the study include longitudinal data collection and a robust sample size, while study limitations included inadequate control of confounding variables. Nonetheless, favourable effects of the

multi-component CPW and MDT intervention on LLA outcomes were detected as described in the result section below.

Overview of Results

Twenty-one of the studies included in the systematic review and meta-analysis by Meza-Torres et al. (2021) examined the effectiveness of multi-component interventions with considerable variability in results and strength of evidence. Of the 21 studies included in the systematic review and meta-analysis by Meza-Torres et al. (2021), four were well-conducted systematic reviews that yielded inconclusive (n=3) and contradictory (n=1) evidence in support of the combined MDT and CPW approach. Despite these noteworthy findings, four additional analytic studies included in the meta-analysis produced high quality evidence in support of the multi-component approach with three of the four studies showing significant reductions in LLA. Of the four studies included in the meta-analysis, McMurray et al. (2002) was the only study that used an RCT, however, the study focused explicitly on dialysis patients rather than diabetes patients, so it was not discussed in detail in this paper. Cumulative results of the meta-analysis and an individual overview of one of the high-quality cohort studies included in the meta-analysis **(Martinez-Gomez al., 2014)** is described below. In addition to LLA, this cohort study also examined mortality and length of hospital admission, but no statistically or clinically significant findings were detected in these outcomes.

LLA. Fixed-effects modeling of the four studies included in the meta-analysis showed an average reduced risk of major LLA associated with implementation of a combined CPW and MDT of 55%. For the study by Martinez-Gomez et al. (2014), Meza-Torres et al. (2021) reported a 45% reduced risk of major LLA (OR=0.55; 95% CI 0.41-0.73) and a 30% risk reduction of total LLA (OR=0.70; 95% CI 0.62-0.80). A critical review of the results of the study by

Martinez-Gomez et al. (2014) showed a significant reduction in total LLA of 18% among recipients of combined CPW and MDT compared to recipients of standard care practices ($p<0.001$). Likewise, a significant reduction of 11% was found between these same groups in the incidence of major LLA ($p<0.001$). There was also a 7.4% reduction in minor LLA between these two groups, but this difference was not statistically significant ($p=0.079$). Nonetheless, the overall impact of the multi-component CPW and MDT intervention on LLA was both statistically and clinically significant.

Summary

Multi-component interventions involving the joint implementation of CPWs and MDTs are on the rise. The systematic review and meta-analysis by Meza-Torres et al. (2014) provided growing evidence from predominantly weak (n=9 cross-sectional) and moderate (n=6 cohort, and n=1 UCBA) design studies of medium and high quality to support the effectiveness of multi-component interventions in reducing LLA. Although four systematic reviews and one RCT contributed to this body of literature, inconclusive (n=5) and contradictory evidence (n=2) from these systematic reviews and additional cross-sectional studies impeded the strength of the existing evidence base. For this reason, there is insufficient evidence to support the effectiveness of the combined MDT and CPW approach in mitigating LLA at this time. While the longitudinal nature of the four studies included in the meta-analysis provided insight into trends in LLA incidence and prevalence overtime, strong study designs with more robust control of confounding and longer follow-up are needed to gain a true sense of the effects of the intervention on diabetic foot outcomes. Given the considerable variability in strength of the evidence and in the consistency of the results, further research is needed to determine the effectiveness of the multi-component MDT and CPW in diabetic foot management.

Summary of State of Evidence

Using Donabedian's model of structure-process-outcome as a conceptual framework, an integrated review of the literature on organizational level strategies to address diabetic foot health was conducted. Through in-depth analysis of the existing literature, four strategies to reduce LLAs were revealed, including: DCTs, CPWs, MDTs and combined CPW and MDT interventions. Following critical appraisal of the literature using the CASP (2018) checklist, the PHAC (2014) toolkit and application of the PHAC (2014) criteria for rating evidence, an overall conclusion was drawn concerning the state of the evidence. Specifically, there was moderate evidence to support the effectiveness of CPWs and MDTs in reducing LLA but inconclusive evidence to support the effectiveness of multi-component interventions and insufficient evidence to draw conclusions regarding the effectiveness of DCTs.

Overall, the systematic review and meta-analysis by Meza-Torres et al. (2021) provided ample evidence in support of the implementation of organizational-level approaches to reduce DFU and LLA. A meta-analysis of seven studies included in this review using fixed-modeling statistics revealed that the implementation of CPWs, MDTs, and multi-component approaches had the potential to reduce the incidence of LLA among patients with DFU by nearly half (OR=0.52; 95% CI 0.30-0.91). Only one study included in the review examined DCTs thus yielding insufficient evidence to support the approach. While there is limited evidence to support the DCT approach, the existing evidence conducted in Alberta by Chan et al. (2020) revealed clinical significance for the potential positive impact of a DCT approach on HCP practices such as screening and referrals. While the DCT approach is promising, more research is needed to strengthen the existing evidence. The systematic review by Musuuza et al. (2020) provided additional support for the MDT approach with 31 of the 33 analytic studies included in the

review demonstrating reductions in LLA following implementation of MDTs. As for multi-component interventions, considerable variability and inconsistency in strength of the evidence and direction of the results resulted in inconclusive evidence to support the effectiveness of the approach in reducing LLA. While four of the studies included in the meta-analysis demonstrated promising results for the impact of multi-component CPWs and MDTs on LLA, inconclusive evidence from four systematic reviews and contradictory evidence from two cohort studies included in the review by Meza-Torres et al. (2021) indicated that the state of the evidence on combined interventions is weak.

While this paper primarily focused on DFU and LLA, secondary outcomes including mortality, self-management, HCP practices, quality of life, pain, cost-effectiveness and health care utilization measures were examined to a lesser extent in this paper with promising results. In relation to the Donabedian model, while outcome measures were well-explored, there was limited evidence to support process measures in the available literature. Specifically, process outcomes were not clearly articulated in the empirical literature, but there was some qualitative data acknowledging the positive impact of CPWs on improving the interaction between health system, HCP and patient (Mullan et al., 2021). Future research endeavours should prioritize exploring process measures such as the relationship between patient, provider, and health systems using qualitative and quantitative research designs to better understand the impact of these organizational strategies on process.

Implications of Findings and Next Steps

Despite the abundance of studies examining organizational level interventions for diabetic foot health, the absence of strong designs impeded the strength of the evidence base and illuminated a need for further research to bridge this gap in the literature. The considerable

heterogeneity noted in the literature regarding the nature of the interventions in terms of composition, function, interdisciplinary involvement, duration, and contact time also impacted the ability to make comparisons between studies. Given the variability among the interventions, there is a need for replication studies investigating strategies of similar composition and function to strengthen the existing evidence base. Further research using stronger designed studies such as RCTs and NRCTs are warranted to determine which approach, composition, and function is most effective in improving diabetic foot outcomes. Furthermore, study designs should consider control of confounding and longitudinal follow-up to improve the strength of the evidence produced. Likewise, the lack of evidence related to process measures, as depicted in the Donabedian model, revealed a need for future research to better understand the exchange between provider, patient and system and its impact on DFU and LLA.

The findings of this review will inform the development of key questions to explore in the consultation phase of this project to elicit important information about diabetic foot health in the local setting. HCP familiarity and knowledge of these four organizational-level interventions will also be explored during consultations, while an environmental scan will be conducted to gain insight into the available organizational strategies across the province and country. Despite the limited evidence in favour of the DCT approach and inconsistent evidence of the combined CPW and MDT approach, promising results from a small number of studies discussed in this paper warrants further exploration of these approaches during the consultations.

Knowles Theory of Adult Learning

In addition to the Donabedian Model of Quality of Care (1997), Knowles Theory of Andragogy (1984) will provide the conceptual direction needed to ensure clinical resource development remains consistent with needs of adult learners. Knowles (1984) Theory of

Andragogy considers six assumptions related to the adult learner: self-concept, experience, readiness to learn, orientation to learning, motivation to learn, and need to know. Likewise, Knowles' theory emphasizes that adults are most interested in learning when it is problem-centered and has immediate relevance and impact to their careers and day-to-day lives. Given the substantial burden of diabetes and diabetes related complications across the province, it is highly likely that the target audience will be motivated to utilize a clinical resource that was developed with a purpose of improving diabetes-related outcomes (Knowles et al., 2015). While the target audience encompasses primary HCPs such as family physicians, nurse practitioners, registered nurses, nurse educators, endocrinologists and internal medicine specialists from varied backgrounds and experiences, all providers share a common goal of promoting health and wellness among their patients. Given that this target audience is likely to have previous experience with managing diabetes and diabetes-related foot concerns, it is conceivable that they will be receptive to expanding their knowledge on the topic to enhance their understanding and improve the level of care they provide to patients.

Together, the Donabedian Model of Quality of Care (1997) and Knowles' Theory of Andragogy (1984) will provide the theoretical foundation for the remaining practicum project activities and will inform the design, content and mode of delivery of a clinical resource for HCPs across NL to assist in the provision of diabetic foot health.

Conclusion

Diabetes is a devastating chronic condition with a widespread prevalence and impacts across Canada and around the world. Currently, NL has one of the highest incidences of diabetes and DFU in the country, which has had an astounding impact on patients, families, providers and health systems. Despite recommendations from leading public health agencies to integrate a

systematic approach to diabetes and DFU management, to date, there has been no organizational-level approaches adopted within the province. An integrative review of the literature guided by Donabedian's model has revealed four strategies for diabetic foot health including DCTs, CPWs, MDTs and multi-component approaches. A critical analysis of the available literature demonstrated moderate evidence to support the effectiveness of CPWs and MDTs in reducing LLA in patients with DFU, however, there remains inconclusive and contradictory evidence to support the effectiveness of combined MDT and CPW approaches, and insufficient evidence to support the effectiveness of DCTs at this time. While both of the aforementioned approaches seemed promising, further research is needed to strengthen the existing evidence base. The Donabedian model (1997) provided the conceptual direction for this paper and assisted with the interpretation of the evidence in relation to the dimensions of structure, process and outcome. While structure and outcome measures were well-explored in the available literature, process measures were only addressed in one qualitative study, which illustrated a need for future research to better understand this concept. Information obtained from this comprehensive review will be used to inform the environmental scan and consultation phase of the project and guide the development of a clinical resource to assist HCPs across NL in the provision of diabetic foot health. Knowles Theory of Andragogy (1984) will provide the conceptual direction needed to ensure clinical resource development remains consistent with needs of adult learners.

References

Abrahamyan, L., Wong, J., Pham, B., Trubiani, G., Carcone, S., Mitsakakis, N., Rosen, L., Rac,V. E., & Krahn, M. (2015). Structure and characteristics of community-based multidisciplinary wound care teams in Ontario: An environmental scan. *Wound Repair and Regeneration*, *23*(1), 22–29. https://doi.org/10.1111/wrr.12241

Armstrong, D. G., Boulton, A. J., Bus, S. A., & Ingelfinger, J.R. (2017). Diabetic foot ulcers and their recurrence. *The New England Journal of Medicine*, *376*(24), 2367–2375. https://doi.org/10.1056/NEJMra1615439

Armstrong, D. G., Swerdlow, M. A., Armstrong, A. A., Conte, M. S., Padula, W. V., & Bus, S. (2020). Five-year mortality and direct costs of care for people with diabetic foot complications are comparable to cancer. *Journal of Foot and Ankle Research*, *13*(1), 16–16. https://doi.org/10.1186/s13047-020-00383-2

Barg, F. K., Cronholm, P. F., Easley, E. E., Davis, T., Hampton, M., Malay, D. S., Donohue, C., Song, J., Thom, S. R., & Margolis, D. J. (2017). A qualitative study of the experience of lower extremity wounds and amputations among people with diabetes in Philadelphia. *Wound Repair and Regeneration: official publication of the Wound Healing Society [and] the European Tissue Repair Society*, *25*(5), 864–870. https://doi.org/10.1111/wrr.12593

Basu, S., Garg, S., Sharma, N., Singh, M. M., & Garg, S. (2018). Adherence to self-care practices, glycemic status and influencing factors in diabetes patients in a tertiary care hospital in Delhi. *World Journal of Diabetes*, *9*(5), 72–79. https://doi.org/10.4239/wjd.v9.i5.72

Beck, J., Greenwood, D. A., Blanton, L., Bollinger, S. T., Butcher, M. K., Condon, J. E.,

Cypress, M., Faulkner, P., Fischl, A. H., Francis, T., Kolb, L. E., Lavin-Tompkins, J. M., MacLeod, J., Maryniuk, M., Mensing, C., Orzeck, E. A., Pope, D. D., Pulizzi, J. L., Reed, A. A., … Wang, J. (2021). 2017 National standards for diabetes self-management education and support. *The Science of Diabetes Self-Management and Care*, *47*(1), 14–29. https://doi.org/10.1177/0145721720987926

Bus, S. A., Lavery, L. A., Monteiro-Soares, M., Rasmussen, A., Raspovic, A., Sacco, I., van Netten., J. (2019). *IWGDF Guideline on the prevention of foot ulcers in persons with diabetes*. https://iwgdfguidelines.org/wp-content/uploads/2019/05/02-IWGDF-prevention-guideline-2019.pdf

Canadian Broadcasting Corporation (2022, February 12). As the cost of living soars in N.L., seniors' advocacy groups are sounding the alarm. *Canadian Broadcasting Corporation*. https://www.cbc.ca/news/canada/newfoundland-labrador/nl-seniors-cost-of-living-1.6347818

Captieux, M., Pearce, G., Parke, H. L., Epiphaniou, E., Wild, S., Taylor, S. J. C., & Pinnock, H. (2018). Supported self-management for people with type 2 diabetes: a meta-review of quantitative systematic reviews. *BMJ Open*, *8*(12), e024262–e024262. https://doi.org/10.1136/bmjopen-2018-024262

Centre for Disease Control and Prevention. (2020). *What is Diabetes?* https://www.cdc.gov/diabetes/basics/diabetes.html

Centre for Policy on Ageing. (2014). *Rapid review of care pathways.* http://www.cpa.org.uk/information/reviews/CPA-Rapid-Review-Effectiveness-of-care-pathways.pdf

Chan, C. B., Dmytruk, K., Labbie, M., & O'Connell, P. (2020). Organizational

changes in diabetic foot care practices for patients at low and moderate risk after implementing a comprehensive foot care program in Alberta, Canada. *Journal of Foot and Ankle Research*, *13*(1), 1-15. https://doi.org/10.1186/s13047-020-00393-0

Coffey, L., Mahon, C., & Gallagher, P. (2019). Perceptions and experiences of diabetic foot ulceration and foot care in people with diabetes: A qualitative meta-synthesis. *International Wound Journal*, *16*(1), 183–210. https://doi.org/10.1111/iwj.13010

Critical Appraisal Skills Programme (2018). CASP qualitative checklist [online]. https://casp-uk.b-cdn.net/wp-content/uploads/2018/03/CASP-Qualitative-Checklist-2018_fillable_form.pdf

Crocker, R. M., Palmer, K. N. B., Marrero, D. G., & Tan, T. W. (2021). Patient perspectives on the physical, psycho-social, and financial impacts of diabetic foot ulceration and amputation. *Journal of diabetes and its complications*, *35*(8), 1-5. https://doi.org/10.1016/j.jdiacomp.2021.107960

Degefa, G., Wubshet, K., Tesfaye, S., & Hirigo, A. T. (2020). Predictors of adherence toward specific domains of diabetic self-care among type-2 diabetes patients. *Clinical Medicine Insights: Endocrinology & Diabetes*, 1–12. https://doi-org.qe2a-proxy.mun.ca/10.1177/1179551420981909

Diabetes Canada. (2018). Clinical practice guidelines for the prevention and management of diabetes in Canada. *Canadian Journal of Diabetes*, *42*(1), S1-S325. https://guidelines.diabetes.ca/cpg

Diabetes Canada. (2020). *Diabetes in Newfoundland and Labrador: Backgrounder*. https://diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/20

20_Backgrounder_Newfoundland_FINAL.pdf

Diabetes Canada. (2021). *Diabetes in Canada: Backgrounder.* https://diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2021_Backgrounder_Canada_English_FINAL_MAR.pdf

Diabetes Canada. (no date.). *Amputation prevention*. https://www.diabetes.ca/advocacy--policies/our-policy-positions/amputation-prevention

Diabetes Canada. (no date). *The economic impact of offloading devices for the prevention of amputations in Newfoundland and Labrador.* https://www.diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Advocacy%20Reports/Economic-Impact-of-Offloading-Devices-on-DFU-Costs-in-NL_FINAL.pdf

Dickinson, A. M., Frescos, N., Firth, J., & Hamblin, P. (2016). The characteristics of wound pain associated with diabetes-related foot ulcers: A pilot study. *Wound Practice & Research, 24*(3), 138–148. https://journals.cambridgemedia.com.au/application/files/2515/8450/9550/dickinson.pdf

Donabedian, A. (1997). Special article: The quality of care: How can it be assessed? *Archives of Pathology & Laboratory Medicine, 121*(11), 1145-50. https://qe2a-proxy.mun.ca/login?url?url=https://www-proquest-com.qe2a-proxy.mun.ca/scholarly-journals/special-article-quality-care-how-can-be-assessed/docview/211957437/se-2?accountid=12378

Flanagan, D., Moore, E., Baker, S., Wright, D., & Lynch, P. (2008). Diabetes care in

hospital - The impact of a dedicated inpatient care team. *Diabetic Medicine: A Journal of the British Diabetic Association*, *25*(2), 147–151. https://doi.org/10.1111/j.1464-5491.2007.02326.X

Frescos, N. & Copnell, B. (2020). Podiatrists' views of assessment and management of pain in diabetes-related foot ulcers: a focus group study. *Journal of Foot and Ankle Research*, *13(*1), 1-8. https://doi.org/10.1186/s13047-020-00399-8

Government of Newfoundland and Labrador. (2017). *The way forward: Chronic disease action plan*. https://www.gov.nl.ca/hcs/files/chronicdisease-pdf-chronic-illness.pdf

Hançerlioğlu, S., Toygar, İ., Ayhan, A., Yilmaz, İ., Orhan, Y., Özdemir, G. S., Şimşir, I. Y., & Çetinkalp, Ş. (2021). Burden of diabetic foot patients' caregivers and affecting factors: A cross-sectional study. 1-7. *International Journal of Lower Extremity Wounds*, 153473462110365–15347346211036530. https://doi.org/10.1177/15347346211036530

Harding, J. L., Pavkov, M. E., Magliano, D. J., Shaw, J. E., & Gregg, E. W. (2019). global trends in diabetes complications: a review of current evidence. *Diabetologia*, *62*(1), 3–16. https://doi.org/10.1007/s00125-018-4711-2

Harrison, M. B., & Graham, I. D. (2021). *Knowledge translation in nursing and healthcare: a roadmap to evidence-informed practice*. John Wiley & Sons, Inc.

Hicks, C.W. & Selvin, E. (2019). Epidemiology of peripheral neuropathy and lower extremity disease in diabetes. *Current Diabetes Reports*, *19*(10), 1–8. https://doi.org/10.1007/s11892-019-1212-8

Holmen, H., Larsen, M. H., Sallinen, M. H., Thoresen, L., Ahlsen, B., Andersen, M. H., ... & Mengshoel, A. M. (2020). Working with patients suffering from chronic diseases can be a balancing act for health care professionals-a meta-synthesis of qualitative studies. *BMC health services research, 20*(1), 1-16. https://doi.org/10.1186/s12913-019-4826-2

Hopkins, R. B., Burke, N., Harlock, J., Jegathisawaran, J., & Goeree, R. (2015). Economic burden of illness associated with diabetic foot ulcers in Canada. *BMC health services research, 15:13,* 1-9. https://doi.org/10.1186/s12913-015-0687-5

Imam, B., Miller, W. C., Finlayson, H. C., Eng, J. J., & Jarus, T. (2017). Incidence of lower limb amputation in Canada. *Canadian Journal of Public Health, 108*(4), e374–e380. https://doi-org.qe2a-proxy.mun.ca/10.17269/CJPH.108.6093

International Diabetes Federation. (2021). *IDF Diabetes Atlas*. https://diabetesatlas.org

International Working Group on the Diabetic Foot. (2019). *IWGDF practical guidelines on the prevention and management of diabetic foot disease.* https://iwgdfguidelines.org/wp-content/uploads/2021/03/IWGDF-2019-final.pdf

Khunkaew, S., Fernandez, R., & Sim, J. (2018). Health-related quality of life among adults living with diabetic foot ulcers: a meta-analysis. *Quality of Life Research, 28*(6), 1413-1427. https://doi.org/10.1007/s11136-018-2082-2

Knowles, M. (1984). *The modern practice of adult education: From pedagogy to androgogy.* Chicago, IL: Associated Press, Follett Publishing Company. https://pdfs.semanticscholar.org/8948/296248bbf58415cbd21b36a3e4b37b9c08b1 .pdf

Knowles, M. S., Holton, E. F., III, & Swanson, R. A. (2015). *The adult learner: The*

definitive classic in adult education and human resource development (8th ed.). Elsevier

Kumah, E., Otchere, G., Ankomah, S.E., Fusheini, A., Kokuro, C., Aduo-Adjei, K., & Amankwhah, J.A. (2021). Diabetes self-management education interventions in the WHO African Region: A scoping review. *PLoS ONE 16*(8): e0256123. https://doi.org/10.1371/journal.pone.0256123

Lawal, A. K., Groot, G., Goodridge, D., Scott, S., & Kinsman, L. (2019). Development of a program theory for clinical pathways in hospitals: Protocol for a realist review. *Systematic Reviews*, *8*(1), 1-7. https://doi.org/10.1186/s13643-019-1046-0

LeBlanc, A.G., Jun Gao, Y., McRae, L., & Pelletier, C. (2019). At-a-glance – Twenty years of diabetes surveillance using the Canadian Chronic Disease Surveillance System. *Health Promotion and Chronic Disease Prevention in Canada*, *39*(11), 306–309. https://doi.org/10.24095/hpcdp.39.11.03

Lukewich, J., Buote, R., Asghari, S., Aubrey-Bassler, K., Knight, J., & Mathews, M. (2020). Adults with diabetes mellitus in Newfoundland and Labrador: A population-based, cross-sectional analysis. *CMAJ Open*, *8*(4). E895–E901. https://doi.org/10.9778/cmajo.20190233

Manu, C., Lacopi, E., Bouillet, B., Vouillarmet, J., Ahluwalia, R., Lüdemann, C., Garcia Klepzig, J. L., Meloni, M., De Buruaga, V. R., Sánchez-Ríos, J. P., Edmonds, M., Apelqvist, J., Lázaro-Martínez, J. L., & Van Acker, K.

(2018). Delayed referral of patients with diabetic foot ulcers across Europe: patterns between primary care and specialised units. *Journal of Wound Care, 27*(3), 186–192. https://doi.org/10.12968/jowc.2018.27.3.186

Meza-Torres, B., Carinci, F., Heiss, C., Joy, M., & de Lusignan, S. (2021). Health service organisation impact on lower extremity amputations in people with type 2 diabetes with foot ulcers: Systematic review and meta-analysis. *Acta Diabetologica*, *58*(6), 735–747. https://doi.org/10.1007/s00592-020-01662-x

Mullan, L., Driscoll, A., Wynter, K., & Rasmussen, B. (2019). Barriers and enablers to delivering preventative and early intervention footcare to people with diabetes: a scoping review of healthcare professionals' perceptions. *Australian Journal of Primary Health*, *25*(6), 517–525. https://doi.org/10.1071/PY19115

Mullan, L., Wynter, K., Driscoll, A., & Rasmussen, B. (2021). Barriers and enablers to providing preventative and early intervention diabetes-related foot care: A qualitative study of primary care healthcare professionals' perceptions. *Australian Journal of Primary Health*, *27*(4), 319–327. https://doi.org/10.1071/PY20235

Musuuza, J., Sutherland, B. L., Kurter, S., Balasubramanian, P., Bartels, C. M., & Brennan, M. B. (2020). A systematic review of multidisciplinary teams to reduce major amputations for patients with diabetic foot ulcers. *Journal of Vascular Surgery*, *71*(4), 1433–1446.e3. https://doi.org/10.1016/j.jvs.2019.08.244

Newfoundland and Labrador Centre for Health Information (2018, February). *eHealth Report.* https://www.nlchi.nl.ca/images/FINAL_NLCHI_-_eHealth_Report_-_Feb_2018.pdf

Public Health Agency of Canada. (2014). *Infection prevention and control guidelines: Critical appraisal tool kit.* http://publications.gc.ca/collections/collection_2014/aspc-phac/HP40-119-2014-eng.pdf

Qin, W., Blanchette, J. E., & Yoon, M. (2020). Self-Efficacy and diabetes self management in middle-aged and older adults in the United States: A systematic review. *Diabetes Spectrum, 33*(4), 315–323. https://doi-org.qe2a-proxy.mun.ca/10.2337/ds19-0051

Rasmussen, B., Wynter, K., Rawson, H. A., Skouteris, H., Ivory, N., & Brumby, S. (2021). Self-management of diabetes and associated comorbidities in rural and remote communities: a scoping review. *Australian Journal of Primary Health, 27*(4), 243–254. https://doi-org.qe2a-proxy.mun.ca/10.1071/PY20110

Ren, Y., Luo, X., Xie, C., Zhang, P., Meng, M., & Song, H. (2019). Assessment and management of pain during dressing change in patients with diabetic foot ulcers: a best practice implementation project. *JBI Database of Systematic Reviews and Implementation Reports*, *17*(10), 2193–2201. https://doi.org/10.11124/JBISRIR-2018-004039

Russell, C.L. (2005). An overview of the integrative research review. *Progress in Transplantation 15*(1), 8–13. https://doi.org/10.1177/152692480501500102

Schaper, N.C., van Netten, J. J., Apelqvist, J., Bus, S. A., Hinchliffe, R. J., & Lipsky, B. A. (2020). Practical guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update).

Diabetes/metabolism Research and Reviews, *36*(S1), 1-10. https://doi.org/10.1002/dmrr.3266

Silva-Tinoco, R., Gonzalez-Cantu, A., De La Torre-Saldana, V., Guzman-Olvera, E., Cuatecontzi-Xochitiotzi, T., Castillo Martinez, L., Romero Ibarguengoitia, M. E., Nahuacatl-Lopez, A., Castillo-Galindo, C., Orea-Tejeda, A., Serna-Alvardo, J., Leon Garcia, E., & Ochoa-Moreno, J. (2021). Effect in self-care behavior and difficulties in coping with diabetes during the COVID-19 pandemic. *Revista Mexicana de Endocrinología, Metabolismo y Nutrición*, *8*(1), 13–19. https://doi-org.qe2a-proxy.mun.ca/10.24875/RME.20000063

Slama-Chaudhry, A. & Golay, A. (2019). Patient education and self-management support for chronic disease: methodology for implementing patient-tailored therapeutic programmes. *Public Health Panorama*, *5* (2-3), 357-361. https://apps.who.int/iris/bitstream/handle/10665/330106/php-5-2-3-357-361-eng.pdf?sequence=1&isAllowed=y

Stevens, K., Moralejo, D., Ersser, S., & MacLean, C. (2022). Patient, support-person and Health care provider perspectives on foot self-management for adults with type 1 and type 2 diabetes: personal challenges. *Canadian Journal of Diabetes*, *46*(1), 40–46. https://doi.org/10.1016/j.jcjd.2021.04.011

Thanh, N. X., Dmytruk, K., O'Connell, P., Rogers, E., Fillier, D., MacRae, J. M., Thomas, C., Rennie, C., Eitzenberger, C., Newman, C., Match, B., Thompson, C., Nhan, J., & Wasylak, T. (2020). Return on investment of the diabetes foot care clinical pathway implementation in Alberta, Canada. *Diabetes Research and Clinical Practice*, *165*, 108241–108248. https://doi.org/10.1016/j.diabres.2020.108241

Thorud, J.C., Plemmons, B., Buckley, C. J., Shibuya, N., & Jupiter, D. C. (2016). Mortality after nontraumatic major amputation among patients with diabetes and peripheral vascular disease: A systematic review. *The Journal of Foot and Ankle Surgery*, *55*(3), 591–599. https://doi.org/10.1053/j.jfas.2016.01.012

Whittemore, R., & Knafl, K. (2005). The integrative review: updated methodology. *Journal of advanced nursing*, *52*(5), 546–553. https://doi.org/10.1111/j.1365-2648.2005.03621.x

World Health Organization. (2013). *Global action plan for the prevention and control of noncommunicable diseases 2013-2020*. https://apps.who.int/iris/handle/10665/94384

World Health Organization. (2020, December 9). *The top 10 causes of death.* https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

Yunus, Y.M. & Rajbhandari, S. (2011). Insensate foot of diabetic foot ulcer can have underlying silent neuropathic pain. *International Wound Journal*, *8*(3), 301–305. https://doi.org/10.1111/j.1742-481X.2011.00796.x

Zhang, P., Lu, J., Jing, Y., Tang, S., Zhu, D., & Bi, Y. (2017). Global epidemiology of diabetic foot ulceration: a systematic review and meta -analysis. *Annals of Medicine, 49(2*), 106-116. https://doi.org/10.1080/07853890.2016.1231932

Appendix A

Table 1: Literature Summary Table

Key Question: "What organizational-level strategies are effective in diabetic foot health?

Study/Design	Methods	Key Results	Comments
Chan et al. (2020) **Cross-sectional** **Aim: Evaluate impact of organizational changes (HRFTs) on HCP practices** **Approach: DCT**	**Sample and Setting** N=179 HCPs (RNs, LPNs, physicians, surgeons, OT, PT and dieticians) recruited from n=6 PHC, acute, and LTC care sites across Alberta Country: Canada **Sample** 2014: n=104 2019: n=75 **Intervention** HRFTs trained in wound management and DFU implemented across six sites in Alberta in 2014 to improve screening, assessment and referral of patients with diabetic foot concerns **Outcomes** Primary: HCP practice changes with respect to following CPW guidelines (i.e., screening, vascular assessment and referrals) **Data Collection:** Survey distributed online **Data Analysis:** Means, Fisher's exact test and Chi-square test	**HCP Practices** DFU screening increased significantly from 2014 to 2019 ***PHC*** 2014: 30% failed to screen 2019: 5% failed to screen ($p<0.01$) ***LTC*** 2014: 53% failed to screen 2019: 40% failed to screen $p<0.05$ Mod-risk pt screening increased significantly across all sites 2014**:** 35% (34/96 sites) 2019**:** 55% (36/65 sites), $p<0.05$ **Vascular Assessment** 2014: 60% sites 2019: 90% sites, $p<0.05$ **Frequency of DFU Assessment** 2014: 53% not using schedule 2019: 18% not using schedule $p<0.001$ **Number of Referrals** # of referrals increased significantly across all sites from 2014 to 2019 ($p<0.001$) Referrals to MD for assessment increased from n=36/96 (38%) to n=23/39 (59%), $p=0.035$	**Design: Weak** **Quality: High** **Comments:** • Convenience sampling then targeted and snowball sampling • Different respondents in 2014 and 2019 • Questionnaire not previously validated but content validity can be assumed based on nature of questions asked • 40% (n=44) of respondents were nurses • Low response rate

El Sakka et al. (2006) **Cohort** **Aim:** **Evaluate the effectiveness of MDT management on DFU outcomes** **Approach:** **MDT**	**Sample and Setting** N=128 patients with DFU recruited from hospital and clinic Country: United Kingdom **Time Period**: January 2002 to June 2003 (18 months) **Intervention** MDT conducted weekly joint diabetes/vascular/podiatry ward rounds and outpatient clinics to assess and triage patients with DFU. Based on assessment (clinical examination, ABI, duplex angiogram and TCOP), patients allocated to: 1. n=76 (59.4%) active medical-surgical-radiological treatment 2. n=34 (26%) medical treatment only 3. n=18 (14.1%) palliative care **Outcomes:** LLA, mortality **Data Collection:** Clinical exams, chart reviews **Data Analysis:** Means, percentages	**Minor LLA** n=35 (46%) after revascularization with a limb salvage rate of 81% at 6 months **Major LLA** n=3 (4%) of active treatment **Mortality** n=11 (14%) of active treatment n=17 (95%) of palliative care	**Design: Weak** **Quality: Medium** **Comments:** • Single site recruitment • No control of confounding variables • Valid and reliable tools • More sophisticated statistics such as modeling would improve the ability to draw conclusions about the association between intervention and outcome

Giorda et al. (2012) **Cohort** **<u>Aim</u>: Examine the impact of CPW and adherence to recommended care guidelines on morbidity and mortality in patients with diabetes** **Approach: CPW**	**Sample and Setting** N= 31,104 patients 20 years and older with a diagnosis of diabetes recruited from review of hospital discharge records and population data <u>Country</u>: Italy **Time period**: data collected over 4 years (2003-2006) **Sample** Cohort 1: n= 638 Cohort 2: n= 1798 Cohort 3: n= 2559 Cohort 4: n= 5180 **Intervention** Cohort 1: primary physician care only Cohort 2: primary physician care + specialist care Cohort 3: primary physician care + adherence to GCI Cohort 4: primary physician care + specialist care + adherence to GCI **Outcomes** <u>Primary:</u> mortality and morbidity (including LLA) **Data Collection:** chart reviews, analysis of population data from discharge records and prescription records **Data Analysis:** cumulative survival probabilities (Kaplan-Meier method), Poisson regression, adjusted RR and 95% CI	**Mortality** Patients with the lowest level of care (Cohort 1) had significantly higher all-cause mortality per 1000 person years (p=<0.0001): Cohort 1: 31.3 Cohort 2: 19.9 Cohort 3: 26.0 Cohort 4: 19.1 <u>RRs and 95% CIs:</u> Cohort 1: 1.72 (1.57–1.89) Cohort 2: 0.95 (0.81–1.12) Cohort 3: 1.29 (1.17–1.41) Cohort 4: 1.0 **LLA** <u>RRs and 95% CIs:</u> Cohort 1: 2.03 (1.26–3.28) Cohort 2: 1.15 (0.51–2.56) Cohort 3: 1.57 (0.99–2.50) Cohort 4: 1.0	**Design: Weak** **Quality: High** • Longitudinal data collection over 4-year period • Strong statistical analysis for level of data • Control of confounding variables (education, age, treatment) • Multi-source recruitment • Groups comparable at baseline

Martinez-Gomez et al. (2014) **Cohort** **Aim:** **Evaluate impact of integrated CPW on LLA in patients with diabetes** **Approach: Multi-component (MDT + CPW)**	**Sample and Setting** N=1460 patients with DFU admitted to urban hospital Country: Spain **Time Period:** 14 years (1998-2012) **Sample** Group A: n=227 (1998-2000) Group B: n=438 (2001-2005) Group C: n=795 (2006-2012) **Intervention** Group A: No standardized approach for DFU Group B: Integrated CPW for DFU + standardized approach to management and referrals Group C: Integrated CPW + MDT foot clinic **Outcomes** Primary: major and minor LLAs Secondary: hospital LOS, mortality **Data Collection:** Chart reviews **Data Analysis:** Means, Chi square tests, ANOVA	**Overall LLA** Group A: n=138 (60.8%) Group B: n=220 (50.2%) Group C: n=340 (42.8%) p<0.001, significant decrease from A to C **Major LLA** Group A: n=56 (24.7%) Group B: n=79 (18%) Group C: n=107 (13%) p<0.001, significant difference between A and C **Minor LLA** Group A: n=82 (36.1%) Group B: n=141 (32.2%) Group C: n=228 (28.7%) p=0.079, not significant **Mortality** No significant differences in mortality between groups (p=0.065) Group A: 11 (4.8%) Group B: 13 (2.9%) Group C: 16 (2%) **Hospital LOS** No significant differences in LOS btw groups (p=0.115) Group A: 11.2 +/- 4.1 Group B: 11.4 +/- 4.4 Group C: 10.1 +/- 4.3	**Design: Weak** **Quality: High** **Comments:** • Large sample size, but single source of recruitment • Appropriate statistics for design and level of data • Biases minimized with data collection • Groups comparable at baseline? • Longitudinal study

Paisey et al. (2018) **Cross-sectional study** **<u>Aim:</u>** **Examine effects of diabetic foot care service provisions on LLA** **Approach: CPW**	**Sample and Setting** ~3000 receiving diabetic foot services across 14 health service provider sites in South West, England (n=unknown) <u>Country:</u> United Kingdom **Time period:** 2005 to 2015 **Intervention** 10 key service provisions (i.e., CPW): 1. Annual patient education 2. Regular community HCP education 3. Administrative support 4. Standardized GP foot screening 5. Adequate community podiatry staffing 6. Foot clinics 7. Pathways and communication processes 8. Orthotist availability on foot care team 9. DFU database 10. Urgent vascular opinion **Outcomes** <u>Primary</u>: incidence and prevalence of LLA **Data Collection:** Peer review of regional services, audit of case records (n=122) and structured interviews (n=50), analysis of population data **Data Analysis:** Means, linear model, least squares mean regression, CIs	**LLA** Reduction in amputation over time, p=0.015, residual deviance= 3.4, significant **2005:** 2 service provisions DFU incidence = 15 per 1000 persons with diabetes DFU prevalence = 17 per 1000 persons with diabetes LLA prevalence = 33 per 10,000 persons with diabetes **2015:** 9 service provisions DFU incidence = 6 per 1000 persons with diabetes DFU prevalence = 23 per 1000 persons with diabetes LLA prevalence = 4 per 10,000 persons with diabetes **2012-2015** Inverse correlation with number of key service provisions and LLA R^2=0.56, p<0.0012 (significant)	**Design: Weak** **Quality: High** **Comments:** • Robust population-based data provided information about trends overtime • Strong statistical analysis for level of data • Multi-site recruitment • Longitudinal study • Generalizability to non-Caucasian population limited due to 95% of patient population in analysis identifying as white.

Spanos et al. (2017) **UCBA** **<u>Aim:</u> Evaluate impact of a vascular surgeon-led foot care team on DFU healing and limb-salvage** **Approach: DCT**	**Sample and Setting** N=103 patients with diabetes recruited to foot care clinic through ED, endocrinologists, GPs and other specialists <u>Country:</u> Greece **Time-Period**: 2012-2014 **Intervention** DCT led visits whereby patients received routine physicals, education about self-management practices and diagnostic tests as needed such as palpation of the peripheral arteries and ABI. **Outcomes** <u>Primary</u>: wound healing and minor LLA <u>Secondary:</u> QOL, pain, self-management **Data Collection:** Clinical assessment, diagnostic tests, chart reviews and ulcer grading using UTWCS and other V&R wound classification systems QOL (DSF-SF), pain (s-LANSS and VASs) and self-management (self-developed survey) assessed at baseline and 12 months **Data Analysis:** Means, X^2 statistic, independent t-tests, Mann-Whitney test, and binary logistics regression	**DFU Healing** 41% (n=42) of participants achieved complete DFU healing at 12 months as per UTWCS **Minor LLA** 41% (n=43) at 12 months **Major LLA** 17.6% (n=18) at 12 months No new ulcers from baseline to 12 Nonpalpable popliteal artery associated with 5.2 increased odds risk for major LLA (95% CI: 1.03-26, P=0 .045) **Pain** N=103 s-LANSS scores of greater than 12 (neuropathic pain) For every 1 unit increase in s-LANSS, minor LLA risk increased significantly by 43% (95% CI: 2%-100%, p= 0.040, significant) VAS scores decreased from baseline to 12 months (p=0.05, significant): ADL: 6.8 (SD 2.5) to 4.2 (SD 1.2) Intensity: 6.3 (SD 2.2) to 2.9 (SS 1.3) **QOL** Significant improvements across all domains of the DFS-SF at 12 months (p<0.0001):	**Design: Weak** **Quality: Medium** **Comments:** • Reliable and valid tools • High retention • Use of sophisticated statistics such as multivariable analyses • Potential for selection bias due to single source recruitment • Multiple comorbidities among participants could have influenced results (50% had PAD which was not controlled for during analysis)

		physical health (mean increase 9.9) dependency (mean increase 10.9) treatment satisfaction (mean increase 12.4) leisure (mean increase 16.5) negative emotions (mean increase 18.2) **Self-Management** Significant improvement in all domains of self-developed survey at 12 months (p=0.05) weekly self-exam (mean increase 6.56) weekly foot wash (mean increase 3.9) Wearing special footwear increased from n=8 (7.8%) to n=20 (20%).	
Weck et al. (2013) **NRCT** **<u>Aim:</u>** **Examine effects of structured health care program for**	**Sample and Setting** N = 1192 patients admitted to tertiary hospitals for DFU <u>Country:</u> Germany **Time period:** 2000 to 2007 **Sample** <u>IG</u>: n = 684 <u>CG</u>: n = 508 **Groups**	**Overall LLA:** IG: 39% (n=269) CG: 57% (n=289) OR 0.49 (9.5% CI 0.39-0.62) **Major LLA:** IG: 8% (n=54) CG: 22% (n=110) age-adjusted OR 0.31 (95% CI 0.22-0.44, p<0.0001, significant) **Minor LLA:**	**Design: Strong** **Quality: Medium** **Comments:** • Multi-site recruitment • Appropriate statistical tests for level of data • Strong statistics and control of

diabetic foot on LLA **Approach: MDT**	IG: structured foot care interdisciplinary program consisting of integrated inpatient, outpatient, and rehabilitative treatment CPW CG: usual care (recruited from another regional hospital that does not have integrated interdisciplinary program for foot care) **Outcomes** Primary: major and minor LLAs Secondary: mortality, ulcer severity and healing **Data Collection:** chart reviews and clinical examination for DFU severity based on V&R tools such as UoT at baseline and 2 years (baseline only for CG) **Data Analysis:** Means; t-tests, Mann-Whitney-U tests, Chi-square tests; ANCOVA	IG: 31% (n=215) CG: 35% (n= 179) OR 0.84 (95% CI 0.66-1.07) **Ulcer Healing:** IG: 28.3% (n=189) CG: 23% (n=106) achieved complete ulcer healing at discharge from hospital (p=0.001, significant) **Mortality:** IG: 2.5% (n=17) CG: 9.4% (n=48) p<0.001 (significant) during hospitalization	confounding variables • Groups comparable at baseline, except for age which could have contributed to bias • No randomization • Biases minimized with respect to data collection • Longitudinal follow-up but inconsistent between IG and CG. Baseline only for CG

Legend: ABI: ankle-brachial-index-pressures; CPW: clinical pathway; DCT: dedicated care team; DFU: diabetic foot ulceration; DSF-SF: Diabetic Foot Ulcer Scale–Short Form; ED: emergency department; GCI: glycemic composite indicator; HRFT: high risk foot care teams; LOS: length of stay; LTC: long-term care; LLA: lower limb amputation; MDT: multidisciplinary care team; OT: occupational therapist; PAD: peripheral arterial disease; PHC: primary health care; PT: physiotherapist; RR: rates ratios; s-LANSS scale: Leeds Assessment of Neuropathic Symptoms and Signs; TCOP: transcutaneous oxygen pressures; UTWCS: University of Texas Wound Classification System; VAS: visual analog scales

Appendix D

Clinical Resources for Diabetic Foot Care: Environmental Scan

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Diabetic foot ulceration (DFU) is defined as an ulceration of the foot secondary to diabetes and is recognized as one of the most devastating complications of poorly controlled diabetes with far-reaching implications for patients, families, health care providers (HCPs) and health systems (International Diabetes Federation [IDF], 2021; International Working Group on the Diabetic Foot [IWGDF], 2019). Without proper management, poorly treated DFUs can evolve to infection, ischemia, and LLA, and has been identified as a major cause of diabetes-related morbidity and mortality (IWGDF, 2019; Thorud et al., 2016). To reduce the burden of DFU, leading health officials recommend the integration of a systematic interdisciplinary approach to aid the prevention, screening, treatment and management of diabetic foot complications (Diabetes Canada, 2021; IDF, 2021; Schaper et al., 2020).

The overall goal of the practicum is to develop a comprehensive clinical resource to reduce diabetic foot complications and improve outcomes for patients living with diabetes in Newfoundland and Labrador (NL). Specifically, a clinical resource is proposed to assist HCPs in the provision of care of patients with diabetic foot needs in acute and primary health care settings within Eastern Health (EH). An integrative review of the literature was conducted to gain insight into the effectiveness of organizational-level strategies to mitigate the impact of DFU. Based on the findings of the literature review, there was moderate evidence to support the effectiveness of clinical pathways (CPWs), multidisciplinary teams (MDTs), and interventions that combine the two approaches in the management of the diabetic foot. The purpose of the environmental scan was to identify existing resources and tools used by health care authorities nationally and internationally in relation to diabetic foot management. The findings of the environmental scan will be used in conjunction with the literature review and consultations to inform the

development of a comprehensive clinical resource to assist HCPs in the management of the diabetic foot.

Objectives of the Environmental Scan

An environmental scan was performed to elicit existing knowledge from established internal and external databases and published guidelines to gain insight into the management of diabetic foot complications on a provincial and national scale. The specific objectives for the environmental scan were to:

1. Determine the extent of the available clinical resources used by HCPs to direct management of the diabetic foot within EH, Central Health (CH), Western Health (WH), and Labrador-Grenfell (LGH) Health Authorities.
2. Determine the extent of the available clinical resources used by HCPs to direct management of the diabetic foot across Canada, with a focus on CPWs and MDTs.
3. Identify what tools are recommended from leading national and international professional associations to help HCPs care for patients with diabetes in relation to foot management.

Sources of Information

Sources of information for the environmental scan included provincial, national, and international clinical resources for diabetic foot management. On a provincial level, clinical practice guidelines and policies for diabetic foot management were obtained from EH, CH, WH and LGH. Applicable EH policies and protocols were retrieved from the internal electronic database referred to as the Intranet. Given the limited information available on respective regional health authority (RHA) websites however, contact was made with nurses working within these regions via email to obtain information on the clinical resources used by CH, WH and LGH. The nurses who were contacted for the purpose of the environmental scan were

previously known to the writer and gave permission for their input to be shared.

On a national level, sources of information were restricted to the provinces of Alberta (AB), British Columbia (BC), New Brunswick (NB), Nova Scotia (NS) and Ontario (ON) to ensure the amount of information in the environmental scan was manageable. The tools developed and used by AB, in particular, contributed greatly to the environmental scan. On an international level, clinical guidelines published on the respective websites of several leading national and international associations were reviewed to inform project development. Specifically, a review of applicable clinical guidelines from Diabetes Canada, Wounds Canada, the International Working Group on the Diabetic Foot (IWGDF) and the National Institute for Health and Care Excellence (NICE) was conducted. Given the potential differences between our health care system and the health care systems of those outside of Canada, the bulk of the content included in the environmental scan is related to Canadian resources and tools. Considering the setting for implementation within EH is diverse and encompasses both inpatient (5 East) and outpatient diabetes services (Diabetes Centre), clinical resources developed for the purpose of acute and primary health care settings were considered applicable for inclusion in the environmental scan. The data collection methods used are described in detail below.

Data Collection

Data for the environmental scan were collected primarily through review of professional organization websites and published guidelines. As a secondary data collection strategy, email correspondence was carried out with nurses from RHAs across the province who were previously known to the writer. To ensure consistency, standard questions were applied to the review process as outlined in the Appendix B. For the purpose of this project, clinical resource referred to any resource or tool specifically targeted toward HCPs to aid in the management of

diabetic foot concerns. Specific examples of clinical resources included CPWs, MDTs, dedicated care teams, care maps and decision support tools. Only tools with a specific focus on diabetic foot health were included in the scan.

Data Management and Analysis

All data were managed and analyzed by the writer through use of an Excel spreadsheet. Descriptive analysis involved organizing meanings found in the data and identifying patterns between sources and establishing themes (Sundler et al., 2019). Two tables depicting key results can be found in Appendices C and D and are categorized according to regional health authorities (RHAs) and province. Information from each resource that supported the identified themes were transcribed within the appropriate column. All data were stored on a password protected personal computer accessed only by me in a locked office space.

Ethical Considerations

As per the Health Research Ethics Authority (HREA) review checklist, approval from institutional review board was not required for this project as it involves research based on published literature. Please see completed HREA checklist in Appendix A. The majority of data were collected from websites that are publicly accessible. However, permission to share the information obtained from individuals outside of the EH organization was obtained during initial contact. No identifiable information was kept to protect the anonymity of the participants who responded to email correspondence.

Results of the Environmental Scan

In the following paragraphs, an overview of the clinical resources and services used within the province of NL is described, followed by an overview of the available resources for HCPs implemented in several provinces across Canada.

Newfoundland and Labrador

An extensive review of the diabetes services in the province of NL revealed a lack of clinical resources to guide HCPs in the provision of diabetic foot care. Despite recommendations from Diabetes Canada (2019, 2022) to adopt a provincial diabetes strategy, services for patients in the province remain divided across RHAs. Services specific to the diabetic foot are especially limited within the province. Specific details related to the services available within each RHA is summarized below.

Eastern Health

An extensive review of policies and procedures available on the EH intranet website provided no evidence of formal pathways or foot care teams dedicated to the diabetic foot. Nonetheless, a variety of services were offered for patients with diabetes at the Diabetes Centre located in St. John's. At this clinic, patients were able to access care from multiple disciplines including endocrinologists, internal medicine specialists, family physicians, nurse practitioners (NPs), registered nurses (RNs), diabetes educators and dieticians via a referral from a physician or an NP. However, there are no specific pathways in place whereby entry into the program guaranteed an automatic referral or consult for foot screening. While not specific to the diabetic foot, EH also offered a specialized wound care clinic comprised of wound care experts from disciplines of nursing, dermatology, plastics and orthopedic specialties. However, such services are only accessible to patients via consultation from a physician or an NP. Personal communication with HCPs working in the region verified the findings of the environmental scan in relation to the resources used by HCPs. Diabetes Canada CPGs was frequently identified as a common resource used.

Central Health

As an integral part of their multidisciplinary diabetes care program, CH offered a number of services in diabetes management that involve the targeted assessment, screening, referral and treatment of patients with diabetes as well as the facilitation of supportive education to improve self-management. To ensure accessibility, this innovative program is offered at thirteen health care sites across Central NL. CH also offered free foot care clinics for patients with diabetes, whereby RNs performed comprehensive foot assessments and provided tailored education to patients with diabetic foot concerns (Central Health, n.d.). Unfortunately, such foot care services were only offered at two of the main tertiary care hospitals in Gander and Grand Falls, which may not be accessible to all patients in the region. Personal communication with HCPs in the region suggested Diabetes Canada CPGs were also frequently used to inform diabetes management.

Western Health

A review of the services available on the WH website suggested that resources and support services for patients with diabetic foot concerns were limited within this region of the province. While self-management and supportive education by nurses and diabetes educators is available upon referral, there were no specific diabetic foot care programs or pathways in place to direct care priorities (Western Health, n.d.). Personal communication with nurses working in the region confirmed that there were no internal protocols for diabetic foot management but Diabetes Canada's CPGs are accessible to inform care. The review revealed no evidence of the existence of clinical resources specific to the diabetic foot.

Labrador-Grenfell Health

Clinical resources to aid in the provision of diabetic foot care services in the LGH region were also limited. A review of the external database and discussion with a nurse from the region

revealed a lack of clinical resources for HCPs that were specific to the diabetic foot. Other than diabetic education services which were primarily focused on newly diagnosed patients, there were no programs specifically dedicated to diabetic foot health (Labrador Grenfell Health, n.d.). Advanced foot care services by nurses were available upon referral but are not sufficient to meet the current demand according to two nurses working in the region. Consistent with other RHAs, no standardized clinical resources existed internally to guide HCPs in the provision of foot care. Rather, Diabetes Canada CPGs were frequently referred to by HCPs.

Clinical Resources across Canada

Given the lack of clinical resources in place to inform the care of the diabetic foot within the province of NL, a broad search into the clinical resources used by jurisdictions across Canada was employed. A summary of the clinical resources used by HCPs in the provinces of AB, BC, NB, NS, and ON is presented below.

Alberta

The province of Alberta has been paving the way in the delivery of diabetic foot services across Canada. In 2014, Alberta Health Services (AHS) implemented the Diabetes Foot Care Clinical Pathway with the addition of High-Risk Foot Care Teams (HRFTs) as a strategy to reduce the incidence of LLAs. This comprehensive pathway consisted of five target areas including: screening, assessment, referral, treatment and follow-up. This CPW encompasses evidence-based practice guidance, education and support for HCPs in the ongoing management of diabetic foot concerns. The implementation guide associated with the CPW identified primary HCPs such as physicians and NPs as the main target audience for implementation efforts but acknowledged the important role of foot care nurses, podiatrists and other invested professionals in improving uptake of the CPW across the province. The purpose of the implementation guide

was to support primary care providers and teams in implementing the pathway into their practice. Within the CPW, patients with diabetic foot concerns were categorized based on risk using a colour-coded system whereby *green* referred to low risk of LLA wherein no referral was needed; *yellow* referred to moderate risk of LLA wherein patients were to be seen within one month; *orange* referred to high risk of LLA wherein patients were to be seen within one to two weeks; and *red* referred to urgent risk and required patients to be seen within 24 hours of referral (AHS, 2019). The comprehensive, systematic and easy-to-follow design of the CPW provided clear evidence-based direction for HCPs in the provision of diabetic foot care. Recent cross-sectional studies discussed within the literature review found positive associations between the implementation of this pathway and patient and provider outcomes including HCP screening practices (Chan et al., 2020) and LLA incidence (Thanh et al., 2020). Specific details related to these studies can be found in the literature review.

As a joint venture to the CPW, HRFTs were established in 2014 and 2015 within a number of primary health care, community, long-term care, acute care and specialty sites across Alberta to improve access to specialty foot care for patients living with diabetes (Chan et al., 2020). AHS defined HRFTs as a dedicated care team of HCPs that specialized in multidisciplinary assessment, management, and referral of patients living with diabetes at risk of DFU or currently suffering from DFU. Typical composition of the multidisciplinary teams consisted of the collaboration of two or more HCPs from disciplines of medicine, surgery, nursing, or occupational therapy (Chan et al., 2020). Consistent with the implementation guidelines for the CPW, evidence-based guidelines for HRFT implementation were also developed by AHS to assist with the timely identification and assessment of DFU (AHS, n.d.). A sample of the CPW is

included in Appendix F.

British Columbia

A review of the Government of British Columbia website provided insight into resources for diabetes care within the province. According to the website, comprehensive CPGs for diabetes care were recently developed that provide numerous recommendations for systematic management of DFU (Government of British Columbia, 2021). While not specific to the diabetic foot, the guideline outlined evidence-based direction for HCPs in the prevention, diagnosis and management of diabetes that included a brief section on the diabetic foot. A closer look into resources available within the province revealed the existence of a CPW developed by the BC Provincial Nursing Skin and Wound Care Committee (2012) targeted towards DFU. This specific CPW was developed in 2012 in collaboration with wound care clinicians across all health authorities within the province of BC. In contrast to the other provinces, nurses were identified as the explicit target audience for CPW use rather than all HCPs caring for patients with DFU. Encompassed within the CPW were detailed recommendations for nurses to direct the screening, assessment, treatment and wound management of DFU, as well as guidance for patient education and family support interventions. The guideline was made accessible through the BC Ministry of Health Connecting Learners with Knowledge intranet website and was intended for use by all nurses working within the province.

New Brunswick

A review of the Government of New Brunswick diabetes care resources available on their website provided insight into several forms and pathways used by clinicians to manage DFU within the province. The available tools included a foot risk assessment form, a foot referral algorithm, and patient materials that included information about foot care practices and self-care

measured based on level of risk for DFU (Government of New Brunswick, 2014). In addition to these CPWs, collaborative high risk diabetic foot and wound care clinics were also established within the Horizon Health Network for patients with DFU by referral only. These high-risk foot care clinics were led by multidisciplinary teams that consisted of wound care experts from disciplines of nursing, podiatry and vascular surgery (Saint John Regional Hospital, 2016).

Nova Scotia

As part of their provincial Wound Prevention Strategy, the Nova Scotia Health Authority (NHS) developed and implemented a CPW for HCPs to improve diabetic foot management in 2021 (NHS, 2022). A review of their publicly accessible website provided a wealth of information about DFU pathophysiology, prevention, screening, assessment and management. For HCP management of DFU specifically, NHS provided an easy-to-follow flowchart depicting clear instructions for DFU management based on the acronym DFU-VIPS where *D* referred to overall diabetes management, *F* referred to the causation of the foot issue, *U* referred to ulcer assessment, *V* referred to vascular assessment, *I* referred to infection assessment, *P* referred to pressure assessment and *S* referred to sharp debridement of calluses. Within each category, a number of possible interventions were listed to direct HCPs regarding next steps to take to manage the DFU based on the patient's immediate needs. In addition to the flowchart, NHS also provided direct links to a number of key resources such as the IWGDF and Wounds Canada guidelines. In addition to the quick and easy DFU-VIPS flowchart, NHS developed a comprehensive assessment and management tool for DFU wound care and treatment interventions that provided in-depth instructions on optimization, assessment, cleansing, debridement, dressing, offloading, client education and expected outcomes.

Ontario

Consistent with the province of BC, the role of the nurse in DFU management was also emphasized by the Government of Ontario as evidenced by clinical best practice guidelines developed by the Registered Nurses' Association of Ontario (RNAO) in partnership with the Ontario Ministry of Health (RNAO, 2013). The authors did not explicitly distinguish between RNs and licensed practical nurses (LPNs) in the guidelines. The goal of these comprehensive CPGs was to be widely distributed across all sites in Ontario to improve diabetic foot outcomes for Canadians. The guidelines were intended to be used as a tool for HCPs to enhance decision in the provision of diabetic foot health. Encompassed within the guidelines was detailed direction for HCPs to guide the detection, screening, assessment, referral and treatment of diabetic foot concerns. While the document described a specific focus of educating nurses to assist their management of DFU, RNAO also explicitly stated that the guidelines were recommended for adoption by other HCPs to optimize care. The practice recommendations included within the document were categorized according to target areas of assessment, planning, implementation, evaluation, education, and organization and policy recommendations. The latter category detailed recommendations to develop a systematic approach to DFU that was multidisciplinary in focus and conducive to the facilitation of appropriate referral pathways for patients with DFU. Throughout this document, RNAO (2013) frequently referenced resources and flowcharts developed by leading professional associations such as Wounds Canada and the IWGDF. While these guidelines may be slightly outdated, a review of the RNAO website indicated that new CPGs are currently in progress.

A review of various health network websites in Ontario unveiled the existence of a detailed CPW by the Waterloo Wellington Integrated Wound Care Program (WWIWCP, 2015)

intended for local use by the region. This integrative CPW provided evidenced based direction for HCPs in holistic psychosocial assessment, lower limb assessment, diagnostics, treatment, referral and discharge planning for patients with DFU. These guidelines were very detailed and included explicit timelines for achievement of particular wound care outcomes (such as complete healing). Although the intended audience for the CPW was HCPs working within the Waterloo Wellington district, the resource was available on their website for easy access by HCPs across other jurisdictions.

Summary

An environmental scan of the available resources to guide the provision of diabetic foot care in NL shed light on the paucity of clinical resources for HCPs in the province. In contrast to other provinces in Canada, NL was lagging behind in the systematic management of the diabetic foot. A review of the available resources implemented in the provinces of AB, BC, NS, NB and ON highlighted the widespread use of CPGs, CPWs, and multidisciplinary teams to improve management of the diabetic foot. Considering most of the resources were published prior to 2018, it is plausible that many of these resources would be outdated compared to current evidence-based recommendations from Diabetes Canada (2018) and IWGDF (2019). NS was the only province included in this environmental scan that referenced the latest versions of the aforementioned guidelines. An overview of current evidenced-based recommendations from leading professional associations is presented below.

Recommendations from Professional Associations

Many of the clinical resources developed by health care organizations across Canada referenced guidelines from the following national and international professional associations: Diabetes Canada, Wounds Canada, IWGDF, and NICE. A summary of the clinical resources and

tools provided by these prominent organizations is explored in this section.

Diabetes Canada

As one of the leaders in diabetes care in Canada, Diabetes Canada provided a wealth of resources for HCPs to support diabetes management. The 2018 edition of the Diabetes Canada CPGs dedicates an entire chapter to diabetic foot care specifically. Encompassed within this chapter were detailed recommendations for HCPs related to foot screening, assessment, referral, treatment and patient education. Diabetes Canada (2018) also developed a PowerPoint presentation and a smart phone application for HCPs to facilitate easy access to these clinical resources. Across Canada, a common theme identified in the environmental scan was the widespread use of Diabetes Canada CPGs to inform HCP management of the diabetic foot.

Wounds Canada

Wounds Canada, formerly Canadian Association of Wound Care, is a non-for-profit organization devoted to enhancing wound management for all Canadians. While their mandate is not specific to DFU, improving outcomes for patients with DFU and preventing LLA was identified as one of their primary goals (Evans et al., 2022). In a recent article by Evans et al. (2022), an integrative foot care pathway developed by key stakeholders associated with Wounds Canada was presented as a national strategy to improve the systematic management of DFU. This population health model focused not only on improving patient outcomes, but also on enhancing the provider experience and facilitating value-based care. The pathway encompassed four colour-coded domains of risk to guide provider activities: green being low risk, yellow being moderate risk, orange being high risk, and red being urgent risk. Specific patient indications, goals of care and settings for treatment were clearly defined within each domain to assist HCPs in determining the appropriate course of action for the patient based on risk of DFU.

Although this CPW has yet to be adopted by health care organizations on a national scale, it was proposed by Wounds Canada for use as a clinical tool for HCPs across Canada to enhance diabetic foot management using a population health approach. It is depicted in Appendix G.

International Working Group on the Diabetic Foot

The IWGDF has been leading diabetic foot care and wound prevention on a global scale for more than two decades and is often referred to by national and international organizations as a primary source of evidence-based recommendations for DFU. The recent adaption of the IWGDF guidelines included recommendations based on the most up-to-date evidence from systematic reviews and high-quality studies from all over the world (IWGDF, 2019). The focus of the comprehensive guideline was "to aid HCPs in reducing the global burden of diabetic foot disease" (IWGDF, 2019, p. 5). Encompassed within the document was detailed recommendations for DFU screening, prevention, assessment, diagnosis, management and treatment as well as a number of flowcharts and diagrams to aid HCP decision-making. It is clear from a review of the available resources used by health care organizations across Canada that these guidelines contribute greatly to the recommendations outlined within existing CPWs.

National Institute for Health Care and Excellence

NICE is a United Kingdom-based professional association that provides evidence-based guidance and advice to improve health care, social care and public health. NICE released guidelines for diabetic foot management in 2019 to assist providers and organizations in the provision of diabetic foot care. Consistent with the IWGDF, these comprehensive guidelines detailed a number of recommendations for screening, assessment, diagnosis, treatment, referral and patient education in relation to diabetic foot concerns. While some of the recommendations related to DFU treatment must be interpreted with caution in light of the differences between the

United Kingdom and Canadian health care systems, this resource was another valuable tool for HCPs to assist with the provision of diabetic foot care. Recommendations from the IWGDF are also referenced by NICE in their guidelines. However, a recent update from the organization indicated that these guidelines were currently under review (NICE, 2021).

Summary

A review of resources developed by Diabetes Canada, Wounds Canada, IWGDF and NICE revealed a number of informative resources and tools for HCPs to guide the provision of foot care. On a national level, Diabetes Canada and Wounds Canada provided detailed guidance for HCPs in the form of CPGs (Diabetes Canada, 2018) and CPWs (Wounds Canada, 2022). Diabetes Canada's website also provided links to accessible resources such as a PowerPoint presentation and a Smartphone application for ease of knowledge sharing on a variety of topics related to DFU prevention, screening, assessment, treatment and patient education. Consistent with Diabetes Canada, Wounds Canada developed a number of valuable resources for diabetes care including the most recent development of an integrated CPW. On an international level, IWGDF and NICE continued to lead diabetes care with the development of tools and resources to guide management, advance knowledge and improve patient care. It is clear from a review of these organizations that there are a multitude of resources available to inform DFU management.

Implications of Findings

The findings of the environmental scan shed light on the available resources for DFU management nationally and internationally, while also illuminating the lack of resources within the province to support HCPs with the provision of diabetic foot care. Next, consultations with HCPs and key stakeholders are needed to determine whether or not the resources identified during the environmental scan could be potentially adapted for use within the local context. The

findings of the environmental scan will be used to inform the nature of the questions asked during the consultations regarding the types of resources used within the local context. It is hoped that the consultations with experts working in diabetes care in the province will uncover the barriers and facilitators that could potentially hinder, or support, the implementation of standardized clinical resources on an organizational-level.

Conclusion

It is evident from an extensive environmental scan that NL is lagging behind other provinces in the fight against DFU and urgent action is needed to address the gap in diabetes care in relation to diabetic foot management. Fortunately, a plethora of clinical resources have been successfully implemented in jurisdictions outside of the province to assist HCPs in the systematic management of the diabetic foot that could be adapted for adoption within NL. Consultations with HCPs and key stakeholders from EH are needed to identify resources currently being used by HCPs and to determine the specific resource-related needs of the local context. Based on the cumulative findings of the literature review, environmental scan and consultations, a decision will be made regarding the best course of action for resource development to support the provision of diabetic foot care in NL.

References

Alberta Health Services. (2019). *Alberta diabetic foot care clinical pathway.* https://www.albertahealthservices.ca/assets/about/scn/ahs-scn-don-diabetes-foot-care-clinical-pathway-overview.pdf

BC Provincial Nursing Skin and Wound Care Committee. (2012). *Guideline: Assessment and treatment of diabetic and neuropathic ulcers in adults.* https://www.clwk.ca/buddydrive/file/guideline-diabetic-neuropathic-ulcers/

Central Health. (n.d.). *Diabetes care program*. https://www.centralhealth.nl.ca/diabetescare

Chan, C.B., Dmytruk, K., Labbie, M., & O'Connell, P. (2020). Organizational changes in diabetic foot care practices for patients at low and moderate risk after implementing a comprehensive foot care program in Alberta, Canada. *Journal of Foot and Ankle Research, 13*(1), 1-15. https://doi.org/10.1186/s13047-020-00393-0

Diabetes Canada. (2018). Clinical practice guidelines for the prevention and management of diabetes in Canada. *Canadian Journal of Diabetes, 42*(1), S1-S325. https://guidelines.diabetes.ca/cpg

Diabetes Canada (2019). *Diabetes in Newfoundland and Labrador: Backgrounder.* https://www.diabetes.ca/DiabetesCanadaWebsite/media/About-Diabetes/Diabetes%20Charter/2019-Backgrounder-Newfoundland-and-Labrador.pdf

Diabetes Canada. (2021). *Diabetes in Canada: Backgrounder.* https://diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2021_Backgrounder_Canada_English_FINAL_MAR.pdf

Diabetes Canada. (2022). *Diabetes in Newfoundland and Labrador: Backgrounder.* https://www.diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2022_Backgrounder_Newfoundland.pdf

Evans, R., Kuhnke, J. L., Blanchette, V., Botros, M., Rosenthal., S., Alleyre, J., & Costa, I. (2022). A foot health pathway for people living with diabetes: Integrating a population health approach. *Limb Preservation in Canada, 3*(1), 12-25. https://www.woundscanada.ca/dhfy-doc-man/public/limb-preservation-in-canada/2022-vol-3-no-1/2501-lpc-spring-2022-v3n1-final-p-12-25-foot-health-pathway/file

Government of British Columbia. (2021). *Diabetes care.* https://www2.gov.bc.ca/assets/gov/health/practitioner-pro/bc-guidelines/diabetescare_guideline_full_2021.pdf

Government of New Brunswick. (2014). *Comprehensive diabetes strategy.* https://www2.gnb.ca/content/gnb/en/departments/health/patientinformation/PrimaryHealthCare/A-Comprehensive-Diabetes-Strategy-for-New-Brunswickers/OfficeToolsFormsForPrimaryCareProviders.html

Government of Ontario. (n.d.). *Diabetic foot ulcers*. https://www.hqontario.ca/evidence-to improve-care/quality-standards/view-all-quality-standards/diabetic-foot-ulcers

Harrison, M. B., & Graham, I. D. (2021). *Knowledge translation in nursing and healthcare: a roadmap to evidence-informed practice*. John Wiley & Sons, Inc.

International Diabetes Federation. (2021). *IDF Diabetes Atlas*. https://diabetesatlas.org

International Working Group on the Diabetic Foot. (2019). *IWGDF practical guidelines on the prevention and management of diabetic foot disease.* https://iwgdfguidelines.org/wp-content/uploads/2021/03/IWGDF-2019-final.pdf

National Institute for Health and Care Excellence. (2021). *2021 exceptional surveillance of diabetic foot problems: Prevention and management.* https://www.nice.org.uk/guidance/ng19/resources/2021-exceptional-surveillance-of-diabetic-foot-problems-prevention-and-management-nice-guideline-ng19-9260014573/chapter/Surveillance-decision?tab=evidence

National Institute for Health and Care Excellence. (2022). *Diabetic foot problems: Prevention and management*. https://www.nice.org.uk/guidance/ng19/resources/diabetic-foot-problems-prevention-and-management-pdf-1837279828933

Nova Scotia Health. (2021). *Diabetic foot ulcer*. https://library.nshealth.ca/ld.php?content_id=35335997

Labrador-Grenfell Health. (n.d.). *Regional diabetes education.* https://www.lghealth.ca/your-health/programs-and-services/population-health/regional-diabetes-education/

Registered Nurses Association of Ontario. (2013). *Assessment and management of foot ulcers for people with diabetes, 2nd edition.* https://rnao.ca/bpg/guidelines/assessment-and-management-foot-ulcers-people-diabetes-second-edition

Saint John Regional Hospital. (2016). *High risk diabetic foot clinic – Saint John triage form.* https://sjrhem.ca/high-risk-diabetic-foot-clinic-saint-john-triage-form/

Schaper, N.C, van Netten, J. J., Apelqvist, J., Bus, S. A., Hinchliffe, R. J., & Lipsky, B. A. (2020). Practical Guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). *Diabetes/metabolism Research and Reviews, 36*(S1), 1-10. https://doi.org/10.1002/dmrr.3266

Sundler, A. J., Lindberg, E., Nilsson, C., & Palmér, L. (2019). Qualitative thematic analysis

based on descriptive phenomenology. Nursing Open, 6(3), 733–739. https://doi-org.qe2a-proxy.mun.ca/10.1002/nop2.275

Thanh, N.X., Dmytruk, K., O'Connell, P., Rogers, E., Fillier, D., MacRae, J. M., Thomas, C., Rennie, C., Eitzenberger, C., Newman, C., Match, B., Thompson, C., Nhan, J., & Wasylak, T. (2020). Return on investment of the diabetes foot care clinical pathway implementation in Alberta, Canada. *Diabetes Research and Clinical Practice, 165*, 108241–108248. https://doi.org/10.1016/j.diabres.2020.108241

Thorud, J.C., Plemmons, B., Buckley, C. J., Shibuya, N., & Jupiter, D. C. (2016). Mortality after nontraumatic major amputation among patients with diabetes and peripheral vascular disease: A Systematic Review. *The Journal of Foot and Ankle Surgery*, *55*(3), 591–599. https://doi.org/10.1053/j.jfas.2016.01.012

Waterloo Wellington Integrated Wound Care Program (2015). *Diabetic foot ulcer clinical pathway.* https://wwwoundcare.ca/Uploads/ContentDocuments/Edited_Final%20Diabetic%20Foot%20Ulcer%20Pathway%20Waterloo%20Wellington%20Integrated%20Wound%20Care%20Program%20Nov%202016.pdf

Western Health. (2016). *Diabetes education*. https://westernhealth.nl.ca/diabetes/

Wounds Canada. (2022). *Foot health pathway for people living with diabetes.* https://www.woundscanada.ca/docman/public/1829-diabetic-foot-complications-a-tab-1823e-final/file

Appendix A: HREA Screening Tool

Student Name: Ashley Hunt

Title of Practicum Project: A Clinical Resource for Health Care Providers to Improve Diabetic Foot Care

Date Checklist Completed: February 4, 2022

This project is exempt from Health Research Ethics Board approval because it matches item number ___3__ from the list below.

1. Research that relies exclusively on publicly available information when the information is legally accessible to the public and appropriately protected by law; or the information is publicly accessible and there is no reasonable expectation of privacy.
2. Research involving naturalistic observation in public places (where it does not involve any intervention staged by the researcher, or direct interaction with the individual or groups; individuals or groups targeted for observation have no reasonable expectation of privacy; and any dissemination of research results does not allow identification of specific individuals).
3. Quality assurance and quality improvement studies, program evaluation activities, performance reviews, and testing within normal educational requirements if there is no research question involved (used exclusively for assessment, management or improvement purposes).
4. Research based on review of published/publicly reported literature.
5. Research exclusively involving secondary use of anonymous information or anonymous human biological materials, so long as the process of data linkage or recording or dissemination of results does not generate identifiable information.
6. Research based solely on the researcher's personal reflections and self-observation (e.g., auto-ethnography).
7. Case reports.
8. Creative practice activities (where an artist makes or interprets a work or works of art).

For more information, please visit the Health Research Ethics Authority (HREA) at https://rpresources.mun.ca/triage/is-your-project-exempt-from-review/

Appendix B: Questions to Guide Data Collection and Analysis

1. What clinical resources are available for diabetic foot care?
2. What type of resource is provided? i.e., clinical pathway, care map, integrated pathway, decision map, etc.
3. Who is the target audience for the guideline?
4. What area(s) of foot care management does it address? i.e., prevention, screening, referrals, treatment, etc.
5. Who created the resource? Was it created by a professional organization? If so, what is the association's mandate? Is it a provincial, national or international organization? Were other key stakeholders involved?
6. When was the guideline or resource created? Is it the latest publication from the organization?
7. How is the organization funded? Is it industry-funded, non-for-profit, or government-funded? Are there any conflicts of interest?

Appendix C

Table 1

Clinical Resources to aid in the management of the Diabetic Foot in Select Canadian Provinces

	Nova Scotia	**New Brunswick**	**British Columbia**	**Alberta**	**Ontario**
Type of Resource	CPW (wound prevention strategy) Includes implementation guidelines for HCPs	CPW and HRFTs Includes guidelines to assist HCPs with implementation, hyperlinks to resources for wound assessment, details regarding glycemic control screening and targets, and patient educational materials	CPW Includes detailed guidelines for HCPs to aid implementation as well as hyperlinks to wound care resources and patient education information	CPW and HFRTs (MDT) Includes implementation guideline for HCPs, hyperlinks to referral guidelines, screening forms, and triage forms.	CPGs and CPW (Waterloo) Includes detailed guidelines for HCPs to aid implementation as well as hyperlinks to wound care resources
Target Audience	HCPs	HCPs	Nurses	HCPs (primarily physicians and NPs)	Nurses and HCPs
Target Focus	• Prevention • Screening • Assessment • Referral • Treatment • Wound care	• Screening • Assessment • Referral (HRFTs) • Patient education and support	• Prevention • Screening • Assessment • Treatment • Wound care • Patient education	• Screening • Assessment • Referral (HRFTs) • Treatment and Follow-up	• Prevention • Screening • Assessment • Referral • Treatment and follow-up

		• Treatment and Follow-up			• Wound care
Type of Organization	Provincial health authority	Provincial health authority	Special Interest Group titled BC Provincial Nursing Skin and Wound Care Committee collaboration with government and health authorities	Provincial health authority	RNAO developed CPGs in collaboration with government, health authorities and key stakeholders CPW was specific to Waterloo region
Year Established	2021	2014/2016	2012	2014/2015	2013 (CPGs) 2015 (CPW)
Level of Intended Reach	Province-wide adoption	Province wide-adoption	Province-wide adoption	Province-wide adoption	Intended for use provincially and nationally whereas Waterloo CPW was intended for regional use

Appendix D

Table 2

Clinical Resources to aid in the Management of the Diabetic Foot Care within Regional Health Authorities

	EH	CH	WH	LGH
Policies	No formal policies for diabetic foot	No formal policies for diabetic foot	No formal policies for diabetic foot	No formal policies for diabetic foot
Resources	1. Diabetes Centre: multidisciplinary clinic (endocrinologists, internal medicine specialists, GPs, NPs, RNs, diabetes educators and dieticians) by referral only 2. Specialized wound care clinic (nursing, dermatology, plastics and orthopedic expects) by referral only (not specific to DFU	1. Diabetes program involving assessment, screening, referral and treatment of diabetes as well as self-management education offered at 13 sites 2. Free foot care clinics to patients with diabetes, whereby RNs perform foot assessments and provide education (Gander and GFW)	1. Self-management education by RNs and diabetes educators available by referral	1. Diabetic education services primarily focused on newly diagnosed patients 2. Advanced foot care services by nurses are available upon referral
Comments from HCPs	Internal medicine specialist comments: • HCP practices not standardized but at each practitioner's discretion Diabetic nurse educator comments: • Diabetes Canada CPGs frequently referred to for guidance	NP comments: • No protocols, Diabetes Canada CPGs frequently used to inform diabetes care	Medicine nurse comments: • no internal protocols for diabetic foot management but external resources such as Diabetes Canada's CPGs made accessible to HCPs on intranet	Primary Care Nurses Comments: • no internal protocols or pathways • Refer to Diabetes Canada CPGs

Appendix E

Table 3

Clinical Resources Developed by Select Professional Associations

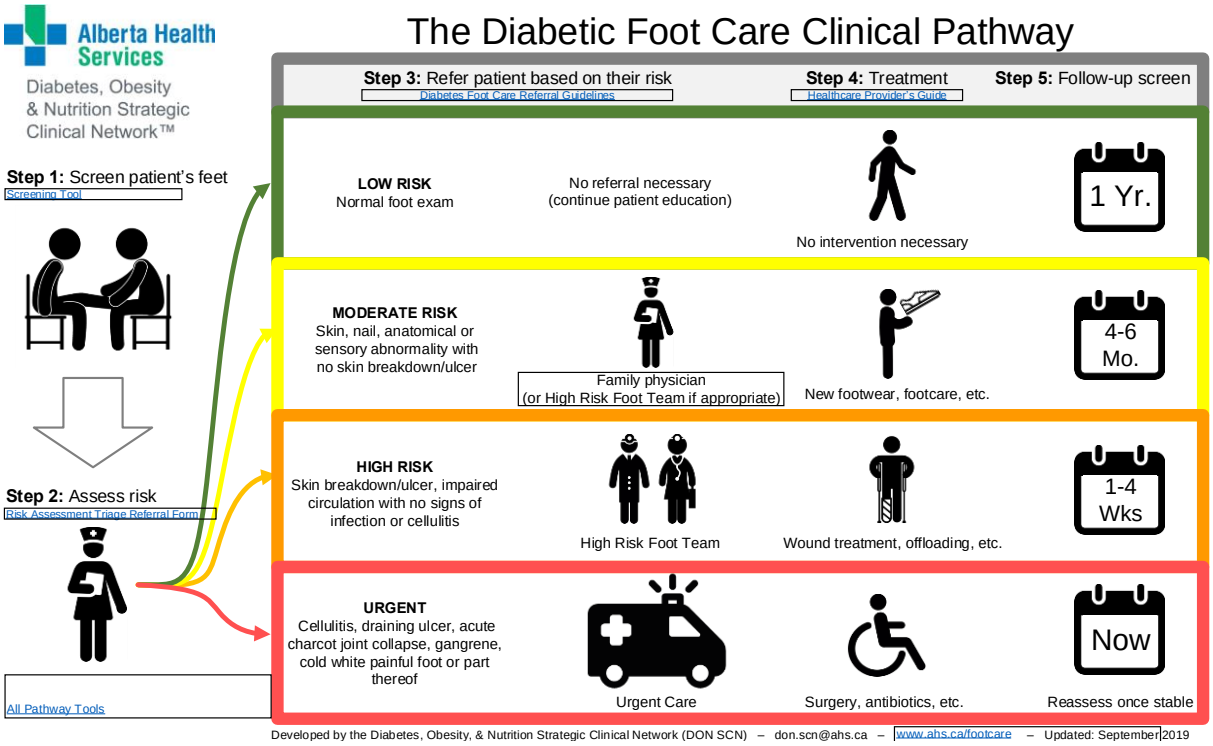
	Diabetes Canada	**Wounds Canada**	**IWGDF**	**NICE**
Type of Resource	CPGs chapter on foot care PowerPoint Presentation Smartphone application Patient information	CPW Screening Tools for HCPs Hyperlinks to resources from other professional associations Patient information materials	CPGs – comprehensive resource on latest best practices updated every four years Numerous flowcharts and diagrams to assist decision-making.	CPGs- comprehensive guidelines and recommendations
Target Audience	HCPs but also includes materials for patients	HCPs but also includes materials for patients	HCPs Organizations Patient education materials	HCPs Organizations Patient education materials
Target Focus	Prevention Screening Assessment Referral Treatment Patient Education	Prevention Screening Assessment Risk-Stratification Individualized Care Plan Patient Education Treatment	Prevention Screening Assessment Diagnosis Management Treatment	Prevention Screening Assessment Diagnosis Treatment Referral Patient Education
Type of Organization	Non-for-profit advocacy group focused on diabetes prevention, education, and improving the quality of	Non-for-profit organization devoted to enhancing wound management for all	Non-for-profit organization dedicated to producing evidence-based guidelines to inform HCPs all over	United Kingdom-based non-for-profit organization devoted to providing evidenced-based guidance for

	life for people with diabetes (not DFU specific).	Canadians (not DFU specific)	the world on the prevention and management of the diabetic foot (DFU specific)	HCPs to improve health care, social care and public health (not DFU specific)
Year of Latest Publication	2018	2022	2019	2019

Appendix F

Figure 1

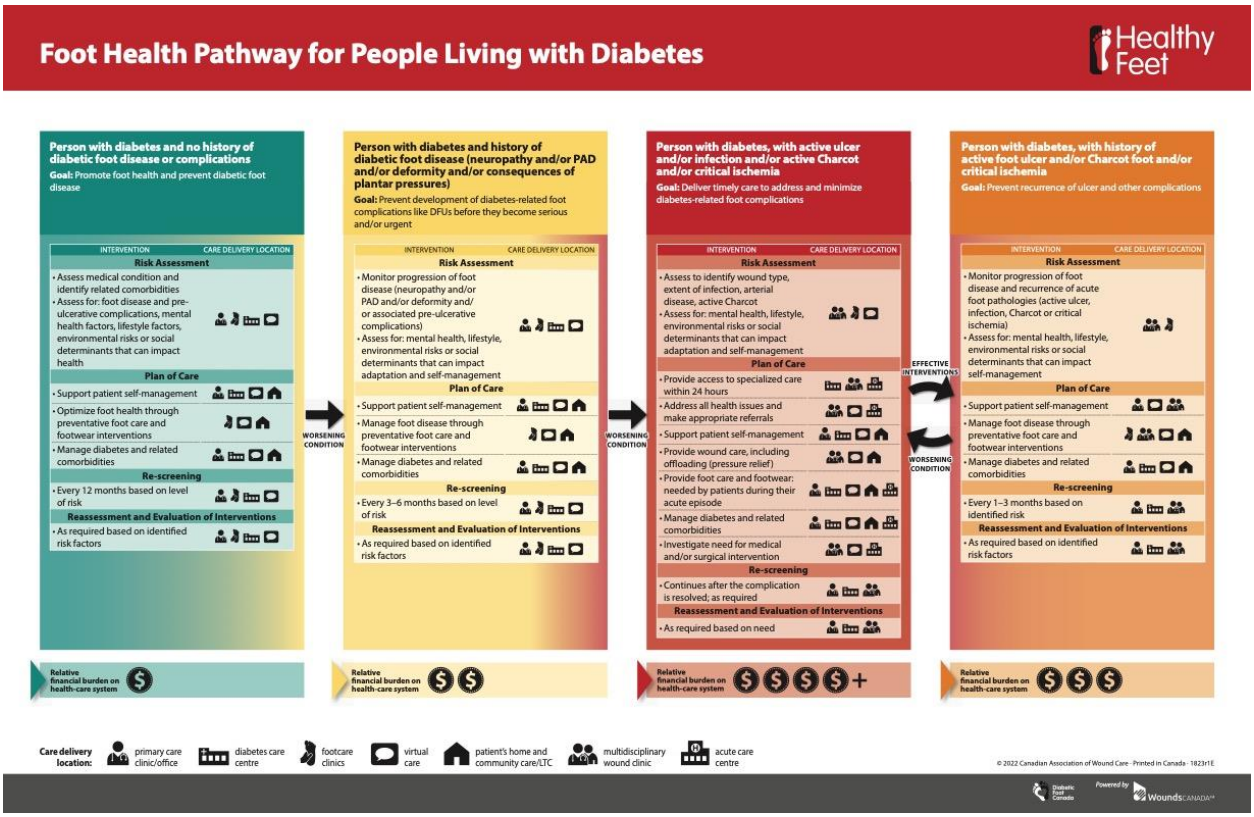
Example of Clinical Pathway from Alberta Health Services



Appendix G

Figure 2

Example of Clinical Pathway from Wounds Canada



Appendix E

A Clinical Resource for Diabetic Foot Care: Consultation Report

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Diabetic foot ulceration (DFU) is defined as an ulceration of the foot secondary to diabetes and is recognized as one of the most devastating complications of poorly controlled diabetes with far-reaching implications for patients, families, health care providers (HCPs) and health systems (International Diabetes Federation [IDF], 2021; International Working Group on the Diabetic Foot [IWGDF], 2019). Without proper management, poorly treated DFUs can evolve to infection, ischemia, and LLA, and has been identified as a major cause of diabetes-related morbidity and mortality (IWGDF, 2019; Thorud et al., 2016). To reduce the burden of DFU, the literature recommends the integration of a systematic interdisciplinary approach to aid the prevention, screening, treatment and management of diabetic foot complications (Diabetes Canada, 2021; IDF, 2021; Schaper et al., 2020).

The overall goal of the practicum is to develop a comprehensive clinical resource to reduce diabetic foot complications and improve outcomes for patients living with diabetes in Newfoundland and Labrador (NL). Specifically, a clinical resource is proposed to assist HCPs in the provision of care of patients with diabetic foot needs in acute and primary health care settings within Eastern Health (EH). An integrative review of the literature was conducted to gain insight into the effectiveness of organizational-level strategies to mitigate the impact of DFU. Based on the findings of the literature review, there is moderate evidence to support the effectiveness of clinical pathways (CPWs) and multidisciplinary teams (MDTs) in the management of the diabetic foot. Following the literature review, an environmental scan was conducted to gain insight into existing resources for HCPs on a provincial and national level to aid in diabetic foot management. The environmental scan was successful in illuminating the widespread availability of CPWs and MDTs in jurisdictions outside of NL, while also drawing attention to the lack of organizational-level approaches within NL, in comparison. The purpose of the consultation

phase of the practicum project was to determine the specific needs of HCPs within the local context of NL in relation to clinical resources for diabetic foot management. Consultations with local experts from varied backgrounds and experiences provided a deeper understanding of the current climate in relation to diabetic foot management in NL. Discussions with providers also allowed for the identification of barriers and facilitators that could potentially hinder or drive the future implementation of a clinical resource within the province. The findings of the consultations will be used in conjunction with the environmental scan and literature review to inform the development of a comprehensive clinical resource for the diabetic foot that reflects the local needs of providers.

Objectives of the Consultations

The primary goal of the consultations was to identify clinical resources available to inform diabetic foot management in NL and to understand how they are being used and how they could be improved upon. The information obtained from the consultations will be used in collaboration with the environmental scan and literature review to direct the content, delivery, and implementation of a clinical resource to improve management of the diabetic foot. Specific objectives of the consultations were:

1. To explore health care providers (HCPs) experiences with clinical resources for diabetic foot management.
2. To identify current gaps in the delivery of diabetic foot care within Eastern Health (EH).
3. To identify learning needs of HCPs in relation to diabetic foot care.
4. To identify barriers and facilitators to implementation of a clinical resource for diabetic foot management.
5. Identify key areas to target in a clinical resource for diabetic foot management.

Setting and Sample

Consultations were conducted with a number of key informants from diverse backgrounds and experiences in the realm of diabetes. Nine consultations that consisted of semi-structured telephone and email-based interviews were conducted to gain insight into the available resources for diabetic foot management in the province and to identify the priority needs of providers. A table depicting the questions and responses of participants is included in Appendix C. A total of ten participants were involved in the nine consultations conducted. Participants consisted primarily of representatives from the nursing profession, including one LPN, six RNs, and one NP. The LPN that was interviewed is specialized in advanced foot care and provides private services in a remote region of the province. The NP that was interviewed is a practitioner who specializes in vascular surgery. The RNs interviewed included a vascular surgery nurse, a research nurse coordinator, a diabetes nurse educator, two wound care nurse consultants, and a community health nurse. Consultations were also conducted with an endocrinologist who expressed a keen interest in diabetic foot care as well as a local podiatrist. I had also planned to interview a family physician, but unfortunately my previous contact was unavailable at the time of consultations. Consultations with key stakeholders from jurisdictions outside of the province including Alberta Health Services (Kathy Dmytruk) and Wounds Canada (Janet Khunke) were postponed at this time, but will be revisited once planning and development of the clinical resource is underway, should the need arise. Potential consultants were approached first by email to determine interest in participating and contacted via telephone for an interview if at all possible. Due to scheduling conflicts, two of the nine consultations were completed through email (community health nurse and NP). A sample of the email that was sent to potential participants is included in Appendix B.

As the clinical resource is intended for HCPs to enhance diabetic foot management, engaging with HCPs from a variety of contexts and settings was considered paramount to ensure content is appropriately tailored to the needs of the target audience. As previously discussed, previous connections had been established with many of the participants through professional relationships or through the nurse manager of vascular surgery (primary point of contact). Therefore, contact regarding participation in the consultation was made with potential participants via email. A sample of the email used is included in the Appendix. Once agreement to participate was obtained, I made contact with participants via telephone or Microsoft Teams to complete a semi-structured interview for approximately 20 minutes. Two interviews were completed through email exchange due to scheduling conflicts. Prior to commencing the interview, I provided an overview of the practicum project and outlined the purpose for conducting the consultations. Participants were given the opportunity to answer questions at this time. Through email, I made sure to inform participants of how privacy, confidentiality, and anonymity will be maintained. A follow-up email was sent to participants thanking them for their participation.

Data Management and Analysis

All data was managed, analyzed, and properly secured on my personal computer. Once permission was obtained from key consultants, I recorded detailed notes during interviews of participant responses and typed notes into a Microsoft Word document for further analysis. Consistent with the Environmental Scan, descriptive analysis was performed to analyze the data collected during the consultations and a table was created to depict the results. Descriptive analysis was used to identify similarities in responses, to organize meanings found in the data, and to identify patterns between sources and establish themes (Sundler et al., 2019). Tables are

organized by question and by participant role. I will continue to store data on my password protected personal computer until practicum completion. No identifiable information will be kept beyond sharing with my practicum supervisor to protect the anonymity of the participants. Participants were informed of the sharing of data with practicum supervisor to validate thematic analysis and ensure rigour. Data will be kept until practicum project is fully developed and then deleted from the computer in Fall of 2022. Through the consultations, a number of key themes emerged related to factors affecting diabetic foot management. For ease of reading, findings are categorized under three overarching themes: organizational-level factors, provider-level factors, and patient-level factors. These themes and the associated subthemes are addressed in the results section.

Ethical Considerations

As per the Health Research Ethics Authority (HREA) review checklist, approval from institutional review board was not required for this project as it considered a quality improvement initiative. Please see completed HREA checklist in Appendix A. The consultations were informal and agreement to participate was obtained via email or inferred through verbal consent. Participant confidentiality was maintained and names of participants will not be shared during development of the project. Participation is voluntary and not associated with any potential harm or undue risk. No identifiable information will be kept to protect the anonymity of the participants. As previously stated, data will be stored on a password protected personal computer accessed only by the writer in a locked office space. Data will be deleted upon project completion in the Fall of 2022.

Results

The results obtained from the consultations were categorized under three main headings: organizational-level factors, provider-level factors and patient-level factors. Within each category, subthemes specific to that level of care were identified as presented below.

Organizational-Level Factors

Key themes identified related to organizational-level factors included: lack of standardized resources, lack of funding models for diabetic foot care, limited resources, long wait times for appointments, and lack of processes to promote communication between private and public sectors.

Lack of Standardized Resources

The absence of standardized clinical resources for diabetic foot care was identified by all participants interviewed during the consultations. All ten participants denied the existence of organizational-level tools to assist HCPs with diabetic foot management such as clinical pathways and multidisciplinary teams. While two of the wound care consultants interviewed described the multidisciplinary nature of their wound management team, they denied a specific focus on providing comprehensive DFU management. The nurse interviewed from the collaborative clinic also described the multidisciplinary focus of the clinic, but stated that their mandate was not specific to the diabetic foot. Despite the lack of organizational structures to govern the management of DFU on a systematic level, all participants used a variety of internal and external resources to inform their practice including Eastern Health educational materials and external resources from Diabetes Canada, Wounds Canada and the International Working Group of the Diabetic Foot (IWGDF). The wound care clinic and its nurses were identified as an invaluable resource for knowledge by the majority of the participants interviewed. Provincial and

Eastern Health developed resources were identified by a community health nurse, diabetes nurse educator, research nurse, both wound care nurse consultants, and NP. In particular, the patient information pamphlet titled *Foot Care for People with Diabetes* was identified as a resource utilized by the diabetes educator, research nurse, NP and wound care nurses. Two participants discussed the use of the new provincial electronic medical record (EMR) system referred to as eDOCsNL to assist with management of patients with diabetes. These two participants (endocrinologist and diabetes nurse educator) described the integrated diabetes form feature of the EMR which includes the use of prompts for annual foot examination. While the EMR is a promising organizational-level strategy, it has yet to be adopted by all HCPs within the province, therefore, the use of this clinical resource was not widespread. It is clear from the consultations that a number of tools and resources were used by HCPs but no standardized or formal structural approaches existed. Given the variability in resources used by HCPs, it is evident that a standardized approach to diabetic foot management is needed.

Lack of Funding

Lack of provincial funding models for diabetic foot care was identified by all participants as a significant barrier to improving diabetic foot health. Seniors were identified as a sub-population who were specifically in need of financial support to assist with wound management and diabetic supplies. The availability of coverage for patients who were recipients of home care support was identified by two of the participants interviewed as a step in the right direction, but the demand for financial support for all patients was identified as a concern in all of the consultations. One participant (the podiatrist) discussed funding models employed in other provinces such as Ontario to cover podiatry services for seniors and remarked that a similar

initiative should be explored in NL. The need for creative solutions and improved funding models to allow providers to implement recommendations was clearly illustrated.

Lack of Resources

In addition to limited funding for diabetic foot services, lack of resources was also identified as an organizational-level factor impacting diabetic foot management in NL. Outside of the urban areas, there were very limited foot services for patients with diabetes and limited places to receive proper fitting footwear. The need for more resources such as vascular, wound care, and podiatry services was identified as an important prerequisite to clinical pathway development and implementation by an advanced foot care nurse working in a rural region. Similarly, transportation issues to and from services was identified as a concern by a community health nurse working with EH. In keeping with the issue of long wait times, the need for more services and providers to assist with the current demand for diabetic foot care as well as applicable resources (financial, human) to assist patients to better access these services is clear. Limited time was identified as a barrier to implementing a standardized tool or educational resource among providers, thus a need to consider the lack of resources available at an organizational-level was clear.

Long Wait-Times

Extensive wait-times to see primary care providers and specialists is not uncommon in the current health care climate. The inability to secure in-person appointments with providers was identified as a potential barrier to proper diabetic foot management by five participants. Remarks surrounding patients going back and forth to emergency departments and not being able to be seen by their family doctors was commonly noted by consultants. According to the wound consultants interviewed, the waitlist to see an orthotist was approximately six months, thus

creating another barrier. It was evident from the consultations that lengthy wait-times to see providers was considered a hinderance to proper management and treatment of diabetic foot concerns.

Lack of Communication

Two of the participants who were interviewed reported working exclusively in private sector (the advanced foot care nurse and the podiatrist). Currently, there are no communication pathways to assist with the coordination of care for patients who receive both private and public services. The podiatrist interviewed commented on this barrier in relation to the wound management clinic, in that appointments were not always coordinated as they should have been promote optimal wound healing. The advanced foot care nurse interviewed also discussed the lack of support from the local health care authority in terms of advertisement of foot care services to patients who visited the clinic. Based on the consultations, it is clear that better communication processes are needed to improve coordination of care and improve uptake of much needed foot care services.

Provider-Level Factors

Common themes identified related to provider-level factors included inconsistency in care between providers, a need for tailored education related to diabetic foot management, a need for better utilization of existing expert knowledge, and a need for preventative care and screening.

Inconsistent Care

Inconsistencies in care and in advice given by HCPs was certainly evident during the consultations. All participants commented on the inconsistencies among HCPs in the resources used to guide their care, advice and education given to patients, and in the practices and

treatment plans they devise. The findings suggest that not all primary care providers performed foot assessments on their patients without being prompted by patients. Lack of preventative foot screening was a growing concern among the HCPs interviewed. In addition to the lack of foot screening, differences in practices were also observed by consultants regarding wound management and patient education. For instance, three participants reported being told by patients that they received guidance from their primary care providers to soak their feet. Such a practice is inconsistent with current best practice guidelines. Referral practices and level of assessment were also identified as inconsistent areas. Consultants remarked that some providers performed brief clinical assessments and made late referrals, while other providers, especially NPs, performed thorough assessments and made early referrals. Likewise, five participants reported hearing the same story from multiple patients about having to go back and forth to their provider or to the emergency department concerning their feet only to be sent home with antibiotics and referred to community health, rather than referred to wound management, podiatry, dietician, diabetes educator or vascular surgery. It is clear from the consultations that there is an urgent need to improve consistency in all aspects of diabetic foot management in NL.

Need for Education

All participants recognized a need for education among HCPs to improve screening, assessment, prevention and standardization of care in relation to diabetic foot management. As previously mentioned, inconsistent care was a substantial concern identified by all participants in relation to foot assessment, screening, patient education, wound management and referral practices among HCPs. A need for education and re-education on a quarterly basis was recommended by the endocrinologist interviewed during the consultations as a priority to ensure screening and risk-stratification by HCPs remained consistent with clinical practice guidelines.

The need for an educational resource that specifically targeted prevention and screening was identified in the consultations as a necessary step to improve diabetic foot care. Risk stratification, patient education materials, pathophysiology and wound management and treatment were identified as important topics to cover within an educational resource. A specific focus of ensuring timely referrals to relevant disciplines (podiatry, wound management) was emphasized. Despite the variability among participants in the type of education resource and target focus suggested, all were in agreement of the critical need for education to improve consistency in management of the diabetic foot.

Need for Prevention and Screening

As emphasized in the previous section, all participants agreed that a standardized resource would be beneficial and identified the areas of prevention and screening as the most critical to target. Despite the clear support for an accessible streamlined resource, there was considerable variation in relation to the types of resource suggested. The need for a collaborative and multidisciplinary approach was identified by all participants, however, some specific suggestions included a nurse-led team approach, an internet accessible learning module, a triage pathway, and a grand rounds educational presentation. The endocrinologist who was interviewed advocated for a resource that was accessible at finger-point and tightly linked to existing integrated forms and resources so that providers could reconcile where to go for access to the pathways, forms and resources they needed. Despite the variability, the need for a standardized resource that targets prevention and screening was evident in all of the consultations

Need to Utilize Existing Resources and Expert Knowledge

One of the most interesting themes that emerged from the consultation phase of the project was the acknowledgement of existing resources, experts and services within EH to

support diabetic foot management. While a need for additional resources was identified, several participants also acknowledged the availability of existing resources and experts to support the provision of diabetic foot care that had not previously been considered. The endocrinologist who was interviewed raised an important point regarding the need for better utilization of the wealth of knowledge that we currently have at our disposal in terms of skilled professionals from the wound management clinic, vascular and orthopedic surgeons, internal medicine and infectious disease specialists, dieticians, orthotists, podiatry, physiotherapy and occupational therapy and advanced foot care nurses. This particular participant also described the provincial initiative *Practice 360*, an extension of eDOCsNL, and its specific features for diabetes care planning and management that was previously alluded to by the diabetes nurse educator. Specifically, the diabetes nurse educator described the potential initiative and reported using the features of the EMR that support diabetes foot care, such as reminders and prompting for annual foot examination. The wound care consultants also described an existing internal e-resource that had not been identified during the environmental scan portion of the practicum project. This learning module was developed by the wound care nurses to educate providers about wound management of diabetic foot ulcers and was accessed through the Wound Care tab on the Eastern Health intranet. According to the perspectives of the wound care nurses, however, this module was not well known among providers. Thus, in addition to the need for a standardized resource, the need to improve utilization of existing resources and awareness among experts in the field was evident. The need for education and direction for providers regarding the resources that are available to support management of the diabetic foot was clearly conveyed in the consultations.

Patient-Level Factors

The patient-level factors identified are largely intertwined with the socioeconomic circumstances that impact a patient's ability to avail of proper care and services. Common themes identified within this category included: inadequate knowledge, lack of resources to cover cost of care, presence of multiple comorbidities and noncompliance with self-management and treatment.

Inadequate Knowledge

In relation to inadequate knowledge, it was clear from the participants retelling of their encounters with patients that there continues to be many misconceptions among patients about recommended diabetic foot self-care, treatment and prevention. As previously stated, the belief that soaking feet in water is beneficial or that having pedicures at a salon is equivalent to receiving foot care, was noted by several participants as a common observation. Lack of knowledge among patients regarding prevention and screening was identified by participants as a barrier to achieving proper diabetic foot care, which was further complicated by the inconsistent practices and advice received by their providers. To enhance knowledge among patients, one participant suggested improving the distribution of patient educational materials by providers. One resource that was identified by several participants as a go-to resource to give to patients was an Eastern Health pamphlet titled Foot Care for People with Diabetes. It was evident from the consultations that there is a need to enhance patient knowledge related to current evidence-based practices and to minimize the amount of misinformation being shared by different providers.

Lack of Resources

Similar to lack of knowledge, limited resources and financial means to achieve proper foot care was identified as a major deterrent by all participants interviewed. The financial burden of diabetes incurred by the patient in relation to the cost of supplies, including blood glucose monitoring strips and proper footwear was identified. Services such as podiatry and advanced foot care were described by participants as unwelcome expenses for patients, whom, according to the consultants, were predominantly seniors who were low-income. Many participants described the common occurrence of patients having to pay out of pocket for all expenses without insurance coverage being a significant barrier to proper care. Unless patients were receiving homecare and entitled to coverage for a portion of foot care services through home care programs, they were typically paying considerable amounts of money for daily diabetes care. The socioeconomic profile of many of the patients described by providers was seniors who were low-income and without insurance. Accessibility and means of transportation to and from appointments was another barrier identified during the consultations, especially in rural and remote areas. In relation to the high cost of care, one participant (diabetes nurse educator) remarked that “in the grand scheme of things, putting food on the table is more important [to patients] than compression and orthotics”. For this reason, the participant emphasized the importance of ensuring the tool that was developed considered affordability to ensures providers would be able to adapt recommendations to meet the unique needs of this demographic of patients. The importance of taking a holistic approach that considers the socio-economic circumstances as well as the physical health and well-being of patients was emphasized in many of the consultations.

Multiple Comorbidities

The prevalence of multiple co-morbidities was identified as a factor impacting the provision of diabetic foot care by several participants. Specifically, the nurse and nurse practitioner working on vascular surgery described the micro and macrovascular complications affecting many of their patient population including the presence of peripheral vascular disease, cardiovascular disease, and smoking, which complicates wound management. The need to consider the increasing medical complexity of patients with diabetes when developing the resource was reiterated in the consultations.

Noncompliance with Self-Management

In addition to the presence of multiple co-morbidities, non-compliance with recommended self-care practices and treatment was identified as an issue by all participants. No shows were identified as a common occurrence experienced by providers which would hinder implementation of standardized recommendations. The importance of considering the socioeconomic circumstances of patients in relation to cost, transportation, and knowledge when developing a resource for diabetic foot management was clearly conveyed in the consultations.

Summary of Findings

Consultations with a variety of RNs, NP, advanced foot care LPN, podiatrist, and an endocrinologist provided insight into the local context of diabetes foot care within Eastern Health and allowed for the identification of the unique needs of providers in relation to a clinical resource for diabetic foot management. It was clear from the consultations that diabetic foot management is complex and influenced by a number of organizational-level, provider-level and patient-level factors. Primarily, a lack of standardized resources was a consistent finding that emerged from the consultations. Despite the identification of a variety of resources from internal

sources such as Eastern Health and external sources such as Diabetes Canada, Wounds Canada and IGWDF, no standardized pathways or multidisciplinary teams have been established at the organizational-level to assist providers with diabetic foot management. Other organization-level themes identified included lack of funding to support coverage for services such as podiatry and foot care, lack of fiscal and human resources to meet the demands of the population in terms of diabetic foot needs, long wait times to see primary care providers and specialists, and ineffective communication lines of communication between private and public sectors to optimize the coordination of care for patients with diabetic foot needs.

On a provider level, inconsistencies in provider practices and in the advice given to patients was the most notable finding that emerged from the consultations. Other important themes identified on the provider-level include a critical need for provider education and standardized resource targeted towards prevention and screening. It also became clear during the consultations of the underutilization of existing resources and experts in the field of diabetic foot care. The diabetic foot care resource developed by the wound management clinic nurses, in particular, was identified as a tool that has not been widely adopted.

On a patient-level, many of the factors impacting provider management of the diabetic foot are related to socioeconomic factors such as soaring costs of supplies, lack of resources due to low-income and limited means to afford services, lack of knowledge regarding preventative care and maintenance, and noncompliance with recommendations. Providers also acknowledged the comorbid status and medical complexity of many patients with diabetes as a major factor impacting management of the diabetic foot.

Implications of Findings

It is clear from the consultations with providers that management of the diabetic foot is complex and influenced by numerous organizational, provider, and patient-level factors. To ensure successful uptake of a clinical resource by providers, careful consideration of the diverse factors impacting diabetic foot care in the local context will need to be applied. Next steps in practicum project development will include revisiting the literature review and environmental scan to determine the most appropriate clinical resource to develop given the identified needs of providers in the local context.

Conclusion

Consultations were conducted with ten key HCP informants from diverse backgrounds and experiences to gain insight into diabetic foot management within the local context of EH and NL. The results of the consultations highlight the complexity of diabetic foot management on an organizational, provider and patient level. Key themes that emerged from the consultations related to organizational-level factors included: lack of standardized resources, lack of funding models for diabetic foot care, limited resources, long wait times and lack of communication between private and public sectors. Provider-level themes included: inconsistent care and needs for tailored education, better utilization of expert knowledge, and preventative foot care and screening. On a patient-level, key themes that emerged related largely to socioeconomic circumstance and included: inadequate knowledge, lack of resources, presence of multiple comorbidities and noncompliance with self-management and treatment. It is clear from the consultations that there is a need for a clinical resource to improve management of the diabetic foot in NL. Subsequent steps in practicum project development will involve revisiting the

literature review and environmental scan to ensure the clinical resource selected is best suited to the needs of providers in the local context.

References

Diabetes Canada. (2021). *Diabetes in Canada: Backgrounder.* https://diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2021_Backgrounder_Canada_English_FINAL_MAR.pdf

Diabetes Canada. (2022). *Diabetes in Newfoundland and Labrador: Backgrounder.* https://www.diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2022_Backgrounder_Newfoundland.pdf

improve-care/quality-standards/view-all-quality-standards/diabetic-foot-ulcers

Harrison, M. B., & Graham, I. D. (2021). *Nursing translation in nursing and healthcare*. John Wiley & Sons, Inc.

International Diabetes Federation. (2021). *IDF Diabetes Atlas*. https://diabetesatlas.org

International Working Group on the Diabetic Foot. (2019). *IWGDF practical guidelines on the prevention and management of diabetic foot disease.* https://iwgdfguidelines.org/wp-content/uploads/2021/03/IWGDF-2019-final.pdf

Schaper, N.C., van Netten, J. J., Apelqvist, J., Bus, S. A., Hinchliffe, R. J., & Lipsky, B. A. (2020). Practical guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). *Diabetes/metabolism Research and Reviews*, *36*(S1), 1-10. https://doi.org/10.1002/dmrr.3266

Sundler, A. J., Lindberg, E., Nilsson, C., & Palmér, L. (2019). Qualitative thematic analysis based on descriptive phenomenology. *Nursing Open, 6*(3), 733–739. https://doi-org.qe2a-proxy.mun.ca/10.1002/nop2.275

Thorud, J.C., Plemmons, B., Buckley, C. J., Shibuya, N., & Jupiter, D. C. (2016). Mortality after

nontraumatic major amputation among patients with diabetes and peripheral vascular disease: A systematic review. *The Journal of Foot and Ankle Surgery, 55*(3), 591–599. https://doi.org/10.1053/j.jfas.2016.01.012

Wounds Canada. (2022). *Foot health pathway for people living with diabetes.* https://www.woundscanada.ca/docman/public/1829-diabetic-foot-complications-a-tab-1823e-final/file

Appendix A: Health Research Ethics Authority (HREA) Screening Tool

Student Name: Ashley Hunt

Title of Practicum Project: A Clinical Resource for Health Care Providers to Improve Diabetic Foot Management

Date Checklist Completed:

This project is exempt from Health Research Ethics Board approval because it matches item number ____3___ from the list below.

9. Research that relies exclusively on publicly available information when the information is legally accessible to the public and appropriately protected by law; or the information is publicly accessible and there is no reasonable expectation of privacy.
10. Research involving naturalistic observation in public places (where it does not involve any intervention staged by the researcher, or direct interaction with the individual or groups; individuals or groups targeted for observation have no reasonable expectation of privacy; and any dissemination of research results does not allow identification of specific individuals).
11. Quality assurance and quality improvement studies, program evaluation activities, performance reviews, and testing within normal educational requirements if there is no research question involved (used exclusively for assessment, management or improvement purposes).
12. Research based on review of published/publicly reported literature.
13. Research exclusively involving secondary use of anonymous information or anonymous human biological materials, so long as the process of data linkage or recording or dissemination of results does not generate identifiable information.
14. Research based solely on the researcher's personal reflections and self-observation (e.g. auto-ethnography).
15. Case reports.
16. Creative practice activities (where an artist makes or interprets a work or works of art).

For more information please visit the Health Research Ethics Authority (HREA) at https://rpresources.mun.ca/triage/is-your-project-exempt-from-review/

Appendix B: **Consultant Recruitment Email**

Dear Participant,

My name is Ashley and I am completing a Master of Nursing degree at Memorial University under the supervision of Dr. Kathleen Stevens. The goal of my practicum project is to develop a comprehensive clinical resource to reduce diabetic foot complications and improve outcomes for patients living with diabetes in Newfoundland and Labrador.

I am reaching out to health care providers and patients in an effort to gain as much information as possible about the clinical resources available to support the management of diabetic foot concerns. I am writing to you to ask for your assistance in sharing information about your experience with diabetic foot management in your respective area. Your input will help to inform the development of a clinical tool for health care providers to use within Eastern Health.

If you are interested in participating, you can respond by replying to this email or by contacting me via telephone at the number listed below. Once your permission has been obtained, a telephone interview will be arranged to gather information about your experience with diabetic foot management. I expect that the telephone interview will take approximately 10-15 minutes of your time. Please be assured that all information you share is voluntary and will remain confidential. All identifying information (i.e., name, location, and specific comments) will be kept confidential and anonymous and will only be shared with my immediate supervisor.

There are no known or anticipatory risks to the participation in this project.

Your contribution is valuable to my fulfillment of the requirements of the Master of Nursing degree.

Please feel free to contact me via email or telephone if you have any questions.

Thank you for your time.

Ashley Hunt BN RN CNCCP (c)
amh574@mun.ca
709-777-8246

Appendix C: Interview Questions

Health Care Providers

Initials: **Role:**

The following questions relate to clinical resources for diabetic foot care:

1. What resources are available for HCPs in your area to guide diabetic foot care?
2. When working with other disciplines are they using other sources?
3. In your experience, is a standardized approach being used to manage the diabetic foot?
4. Are you aware of any standardized tools such as clinical pathways, integrated pathways, care maps or multidisciplinary teams for diabetic foot management?
5. If so, are they being used on a routine basis?
6. If no, what are the barriers and facilitators to their use?
7. Do you think there is a need for a clinical resource to improve diabetic foot management? If so, what type of resource would you suggest?
8. Which resource do you think would work best in NL?
9. Do you think there is a need for education among HCPs surrounding diabetic foot screening, assessment, diagnosis and treatment? If so, why do you think there is a need?
10. What area of diabetic foot management do you think is the most critical to target? Such as prevention, screening, diagnosis, or treatment? And why?
11. What content would be most important to include in a clinical resource for diabetic foot management?
12. What do you hear from patients about their experiences with diabetic foot care?
13. Do you have any other suggestions or comments surrounding this practicum project? Is there anything else you would like to add?

Appendix D

Table 1

Provider Responses

	RN *Vascular Surgery*	**RN** *Clinical Research*	**RN** *Diabetes Educator*	**RN** *Community Health*	**LPN** *Foot Care*
1. What resources are available for HCPs in your role to guide diabetic foot care?	No resources in place – at least nothing standardized Wound care consultant – Margo is our go to.	No internal resources – refer to Diabetes Canada website and app	For foot care examinations, there are EMR prompts that inform provider when patients are due for annual foot examination. For guidance, I refer to the resource *Foot Care for People with Diabetes* available on Eastern Health Intranet	There is a provincial wound care manual that has been around for a while. We have wound care specialists that provide us with info and pamphlets about diabetic foot care. She sends us out links to webinars and any educational opportunities	Active member of the Canadian Association of Foot Care Nurses so I refer to their available resources (IWGDF, Wounds Canada)
2. When working with other disciplines, are they using other sources?	Not to my knowledge in terms of anything standardized but do notice inconsistencies among HCPs	Consult wound care team as needed to discuss issues or refer to Diabetes Foot Care handout – I do find there is consistency in the recommendations I receive from Wound	No other resources besides Diabetes Canada and Eastern Health guidelines mentioned.	Not sure about clinical guidelines. I have read articles and info from sites about wound care and diabetes management	I work privately so I am not affiliated with any health authority or familiar with any standardized pathways

		Management and Vascular			
3. In your experience, is a standardized approach being used to manage the diabetic foot?	No standardized approach, but more of a trial and error We do get orthotist involved sometimes once circulation has improved to provide offloading – one strength on the unit is that we are really consistent with offloading and using Prevalon boots	It seems HCPs are not doing as much in terms of preventative care – limited patient education provided	Standardized approach not being used at the Collaborative Clinic. Patient care varies based on provider discretion.	No, but it would be nice to have standardized approach. I find community health nurses get referrals to care for wounds but their providers have not done some ground work such as looking at sugar, adjusting insulin, referring to dietician, x-rays, circulation tests. Dressing wound is only small portion for caring for wounds. Much more difficult for people living in rural areas to obtain services	No, I do not believe a standardized approach is being applied. Especially here in Labrador where we have limited resources. There are no podiatry services and very few foot care nurses. Only have Walmart and Mark's for footwear. Providers not able to refer as they would in an urban area.
4. Are you aware of any standardized tools such as clinical pathways, integrated pathways, care maps or multidisciplinary	No standardized pathways – not seeing consults to vascular surgery from ER until ulcer is in late stage	No standardized pathways	No, but the Collaborative Clinic functions similarly to a multi-disciplinary team, however focus is not	No, not aware.	No, not to my knowledge.

teams for diabetic foot management?			diabetic foot specifically. It is essentially a family practice. Patients are assigned providers at collaborative clinic and then referred to other clinicians as needed. I sort of act like a case manager and can set reminders to check up every 3 months on my patients and transfer care back to the primary provider as needed. We use EMR that incorporates guidelines from Diabetes Canada and prompts for exams.		
5. If so, are they being used on a routine basis? If no, what are the barriers and facilitators to their use? Or barriers in general?	Major barrier among nursing staff is resistance to change as well as nursing shortage with 24-hour shifts limiting time for	People cannot get into see family doctors, financial barriers, access to podiatry and foot care nurses limited especially outside of EH	We see the impact of many socio-economic issues. Podiatry services are not covered. Patients can barely afford strips (cost $100 a day if used	Always barriers. Lack of resources especially in rural area. No transportation or money to travel for appointments, no services to have	No pathways but a barrier to implementing such a pathway in this region is the isolation and limited

	continuing education		4 times). Compliance is a big issue as well. In the grand scheme of things, putting food on the table is more important [to patients] than compression and orthotics. No shows are also an issue.	proper foot care for prevention. Need funding.	resources which impacts accessibility for patients to podiatry and wound care services. As well, the local health authority will not allow me to advertise in their facilities due to being privatized so there is no direct link between me and the primary HCPs in the area. Financials are not such a barrier here in this region as I find people do not mind paying for the service.
6. Do you think there is a need for a clinical resource to improve diabetic foot	Yes, there is definitely a need for it. Novice nurses are ill-	Yes. There is a need for a resource. Current practices sometimes not	Yes. A streamlined resource to standardize care is needed but if 70%	Yes, there is need for clinical resources for all disciplines.	Yes. For us, a pathway would not be ideal without

management? If so, what type of resource would you suggest?	prepared to manage the complexity of patient issues – especially related to offloading and nature of resources is not known. We (surgery team) need medicine to help with the management of patients increasingly complex medical needs	reflecting best practices – perhaps something more holistic – an admission checklist during admission to hospital – A nurse-led resource that involve a triage-based screening (risk-assessment)	of people cannot enact the recommendations then it could be futile to implement.	Diabetic related problems are increasing. Would be nice to have more health promotion to prevent complications before they happen. Increasing number of people with diabetic foot ulcers. Would be great idea to have clinical resource to guide our practices to try and help prevent and treat complications in timely manner to reach best possible outcomes for our patient.	the availability of resources such as vascular, wound care consultants and podiatry. However, education would be helpful.
7. Which resource do you think would work best in NL?	Leap learning module would be really good as HCPs often refer to learning modules -	Standardized education module for all HCPs – a "*based on these findings, we should do this"* type of resource.	Standardized tool. Educational to help debunk misinformation.	Any standard tool. There are inconsistencies depending on health care providers. A standard tool would prevent that.	Given the geography, something streamlined and accessible to all.

8. Do you think there is a need for education among HCPs surrounding diabetic foot screening, assessment, diagnosis and treatment? If so, why do you think there is a need?	Definitely. Seeing patients with micro and macrovascular issues being treated incorrectly and With HCPs not assessing root cause – so seeing diagnoses of ingrown toe rather than true diabetic foot circulation – We see that NPs (primary care providers) assess feet but in general it seems feet are not assessed regularly by primary care providers Emerge and primary care need more education on screening and prevention – very late referral – no choice but to amputate is what	Definitely, some internal medicine doctors are not consistently checking feed and patient's do not complain and accept that the Doctor knows best so don't question the fact that their feet are not being assessed.	Definitely! Help ensure more consistent practices among HCPs. Some of the internal medicine specialists do assess feet and perform additional sensation testing, however, many do not. NPs are great and thorough. Major's path diabetic nurse educators do not assess feet.	There is always a need for further education for all providers. With wound care products changing all the time, it is difficult to keep up with latest research.	Most definitely. I do hear from clients that no one is assessing their feet therefore education regarding screening and prevention is needed to improve care.

	we are seeing – but noted in chart that they have been back and forth to emerge and loaded up on antibiotics and referred to community health but not consulted to vascular				
9. **What area of diabetic foot management do you think is the most critical to target? Such as prevention, screening, diagnosis, or treatment? And why**?	Screening and prevention of early diabetic foot ulcers	Prevention and screening, and risk stratification and education	Prevention and screening. People being told misinformation. Providers need education.	All areas.	Prevention for sure. It would be great if more providers would share information with patients regarding how to get in contact with foot care nurses and how to access other resources.
10. What content would be most important to include in a clinical resource for diabetic foot management?	Pathophysiology of micro and macrovascular complications –	Need more education and posters and pamphlets for patients – HCPs	Recommendations for the Treatment of DFU. Noticing some inconsistencies in	All areas are important to target. If we could prevent them from happening it would	Tips for foot care – focus on prevention. Ensuring patients

	walking and offloading practices	should not assume people are looking up the information – we should be including education as standard care	wound management and advice given.	be great. However, most times people don't seek medical attention until a problem arises. And now with so many people without health care provider things will probably worsen. Before they seek help, wounds are already bad.	understand that foot care is not a pedicure at a salon.
11. What do you hear from patients about their experiences with diabetic foot care?	Back and forth about the DFU for years and no one (HCPs) took it seriously; no one is assessing Pulses; rural NL is big problem – no one seeing family doctor	Inconsistencies among HCPs – some providers checking feet, others not. Seems to be common complaint from patients of the doctors brushing off patient's concerns regarding their feet until the DFU is at the point of needing to do something (no preventative care)	Not many availing of diabetic foot services. Coverage is a big thing. Provider recommendations change based on what people can afford. Many misconceptions about diabetic foot care in general. Some patients have been told by HCPs that it is ok to soak feet in salt water.	People are noncompliant with their plan of care, funding to implement. No transportation or money to travel for appointments, no services to have proper foot care for prevention.	Not having feet assessed. No family doctors. Difficult to get into see anyone. Have to go to ER to be seen.

12. Suggestions/Comments					

Table 2
Provider responses continued

	Endocrinologist	Wound Consultants	Podiatrist	Nurse Practitioner (Vascular)
1. What resources are available for HCPs in your role to guide diabetic foot care?	In Alberta, where I am currently practicing, there is an established clinical pathway that is accessible in a similar way as HealtheNL with tabs for each part of the pathway that includes hyperlinks to resources and link to high-risk foot care teams, but no prompts available. In NL, there is a new initiative referred to as Practice 360 whereby integrated diabetes care plan is featured on the EMR as a tool developed in collaboration with Diabetes Canada. This form consists of a care plan that reinforces guidelines and includes a reporting dashboard. Providers receive prompts when a clinical assessment is	We refer people to Eastern Health's *Foot Care for Patients with Diabetes* patient information handout for patients. We developed a wound care module for diabetic foot ulcers which is accessible on the EH intranet. Within this module is a pathway to assess and treat DFUs, however it is not readily used by providers. Many providers tell us they didn't know that this resource existed.	The podiatrists I collaborate with use our own professional guidelines and standards, but IWGDF has great resources. I have also used Wounds Canada in the past.	The resources that are available are Diabetes Canada and are used to help guide patients with better diabetes control which will help prevent diabetic infections. It also guides proper foot care. For education we recommend the diabetic educator for patients to aid them in taking better control of their diabetes. In terms of wound care, we use the guidelines outline by Wound Canada and also have a Wound Care Specialist that we can consult with in Eastern Health.

	due such as ECG, HbA1c, and foot screening. However, only providers who use EMR (eDOCsNL) have access to this tool.			
2. When working with other disciplines, are they using other sources?	Yes. Many providers are doing different things. Personally, I perform my own foot screening for all my patients but I do the actual foot care collaboratively. I will refer to podiatry as needed or consult Dr. Brown-Maher and the nurses at the wound care clinic as needed. I also consult or refer to vascular, ortho, and orthotists at the Miller Centre when necessary.	We work with many different disciplines but are not sure what resources they use.	Huge barrier is the disconnect between private and public health sectors. It creates delays in coordination of care therefore not certain on what is being used by other providers, however, I have noticed inconsistencies in how patients have been treated in the past.	Much of the same as above.
3. In your experience, is a standardized approach being used to manage the diabetic foot?	Not in NL, currently, although eDOCsNL is promising. We do have many experts in each field who should be utilized. Availability of	No, although we do have a multidisciplinary wound care clinic, it is not a standardized approach as such. We work with many	Standardized approach is not being used but is very much needed.	I don't think there is a standardized approach to wound care. When patients are admitted to hospital, we see a variety and wound care

	these resources in rural areas is more limited.	physicians including Dr. Stone, Dr. Smith, and Dr. Brown-Maher. Vascular surgeons used to come to the clinic but now we have to consult out after a patient has vascular studies. We do not have physio at the clinic so we have to refer as outpatients. We connect with Orthotists from the Miller Centre but the waitlist for an outpatient appointment is 6 months, which is a barrier.		products/information given to patients.
4. Are you aware of any standardized tools such as clinical pathways, integrated pathways, care maps or multidisciplinary teams for diabetic foot management?	I refer to Wounds Canada pathway, Diabetes Canada Guidelines, IWGDF which I am assisting with review of the 2023 guidelines. The IWGDF summary table titled prevention summary is one of my go-to resources. We already have a great wound care clinic here and multiple	See above for details.	Not in the province but I think a team approach is the way to go. The collaborative clinic is promising but not accessible to everyone. Again, the disconnect between public and private is a major barrier. A team approach is especially needed for low-income seniors.	There are guidelines from the above organizations mentioned above. Anyone with diabetes, needs to have a thorough exam of their feet. Inspected for areas of potential infection or breakdown and based on that assessment will depend on treatment. No

	disciplines involved in DFU are but not standardized as such.			standardized path specific for here.
5. If so, are they being used on a routine basis? If no, what are the barriers and facilitators to their use? Or barriers in general?	We have the people here, but we need to improve communication and collaboration. Wait times, cost of services, supplies, and proper foot wear is certainly an issue. Proper fitting shoes could cost $500-1000. Offloading is important but not always possible due to coverage. Podiatry not covered. Foot care not covered although patients who receive home support are eligible for so much foot care which they may not know. Education is a barrier among providers who need to be updated on latest guidelines. Organizational-level	There are many, many barriers with the cost being the most prominent. Offloading is big focus, but expensive. Patients cannot always afford what they need or they are not compliant. We often recommend affordable alternatives to proper footwear such as Dr. Scholl's or New Balance sneakers. Unfortunately, have to work within what is realistic for patients.	Socio-economic barriers including podiatry not being covered. Patients can barely afford strips. I end up stretching out appointments to accommodate patient coverage and doing free wound care because patients need to be seen and cannot afford to pay. In Ontario, OHIP covers podiatry services for seniors. Something like that should be explored here.	Time for providers to be educated. Limited resources. And the vast geographical area we service are barriers that could prevent implementing a standardized tool.

	barriers include the lack of structures like point of care access and prompts.			
6. Do you think there is a need for a clinical resource to improve diabetic foot management? If so, what type of resource would you suggest?	Yes. Definitely. A resource that is accessible at a finger-point is what is needed.	Yes. 100%. Definitely need a resource to improve diabetic foot management here in the province. Nurse-led and collaborative would be ideal.	Yes – very much need to get everyone on the same page. One particiular area to target would be triage as the number of late referrals to podiatry is vast.	Yes, a standardized clinical resource is needed. Guidelines are just that and clinical judgement also plays a role. There are a variety of ways wounds are managed. In our setting, patients with PAD as well, we keep our wounds as dry as possible. If wounds become wet, they become infected and then increased risk of limb loss. There are many resources available in our Eastern Health portal to help guide us (re: Wound Care and hyperlinks).

7. Which resource do you think would work best in NL?	Improving the implementation of eDOCsNL so that the diabetes integrated forms are being used would help. Care plan needs to be tightly linked with pathways, intervention and resources so people know where to go.	Nurse-led approach that is collaborative and included occupational therapists, podiatrists and PTs, dietician and foot care nurses and coverage for offloading and proper footwear and boots.	Team approach and triage pathway would be my suggestions.	Prevention and screening tools.
8. Do you think there is a need for education among HCPs surrounding diabetic foot screening, assessment, diagnosis and treatment? If so, why do you think there is a need?	Education is 100% needed. Initial education as well as re-education quarterly to ensure screening and risk-stratification is on par with guidelines.	Definitely. We need diabetes education as we are not treating wounds early enough due to delays in referral and mismanagement by HCPs.	Yes – it is very clear that education is varied and patients are not receiving same treatment from all providers. Need to standardize approach	Education is always key.
9. What area of diabetic foot management do you think is the most critical to target? Such as prevention, screening, diagnosis, or treatment? And why?	As stated above, prevention and screening to ensure on par with current evidence-based guidelines.	Prevention is big and early referral to wound care clinic.	Prevention and screening (triage). HCPs need to do better in early stages, even so far as to promptly refer to dieticians. Patients need more education about self-care practices.	Prevention is key. And then screening.

10. What content would be most important to include in a clinical resource for diabetic foot management?	Reiterated in responses above – should reference IWGDF, Diabetes Canada and Wounds Canada.	Information about offloading and importance of early referral. Huge issue is lack of referrals until patients have developed complicated wounds with multiple rounds of antibiotics and no improvement. We do see improvement in our patients who are referred early in wound stage.	Prevention and early intervention recommendations. Emphasis on early referral to podiatry.	Diabetes education and foot care go hand and hand and are extremely important and need to be implemented long before they become inpatients on the vascular unit. Generally, patients with diabetes on our floor are consulted to the diabetic educator as an outpatient. While in hospital and if they have an infection, their sugars are not well controlled due to infection, so to obtain better glycemic control their infection needs to be controlled. It is a bad cycle on our floor for that reason. Hope that makes sense.
11. What do you hear from patients about their experiences with diabetic foot care?	90% state they are not receiving foot care. Not seeing family doctors in person or having foot exam.	A lot of people soaking feet and report that doctor told them to soak their feet. We also hear the same stories of patents going back and forth to provider multiple times and	Patients report that they are not having feet assessed by HCPs. They are not receiving education about diabetes, and not seeing dietician.	Many of our patients once they get to us have been diabetics for years and usually already have tissue loss with PAD as well. Many usually state that they haven't see anyone

		being sent home with antibiotics or Fucidin but never referred to community health nurse. We need to improve referrals.		about their diabetes for years. In addition, our patient population is 'unique'. Typically, they are smokers and have many risk factors for PAD. Once they get to us it is usually to late so prevention and screening are important.
12. Suggestions/Comments	Accessibility at a finger-point is very important. Also collaborate with other Atlantic Provinces and CADTH for mapping and pathway development.	Perhaps reach out to med school or do a presentation during grand rounds to educate providers on issue.	Very much need a resource but foot management is a complex issue so approach needs to consider the socioeconomic factors, especially related to low income and seniors	

Appendix F

Wounds Canada Copyright Permission Correspondence

From: WoundsCanada <noreply@woundscanada.ca>
Sent: Monday, September 26, 2022 1:45 PM
To: Ashley Hunt
Subject: Your Republication Request

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