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Assessment and Management of Foot Ulcers for People with Diabetes

Second Edition

RNAO
Registered Nurses' Association of Ontario
L'Association des infirmières et infirmiers
autorisés de l'Ontario

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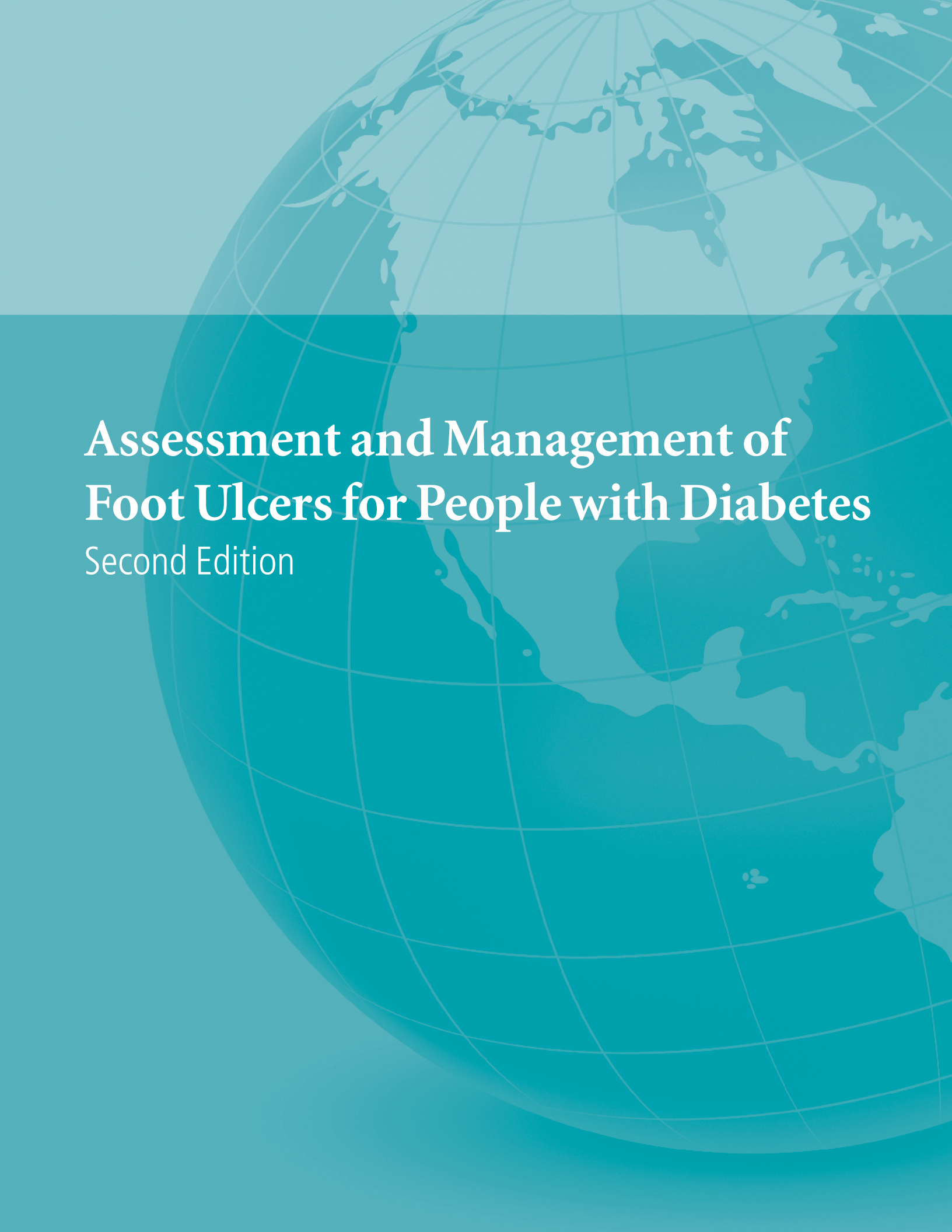
Contact Information

Registered Nurses' Association of Ontario
158 Pearl Street, Toronto, Ontario M5H 1L3

Website: www.rnao.ca/bestpractices



Assessment and Management of Foot Ulcers for People with Diabetes

Second Edition

Greetings from Doris Grinspun,

Chief Executive Officer, Registered Nurses' Association of Ontario

The Registered Nurses' Association of Ontario (RNAO) is delighted to present the second edition of the clinical best practice guideline, *Assessment and Management of Foot Ulcers for People with Diabetes*. Evidence-based practice supports the excellence in service that health professionals are committed to delivering every day. RNAO is pleased to provide you with this key resource, selected by the Council of the Federation for national implementation.

We offer our heartfelt thanks to the many stakeholders that are making our vision for Best Practice Guidelines (BPG) a reality: the Government of Ontario, for recognizing RNAO's ability to lead the program and for providing multi-year funding; Drs. Irmajean Bajnok and Monique Lloyd, Director and Associate Director (respectively) of the RNAO International Affairs and Best Practice Guidelines (IABPG) Centre, for their expertise and leadership in advancing the development of BPGs; and Expert Panel Chair Laura Teague, Wound Specialist at Saint Michael's Hospital in Toronto, Canada, for her exquisite expertise and stewardship of this guideline. Thanks also to RNAO staff Rishma Nazarali, Sarah Xiao, Anastasia Harripaul and Andrea Stubbs, for their intense work in the production of this second edition. Special thanks to the entire BPG Expert Panel for generously providing time and expertise to deliver a rigorous and robust clinical resource. We couldn't have done it without you!

The nursing and health-care community, with their unwavering commitment and passion for excellence in patient care, have provided the expertise and countless hours of volunteer work essential to the development and revision of each guideline. Employers have responded enthusiastically by nominating best practice Champions, implementing guidelines, and evaluating their impact on patients and organizations. Governments at home and abroad have joined in this journey. Together, we are building a culture of evidence-based practice.

Successful uptake of BPGs requires a concerted effort from educators, clinicians, employers, policy makers and researchers. After lodging the evidence into their minds and hearts, knowledgeable and skillful health professionals and students need healthy work environments to enable guideline use and practice changes.

We ask that you share this guideline with members of the interprofessional team, as there is much to learn from one another. Together, we must ensure that the public receives the best possible care every time they come in contact with us – making them the real winners in this important effort!

Doris Grinspun, RN, MSN, PhD, LLD (Hon), O. ONT.
Chief Executive Officer
Registered Nurses' Association of Ontario

Greetings from Vasanthi Srinivasan and Susan Williams,

Lead ADMs, Council of the Federation, Clinical Practice Guidelines Working Group

Vasanthi Srinivasan

Susan Williams

At their Council of the Federation meeting in January 2012, provincial and territorial Premiers launched a series of new initiatives designed to encourage collaboration and cooperation on health care innovations across the country. Premiers received the first report from the *Health Care Innovation Working Group* co-chaired by PEI Premier Ghiz and Saskatchewan Premier Brad, and directed their Ministers of Health to come together and work closely with national and regional health professional organizations to ensure that Canadians have access to the best quality health care in the world. While Premiers acknowledged that Canada's provinces and territories are pursuing innovation in their own jurisdictions, they recognized that more transformative, lasting change can be achieved together.

As part of this new initiative, Premiers asked Ontario and Alberta to co-lead work on accelerating the adoption of key clinical best practice guidelines across the country. Premiers want to ensure that all Canadians benefit from up to date, evidence-based guidance, regardless of where in Canada it is developed. So, after consulting with government health officials, major health professional groups including CMA, CNA/RNAO, HEAL, and many other relevant experts, provincial and territorial Ministers of Health recommended to their Premiers the wide adoption of two guidelines for the initial phase of this pan-Canadian work. One of these two guidelines was the Registered Nurses' Association of Ontario (RNAO) *Assessment and Management of Foot Ulcers for People with Diabetes.*

Ensuring quality health care requires access to high-quality, regularly updated advice for patient care. The RNAO's Nursing Best Practice Guidelines Program provides Premiers with exactly the level of scientific rigour they are looking for, combined with the accessibility and usability needed to quickly spread the guideline to nursing practitioners and other health professionals across the country.

Given Canada's aging population and rising rates of diabetes, our health systems will increasingly depend on resources like the RNAO's *Assessment and Management of Foot Ulcers for People with Diabetes* guideline to manage demands for these important health care services. We would like to thank RNAO for their hard work and leadership in transforming evidence into action. This ongoing commitment is helping to ensure quality health care for all Canadians.

Co-Leads
Clinical Practice Guidelines Working Group,
Health Care Innovation Working Group

Vasanthi Srinivasan
Assistant Deputy Minister
Ontario Ministry of Health and Long-Term Care

Susan Williams
Assistant Deputy Minister
Alberta Health

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BACKGROUND

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How to Use this Document

This nursing best practice guideline[G] is a comprehensive document that provides resources necessary for the support of evidence-based nursing practice. The document needs to be reviewed and applied, based on the specific needs of the organization or practice setting/environment, as well as the needs and wishes of the client[G]. This guideline should be applied as a tool or template that is intended to enhance decision making in the provision of individualized care. In addition, the guideline provides an overview of appropriate structures and supports necessary for the provision of the best possible evidence-based care.

Nurses, other health-care professionals and administrators who lead and facilitate practice changes will find this document invaluable for the development of policies, procedures, protocols, educational programs and assessments, interventions and documentation tools. Nurses providing direct care will benefit from reviewing the recommendations, the evidence[G] in support of the recommendations and the process that was used to develop this edition of the guideline. However, it is highly recommended that practice settings/environments adapt these guidelines in formats that would be user-friendly for daily use. This guideline has some suggested formats for local adaptation and tailoring.

Organizations adopting the guideline are advised to carry out the following processes:

a) Assess current nursing and health-care practices using the recommendations in the guideline.
b) Identify recommendations that will address needs or gaps in services.
c) Develop a plan to implement the recommendations systematically using associated tools and resources, with particular attention to the RNAO *Implementation Toolkit* (2012b).

The Registered Nurses' Association of Ontario is interested in hearing how you have implemented this guideline. Please contact us to share your story. Implementation resources are available through the RNAO website (www.RNAO.ca) to assist individuals and organizations to implement best practice guidelines.

* Throughout this document, terms marked with the superscript symbol G ([G]) can be found in the Glossary of Terms (**Appendix A**).

Purpose and Scope

Best practice guidelines are systematically developed statements designed to assist nurses and clients in decision making about appropriate health care (Field & Lohr, 1990). This guideline has been developed to address the question of how to assess and manage people with established diagnosis of diabetic foot ulcer(s)[G]. It provides evidence-based recommendations to all nurses and the interprofessional team[G] who provide care in all health-care settings to people (>15 years of age) with type 1 and/or type 2 diabetes and who have established diabetic foot ulcers.

Caring for people with diabetic foot ulcers is an interprofessional endeavour. Effective care depends on a coordinated interprofessional approach incorporating ongoing communication between health-care professionals and people with diabetic foot ulcers. It is, however, acknowledged that personal preferences and unique needs as well as the personal and environmental resources available to each client must always be considered in the delivery of care. The intent of this document is to assist all nurses and the interprofessional team to focus on evidence-based strategies, within the context of the health-care professional-client relationship. It is further acknowledged that individual competencies of nurses may vary among nurses and across categories of nursing professionals. These competencies are based on knowledge, skills, attitudes and judgment enhanced over time by experience and education. It is expected that individual nurses will perform only those aspects of care for which they have received appropriate education and experience. All nurses should seek consultation in instances where the client's care needs surpass the individual nurse's ability to act independently.

See **Appendix A** for a glossary of terms. See **Appendices B** and **C** for the guideline development process and process for systematic review[G]/search of the literature.

Summary of Recommendations

This guideline is a new edition of, and replaces, the 2005 publication of the RNAO Nursing Best Practice Guideline: *Assessment and Management of Foot Ulcers for People with Diabetes*. Recommendations are marked as ✔, ✚, or **NEW** according to the following:

✔ No change was made to the recommendation as a result of the systematic review evidence.

✚ The recommendation and/or supporting evidence were updated as a result of the systematic review evidence.

NEW A new recommendation was developed as a result of the systematic review evidence*.

PRACTICE RECOMMENDATIONS[G]		LEVEL OF EVIDENCE	
Assessment	1.0 Obtain a comprehensive health history and perform physical examination of affected limb(s).	Ib – IV	✚
	1.1 Identify the location and classification of foot ulcer(s) and measure length, width and depth of wound bed.	Ia – IV	✚
	1.2 Assess bed of foot ulcer(s) for exudate, odour, condition of peri-ulcer skin and pain.	IV	✚
	1.3 Assess affected limb(s) for vascular supply and facilitate appropriate diagnostic testing, as indicated.	III – IV	✚
	1.4 Assess foot ulcer(s) for infection[G] using clinical assessment techniques, based on signs and symptoms, and facilitate appropriate diagnostic testing, if indicated.	Ia	✚
	1.5 Assess affected limb(s) for sensory, autonomic and motor changes.	IIa	✚
	1.6 Assess affected limb(s) for elevated foot pressure, structural deformities, ability to exercise, gait abnormality, and ill-fitting footwear and offloading devices.	Ia – IV	✚
	1.7 Document characteristics of foot ulcer(s) after each assessment including location, classification and any abnormal findings.	IV	✚

PRACTICE RECOMMENDATIONS		LEVEL OF EVIDENCE	
Planning	2.0 Determine the potential of the foot ulcer(s) to heal and ensure interventions to optimize healing have been explored.	IV	✔
	2.1 Develop a plan of care incorporating goals mutually agreed upon by the client and health-care professionals to manage diabetic foot ulcer(s).	IV	✚
	2.2 Collaborate with the client/family and interprofessional team to explore other treatment options if healing has not occurred at the expected rate.	IV	✚
	2.3 Collaborate with client/family and the interprofessional team to establish mutually agreed upon goals to improve quality[G] of life if factors affecting poor healing have been addressed and complete wound closure is unlikely.	IV	✔
Implementation	3.0 Implement a plan of care to mitigate risk factors that can influence wound healing.	IV	✚
	3.1 Provide wound care consisting of debridement, infection control and moisture balance where appropriate.	Ia – IV	✚
	3.2 Redistribute pressure applied to foot ulcer(s) by the use of offloading devices.	Ia	✚
	3.3 Provide health education to optimize diabetes management, foot care and ulcer care.	Ia	✚
	3.4 Facilitate client-centred learning based on individual needs to prevent or reduce complications.	III	✚
Evaluation	4.0 Monitor the progress of wound healing on an ongoing basis using a consistent tool, and evaluate the percentage of wound closure at 4 weeks.	Ib	✚
	4.1 Reassess for additional correctable factors if healing does not occur at the expected rate.	IV	✚

EDUCATION RECOMMENDATIONS[G]		LEVEL OF EVIDENCE	
	5.0 Health-care professionals participate in continuing education opportunities to enhance specific knowledge and skills to competently assess and manage clients with diabetic foot ulcers, based on the RNAO Nursing Best Practice Guideline, *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)*.	IV	✚
	5.1 Educational institutions incorporate the RNAO Nursing Best Practice Guideline, *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)*, into basic registered nurse, registered practical nurse, doctor of medicine and interprofessional curricula to promote a culture[G] of evidence-based practice.	IV	✚
ORGANIZATION AND POLICY RECOMMENDATIONS[G]		**LEVEL OF EVIDENCE**	
	6.0 Use a systematic approach to implement the *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)* clinical practice guideline and provide resources and organizational and administrative supports to facilitate clinician uptake.	IV	✚
	6.1 Develop policies that acknowledge and designate human, material and fiscal resources to support the interprofessional team in diabetic foot ulcer management.	IV	✔
	6.2 Establish and support an interprofessional, inter-agency team comprised of knowledgeable and interested persons to address and monitor quality improvement in the management of diabetic foot ulcers.	IV	✔
	6.3 Develop processes to facilitate the referral of clients with diabetic foot ulcers to local diabetes resources and health-care professionals.	IV	✔
	6.4 Advocate for strategies and ongoing funding to assist clients in obtaining appropriate pressure redistribution devices during and after ulcer closure.	IV	✚

* Note that no new recommendations were developed as a result of the updated systematic review evidence.

Interpretation of Evidence

Levels of Evidence

Ia	Evidence obtained from meta-analysis or systematic reviews of randomized controlled trials[G].
Ib	Evidence obtained from at least one randomized controlled trial.
IIa	Evidence obtained from at least one well-designed controlled study without randomization.
IIb	Evidence obtained from at least one other type of well-designed quasi- experimental study, without randomization.
III	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.
IV	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

Adapted from "Annex B: Key to evidence statements and grades of recommendations," by the Scottish Intercollegiate Guidelines Network (SIGN), 2012, in *SIGN 50: A Guideline Developer's Handbook.* Available from http://www.sign.ac.uk/guidelines/fulltext/50/annexb.html

Panel Members

Laura M. Teague, RN, MN, NP

Panel Chair

Nurse Practitioner, St. Michael's Hospital,
Lecturer, University of Toronto, Faculty of Nursing
Adjunct Faculty, Western University –
Faculty of Physical Therapy
(Master of Clinical Science, Wound Healing)
Toronto, Ontario

Karen Bruton, RN, BScN, CETN(C)

Professional Practice Leader,
Northumberland Hills Hospital
Cobourg, Ontario

Patricia Coutts, RN

Wound Care Specialist and Clinical Trials Coordinator,
Dermatology Office of Dr. R. Gary Sibbald
Mississauga, Ontario

Laurie Goodman, RN, BA, MHScN

Advanced Practice Nurse/Educator
Toronto Regional Wound Healing Clinic
CoDirector & Course Coordinator IIWCC-CAN
Mississauga, Ontario

Christine A. Murphy,

RN, CETN(C), BSc (Hons), MClScWH, PhD (cand).

Enterostomal Therapist,
The Ottawa Hospital
Adjunct Faculty, Western University
(Master of Clinical Sciences, Wound Healing)
Ottawa, Ontario

Heather Nesbeth, RN, BSN, CDE

Diabetes Educator
Trillium Health Centre – Diabetes Centre,
Toronto, Ontario

Deirdre O'Sullivan-Drombolis,

BScPT, MClSc PT (Wound Healing)

Physical Therapist, Wound Resource,
Riverside Health Care Facilities
Adjunct Faculty, Western University
(Master of Clinical Sciences, Wound Healing)
Adjunct Faculty, Northern Ontario School of Medicine
Fort Frances, Ontario

Ruth Thompson, DCh, MCISC-WH

Chiropodist,
The Ottawa Hospital
Ottawa, Ontario

Declarations of interest and confidentiality were made by all members of the guideline development panel. Further details are available from the Registered Nurses' Association of Ontario.

RNAO Best Practice Guideline Program Team

Kateryna Aksenchuk, RN, BScN
Research Assistant,
Registered Nurses' Association of Ontario
Toronto, Ontario

Erica D'Souza, BSc, GC
Project Coordinator (June - September 2012),
Registered Nurses' Association of Ontario
Toronto, Ontario

Kim English, RN, BScN, MN
Research Assistant,
Registered Nurses' Association of Ontario
Toronto, Ontario

Anastasia Harripaul, RN, BScN (Hons)
Nursing Research Associate (February - March 2013),
Registered Nurses' Association of Ontario
Toronto, Ontario

Monique Lloyd, RN, PhD
Associate Director, Guideline Development,
Research and Evaluation
Registered Nurses' Association of Ontario
Toronto, Ontario

Rishma Nazarali, RN, MN
Program Manager,
Registered Nurses' Association of Ontario
Toronto, Ontario

Andrea Stubbs, BA
Project Coordinator (January - March 2013),
Registered Nurses' Association of Ontario
Toronto, Ontario

Sarah Xiao, RN, MSc, BNSc (Hons)
Nursing Research Associate (July 2012 - March 2013),
Registered Nurses' Association of Ontario
Toronto, Ontario

Rita Wilson, RN, MEd, MN
eHealth Program Manager
Registered Nurses' Assocation of Ontario
Toronto, Ontario

Alice Yang, BBA
Project Coordinator (September - December 2012),
Registered Nurses' Association of Ontario
Toronto, Ontario

Stakeholder Acknowledgement

Stakeholders[G] representing diverse perspectives were solicited for their feedback, and the Registered Nurses' Association of Ontario wishes to acknowledge the following individuals for their contribution in reviewing this Nursing Best Practice Guideline.

Afsaneh Alavi, MD, FRCPC
Women's College Hospital
Toronto, Ontario

David G. Armstrong, DPM, MD, PhD
Professor of Surgery,
Southern Arizona Limb Salvage Alliance
Department of Surgery
University of Arizona College of Medicine
Tucson, Arizona

Mariam Botros, D.CH, CDE, IIWCC
Director of Diabetic Foot Canada
CAWC, Women's College Hospital
Wound Healing Clinic
Toronto, Ontario

Keith Bowering, MD, FRCPC, FACP
Director, Diabetic Foot Complications
Member, Expert Committee, Canadian Diabetes Association Clinical Practice Guidelines, 2008, 2013, Foot Care Chapter
Edmonton, Alberta

Tim Brandys, MD, Med, FRCSC, FACS
Vascular Surgeon, Program Director
The Ottawa Hospital, University of Ottawa
Ottawa, Ontario

Connie Harris, RN, ET, IIWCC, MSc
Senior Clinical Specialist Wound & Ostomy
Red Cross Care Partners
Waterloo, Ontario

Janet L. Kuhnke, RN, BA, BSN, MS, ET, PhD (cand.)
Faculty/Enterostomal Therapist
St. Lawrence College/Laurentian University BSN Collaborative Program and
St. Elizabeth Health Care Clinic
Cornwall, Ontario

Ann-Marie McLaren, DCh, BSc Pod Med, MClSc WH
Chiropodist/Professional Practice Leader
St. Michael's Hospital
Toronto, Ontario

Stephan Mostowy, MD, FRCS(C)
Vascular and Endovascular Surgeon
Kelowna General Hospital
Kelowna, British Columbia

Lyndsay Orr, BScPT, MClSc (Wound Healing)
Physiotherapist, Wound Care Consultant
Cambridge Memorial Hospital
Cambridge, Ontario

Cynthia Payne, RD, CDE
Registered Dietitian, Certified Diabetes Educator
Northumberland Hills Hospital
Cobourg, Ontario

Gregory W. Rose, MD, MSc(Epi), FRCPC
Assistant Professor of Medicine
University of Ottawa, The Ottawa Hospital, Bruyere Continuing Care and Queensway Carleton Hospital
Ottawa, Ontario

Jenny St. Jean, BScN, WCC
Wound Care Champion
Bayshore Home Health
Ottawa, Ontario

Background Context

Diabetes mellitus is a serious and complex life-long condition affecting 8.3% of the world's population and 2.7 million Canadians (Canadian Diabetes Association (CDA), 2010; International Working Group on the Diabetic Foot (IWGDF), 2011; Lipscomb & Hux, 2007). The prevalence of diabetes has increased 70% since the 1998 publication of the CDA clinical practice guidelines[G], and the rate continues to increase across all age groups. Between 1995 and 2005, the prevalence of diabetes in Ontario increased steadily by an average of 6.2% per year (Lipscomb & Hux, 2007). The rate of diabetes is increasing the greatest among Aboriginal Canadians, who have a three to five times higher rate of diabetes than the general population (Doucet & Beatty, 2010). Diabetes seriously burdens individuals, their families and society. With the increasing prevalence of diabetes in Canada, the annual economic cost attributable to the condition is estimated to rise from $5.2 billion in 1998 to $16.9 billion by 2020 (Lau, 2010).

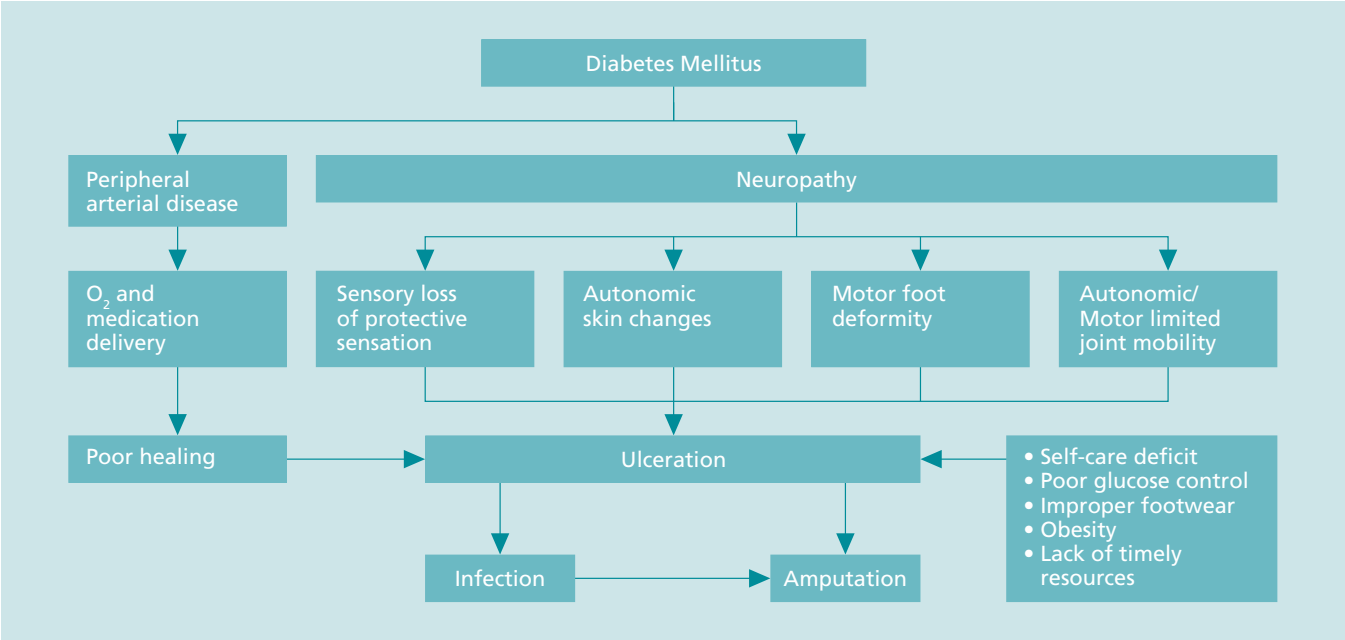
There are two major classifications of diabetes: type 1 and type 2. Type 1 diabetes, also known as insulin-dependent diabetes mellitus (IDDM), affects 10 to 15% of all people with diabetes and is primarily the result of an inability to produce insulin due to beta cell destruction in the pancreas. While type 1 diabetes accounts for fewer individuals with diabetes, it results in a disproportionately higher frequency of diabetes-related complications. Type 2 diabetes, also known as noninsulin-dependent diabetes mellitus (NIDDM), accounts for 90% of those diagnosed with diabetes and results from a combination of insufficient insulin production and resistance of the body's cells to the actions of insulin (CDA, 2010).

Control of blood glucose levels is paramount to minimizing complications related to diabetes (Diabetes Control and Complication Trial (DCCT) Research Group, 1993; United Kingdom Prospective Diabetes Study (UKPDS) Group 33, 1998). This is achieved through lowering of serum glucose levels using oral hypoglycemic agents, subcutaneous injections of insulin, dietary restriction and regular exercise. Other factors contributing to delayed onset of complications include control of hypertension, hyperlipidemia and hyperinsulinemia. Unfortunately, these treatments may not completely control the progression of diabetes-related changes, such as neuropathy (Canadian Diabetes Association (CDA) Clinical Practice Guidelines (CPG) Expert Committee, 2008).

Diabetic foot ulceration and amputation are a result of complications of diabetes such as peripheral arterial disease (PAD) and neuropathy (see Figure 1). Worldwide, the number of lower limb amputations has increased as a result of diabetes. According to the IWGDF, over one million amputations are performed on people with diabetes each year (2011). PAD, also known as peripheral vascular disease, is a circulatory problem in which narrowed arteries reduce blood flow to the lower limbs. This can result in poor oxygen circulation and medication delivery thereby impacting the ability to heal and increasing the risk for ulceration. Neuropathy occurs when the nerves of the peripheral nervous system are damaged (by diabetes) and can result in loss of sensation, skin changes, deformities and limited joint mobility of the foot. When combined with other factors, such as inadequate self care, poor glucose control, improper footwear, obesity and lack of timely resources, these neuropathic changes may lead to foot ulceration.

While the majority of ulcers eventually heal, approximately one third may result in some form of amputation (IWGDF, 2011). Moreover, there is a possibility of infection occurring in any foot ulcer in a person with diabetes. Diabetic foot infections require medical attention ranging from minor (e.g., debridement, antibiotics) to major (resection, amputation) intervention (Lipsky et al, 2012).

Figure 1: Pathway to Diabetic Foot Ulcers



Note. Adapted from "Assessment and Management of Foot Ulcers for People with Diabetes, (1st ed.)," by The Registered Nurses' Association of Ontario. Originally adapted with permission from "Pathogenesis and general management of foot lesions in the diabetic patient," by M. E. Levin, 2001, in J. H. Bowker & M. A. Pfeifer (eds.), *Levin and O'Neals The Diabetic Foot* (6th ed.), p. 222. St. Louis, MO: Mosby, Inc.

Ulcers and amputations result in enormous societal costs, including lost wages, job loss, prolonged hospitalization, lengthy rehabilitation and an increased need for home care and social services. Given the data on the burden of illness and the significant long-term health impact, care of persons with diabetic foot ulcers demands a systematic, team approach from health-care professionals (IWGDF, 2011).

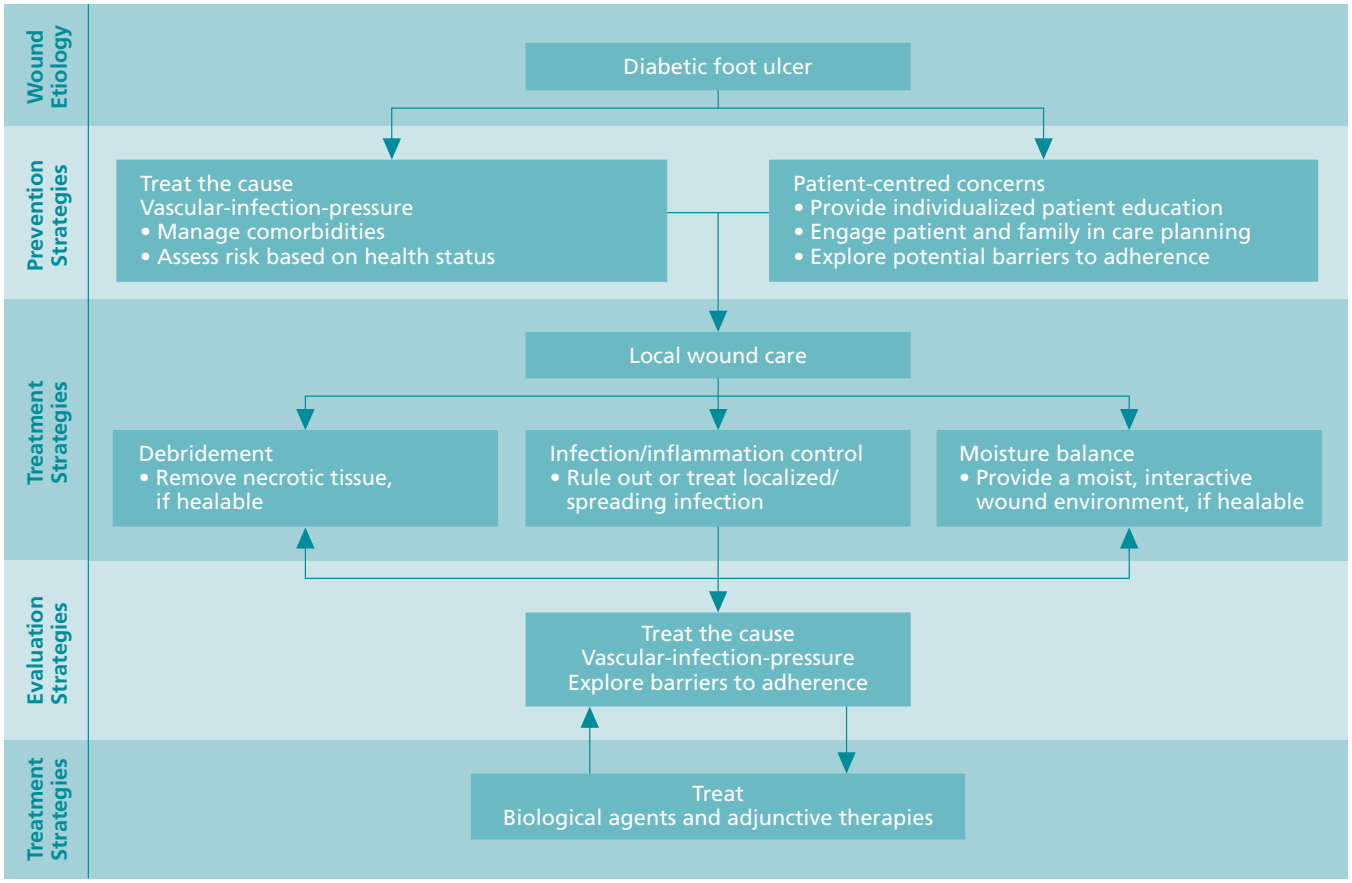
The panel recognizes the complexity of the treatment of persons with diabetic foot ulcers and acknowledges the realities of practice settings that may influence resources available to identify the highest quality evidence to direct care.

To this end, the recommendations serve as an evidence-based guide for nurses and other health-care professionals to identify and assess people in high-risk groups who would benefit from specialized wound care. Interprofessional health-care teams should work closely with clients and their families to address the complex lifestyle, self care and multiple treatment demands of people with diabetes diagnosed with diabetic foot ulcer(s). It is acknowledged that this level of care is not yet fully accessible to or accessed by all people with diabetes. Moreover, few people with foot ulcerations receive optimal wound management (Boulton, Kirsner, & Vileikyte, 2004). Nurses can facilitate and positively influence wound healing outcomes by promoting, collaborating and participating in interprofessional health-care teams that follow best practice guidelines as presented in this document.

The management of persons with foot ulcers is complex. According to Weir (2010), diabetic foot ulcers should be regarded a medical emergency. Principles of clinical management of the person with diabetic foot ulcers involve assessing for: vascular supply (V); infection (I); structural or bony deformities, foot wear and sensation to determine pressure related issues (P); and, sharp debridement of non-viable tissue (s). These principles are often termed by their acronym, VIPs (Inlow, Orsted, & Sibbald, 2000).

The Canadian Association of Wound Care Wound Bed Preparation framework is helpful in outlining the key clinical symptoms and issues related to diabetic foot ulcers and approaches to management utilizing the above principles of VIPs (Botros et al., 2010). This framework is presented in Figure 2.

Figure 2: Pathway to the Prevention and Management of Diabetic Foot Ulcers



Note. From "Best Practice Recommendations for the Prevention, Diagnosis and Treatment of Diabetic Foot Ulcers: Update 2010," by M. Botros, K. Goettl, L. Parsons, S. Menzildzic, C. Morin, T. Smith, et al., 2010, *Wound Care Canada* 8(4), 6-40.
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Practice Recommendations

ASSESSMENT

RECOMMENDATION 1.0:

Obtain a comprehensive health history and perform physical examination of affected limb(s).

Level of Evidence = Ib – IV

Discussion of Evidence:

A comprehensive health history is required for all clients who present with diabetic foot ulceration. This health history must include a history of presenting illness, past medical history, glycemic control, nutritional status, allergies, medications, family history and psychological well-being.

History of Presenting Illness (Level of Evidence = IV)

Assessment of the person with a diabetic foot ulcer requires a detailed history of the presenting illness, including:

- Initiating event;
- Duration of ulceration;
- Treatments undertaken; and
- Outcome of the treatments.

Past Medical History (Level of Evidence = III)

A history of diabetic foot ulcers and several diabetes-related complications are associated with lower limb amputations. Therefore, a thorough past medical history is important to identify individuals at high risk for amputation, and it should include: A) An assessment of co-morbidities and complications associated with diabetes; B) Previous ulcers related to diabetes; and C) A history of smoking.

People with diabetic foot ulcers should be identified as high risk for amputation (Australian Centre for Diabetes Strategies (ACDS), 2001; Falanga & Sabolinski, 2000; IWGDF, 2011).
See **Appendix D** for risk factors for amputation.

A. Co-morbidities and Complications Associated with Diabetes

There are multiple co-morbidities and complications associated with diabetes (CDA CPG Expert Committee, 2008). The following discussion will focus on co-morbidities of renal impairment, hypertension and retinopathy. Early identification of co-morbidities and complications allows the health-care professional to initiate appropriate referrals and develop a comprehensive interprofessional plan of care.

Renal Impairment

Renal impairment is a prevalent microvascular complication. Fifty percent of people with diabetes have renal impairment (CDA CPG Expert Committee, 2008). In a retrospective observational study, Eggers, Gohdes and Pugh (1999) identified that amputation rates for people with diabetes and end-stage renal disease increased 10-fold compared to people with diabetes alone. Furthermore, the post-amputation survival rate for clients with diabetes and end-stage renal disease was approximately 33% (Eggers et al., 1999).

Hypertension

The majority of people with diabetes will develop hypertension, a treatable risk factor (CDA CPG Expert Committee, 2008). Adler and colleagues (2000) identified that elevated blood pressure is strongly linked to macrovascular (e.g., peripheral vascular disease) and microvascular (e.g., retinopathy and nephropathy) complications. Peripheral vascular disease places individuals at a significantly increased risk for amputation (Royal Melbourne Hospital, 2002). Improved control of hypertension results in clinically significant reductions in microvascular and macrovascular complications and diabetes-related death (CDA CPG Expert Committee, 2008).

Retinopathy

Diabetic retinopathy may be the most common microvascular complication of diabetes, affecting 23% of people with type 1 diabetes and 14% of people with type 2 diabetes (CDA CPG Expert Committee, 2008). A multi-national study by Chaturvedi and colleagues (2001) demonstrated that vascular complications, including retinopathy, are a significant risk factor for amputation in both type 1 and type 2 diabetes. A descriptive-analytic study by Shojaiefard, Khorgami, and Larijani (2008) also suggests that the presence of retinopathy increases a client's risk for amputation.

B. Previous Ulcers

A history of previous ulcers is a strong predictor of future ulcers. Up to 34% of people develop another ulcer within 1 year after healing from the previous ulcer. The 5-year rate of re-ulceration has been shown to be 70% (Frykberg et al., 2000). While two thirds of ulcers heal, one third may result in some form of amputation (IWGDF, 2011).

C. Smoking

Smoking is an independent risk factor for cardiovascular disease and a significant risk factor for chronic kidney disease for people with diabetes (Scottish Intercollegiate Guidelines Network [SIGN], 2010). It may also be a risk factor for retinopathy in type 1 diabetes. Smoking cessation reduces these risks and may optimize conditions for wound healing (SIGN, 2010).

Glycemic Control (Level of Evidence = Ib)

Improved glycemic control reduces complications and optimizes wound healing (Marston & Dermagraft Diabetic Foot Ulcer Study Group, 2006). In a cohort study by Moss, Klein and Klein (1996), elevated blood glucose levels were highly correlated with complications of diabetes. In a randomized controlled trial, pharmacological control of blood glucose was shown to reduce diabetes-related complications in overweight clients with type 2 diabetes (UKPDS, 1998). Similarly, a study examining glycemic control and microvascular complications in Japanese people with type 2 diabetes concluded that intensive glycemic control may delay onset and progression of diabetic retinopathy, nephropathy and neuropathy (Ohkubo et al., 1995). Results of a prospective observational study suggested that each one percent reduction in mean hemoglobin A1c[G] (HbA1c; a measure of glycemic control) produced significant decreases in the rate of complications and deaths related to diabetes (Stratton et al., 2000). Furthermore, HbA1c values in the normal range (<6.0%) comprised the lowest risk of complications (Stratton et al., 2000).

From a wound healing perspective, a secondary analysis of data from a prospective, randomized controlled trial by Marston and Dermagraft Diabetic Foot Ulcer Study Group (2006) found that people treated with a human fibroblast-derived dermal substitute had better wound healing rates when A1c levels were controlled or reduced over a 12-week period. Similarly, in a retrospective cohort study by Markuson et al. (2009), patients with higher A1c levels did experience wound healing, but over a significantly longer period than those with lower A1c.

The Canadian Diabetes Association (CDA) Clinical Practice Guidelines (CDA CPG Expert Committee, 2008) recommends the following targets for glycemic control for most people with type 1 and type 2 diabetes:

- A1c ≤ 7.0% to reduce the risk of microvascular and macrovascular complications;
- Fasting plasma glucose of 4.0 to 7.0 mmol/L; and
- 2-hour postprandial plasma glucose targets of 5.0 to l0.0 mmol/L (5.0 to 8.0 mmol/L if A1c targets not being met).

Nutritional Status (Level of Evidence = IV)

The overall nutritional health of a person with diabetes will have an effect on wound healing. Macronutrients and micronutrients play an important role in the different stages of wound healing. A person with diabetes should ensure adequate intake of calories, protein, fat, fluids, vitamins and minerals to achieve positive outcomes. A nutritional assessment by a registered dietician is indicated if nutritional deficits are identified.

Allergies (Level of Evidence = IV)

A comprehensive health history should include a record of any allergies. Allergies pertinent to foot ulcers may consist of medication allergies and sensitivities to dressing adhesives and debridement materials. Being aware of allergies allows the health-care professional to make appropriate choices with regards to medications for treatment of infections, wound dressings and solutions used for debridement.

Medications (Level of Evidence = IV)

A record of current medications should be included as part of the health history. Medication records provide health-care professionals with the necessary information for proper pharmacological diabetes management, such as drug contraindications, potential drug interactions and identification of medications that may impair wound healing.

Family History (Level of Evidence = III)

It is important that people with diabetes are asked about their family health history. Family health history reflects inherited genetic susceptibility and shared environment, behaviours and habits (Centers for Disease Control and Prevention, 2004). People with a family history for certain diseases (e.g., heart disease, diabetes and osteoporosis) are more likely to develop those diseases themselves (Bennett, 1999).

Psychological Well Being (Level of Evidence = IV)

It is important to determine the psychological well being of individuals with diabetes as it can impact on their ability to manage their condition. Clinical depression, anxiety and eating disorders are known factors associated with poor control of type 1 diabetes (SIGN, 2010). More specifically, depression, affecting approximately 15% of people with diabetes, is associated with, but not limited to, poor self-care behaviours and decreased quality of life (CDA, 2012; CDA CPG Expert Committee, 2008; SIGN, 2010). Therefore, health professionals should explore psychological well being as part of a comprehensive health history as it may impede self-management strategies to prevent and manage diabetic foot ulcers.

RECOMMENDATION 1.1:

Identify the location and classification of foot ulcer(s) and measure length, width and depth of wound bed.

Level of Evidence = Ia – IV

Discussion of Evidence:

Identification of Ulcer Location (Level of Evidence = III)

The location of the foot ulcer is important to identify as this information may have an impact on care planning and the use of appropriate pressure redistribution devices. According to a prospective observational study by Reiber et al. (1999), the plantar region of the toes, forefoot and midfoot were the most frequent sites of ulceration followed by the dorsal region of the toes and heels.

Classification (Level of Evidence = 1a)

Diabetic foot ulcer stratification systems are essential tools for predicting a client's risk of developing a foot ulcer (Monteiro-Soares, Boyko, Rebeiro, Rebeiro, & Dinis-Rebeiro, 2011). In addition, using a stratification system facilitates effective communication between health-care professionals regarding the client's risk for amputation, and can facilitate data collection related to disease severity.

The following five stratification systems were identified by a systematic review:

1. University of Texas (Armstrong, Lavery, & Harkless, 1998a; Lavery, Armstrong, Vela, Quebedeaux & Fleischli, 1998; see **Appendices D, E, F**);
2. International Working Group on the Diabetic Foot (Diabetic foot ulcer classification system for research purposes; see **Appendix G**);
3. Scottish Intercollegiate Guideline Network (SIGN);
4. American Diabetes Association; and
5. Boyko and colleagues.

(Monteiro-Soares, 2011)

Five core factors to assess for were identified in all scales: diabetic neuropathy[G], peripheral vascular disease, foot deformity, previous foot ulcer and previous amputation (Monteriro-Soares et al., 2011). The authors concluded that while classification of foot ulcers in itself was important, the best system to use for specific health-care settings could not be determined (Monteiro-Soares et al., 2011).

Measuring the Length and Width (Level of Evidence = Ia)

Standardizing the procedure for measurement of diabetic foot ulcers is crucial to evaluate whether the wound is moving towards desired outcomes. Consistent and accurate measurements of length and width aid in reliable tracking of wound closure progress. Wound measurements should be completed using a consistent method such as tracings (Krasner & Sibbald, 2001). A systematic review evaluating treatments for diabetic foot ulcers classified wounds as healing when the wound length and width decreased (Margolis, Kantor, & Berlin, 1999). Furthermore, a prospective trial conducted by Sheehan, Jones, Caselli, Giurini and Veves (2003) demonstrated that a 50% reduction in wound surface area (length and width) at 4 weeks is a good predictor of complete wound healing at 12 weeks.

Measuring the Depth (Level of Evidence = IV)

Measuring wound depth should accompany the measurement of wound length and width as together they provide quantifiable data to accurately determine wound healing. Wound depth is most commonly measured by gently inserting a sterile swab stick or probe into the wound. The presence of undermining and tunneling can also be determined in this manner by probing a space between the surrounding skin and wound bed. The RNAO expert panel recommends using the "clock" system to document the location of tunneling or undermining (e.g., area of the tunneling or undermining closest to the head is the 12 o'clock position).

RECOMMENDATION 1.2:

Assess bed of foot ulcer(s) for exudate, odour, condition of peri-ulcer skin and pain.

Level of Evidence = IV

Discussion of Evidence:

Exudate (Level of Evidence = IV)

Wound exudate characteristics (e.g., amount and type of drainage) provide important information about the status of the wound. The RNAO expert panel recommends rating the amount of exudate observed using the following terms:

AMOUNT OF WOUND EXUDATE OBSERVED	RATING OF EXUDATE
Dry	No exudate
Moist	Scant or small
Wet/saturated	Heavy

In addition to amount, the RNAO expert panel recommends describing the type of exudate observed from the ulcer using common terminology as follows:

EXUDATE OBSERVED	TYPE OF WOUND EXUDATE
Clear yellow fluid without blood, pus or debris	Serous
Thin, watery, pale red to pink fluid	Serosanguinous
Bloody, bright red	Sanguinous
Thick, cloudy, mustard yellow or tan	Purulent

Odour (Level of Evidence = IV)

All wounds, especially those treated with moisture retentive dressings, can emit an odour, and it is important to assess the foot ulcer bed for the characteristics of this odour. A change in odour may be indicative of an alteration in bacterial balance. A healthy wound has a faint but not unpleasant odour; infections often result in a distinctive and slightly unpleasant odour (Butalia, Palda, Sargeant, Detsky, & Mourad, 2008; Cutting & Harding, 1994). Necrotic wounds tend to have more offensive odours than clean wounds. Wounds infected with anaerobes, suggestive of gangrene, tend to produce a distinct acrid or putrid odour.

Condition of Peri-Ulcer Skin (Level of Evidence = IV)

The condition of the peri-ulcer skin provides important information about the status of the wound and can influence choice of intervention and treatment. The RNAO expert panel recommends a surrounding skin assessment that includes an evaluation of:

- Skin colour and temperature: Redness may be indicative of unrelieved pressure or prolonged inflammation (Boulton, 1991). Pale, white or grey tissue may be indicative of prolonged exposure to moisture. Increased temperature (erythema) in the ulcer area may also indicate infection in the wound (Sibbald, Goodman, Woo, Krasner, & Smart, 2012).
- Callus[G] formation: Callus formation is indicative of ongoing pressure to the affected area. Debridement of callus may be indicated to facilitate accurate assessment; and
- Induration and edema: Induration (an abnormal firmness of the tissue) and edema (swelling) are indicative of infection. They are assessed by gently pressing the skin within 4 cm of the wound. Firmness may be observed.

Pain (Level of Evidence = III)

Although pain may be uncommon in diabetic foot disorders, evidence of increasing pain accompanied by wound breakdown are strong indicators (100% specificity[G]) of chronic wound infection (Gardner, Frantz, & Doebbeling, 2001). Pain in a previously insensate[G] foot may also indicate active charcot arthropathy[G] (see **Appendix H** for a description). Charcot arthropathy can be difficult to distinguish from wound infection or cellulitis[G]. Left untreated, charcot arthopathy may lead to serious foot structure damage and injury. X-rays should be done to differentiate an active charcot foot from infection.

Persons with diabetes may suffer from neuropathic foot pain. This pain is often described as burning and stabbing in nature, and its presence is generally independent of foot position or movements. Neuropathic pain can be difficult to manage and requires careful assessment and monitoring.

As demonstrated in Figure 1, diabetic neuropathy increases the risk of foot ulceration and subsequent amputation (Frykberg, 1991). In the presence of diabetic neuropathy and amputation, clients may suffer from phantom limb pain in the absent leg. Referral to physiotherapy for pain relieving modalities such as transcutaneous electrical nerve stimulation may be necessary to treat both neuropathic and phantom limb pain (CDA CPG Expert Committee, 2008).

RECOMMENDATION 1.3:

Assess affected limb(s) for vascular supply and facilitate appropriate diagnostic testing, as indicated.

Level of Evidence = III – IV

Discussion of Evidence:

The assessment of vascular supply can be achieved through a health history, physical examination and diagnostic testing. The RNAO expert panel recommends the following physical assessment considerations and appropriate diagnostic tests for vascular supply, outlined in Table 1. See **Appendix I** for further detail about these specialized diagnostic tests.

Table 1: Appropriate Assessment and Diagnostic Tests to Determine Vascular Supply

PHYSICAL ASSESSMENT OF THE LOWER EXTREMITIES	DIAGNOSTIC TESTS*
■ Intermittent claudication[G] (calf pain) ■ Peripheral pulses ■ Colour (pallor[G] on limb elevation, rubor[G] on limb dependency, mottling) ■ Cool temperature ■ Ischemic pain (pain causing frequent waking at night, or needing to dangle limb for pain relief) ■ Dry gangrene ■ Hair loss, dystrophic nails (damaged or misshaped nail plates) ■ Shiny, taut, thin, dry skin	■ Ankle brachial pressure index (ABPI)[G] ■ Toe pressures[G] and toe brachial index ■ Arterial duplex scan ■ Transcutaneous oxygen ■ Angiography (including CT angiogram and MR angiogram)

*Accessibility of these diagnostic tests may be limited to centres specializing in vascular surgery and wound care.

Peripheral arterial disease (PAD), also known as peripheral vascular disease, is a narrowing of the peripheral arteries resulting in insufficient vascular supply to the lower extremities. PAD can prolong wound healing and increase the risk of amputation (Apelqvist, 1998; Birke, Patout, & Foto, 2000; Crane & Branch, 1998; Sinacore & Mueller, 2000). The risk of people with diabetes developing PAD increases as the disease progresses (Calhoun, Overgaard, Stevens, Dowling, & Mader, 2002). This risk increases 10-fold in those with diabetes and concurrent renal failure (Apelqvist, 1998; Eggers et al., 1999). In the younger client population, PAD often presents bilaterally. Therefore, adequate blood flow to the affected extremities is essential to support wound healing (Birke et al., 2000; Reiber et al., 1999). Positive findings should be discussed with a vascular surgeon in order to determine potential for intervention.

Bilateral lower extremity assessment should include, at minimum, the assessment of:

- Intermittent claudication;
- Peripheral pedal pulses; and
- Colour.

Intermittent Claudication (Level of Evidence = III)

One of the first presenting symptoms of vascular insufficiency is intermittent claudication, or calf pain. A history of intermittent lower limb claudication combined with non-palpable pedal pulses in both feet increases the probability of vascular insufficiency in clients with diabetes (Boyko et al., 1997).

Peripheral Pedal Pulses (Level of Evidence = IV)

Palpating for the presence of a plantar pulse, such as the dorsalis pedis or posterior tibial, is essential during assessment. The presence of peripheral pulses is represented by a minimum systolic pressure of 80 mmHg and may suggest adequate vascular supply to support wound healing (Lavery & Gazewood, 2000). The National Evidence Based Guidelines for the Management of Type 2 Diabetes Mellitus states that the absence of peripheral pulses has prognostic significance for future amputation in people with or without foot ulceration (ACDS, 2001).

Some regions of the foot with palpable pulses, however, may not be well-perfused. According to the angiosome model, the foot is delineated into five angiosomes, each consisting of skin, subcutaneaous tissue, fascia, muscle and bone, fed by a source artery. The presence of a peripheral pulse may not necessarily indicate that all of the components within a particular angiosome are well-perfused. Although a foot pulse might be palpable, the foot ulcer might be situated in a different angiosome (Sibbald et al., 2011). This concept may help the clinician determine appropriate measures to support successful ischemic ulcer treatment (Attinger, Evans, & Mesbahi, 2006).

Colour (Level of Evidence = IV)

The colour of the foot should be assessed for rubor on dependency, pallor on elevation, mottling and dry gangrene, all of which are signs of ischemia (Bowker & Pfeifer, 2001). A comprehensive vascular assessment is recommended for clients with these signs of arterial insufficiency.

RECOMMENDATION 1.4:

Assess foot ulcer(s) for infection using clinical assessment techniques, based on signs and symptoms, and facilitate appropriate diagnostic testing, if indicated.

Level of Evidence = Ia

Discussion of Evidence:

The diagnosis of foot ulcer infection is based on a clinical examination (IWGDF, 2011). Infection is a destructive process that occurs when bacteria in a wound overcomes the natural defenses of the host's immune system. The likelihood of a wound becoming infected is related to the type of micro-organism and the microbial load. However, equally important factors to consider are the characteristics of the wound (location, classification, length, width and depth), level of blood perfusion and ability of the host to resist infection.

While emphasis is frequently placed on microbial load, the host's resistance is often the critical factor in determining whether infection will develop. Diabetes increases susceptibility to infection. People with diabetes may not be able to mount an effective inflammatory response due to impaired immunodefenses, decreased peripheral circulation and decreased metabolic control (Armstrong, Lavery, Sariaya, & Ashry, 1996; Eneroth, Apelqvist, & Stenstrom, 1997). Increased occurrence of co-morbidities may place older people with diabetes at higher risk for infection than younger people with the disease as the severity of the infection may be masked by the co-morbidities. Use of an assessment tool, such as the Diabetic Foot Infection (DFI) scoring system, validated by Lipsky, Polis, Lantz, Norquist and Abramson (2009), may aid in predicting foot ulcer healing outcomes.

The microbial load in a wound advances over time in a predictable fashion (see Table 2). Most chronic wounds contain more than three species of micro-organisms, increasing the risk for infection as these organisms may develop synergies. In wounds that are infected with a number of species, distinguishing the causative organism is unlikely (Dow, Brown, & Sibbald, 1999). Correct wound swabbing[G] technique should be followed when collecting a culture swab to ensure accurate measure of wound microbial load. See **Appendix J** for wound swabbing technique.

Table 2: Microbial Load and Associated Findings.

TIME	TYPE OF MICRO-ORGANISM	CLINICAL AND LABORATORY FINDINGS
First few days	Cutaneous flora	
1 to 4 weeks	Cutaneous flora accompanied by Gram-positive aerobic cocci, often beta-haemolytic *Streptococci, S. aureus*	■ Purulent discharge ■ Gram-positive ■ Single species
4 weeks onwards	Cutaneous flora accompanied by Gram-negative facultative anaerobic bacteria, particularly coliforms, followed by anaerobic bacteria and *Pseudomonas*	■ Tissue necrosis ■ Undermining ■ Deep involvement ■ Poly-microbial mixture of aerobic and anaerobic pathogens

Note. From "Infection in chronic wounds: Controversies in diagnosis and treatment," by G. Dow, A. Brown and R.G. Sibbald, 1999, *Ostomy Wound Management, 45*(8), p. 23-40. Reprinted with permission.

The RNAO expert panel recommends using clinical assessment with diagnostic testing in the assessment of foot ulcer infection.

Signs and Symptoms of Infection

The presence of infection should be assessed based on the presentation of two or more of the following signs and symptoms of inflammation or purulence (Lipsky et al., 2012):

- Erythema;
- Warmth;
- Tenderness;
- Pain;
- Induration; and
- Purulent exudates.

The signs and symptoms of non-limb-threatening or superficial infection, and limb-threatening or deep wound and systemic infection[G] are summarized in Table 3.

Table 3: Clinical Signs and Symptoms of Infection.

NON-LIMB-THREATENING INFECTION	LIMB-THREATENING INFECTION	
SUPERFICIAL INFECTION	**DEEP WOUND INFECTION**	**SYSTEMIC INFECTION**
■ Non-healing ■ Bright red granulation tissue ■ Friable and exuberant granulation ■ New areas of breakdown or necrosis ■ Increased exudates ■ Bridging of soft tissue and the epithelium ■ Foul odour	■ Pain ■ Swelling, induration ■ Erythema (> 2 cm) ■ Wound breakdown ■ Increased size or satellite areas ■ Undermining or tunneling ■ Probing to bone ■ Anorexia ■ Flu-like symptoms ■ Erratic glucose control	In addition to deep wound infection: ■ Fever ■ Rigour ■ Chills ■ Hypotension ■ Multi-organ failure

(Falanga, 2000; Gardner et al., 2001; Lipsky et al., 2012; Schultz et al., 2003; Sibbald, Orsted, Schultz, Coutts, & Keast, 2003; Sibbald et al., 2000)

Identifying infection in a chronic wound can be a challenge as the clinical assessment for infection in chronic wounds differs from acute wounds. Gardner, Hillis and Frantz (2009) identified the following signs and symptoms of soft tissue infection in a cross-sectional study of 64 subjects with diabetic foot ulcers:

- Increased pain;
- Wound breakdown;
- Friable granulation tissue[G]; and
- Foul odour.

Deep foot infections have been identified as the immediate cause of 25 to 51% of amputations in persons with diabetes (Tennvall, Apelqvist, & Eneroth, 2000). Deep infections often present with erythema and warmth extending two centimeters or more beyond the wound margin (Woo & Sibbald, 2009). This increased inflammatory response may be painful and cause the wound to increase in size or lead to satellite areas of tissue breakdown, known as adjacent ulceration (Woo & Sibbald, 2009).

Deep infections, especially in chronic ulcers, can often lead to osteomyelitis, or bone infection, in the diabetic foot (Lipsky et al., 2012). Probing to bone is a simple technique for rapid identification of osteomyelitis and should be included in the initial assessment of all people with infected pedal ulcers (Grayson, Balaugh, Levin, & Karchmer, 1995). Other methods to diagnose the presence of osteomyelitis in clients with foot ulcers include laboratory and radiographic testing. A systematic review by Butalia et al. (2008) assessed evidence related to using historical features, physical examination and laboratory and basic radiographic testing in the diagnosis of lower extremity osteomyelitis in people with diabetes. The study concluded that, on physical examination, predictors of osteomyelitis included an ulcer area greater than 2cm^2 and a positive probe-to-bone test. Through laboratory testing, an erthrocyte sedimentation rate of more than 70 mm/h was also indicative of osteomyelitis (Butalia et al., 2008).

Signs of deep wound and systemic signs of infection are potentially limb and/or life threatening. These clinical signs and symptoms require urgent medical attention.

Diagnostic Testing of Infection

The timely diagnosis and treatment of infection is vital to the healing of diabetic foot ulcers. Diagnostic tests may be performed in conjunction with the clinical assessment when infection is suspected.

Lipsky et al. (2012) recommend that persons with new diabetic foot infections have plain radiographs to identify bony abnormalities such as bone deformity or destruction, foreign bodies or soft tissue gas. An abnormal plain radiograph finding can be helpful in the diagnosis of osteomyelitis (Butalia et al., 2008).

Magnetic resonance imaging (MRI) is recommended for clients who require additional imaging, especially if soft tissue abscess[G] or osteomyelitis is suspected (Lipsky et al., 2012). In a meta-analysis conducted by Dinh, Abad and Safdar (2008), MRI was determined to be the most accurate imaging test for diagnosis of osteomyelitis. Furthermore, osteomyelitis was found to be highly unlikely in a client with a normal MRI result (Butalia et al., 2008). If MRI is unavailable or contraindicated, a labeled white blood cell scan is the best alternative (Lipsky et al., 2012). It is important to note that accessibility to and interpretation of these tests may be limited to specific geographic locations and medical specialists.

RECOMMENDATION 1.5:

Assess affected limb(s) for sensory, autonomic and motor changes.

Level of Evidence = IIa

Discussion of Evidence:

The presence of peripheral neuropathy, or nerve damage, is determined by assessing for specific changes in sensory, autonomic and motor function. Identifying peripheral neuropathy is particularly important, as it will enable the health-care professional to identify associated potential risk factors for ulcer development. In a case-controlled study, Lavery et al. (1998) noted that clients with peripheral neuropathy and no other risk factors were 1.7 times more likely to develop foot ulceration. Table 4 illustrates the associated pathophysiological involvement, assessment considerations, and clinical indications specific to each of the three components of peripheral neuropathy.

Table 4: Components of Peripheral Neuropathy, Associated Pathophysiological Involvement, Assessment Considerations and Clinical Indications.

COMPONENT	ASSOCIATED PATHOPHYSIOLOGICAL INVOLVEMENT	ASSESSMENT CONSIDERATIONS	CLINICAL INDICATIONS
Sensory	■ Myelin sheath is disrupted by hyperglycemia ■ Disruption leads to the segmental demyelinization process accompanied by a slowing of motor nerve conduction and an impairment of sensory perception	■ Pressure perception testing using a 10-gr* (5.07 Semmes-Weinstein) monofilament, is recommended ■ Vibration perception (using a tuning fork) ■ Tactile sensation (using a cotton ball)	■ Loss of protective sensation ■ Sensory ataxia[G] ■ Falls (15-fold increase compared to those without diabetes) ■ Callus

COMPONENT	ASSOCIATED PATHOPHYSIOLOGICAL INVOLVEMENT	ASSESSMENT CONSIDERATIONS	CLINICAL INDICATIONS
Autonomic	**Sympathetic Denervation** ■ Loss of vasomotor control ■ Peripheral blood flow ■ Arteriovenous shunting ■ Bone blood flow hyperemia ■ Glycosylation of collagen	**Inspect for:** ■ Dry scaly skin caused by lack of hydration ■ Inspect between the toes especially between the fourth and fifth toes for fissures[G] ■ Maceration ■ Loss of hair growth and thickened toenails	■ Anhydrosis[G] ■ Callus ■ Fissure cracks ■ Onychomycosis[G] (fungal nails) ■ Peripheral edema ■ Waxy skin (sign of altered joint mobility)
Motor	■ Non-enzymatic glycosylation ■ Atrophy of intrinsic muscles of the foot (toe plantar flexors) ■ Subluxation of metatarsophalangeal joints	**Inspect for:** ■ Gait assessment ■ Range of motion ■ Muscle testing ■ Absent deep tendon reflexes	■ Callus ■ Claw toes[G] ■ Hammer toes[G] ■ Charcot arthropathy ■ Muscle weakness ■ Ankle equinus ■ Pes cavus[G] ■ Pes planus[G] ■ Contracture of Achilles Tendon

*Using 10 or 4 points on the foot is acceptable.
(CDA CPG Expert Committee, 2008; IWGDF, 2011; RNAO, 2007; Zangaro & Hull, 1999)

Appendix K provides a more detailed description of the monofilament assessment technique for sensory perception in the foot.

RECOMMENDATION 1.6:

Assess affected limb(s) for elevated foot pressure, structural deformities, ability to exercise, gait abnormality, and ill-fitting footwear and offloading devices.

Level of Evidence = Ia – IV

Discussion of Evidence:

Foot ulcers frequently occur as a result of repeated minor trauma, such as from ill-fitting footwear or elevated pressure on the sole of the foot. People with foot ulcers should be assessed regularly for potential causes of such trauma and be provided with interventions to reduce trauma and ulcer risk (IWGDF, 2011; Jeffcoate & Rayman, 2011; Rizzo et al., 2012; Royal Melbourne Hospital, 2002).

Elevated Foot Pressure (Level of Evidence = IIb)

Elevated plantar pressure is a significant risk factor for foot complications (Lavery, Armstrong, Wunderlich, Tredwell, & Boulton, 2003). The plantar surface of the forefoot is the most common location for foot ulcer development (CDA CPG Expert Committee, 2008; IWGDF, 2011). People with severe neuropathy may exhibit increased forefoot-to-rearfoot plantar pressure ratios, suggesting an imbalance in pressure distribution, which may predispose them to foot ulceration.

Pressure mapping is a technique that measures foot pressures in standing and walking positions. A cohort study by Giacomozzi and Martelli (2006) found that screening a person's peak pressure curve may be an effective method to detect risk of foot ulceration in diabetic clients. Similarly, using an F-Scan mat[G] system, Pham et al. (2000) found that foot pressures greater than 6 kg/cm placed people at an increased risk for foot ulceration. Lavery et al. (1998) also identified a significant association between high plantar pressure *(65 N/cm^2)* and presence of foot ulceration.

Pressure over bony prominences can lead to callus formation and predispose the skin to break down (ACDS, 2001; Boyko et al., 1999; Frykberg et al., 1998; Hutchinson et al., 2000). Calluses may act as a foreign body, elevating plantar pressures; therefore, callus removal or reduction often results in a significant reduction in foot pressure (Boulton, Meneses, & Ennis, 1999; Murray, Young, Hollis, & Boulton, 1996; Pataky et al., 2002; Young et al., 1992).

It is also important to ensure that dressings and offloading devices are used effectively, and that they are not contributing to increased pressure either around the ulcer or on other parts of the foot and leg.

Structural Deformities (Level of Evidence = III)

Physical examination of a person with diabetes should include an assessment for foot deformities (IWGDF, 2011; Royal Melbourne Hospital, 2002). Foot deformities include hammer toe, claw toe, hallux deformity[G], pes planus, pes cavus and charcot arthropathy. These structural foot deformities alter the gait or mechanics of walking, and can result in abnormal forces on the foot, poor shock absorption, and shearing and stress to soft tissues (RNAO, 2007; Shaw & Boulton, 1997). Furthermore, the risk for elevated plantar pressure is directly associated with the number of foot deformities (Lavery et al., 2003).

See **Appendix H** for descriptions of each type of foot deformity.

Any deformity of the foot should be referred to a specialist (podiatrist/chiropodist) for further evaluation.

Ability to Exercise (Level of Evidence = IV)

Exercise may help people with diabetes to achieve a variety of health goals, including improved glycemic control (CDA CPG Expert Committee, 2008; SIGN, 2010). Limited joint mobility as a result of peri-articular limitations (e.g., muscle, tendon, joint capsule, ligament and skin) can be effectively treated with exercise-based interventions, including stretching and strength training (Allet et al., 2010).

It is important to note that people with diabetes-associated complications, including ulceration, should be carefully assessed and supervised when undertaking an exercise program. Referral to an exercise specialist, such as a physical therapist, may be indicated to address health and safety concerns.

Gait Abnormality (Level of Evidence = III)

Gait is the manner or style of walking. Neurodegenerative processes are accelerated in diabetes, often resulting in abnormal weight bearing, unstable posture and a decline in motor control (Mason et al., 1999b; Meier, Desrosiers, Bourassa, & Blaszczyk, 2001). Alterations in gait, balance and mobility in a client may also be caused by sensory ataxia, poor vision, debilitation and/or neuropathy secondary to the diabetes disease process (Sinacore & Mueller, 2000).

Assessment of gait is important in order to establish a person's risk of falling and injury. Sinacore and Mueller (2000) found that the risk of falling was 15 times greater in people with diabetic neuropathy than in people with diabetes without neuropathy. Abnormal gait patterns that may be observed in a person with diabetes include: ataxic (unsteady, uncoordinated, employing a wide base of support), steppage (lifting the foot higher to accommodate for foot drop and/or poor ankle-joint mobility) and antalgic (limping, usually signifying discomfort).

Referral to a physical therapist may be indicated if gait abnormalities are noted.

Ill-fitting Footwear and Offloading Devices (Level of Evidence = Ia)

Clients should be assessed for knowledge and understanding of the importance of proper footwear and offloading device use to reduce plantar pressures. Education regarding proper fit and use of footwear and devices should be provided if knowledge gaps or learning needs are identified.

Footwear

In a large prospective study, Abbott and colleagues (2002) found that 55% of ulcerations assessed were attributed to pressure from footwear. Foot ulceration has been associated with constant or repetitive pressure from tight shoes over bony prominences on the dorsum of the lesser toes, at the medial aspect of the first metatarsal head[G] and the lateral aspect of the fifth metatarsal (Lavery et al., 1998).

It is imperative that people with diabetic foot ulcers see a foot- or health-care specialist regularly for the assessment of their feet, footwear and other devices associated with ambulation (American Diabetes Association (ADA), 2001; Campbell et al., 2000; CDA CPG Expert Committee, 2008; Frykberg et al., 2000; Hunt, 2001; Hutchinson et al., 2000; Institute for Clinical Systems Improvement (ICSI), 2000; Lavery & Gazewood, 2000; Maciejewski et al., 2004; McCabe, Stevenson & Dolan, 1998; New Zealand Guidelines Group (NZGG), 2000; Rizzo et al., 2012; Smieja et al., 1999; Zangaro & Hull, 1999).

See **Appendix L** for suggestions in assessing and selecting shoes and socks.

Offloading Devices

Offloading devices, such as foot orthoses, aid in reducing plantar pressure in the diabetic foot. Foot orthoses are custom-made shoe inserts that serve to correct or relieve misalignment and/or pressure areas of the foot. A systematic review by Spencer (2004) found that in-shoe custom orthoses were effective at relieving foot pressure and resolving calluses in people with diabetes.

See **Appendix M** for selection of offloading devices.

RECOMMENDATION 1.7:

Document characteristics of foot ulcer(s) after each assessment including location, classification and any abnormal findings.

Level of Evidence = IV

Discussion of Evidence:

Documentation is used to monitor a client's progress and communicate with other health-care providers (College of Nurses of Ontario (CNO), 2009a). Good record-keeping using common language and objective descriptors such as wound measurements and ulcer grading can increase clarity and improve outcomes. Careful monitoring of wound healing through consistent and thorough documentation is as important as initial assessment and treatment in influencing healing outcomes (Krasner, 1998).

The RNAO expert panel recommends using an interprofessional assessment tool to document assessment results. See **Appendix N** for an example of an assessment tool that may be used by an interprofessional team.

PLANNING

RECOMMENDATION 2.0:

Determine the potential of the foot ulcer(s) to heal and ensure interventions to optimize healing have been explored.

Level of Evidence = IV

Discussion of Evidence:

The healing potential of a wound must be taken into consideration when developing a plan of care. Factors affecting the healing potential of a diabetic foot ulcer may be grouped into three categories: local, host and environment. The RNAO expert panel has summarized these factors in Table 5: Factors Affecting Healing Potential. Implementing interventions addressing these factors should optimize the healing conditions of the foot ulcer.

Table 5: Factors Affecting Healing Potential

LOCAL ⟷	HOST ⟷	ENVIRONMENT
■ Necrosis ■ Infection ■ Pressure injury on the ulcer area ■ Micro-vascular supply ■ Foreign body ■ Iatrogenic/cytotoxic agents ■ Local trauma to ulcer area	■ Co-morbidities: • End-stage renal disease • Immunosuppression • Inflammatory condition • Visual impairments • Glycemic control • Nutrition • Peripheral arterial disease • Venous insufficiency • Lymphedema • Coronary artery disease • Obesity ■ Systemic cytotoxic drugs ■ Smoking ■ Alcohol and substance use ■ Adherence to plan of care ■ Cultural/personal beliefs ■ Mental illness (schizophrenia, depression) ■ Cognitive impairment ■ Low socioeconomic status ■ Concordance to plan of care	■ Access to care ■ Access to appropriate offloading ■ Family support ■ Health-care sector ■ Geographic surroundings ■ Socioeconomic status

(Falanga, 2005; Jeffcoate et al., 2008; Pecoraro, Reiber, & Burgess, 1990)

Moist wound care is not recommended in wounds where complete healing is not the goal. Use a dry dressing to keep the wound bed dry.

If infection is present and the client cannot fight infection, the moist wound will become a breeding ground for infection. Using a topical, cost-effective antiseptic[G] such as povidone iodine should be considered when the risk of infection outweighs the healing potential.

RECOMMENDATION 2.1:

Develop a plan of care incorporating goals mutually agreed upon by the client and health-care professionals to manage diabetic foot ulcer(s).

Level of Evidence = IV

Discussion of Evidence:

Proper goal-setting enables the team to closely monitor the effectiveness of interventions, continuing those that are successful and discontinuing those that are unsuccessful.

Ideally, the primary goal in the treatment of diabetic foot ulcers is to obtain wound closure as expeditiously as possible. The resolution of foot ulcers and decreasing the rate of re-occurrence can lower the probability of lower extremity amputation for clients with diabetes. However, it should not be expected that all diabetic foot ulcers will have wound closure as a primary outcome. Wounds that are unlikely to heal should have alternative goals such as:

- Wound stabilization;
- Reduced pain;
- Reduced bacterial load; and
- Decreased dressing changes.

Beyond tracking progress, goals can also motivate the client, ensure the team is working toward a common end and ensure important actions are not overlooked. Frequent re-evaluation of goals and the overall plan of care is essential as the circumstances affecting wound care may change (Sibbald et al., 2011).

The plan of care should be developed by the client and the interprofessional team, based on client-centred care approaches (RNAO, 2006a; Sibbald et al., 2011). Client-centred care involves collaborative care-planning and an interprofessional team approach to assessing, planning, implementing, monitoring and evaluating care with the client taking a key role (Hayes, 2009). The plan of care for all clients with diabetic foot ulcers should include improving function and quality of life, maintaining health status and controlling costs (Hayes, 2009). The plan of care should also include strategies to prevent deconditioning, which has many detrimental side effects, including psychosocial dysfunction (Hayes, 2009).

In a client-centred model of care, diabetic foot ulcers are managed through a holistic approach where interprofessional team members synchronize activities to ensure the client receives the appropriate treatment from experts of each discipline (Schoen, Balchin & Thompson, 2010). Team members should advocate, collaborate and facilitate the process of goal-directed care to manage foot ulcers for people with diabetes. Fragmentation of care may lead to conflicting advice for the client, wasted time and unnecessary effort, and subsequent protracted wound healing.

RECOMMENDATION 2.2:

Collaborate with the client/family and interprofessional team to explore other treatment options if healing has not occurred at the expected rate.

Level of Evidence = IV

Discussion of Evidence:

Diabetic foot ulcers that have not healed at the expected rate, where potential causative factors have been addressed, may require the use of alternative treatment modalities, such as biological agents, adjunctive therapies or surgery. See **Appendix O** for specific treatment options. These treatment methods often involve the cooperation and coordination of various members of the interprofessional team. Nurses should collaborate with the client and interprofessional team to explore treatment options, determine the best course of action for treatment and implement a revised plan of care.

RECOMMENDATION 2.3:

Collaborate with client/family and the interprofessional team to establish mutually agreed upon goals to improve quality of life if factors affecting poor healing have been addressed and complete wound closure is unlikely.

Level of Evidence = IV

Discussion of Evidence:

The RNAO expert panel has summarized various factors that can contribute to poor healing of chronic wounds:

- Inadequate blood supply;
- Poor glycemic control;
- Non-adherence with treatment plan due to differing goals regarding the plan of care;
- End-stage renal disease;
- Transplant recipients;
- Malnutrition[G];
- Connective tissue disorders;
- Systemic conditions, such as sickle cell disease;
- Osteomyelitis;
- Immobility;
- Heart disease;
- Dementia;
- Cancer; and
- Advancing age.

If factors affecting poor healing of chronic wounds have been addressed and complete wound closure is unlikely, the client and the health-care team should mutually agree upon a plan of care to improve the quality of life for the client (Enoch & Price, 2004). To improve quality of life, the significance of managing exudate, controlling infection, relieving pain and minimizing odour in a non-healing wound must be established and accepted as legitimate goals by the client and the health-care team (Enoch & Price, 2004).

Major or minor amputation may be the most reasonable intervention for clients with complex or life-threatening situations. However, amputation should be a mutual decision between the client and the health-care team.

IMPLEMENTATION

RECOMMENDATION 3.0:

Implement a plan of care to mitigate risk factors that can influence wound healing.

Level of Evidence = IV

Discussion of Evidence:

People with diabetes often have a combination of risk factors that may influence the condition of their skin and wounds. Based on a review of the literature, the RNAO expert panel identified risk factors that may affect wound healing. See Table 5 for a summary of these risk factors.

RECOMMENDATION 3.1:

Provide wound care consisting of debridement, infection control and moisture balance where appropriate.

Level of Evidence = Ia – IV

Discussion of Evidence:

Local wound care is a significant component of the pathway to prevent and manage diabetic foot ulcers (refer to Figure 2). Wounds have the greatest potential for healing with care that includes:

1. Debridement;
2. Infection control; and
3. Moisture balance.

If healing potential is not established, aggressive debridement and moist interactive healing is not recommended.

Debridement (Level of Evidence = Ia)

Debridement is the process of removing necrotic or foreign tissue from a wound to promote healing. Studies have shown that debridement of diabetic foot ulcers increases the rate of healing (Edwards & Stapley, 2010; Inlow et al., 2000; Rodeheaver, 2001). In an extensive review of clinical evidence to determine the utility of debridement, Cardinal et al. (2009) found that frequent or serial debridement of diabetic foot ulcers promoted wound healing and increased wound closure rates. Moreover, Steed, Donohoe, Webster and Lindsley (1996) found that lower rates of healing were correlated with less frequent debridement practices. Frequency of debridement should be based on clinical judgment and correspond to the client's care plan (Inlow et al., 2000). See **Appendix P** for a decision-making algorithm for debridement.

Several methods of debridement are available for varying stages of ulcers. The clinical use of enzymatic and biologic methods of debridement was not included as part of the literature base used for this BPG. This guideline will focus on the three most common methods of debridement for diabetic foot ulcers:

- Autolytic;
- Mechanical; and
- Surgical/Sharp.

Autolytic

Autolytic debridement uses the body's own natural enzymes to break down and digest necrotic tissue. Autolytic debridement also involves the use of moisture in semi-occlusive or occlusive dressings to aid in the efficiency of liquefying devitalized tissue. Dressings for autolytic debridement include hydrocolloids, hydrogels and films (Inlow et al., 2000). In a Cochrane review to determine the effectiveness of debridement methods for diabetic foot ulcers, Edwards and Stapely (2010) found that hydrogels were significantly more effective than gauze dressings or standard care in healing diabetic foot ulcers.

Mechanical

Mechanical debridement involves manually removing necrotic tissue and debris from a wound bed, using wet-to-dry dressings, saline irrigation or pulsed lavage. Mechanical debridement may be indicated in wounds with moderate levels of necrotic tissue (Enoch & Harding, 2003).

Surgical/Sharp

Surgical or sharp debridement[G] involves the use of a medical instrument such as a scalpel to excise necrotic tissue. Surgical debridement is often performed in wounds with large volumes of necrotic and infected tissue. In a prospective trial, sharp debridement was associated with greater wound closure in people with diabetic foot ulcers (Saap & Falanga, 2002).

It should be noted, however, that clinical trials on surgical debridement are inadequately powered. More research is needed to evaluate the methods and effects of all types of debridement (Edwards & Stapley, 2010; Shannon et al., 2010).

Sharp debridement is a high-risk procedure and should be undertaken with caution. It is a procedure that must only be performed by trained and experienced health-care professionals, within the policies of the organization.

Performing a procedure below the dermis is a controlled act that must be carried out by an authorized health-care professional. Health-care professionals should be aware of their professional scope of practice as well as the policies and procedures within their organization.

Callus Reduction

In addition to wound debridement, callus debridement may also assist in the prevention and management of foot ulcers. Reducing a callus often involves surgical or sharp debridement, and has been demonstrated to significantly reduce pressure at the callus site by approximately 30% (Armstrong, Lavery, Vazquez, Nixon, & Boulton, 2002; Pitei, Foster & Edmonds, 1999; Young et al., 1992). Callus debridement is within the scope of practice for certain health-care professionals, and may be performed by those with the appropriate knowledge, skills and judgment about the procedure.

Infection Control (Level of Evidence = III)

Preventing or controlling infection in diabetic foot ulcers is essential to prevent complications such as osteomyelitis (bone infection) or amputation. Infection often results when the number of bacterial organisms exceeds the capacity of local tissue defenses (Peacock & Van Winkle, 1976). Polymicrobial infection should be anticipated in people with diabetic foot ulcers, with a variety of grampositive cocci, gram-negative rods and anaerobic organisms predominating. Antibiotic[G] therapy typically involves broad-spectrum coverage for these organisms and should be initiated based on properly acquired wound cultures (Anti-infective Review Panel, 2010; Lipsky et al., 2012). **Appendix J** provides details of proper swabbing for wound cultures. Table 6 illustrates treatment options recommended by the RNAO expert panel for superficial infection, deep wound infection and systemic infection.

Once wound culture results are obtained, antimicrobial[G] therapy may be tailored to provide specific coverage or therapy against resistant organisms. Antibiotic-resistant organisms, such as methicillin-resistant staphylococcus aureus (MRSA)[G], are an increasing issue with infections in diabetic foot ulcers (Lipsky et al., 2012). Specifically, the prevalence of MRSA in diabetic foot ulcers ranges from 5 to 30% (Lipsky et al., 2012). Infections involving antibiotic-resistant organisms require targeted antibiotic therapy. If infection persists while the client is on antibiotic therapy, surgical assessment and wound culture should be considered.

Moreover, methods to enhance the client's immunity to infections should be considered, which may involve examining co-morbidities, glycemic control, nutritional needs and sleep-wake cycles.

Table 6: Treatment Options for Wound Infections Recommended by the RNAO Expert Panel

NON-LIMB-THREATENING INFECTIONS	LIMB-THREATENING INFECTIONS	
Superficial infection	Deep wound infection	Systemic infection
HOSPITALIZATION: ■ May not be required; support host defenses ■ Team approach ■ Re-evaluate based on clinical findings ■ Facilitate client education **WOUND CARE:** ■ Cleanse and debride wound **INFECTION:** ■ Use topical antimicrobials (may be monomicrobial) ■ May require oral/IV antibiotics **PRESSURE DISTRIBUTION:** ■ Provide offloading devices	**IN ADDITION TO SUPERFICIAL INFECTION:** **HOSPITALIZATION:** ■ Consider admission to hospital (based on host risk) ■ Consider Infectious Disease consultation **WOUND CARE:** ■ May require surgical debridement **INFECTION:** ■ Will require oral/IV antibiotics (may be polymicrobial) **PRESSURE DISTRIBUTION:** ■ Provide offloading device for non-weight bearing status	**IN ADDITION TO DEEP WOUND INFECTION:** **HOSPITALIZATION:** ■ Will require hospitalization **INFECTION:** ■ Will require IV antibiotics **PRESSURE DISTRIBUTION:** ■ Provide offloading device for complete non-weight bearing on affected limb

Non-limb-threatening Infections

A non-limb-threatening infection is a superficial infection that can result from scratches, nail trauma, or heel fissures. These mild-to-moderate infections may be managed on an outpatient basis with close supervision by the health-care professional. Topical antimicrobial medicine may be used to reduce bacterial burden in superficial infections. See **Appendix Q** for a list of Topical Antimicrobial Agents.

There is, however, mixed evidence on the use of antimicrobial agents, specifically, when used with silver-based dressings. In a systematic review of 26 trials comparing silver-containing dressings, creams compared to dressings and creams that did not contain silver, Storm-Versloot, Vos, Ubbink and Vermeulen (2010) concluded that there was insufficient evidence to establish whether silver-containing dressings or topical agents promoted wound healing or prevented wound infections. More research is required, specifically related to diabetic foot ulcers.

If topical antimicrobial agents are used, and increased superficial bacterial burden or delayed healing are noted, treatment should be supplemented with debridement and moisture balance. If deep infection is present, or if the wound fails to heal within 2 weeks of topical antimicrobials, systemic antibiotic therapy should be considered. Systemic antibiotic medication may be prescribed by the appropriate health-care professional according to the Anti-Infective Guidelines for Community-acquired Infections (Anti-infective Review Panel, 2010).

Limb-Threatening Infections

Inappropriately managed infections in diabetic foot ulcers can lead to life- or limb-threatening consequences. These infections may present with cellulitis extending greater than 2 cm beyond the wound border and cardinal signs of infection, such as fever, edema, lymphangitis, hyperglycemia, leukocytosis and/or ischemia (Frykberg et al., 2000). A diabetic foot ulcer presenting with wet gangrene, deep abscesses and advancing cellulitis must be transferred to a medical facility for urgent care.

Hospitalization is required to treat the deep infection and associated systemic effects. Limb-threatening infections require immediate surgical attention, which should not be delayed while waiting for radiologic or medical workup of other co-morbid conditions (Frykberg et al., 2000; Weir, 2010). Although many wound care procedures can be done at the bedside for people with diabetic foot ulcers, limb-threatening infections will require thorough debridement in the operating room (Frykberg et al., 2000). Individuals presenting with limb-threatening infections should be considered for emergent incision, drainage and debridement procedures.

Osteomyelitis

An ulcer that probes to the bone or joint is indicative of osteomyelitis and may require a bone biopsy for microbiological and histopathological evaluation (Frykberg et al., 2000; Grayson et al., 1995). If the affected bone is resected or amputated, the infection may be treated as a soft-tissue infection. If residual bone is in the wound, however, the client will require 4 to 8 weeks of antibiotic therapy, based on wound culture results (Frykberg et al., 2000; IWGDF, 2011). Intravenous or oral agents may also be used, depending on the microbial isolates and infection severity.

Moisture Balance (Level of Evidence = III)

The type of dressing selected for the foot ulcer should promote a moist wound environment that minimizes trauma and risk of infection. Specifically, dressing selection should be based on its ability to provide local moisture balance for the wound to heal. Modern, moisture-promoting dressings used for diabetic foot ulcers include foams (high absorbency), calcium alginates (absorbent, hemostasis), hydrogels (moisture balance), hydrocolloids (occlusion) and adhesive membranes (protection) (Inlow et al., 2000). Consideration should be given to the following when choosing a moist wound dressing for a diabetic foot ulcer (Sibbald et al., 2000):

- Assess the wound bed for bacterial balance, exudate level and the need for debridement;
- Select a dressing or combination of dressings that can manage and/or control the environment above the wound;
- Use a dressing that will keep the wound bed continuously moist and the peri-wound skin dry;
- Choose a dressing that controls exudate but does not dry the ulcer bed;
- Consider the amount of professional caregiver time needed to apply and change dressing(s);
- Eliminate wound dead space by loosely filling all cavities with dressing material;
- Ensure that the dressing does not become a source of increased pressure to the affected area;
- Confirm that the person with a diabetic foot ulcer is aware of the need to reduce pressure to the affected area; and
- Evaluate the wound as prescribed to determine effectiveness of the treatment plan.

Application of moisture retentive dressings in the presence of ischemia and/or dry gangrene can result in a serious limb-threatening infection. In the presence of ischemia and/or dry gangrene, apply a drying antimicrobial, such as povidone iodine, a protective dry dressing and ensure proper off-loading.

There is mixed comparative evidence on the effectiveness of any particular dressing type to heal diabetic foot ulcers (Hinchcliffe et al. 2008). For a list of common products and more information on their use, see **Appendix R**.

RECOMMENDATION 3.2:

Redistribute pressure applied to foot ulcer(s) by the use of offloading devices.

Level of Evidence = Ia

Discussion of Evidence:

Ninety-four percent of diabetic foot ulcers occur at areas of increased pressure (Fleischli, Lavery, Vela, Ashry, & Lavery, 1997). Calluses from repeated friction and contact due to increased plantar pressures can predispose the skin to ulceration. Thus, pressure alleviation is integral to prevent the formation of calluses and to promote ulcer wound healing. Pressure alleviation can be accomplished by redistributing pressure over a larger surface area through the application of external pressure offloading devices. A health-care professional skilled in the fabrication and modification of offloading devices, such as a chiropodist or podiatrist, should be consulted when providing pressure redistribution. See **Appendix M** for a list of offloading devices and selection considerations.

Various effective footwear and offloading devices are available that redistribute foot pressures. A systematic review by Bus et al. (2008) evaluating the effectiveness of footwear and offloading interventions in preventing or healing foot ulcers or reducing plantar foot pressure in diabetic clients reported that 73 to 100% of wounds healed when a total contact cast (TCC) was applied. The healing period ranged between 30 to 63 days. All other casting modalities, such as fiberglass cast shoes, Scotch-cast boots, window casts and custom splints, also reported positive healing rates between 70 to 91%, within a period of 34 to 300 days (Bus et al., 2008).

Surgery may be considered if pressure redistributing devices are ineffective or not a viable option. Several surgical procedures were identified for wounds that have not healed at the expected rate (refer to Recommendation 2.2 and **Appendix O** for specific treatment options).

RECOMMENDATION 3.3:

Provide health education to optimize diabetes management, foot care and ulcer care.

Level of Evidence = Ia

Discussion of Evidence:

Health education and its reinforcement is an essential intervention for clients with diabetic foot ulcers. Nurses, as the single largest group of health-care professionals working in a range of settings, are in a pivotal position to provide and reinforce health education related to diabetes management and foot and ulcer care. They may act as the primary diabetes foot care educator, as a link between clients and their primary care providers, or within specialized diabetes care teams (RNAO, 2007). Historically, diabetes education was didactic, but in recent years it has become more participative to address individual variables in the learning process (Whittemore, 2000).

Clients with diabetes who are at a high risk for foot ulceration benefit from diabetes health education and its regular reinforcement (ADA, 2001; CDA CPG Expert Committee, 2008; Mason et al., 1999a; NZGG, 2000; The University of York – NHS Centre for Reviews and Dissemination, 1999; Valk, Kriegsman, & Assendelft, 2004). Health education interventions result in short-term improvement in the knowledge and self-care behaviours of people with diabetes (Hutchinson et al., 2000; Valk, Kriegsman, & Assendelft, 2002). Diabetes self-care behaviours influence blood glucose control which, when improved, facilitate healing of foot ulcers. These behaviours also prevent or delay diabetes-related complications such as peripheral neuropathies and reduced circulation in lower extremities (IWGDF, 2011; RNAO, 2007; UKPDS Group 33, 1998). Furthermore, health education in a group setting and sustained long-term follow-up have both been shown to enhance knowledge and produce positive outcomes, such as improved glycemic control in type 2 diabetes (CDA CPG Expert Committee, 2008).

Although health education seems to have a positive impact on clients' foot and ulcer care knowledge and behaviours, it is uncertain whether it can prevent foot ulceration and amputation. In a Cochrane review of randomized controlled trials evaluating the impact of client education on diabetic foot ulceration, Dorresteijn, Kriegsman, Assendelft and Valk (2010) concluded that there is insufficient evidence to ascertain whether client education, without additional preventative measures, reduces ulcer incidence. It should be noted, however, that the methodology of inquiry must be in keeping with the research question and that randomized controlled trials may not always be the appropriate design for every question.

See **Appendix S** for a client handout on diabetic foot care.

RECOMMENDATION 3.4:

Facilitate client-centred learning based on individual needs to prevent or reduce complications.

Level of Evidence = III

Discussion of Evidence:

Diabetic foot care education may support health promotion[G] strategies when presented in a way that is meaningful and easily understood by the client (Schoen et al., 2010). Conducting a learning needs assessment prior to delivering diabetic foot care education helps tailor the learning session to help the client receive and understand the information presented to him/her (RNAO, 2012a). This assessment should include the client's learning preferences, individual characteristics and relevant social determinants of health.

Learning Preferences

Clients have diverse learning preferences that may or may not align with the health-care professional's personal teaching style. Every client should be given the opportunity to learn in his/her preferred manner (RNAO, 2012a). The health-care professional should adapt the learning session to meet the client's learning needs and preferences.

Individual Characteristics

Personal attitudes, cultural beliefs, level of literacy, age and physical condition all influence an individual's ability to carry out the recommended regimen (American Association of Diabetes Educators, 1999; Canadian Diabetes Association – Diabetes Educator Section, 2000). Accounting for these individual characteristics prior to the learning session may optimize the diabetic foot care education plan.

Social Determinants of Health

Key factors related to the conditions in which people live and that affect their general health are known as social determinants of health. These factors include:

- Income and social status;
- Social support networks;
- Education and literacy;
- Employment and working conditions;
- Social environments;
- Physical environment;
- Gender;
- Culture;
- Personal health practices and coping skills;
- Healthy child development;
- Health services and biology; and
- Genetic endowment.

(Public Health Agency of Canada, 2012)

Assessing the relevant social determinants of health as part of the learning needs assessment may identify key issues that could impact on the client's ability to implement strategies to prevent or reduce complications.

For further discussion and more detailed information about client centred learning strategies, the reader is encouraged to consult the RNAO Nursing Best Practice Guideline *Facilitating Client Centred Learning (2012)*.

EVALUATION

RECOMMENDATION 4.0:

Monitor the progress of wound healing on an ongoing basis using a consistent tool, and evaluate the percentage of wound closure at 4 weeks.

Level of Evidence = Ib

Discussion of Evidence:

Wound management is a comprehensive process and should therefore include an evaluation of the care plan. The RNAO expert panel suggests posing the questions below when evaluating outcomes of the treatment plan:

1. How is wound healing evaluated?
2. Is wound healing progressing at the expected rate?
3. Is the treatment plan effective?

Wound healing progress should be evaluated on an on-going and systematic basis. In a prospective, randomized controlled trial, Sheehan et al. (2003) found that a 50% reduction in wound surface area at 4 weeks was a good predictor of wound healing at 12 weeks. This finding was further supported by other research evidence, which showed that poor wound healing at 4 weeks was a strong predictor for non-healing at 12 weeks (Flanagan, 2003; Warriner, Snyder, & Cardinal, 2011). Furthermore, in a recent retrospective analysis of two randomized controlled trials of diabetic foot ulcer healing, Warriner et al. (2011) identified that wound healing at 12 weeks was substantially greater in wounds demonstrating more than 90% wound closure at 8 weeks. Therefore, progress of wound healing at 4 and 8 weeks may be correlated with wound closure at 12 weeks.

Assessment tools should be consistently used when monitoring and evaluating the progress of foot ulcer healing. The Pressure Ulcer Scale for Healing tool (PUSH tool) measures wound size, exudates and tissue type, and has recently been validated for assessing diabetic foot ulcer healing (Gardner, Frantz, Bergquist, & Shin, 2005; Hon et al., 2010). A lower PUSH score indicates greater wound closure, less exudate and healthier epithelial tissue. See **Appendix T** for the PUSH Tool.

Furthermore, if a diabetic foot ulcer does not achieve a 50% reduction in surface area at 4 weeks, a comprehensive re-assessment of the treatment plan should be conducted before advanced healing technologies are considered.

RECOMMENDATION 4.1:

Reassess for additional correctable factors if healing does not occur at the expected rate.

Level of Evidence = IV

Discussion of Evidence:

Reassessing correctable factors for a wound that has not healed according to the care plan is integral to wound management. These correctable factors may include infection, poor glycemic control and inadequate pressure redistribution from prescribed devices. Revisiting the client's health history and co-morbidities may also provide useful information to identify potential barriers to wound healing (Collins & Toiba, 2010).

The most common reason for delayed wound healing in a diabetic foot ulcer is inadequate pressure offloading. Inadequate pressure offloading can be due to poor client adherence to offloading devices or a lack of prescription for offloading devices (Armstrong et al., 2001). Poor client adherence to prescribed offloading devices may be due to a variety of reasons. Nurses should assess the client's knowledge about the benefits of pressure-reducing devices, encourage the communication of concerns and engage in health teaching. Identifying strategies that promote informed and engaged clients may be the most critical aspect of care-planning and to ensure adherence to offloading and pressure redistribution devices. If appropriate offloading is not prescribed, however, the person with the diabetic foot ulcer should be referred to a centre specializing in diabetic foot ulcer care.

Appropriate follow-up measures may be indicated for non-healing wounds where all possible correctable factors have been addressed. Several adjunctive approaches can be considered for persistent non-healing wounds (refer to Recommendation 2.2 and **Appendix O** for specific treatment options).

Education Recommendations

RECOMMENDATION 5.0:

5.0 Health-care professionals participate in continuing education opportunities to enhance specific knowledge and skills to competently assess and manage clients with diabetic foot ulcers, based on the RNAO Nursing Best Practice Guideline *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)*.

Level of Evidence = IV

Discussion of Evidence:

Assessment and treatment of people with diabetic foot ulcers is a complex and dynamic process that requires a team of health-care professionals with specialized knowledge and skills. The knowledge and skills necessary to assess and treat a person with a diabetic foot ulcer are not taught in an entry level program. Therefore, team members should participate in accredited continuing education opportunities to receive specific wound care training with appropriate provisions of time, access and funding from their health-care organization. The team should adopt a client-centred approach[G] and have a sound knowledge base enabling them to problem solve and ensure interventions are evidence based according to organizational policies and procedures (Benbow, 2011).

Refer to **Appendix U** for a list of resources for diabetic foot ulcer information.

RECOMMENDATION 5.1:

Educational institutions incorporate the RNAO Nursing Best Practice Guideline, *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)*, into basic registered nurse, registered practical nurse, doctor of medicine and interprofessional curricula to promote a culture of evidence-based practice.

Level of Evidence = IV

Discussion of Evidence:

Members of the interprofessional team play a vital role in the early detection and ongoing assessment of diabetic foot ulcers. They are also in a pivotal position to facilitate an evidence-based team approach to treatment (Hayes, 2009; IWGDF, 2011).

The RNAO expert panel suggests incorporating the RNAO Nursing Best Practice Guideline, *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)*, into interprofessional curricula to ensure health-care professionals are exposed to and provided with evidence-based knowledge, skills and tools that are needed to assist in assessing and managing people with diabetic foot ulcers.

Organization and Policy Recommendations

RECOMMENDATION 6.0:

Use a systematic approach to implement the *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)* clinical practice guideline and provide resources and organizational and administrative supports to facilitate clinician uptake.

Level of Evidence = IV

Discussion of Evidence:

Through a panel of nurses, researchers and administrators, RNAO developed the *Toolkit: Implementation of Best Practice Guidelines (2nd ed.)* (RNAO, 2012b), founded on available evidence, theoretical perspectives and expert consensus[G]. The *Toolkit* is designed to facilitate the successful uptake and implementation of guidelines by nurses and other health-care professionals. RNAO strongly recommends the use of this *Toolkit* for guiding the implementation of the RNAO Nursing Best Practice Guideline, *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)*.

An effective organizational plan for guideline implementation includes:

- An assessment of organizational readiness and barriers to implementation, taking into account local circumstances;
- Involvement of all members (whether in a direct or indirect supportive function) in the implementation process;
- Ongoing educational opportunities to reinforce the importance of best practices;
- One or more qualified individual(s) to provide the support needed for the education and implementation process; and
- Opportunities for reflection on personal and organizational experience in implementing guidelines.

Successful implementation of best practice guidelines requires the use of a structured, systematic planning process and strong leadership from nurses who are able to transform the evidence-based recommendations into policies, procedures and nursing-related practices that impact on care within the organization. The RNAO *Toolkit: Implementation of Best Practice Guidelines (2nd ed.)* (2012b) provides a structured model for implementing practice change.

Refer to the Implementation Strategies section of this guideline and **Appendix V** for a description of the RNAO *Toolkit: Implementation of Best Practice Guidelines (2nd ed.)* (2012b).

RECOMMENDATION 6.1:

Develop policies that acknowledge and designate human, material and fiscal resources to support the interprofessional team in diabetic foot ulcer management.

Level of Evidence = IV

RECOMMENDATION 6.2:

Establish and support an interprofessional, inter-agency team comprised of knowledgeable and interested persons to address and monitor quality improvement in the management of diabetic foot ulcers.

Level of Evidence = IV

RECOMMENDATION 6.3:

Develop processes to facilitate the referral of clients with diabetic foot ulcers to local diabetes resources and health-care professionals.

Level of Evidence = IV

Discussion of Evidence:

Organizations play a pivotal role in advocating and facilitating access to diabetic foot ulcer care services. This role includes advocating for increased availability of and accessibility to diabetic foot ulcer care. To achieve optimal outcomes for people with diabetic foot ulcers, emphasis should be placed on an interprofessional health-care team that can establish and sustain an effective communication network between the client and their immediate health-care system. Teams may collaborate virtually to coordinate efforts and ensure goals are consistently met (Inlow et al., 2000). Furthermore, interprofessional diabetes foot ulcer care should be community-based and considerate of age, gender, cultural beliefs and socioeconomic dispositions. Through a retrospective review of the literature, Frykberg (1998) reported a reduction in non-traumatic amputation rates ranging from 58 to 100% after the implementation of an interprofessional approach to foot care.

Key members of the team, along with the client and their family, may include:

- Diabetologists/endocrinologists;
- Vascular surgeons;
- Plastic surgeons;
- Dermatologists;
- Chiropodists/podiatrists;
- Infectious disease specialists;
- Family physicians;
- Nurses specializing in diabetes and wound care;
- Occupational therapists;
- Physiotherapists; and
- Dietitians.

Diabetes foot care services should be accessible, comprehensive and supported by evidence-based clinical practice guidelines. Within this mandate, the interprofessional team should be dedicated to both maintaining the overall well being of the person with diabetes and preserving the integrity of lower extremities affected by foot ulcer(s) (Inlow et al., 2000).

RECOMMENDATION 6.4:

Advocate for strategies and ongoing funding to assist clients in obtaining appropriate pressure redistribution devices during and after ulcer closure.

Level of Evidence = IV

Discussion of Evidence:

An organizational commitment to provide care and make available pressure redistribution devices is required to ensure quality health outcomes in foot ulcer management. As offloading devices may vary greatly in cost, the selection and effectiveness of appropriate devices should be continually assessed on an individual basis to optimize quality care. While the costs of pressure redistribution devices are substantial, it is important that such costs are viewed in relation to the total cost of care for foot ulcer and increased risk of amputation (Bus et al., 2008). Nurses may advocate for strategies and ongoing funding that increase the accessibility of pressure redistribution devices for clients with foot ulcers in the hospital and community setting.

Research Gaps and Future Implications

The RNAO expert panel, in reviewing the evidence for this edition of the guideline, identified the following priority research areas, many of which were identified in the first edition. These areas have been broadly categorized into practice, outcomes and health system research (see Table 7).

Table 7: Priority Practice, Outcomes and Health System Research Areas

CATEGORY	PRIORITY RESEARCH AREA
PRACTICE RESEARCH	Establishment of a standardized assessment and documentation tool for diabetic foot ulcers
	Dressing choices for local wound care
	Impact of education on health-care professional and specific patient outcomes (ulcer healing/re-occurrence)
OUTCOMES RESEARCH	The effectiveness of debridement and the methods of debridement
	Effectiveness of sharp/surgical debridement on wound healing in diabetic foot ulcers
	Dressing and device options to promote healing
	Effectiveness of adjunctive therapies to promote wound healing in diabetic foot ulcers
	Effectiveness of various devices utilized for pressure redistribution/offloading in diabetic foot ulcers
	Perceptions of and meaning for persons living with diabetic foot ulcers
	Impact of education on health-care professional outcomes and specific patient outcomes (ulcer healing/re-occurrence)
HEALTH SYSTEM RESEARCH	Health delivery issues (government support and funding of programs and treatment for diabetic foot ulcer management, cultural beliefs, high-risk patient populations)
	Health economic evaluations of secondary and tertiary prevention strategies

The above table, although in no way exhaustive, is an attempt to identify and prioritize the critical amount of research that is needed in this area. Many of the recommendations in the guideline are based on quantitative and qualitative research evidence. Other recommendations are based on consensus or expert opinion. Further substantive research is required to validate the expert opinion. Increasing the research evidence can impact knowledge that will lead to improved practice and outcomes for people who experience diabetic foot ulcers.

Evaluation/Monitoring of Guideline

Organizations implementing the recommendations in this nursing BPG are advised to consider how their implementation, and their impact, will be monitored and evaluated. The impact of BPG implementation and sustained use of evidence-based practice can be evaluated objectively through regular review of the utilization of the Nursing Order Sets[G] and their effect on client health outcomes. Nursing Order Sets embedded within clinical information systems simplify this process by providing a mechanism for electronic data capture.

Table 8 is based on a framework outlined in the *Toolkit: Implementation of best practice guidelines (2nd ed.)* (RNAO, 2012b) and illustrates some specific indicators for monitoring and evaluation of the RNAO guideline, *Assessment and Management of Foot Ulcers for People with Diabetes (2nd ed.)*.

Table 8: Structure, Process and Outcome Indicators for Monitoring and Evaluating this Guideline.

LEVEL OF INDICATOR	STRUCTURE	PROCESS	OUTCOME
OBJECTIVES	■ To evaluate the supports available in the organization that allow for nurses and the interprofessional team to integrate in their practice the assessment and management of diabetic foot ulcers.	■ To evaluate the changes in practice that lead towards improved assessment and management of diabetic foot ulcers.	■ To evaluate the impact of implementation of the recommendations.
ORGANIZATION/ UNIT	■ Review of best practice recommendations by organizational committee(s) responsible for policies and procedures. ■ Availability of patient education resources that are consistent with best practice recommendations. ■ Provision of accessible resource people for nurses and the interprofessional team to consult for ongoing support during and after initial implementation period.	■ Development of forms or documentation systems that encourage documentation of assessment and management of diabetic foot ulcers. ■ Concrete procedures for making referrals to internal and external resources and services.	■ Incorporation of *Assessment and Management of Foot Ulcers for People with Diabetes* in staff orientation program. ■ Referrals internally and externally.

LEVEL OF INDICATOR	STRUCTURE	PROCESS	OUTCOME
PROVIDER	■ Percentage of health-care providers attending the best practice guideline education sessions on assessment and management of diabetic foot ulcers.	■ Self-assessed knowledge of assessment and management of diabetic foot ulcers. ■ Average self-reported awareness levels of community referral sources for people with diabetic foot ulcers.	■ Evidence of documentation in the client's record consistent with the guideline recommendations. ■ Referral to the following services or resources within the community or within the organization as necessary – chiropodist/ podiatrist, wound care clinic, diabetes education centre, nurses specializing in wound and diabetes care, dermatologist, infectious disease specialist, vascular surgeon, plastic surgeon, family physician, endocrinologist/ diabetologist, dietitian, occupational therapist, physiotherapist. ■ Provision of education and support to client and family members. ■ Client/family satisfaction.

LEVEL OF INDICATOR	STRUCTURE	PROCESS	OUTCOME
CLIENT *(NEW OR RECURRENT DIABETIC FOOT ULCER)*	■ Percentage of people admitted to unit/facility or seen at the clinic with diabetic foot ulcers.	■ * Percentage of clients who present with diabetic foot ulcerations with documented evidence of bilateral lower extremity assessment. ■ * Percentage of clients who present with diabetic foot ulceration with documented evidence of a complete foot ulcer assessment. ■ * Percentage of clients with a diagnosis of diabetes and foot ulceration with documentation of education and educational materials provided to client, family, or caregivers addressing diabetes management and ulcer care.	■ * Percentage of diabetic foot ulcers that have shown a 50% reduction in wound surface area at 4 weeks. ■ * Percentage of clients with diabetic foot ulcerations that have closed at 12 weeks and that had healed 50% at 4 weeks. ■ * Percentage of clients with diabetic foot ulcerations who have offloading devices prescribed. ■ Improvement in quality of life and satisfaction. ■ Percentage of people adhering to treatment plan at 3 months post-discharge. ■ Percentage of clients who regularly examine their feet. ■ Percentage of clients accessing referral sources in community. ■ Percentage of clients seen or to be seen for referral.

LEVEL OF INDICATOR	STRUCTURE	PROCESS	OUTCOME
FINANCIAL COSTS	■ Provision of adequate financial resources for the level of staffing necessary to implement guideline recommendations.	Cost related to implementing guideline: ■ Education and access to on-the-job supports. ■ New documentation systems. ■ Support systems. ■ Cost related to diagnostic services, equipment, devices and products (e.g., monofilaments, client resource materials, biological agents, surgical interventions, adjunctive therapies, pressure redistribution/ offloading).	■ Cost efficiency and effectiveness of treatment. ■ Overall resource utilization. ■ Length of stay in health system. ■ Hospital readmission rates. ■ Reintegration into community.

* These process and outcome indicators have been taken from the NQuIRE® Data Dictionary for the best practice guideline *Assessment and Management of Foot Ulcers for People with Diabetes* (Registered Nurses' Association of Ontario (RNAO) & Nursing and Healthcare Research Unit (Investén-isciii), 2012). NQuIRE is the acronym for Nursing Quality Indicators for Reporting and Evaluation®. NQuIRE was designed for RNAO Best Practice Spotlight Organizations® (BPSO®) to systematically monitor the progress and evaluate the outcomes of implementing the RNAO Best Practice Guidelines in their organizations. Please visit http://rnao.ca/bpg/initiatives/nquire for more information.

Implementation Strategies

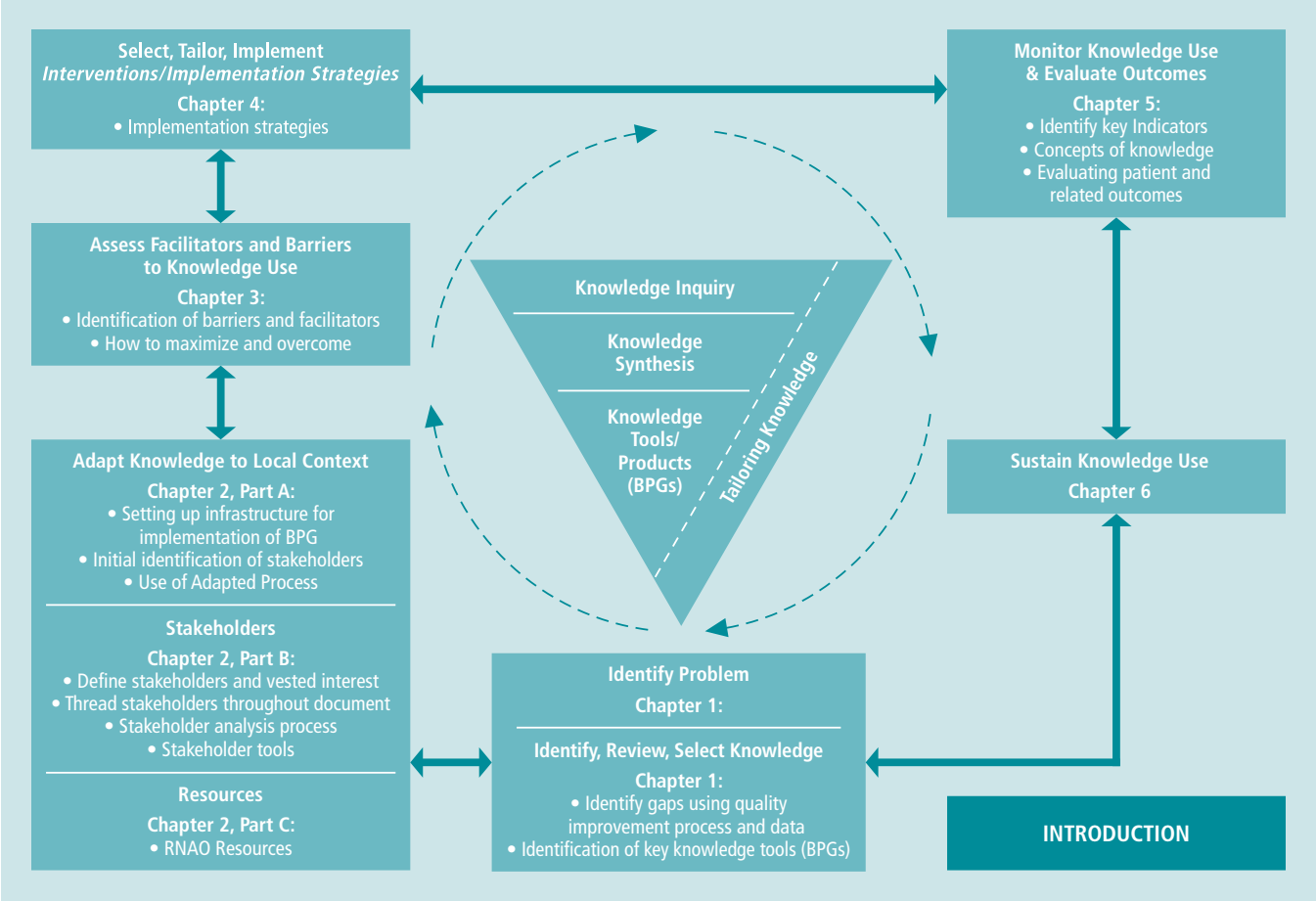
Guideline implementation at the point of care is multifaceted and challenging at all levels. The uptake of knowledge in any practice setting requires more than the awareness and distribution of guidelines. Application of the guideline in any practice setting requires adaptation for the local context. Adaptation must be systematic and participatory to ensure recommendations are customized to fit the local context (Straus, Tetroe, & Graham 2009). The Registered Nurses' Association of Ontario recommends the use of the *Toolkit: Implementation of Best Practice Guidelines (2nd ed.)* (RNAO, 2012b), which provides an evidenced-informed process for a systematic, well-planned implementation.

The *Toolkit* is based on emerging evidence that the likelihood of achieving successful uptake of best practice in health care increases when:

- Leaders at all levels are committed to support facilitation of guideline implementation
- Guidelines are selected for implementation through a systematic, participatory process
- Stakeholders relevant to the focus of the guideline are identified, and engaged in the implementation process
- An environmental readiness assessment for implementation is conducted for its impact on guideline uptake
- The guideline is tailored to the local context
- Barriers and facilitators to use of the guideline are assessed and addressed
- Interventions are selected that promote guideline use
- Guideline use is systematically monitored and sustained
- Evaluation of the impacts of guideline use is embedded into the process
- There are adequate resources to complete the activities related to all aspects of guideline implementation

The *Toolkit* uses the knowledge-to-action model that depicts the process of choosing a guideline in the centre triangle, and follows a detailed step-by-step direction for implementing guideline recommendations at the local level. These steps are illustrated in Figure 3: "Knowledge to Action" framework (RNAO, 2012b; Straus et al., 2009).

Figure 3: Revised Knowledge-to-Action Framework



Note. Adapted from "Knowledge Translation in Health Care: moving from Evidence to Practice," S. Straus, J. Tetroe, and I. Graham, 2009. Copyright 2009 by the Blackwell Publishing Ltd.

A full version of the *Toolkit: Implementation of Best Practice Guidelines (2nd ed.)* is available in PDF format at the RNAO website, http://rnao.ca/bpg.

In addition, RNAO is committed to widespread deployment and implementation of the guidelines and utilizes a coordinated approach to dissemination incorporating a variety of strategies. Guideline implementation is facilitated through RNAO specific initiatives that include the Nursing Best Practice Champion Network®, which serves to develop the capacity of individual nurses and foster awareness, engagement and adoption of BPGs; and the Best Practice Spotlight Organization® (BPSO®) Designation that supports BPG implementation at the organizational and system levels. BPSOs focus on developing evidence-based cultures with the specific mandate to implement, evaluate and sustain multiple RNAO clinical practice BPGs. In addition to these strategies, capacity-building learning institutes related to specific BPGs and their implementation are held annually. (RNAO, 2012b, p. 19-20).

Further information about each of these implementation strategies can be found at:

- RNAO Best Practice Champions Network: http://rnao.ca/bpg/get-involved/champions
- RNAO Best Practice Spotlight Organizations: http://rnao.ca/bpg/bpso
- RNAO capacity-building learning institutes and other professional development opportunities: http://rnao.ca/events

Process For Guideline Update/ Review of Guideline

The Registered Nurses' Association of Ontario (RNAO) commits to update its best practice guidelines (BPG) as follows:

1. Each nursing BPG will be reviewed by a team of specialists (RNAO Expert Panel) in the topic area – to be completed every 5 years following publication of the last edition.

Best Practice Guideline (IaBPG) Centre staff will regularly monitor for new systematic reviews, randomized controlled trials, and other relevant literature in the field.

3. Based on the results of this monitoring, RNAO IaBPG Centre staff may recommend an earlier revision period. Appropriate consultation with a team of members comprised of original RNAO Expert Panel members and other specialists and experts in the field will help inform the decision to review and revise the guidelines earlier than the targeted milestone.

4. Three months prior to the review milestone, the RNAO IaBPG Centre staff will commence the planning of the review process by:

   a) Inviting specialists in the field to participate on the RNAO Expert Panel. The RNAO Expert Panel will be comprised of members from the original panel as well as other recommended specialists and experts.

   b) Compiling feedback received and questions encountered during the implementation, including comments and experiences of Best Practice Spotlight Organizations® (BPSO®) and other organization implementation sites regarding their experience.

   c) Compiling new clinical practice guidelines in the field and conducting a systematic review of the evidence.

   d) Developing a detailed work plan with target dates and deliverables for developing a new edition of the BPG.

5. New editions of guidelines developed will undergo dissemination based on established structures and processes.

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Appendix A: Glossary of Terms

A1c (also known as Glycated Hemoglobin or HbA1c): The A1c test measures average blood glucose level over the preceding 2 to 3 months and, thus, assesses glycemic control. When the A1c is done every 3 months, it can detect whether glycemic control has been reached and maintained within the target range and also reflects departures from the target range.

Abscess: A circumscribed collection of pus that forms in tissue as a result of acute or chronic localized infection. It is associated with tissue destruction and frequently swelling.

Anhydrosis: Failure of the sweat glands to produce sweat, resulting in dryness in the skin, often a result of damaged nerves or neuropathy.

Ankle Brachial Pressure Index (ABPI): A comparison between the brachial systolic pressure and ankle systolic pressure. It gives an indication of arterial perfusion. The normal resting pressure is 1.0.

Antibiotic: An agent that is synthesized from a living organism (e.g., penicillin from mold) and can kill or halt the growth of microbes or bacteria.

Antimicrobial: An agent that is used to kill bacteria or microbes, that is not synthesized from a living organism (e.g., iodine or silver).

Antiseptic (Topical): Product with antimicrobial activity designed for use on skin or other superficial tissues; may damage cells.

Best Practice Guidelines: Systematically developed statements to assist practitioner and client decisions about appropriate health care for specific clinical (practice) circumstances (Field & Lohr, 1990).

Callus: An area of skin that is abnormally thick or hard, usually from continual pressure or friction, sometimes over a bony prominence.

Cellulitis: An infection of the skin characterized most commonly by local heat, redness (erythema), pain and swelling.

Charcot Arthropathy (also known as Charcot Joint or Charcot Foot): A Charcot joint or foot is a form of peripheral neuropathy that often occurs in people with diabetes. Nerve damage from diabetes causes decreased sensation, muscle and ligamental atrophy, and subsequent joint instability. Continuous use and walking on an insensitive and weakened joint causes further damage to the foot structure. In the acute phase, inflammation and bone reabsorption in the foot causes damage to the bone. In the later stages, the foot arch falls and may develop a "rocker bottom" appearance. Weight distribution of the sole is altered in Charcot arthropathy, causing deformities and pressure points that enhance ulcer development. Signs of Charcot arthropathy include increased skin temperature, pain, erythema, swelling, rigid deformities, and callus formation (ADA, 2001; Bowerkey & Pfeifer, 2001).

Claw Toes: The joint at base of toe is bent up and middle joint is bent down, which may cause severe pressure and pain. The ligaments and tendons that have tightened cause the toe's joints to curl downwards and may occur in any toe except the great toe.

Client: A client may be an individual (patient, resident, consumer), family, substitute decision-maker (SDM), group or community (CNO, 2009b; Mental Health Commission of Canada, 2009).

Client-Centred Approach: An approach in which clients are viewed as whole; it is not merely about delivering services where the client is located. The client-centred care approach involves advocacy, empowerment, and respecting the client's autonomy, voice, self-determination and participation in decision-making (RNAO, 2006a).

Clinical Practice Guidelines: See Best Practice Guidelines.

Consensus: A process for making policy decisions, not a scientific method for creating new knowledge. Consensus development makes the best use of available information, be that scientific data or the collective wisdom of the participants (Black et al., 1999).

Culture: Culture refers to the shared and learned values, beliefs, norms and ways of life of an individual or a group. It influences thinking, decisions and actions (CNO, 2009b).

Diabetic Neuropathy: Peripheral, somatic or autonomic nerve damage attributable solely to diabetes mellitus.

Education Recommendations: Statements of educational requirements and educational approaches/ strategies for the introduction, implementation and sustainability of the best practice guideline.

Evidence: Evidence is information that comes closest to the facts of a matter. The form it takes depends on context. The findings of high-quality, methodologically appropriate research provides the most accurate evidence. As research is often incomplete and sometimes contradictory or unavailable, other kinds of information are necessary supplements to, or stand-ins for research. The evidence base for a decision involves combining the multiple forms of evidence and balancing rigor with expedience, privileging the former over the latter (Canadian Health Services Research Foundation, 2006).

Fissures: A long, narrow opening or gap that can extend into other cavities or areas of the body.

Foot Ulcer: A full thickness wound below the ankle in a diabetic patient, irrespective of duration. Skin necrosis and gangrene are also included as ulcers (IWGDF, 2011).

Friable Granulation Tissue: Granulation tissue that bleeds easily with minimal stimulation. Normal healthy tissue is not friable.

F-Scan Mat: Measures dynamic plantar pressures (foot pressure in standing and walking positions). This device measures peak pressures under the forefoot and the rear foot and is used to assist health-care professionals in reducing pressure areas to the foot.

Hallux Deformity: A deformity of the great toe.

Hammer Toes: Middle joint is bent down, which may cause severe pressure and pain. The ligaments and tendons that have tightened cause the toe's joints to curl downwards and may occur in any toe except the great toe.

Health Promotion: A process of enabling people to increase control over and improve their health (WHO, 1986).

Infection: The presence of bacteria or other micro-organisms in sufficient quantity to damage tissue or impair healing. Clinical experience has indicated that wounds can be classified as infected when the wound tissue contains 105 or greater micro-organisms per gram of tissue. Clinical signs of infection may not be present, especially in the immuno-compromised client or the client with a chronic wound.

Insensate: A word that describes a region of the body where the person cannot feel a stimulus. As an example, if a monofilament is applied using proper technique, and the person does not feel the filament, that area of the foot is described as insensate.

Intermittent claudication: The reproducible cramping, aching, fatigue, weakness and/or frank pain in the buttock, thigh or calf muscles (rarely the foot) occurring after exercise and quickly relieved with 10 minutes of rest (Bonham & Flemister, 2008).

Interprofessional Team: Refers to multiple health caregivers who work collaboratively to deliver quality care within and across settings to provide comprehensive health services to clients (Interprofessional Care Steering Committee, 2007).

Malnutrition: State of nutritional insufficiency due to either inadequate dietary intake or defective assimilation or utilization of food ingested.

Metatarsal Heads: The "metatarsal region" of the foot is the area on the bottom of a foot just before the toes, more commonly referred to as the ball-of-the-foot.

Methicillin-Resistant Staphylococcus Aureus (MRSA): MRSA is a strain of the staphylococcus bacterium that is resistant to the main groups of antibiotics.

Nursing Order Set: A nursing order set is a group of evidence-based interventions that are specific to the domain of nursing; it is ordered independently by nurses (i.e., without a physician's signature) to standardize the care provided for a specific clinical condition (e.g. pressure ulcers).

Onychomycosis: Fungal infection in the toe nails. Nails may appear dry, thickened, white or yellow and flaky.

Organization and Policy Recommendations: Statements of conditions required for a practice setting that enables the successful implementation of the best practice guideline. The conditions for success are largely the responsibility of the organization, although they may have implications for policy at a broader government or societal level.

Pallor: White, pale, blanched colour of a limb when in the upright position.

Pes Cavus: A foot characterized by an abnormally high arch. Hyperextension of the toes may be present which can give the foot the appearance of a claw.

Pes Planus: A foot that has a fallen arch and appears abnormally flat or spread out.

Photoplethysmography: Photoplethysmography uses infrared light to assess changes in the blood volume in the micro-circulation.

Practice Recommendations: Statements of best practice directed at the practice of health-care professionals that are ideally evidence-based.

Quality: The degrees to which health-care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge (World Health Organization, 2009).

Randomized Controlled Trials: Clinical trials that involve at least one test treatment and one control treatment, concurrent enrollment and follow-up of the test- and control-treated groups, and in which the treatments to be administered are selected by a random process.

Rubor: Dark purple to bright red colour of a limb when in a dependent position.

Sensory Ataxia: An impairment of one's sense of body position. It may be characterized by striking the ground forcibly with the bottom of the foot as well as a stiff fling of the leg with walking.

Specificity: The chance of having a negative test result given that one does not have a disease.

Sensitivity: The chance of having positive test result given that one does have a disease.

Sharp Debridement (also known as Conservative Sharp Debridement): The removal of dead or devitalised tissue from healthy tissue using a scalpel, scissors and forceps (Gray et al., 2011).

Stakeholder: An individual, group or organization with a vested interest in the decisions and actions of organizations and who may attempt to influence decisions and actions (Baker et al., 1999). Stakeholders include all individuals or groups who will be directly or indirectly affected by the change or solution to the problem.

Swabbing: Technique involving the use of a swab to remove bacteria from a wound and place them in a growth medium for propagation and identification.

Systemic Infection: A clinical infection that extends beyond the margins of the wound. Some systemic infectious complications of pressure ulcers include cellulitis, advancing cellulitis, osteomyelitis, meningitis, endocarditis, septic arthritis, bacteremia and sepsis.

Systematic Review: The Cochrane Collaboration (2005) defines a systematic review as, "a review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review." *(p. 45)*

Toe Pressure: See Photoplethysmography.

Appendix B: Guideline Development Process

The Registered Nurses' Association of Ontario (RNAO) has made a commitment to ensure that this nursing best practice guideline is based on best available evidence. In order to meet this commitment, a monitoring and revision process has been established for each guideline every 5 years.

For this edition of the guideline, RNAO assembled an expert panel of health-care professionals comprised of members from the previous development panel as well as other recommended individuals with particular expertise in this practice area. A systematic review of the evidence based on the scope of the original guideline and supported by four clinical questions was conducted to capture the relevant literature and guidelines published between 2004 and 2012. The following research questions were established to guide the systematic review:

1. What are the most effective methods for the assessment of foot ulcer in clients with diabetes?
2. What are the most effective interventions to manage foot ulcers and prevent re-ulceration in clients with diabetes?
3. What health-care professional education and training is required to ensure the provision of effective diabetic foot ulcer care?
4. How do health-care organizations support and promote optimal assessment and management of foot ulcers in clients with diabetes?

The RNAO expert panel members were given a mandate to review the original guideline (March 2005) in light of the new evidence, specifically to ensure the validity, appropriateness and safety of the guideline recommendations. Where necessary, sections of the guideline have been updated based on new evidence. This current edition (2013) is the culmination of the RNAO expert panel's work in integrating the most current and best evidence to update the guideline recommendations and supporting evidence from the first edition.

Appendix C: Process for Systematic Review/Search Strategy

Guideline Review

A member of the RNAO guideline development team (project coordinator) searched an established list of websites for guidelines and other relevant content published between 2004 and 2012. This list was compiled based on existing knowledge of evidence-based practice websites and recommendations from the literature. Guidelines were also identified by members of the RNAO expert panel.

Members of the panel critically appraised nine international guidelines using the *Appraisal of Guidelines for Research and Evaluation Instrument II* (Brouwers et al., 2010). From this review, the following four guidelines were selected to inform the review process:

Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. (2008). Clinical practice guidelines for the prevention and management of diabetes in Canada. Canadian Journal of Diabetes, 32(suppl 1), S1-S201.

International Working Group on the Diabetic Foot [IWGDF] (2011). *International consensus on the diabetic foot and practical and specific guidelines on the management and prevention of the diabetic foot 2011.* International Working Group on the Diabetic Foot. Retrieved from http://www.iwgdf.org/index.php?option=com_content&task=view&id=33&Itemid=48

Scottish Intercollegiate Guidelines Network (SIGN). (2010). *Management of diabetes: A national clinical guideline.* Edinburgh, Scotland: Scottish Intercollegiate Guidelines Network.

Lipskey, B. A., Berendt, A. R., Cornia, P. B., Pile, J. C., Peters, E. J. G., Armstrong, D. G., et al. (2012). 2012 Infectious Disease Society of America clinical practical guideline for the diagnosis and treatment of diabetic foot infections. *Clinical Infectious Diseases, 54*(1), 132-173.

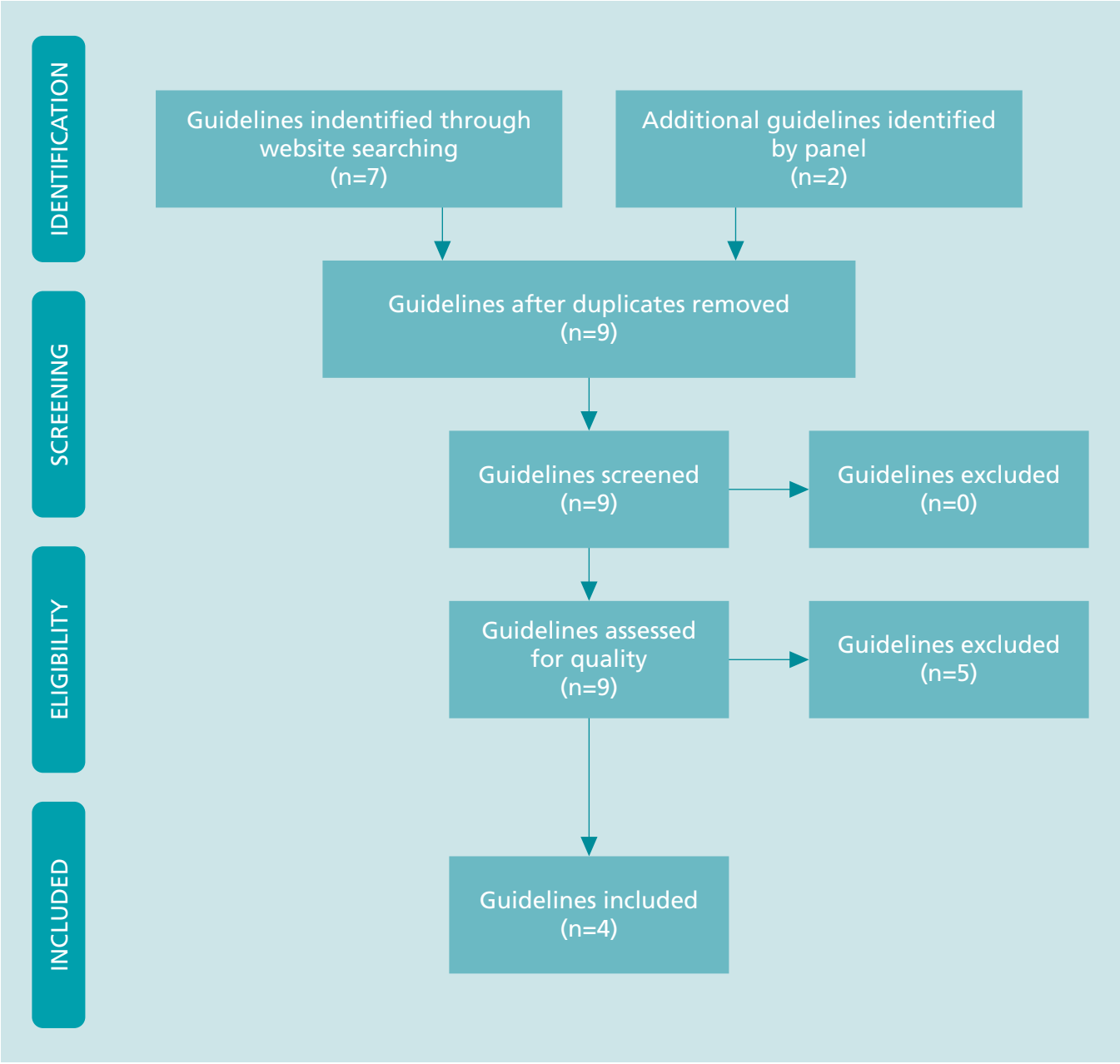
Systematic Review

Concurrent with the review of existing guidelines, a search for recent literature relevant to the scope of the guideline was conducted with guidance from the RNAO expert panel chair. The systematic literature search was facilitated by a health sciences librarian. The search, limited to English-language articles published between 2004 and 2012, was applied to CINAHL, Embase, DARE, Medline, Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reivews. Two Research Assistants (Master's prepared nurses) independently assessed the eligibility of studies according to established inclusion/exclusion criteria. The RNAO Best Practice Guideline (BPG) Program Manager involved in supporting the RNAO expert panel, resolved disagreements.

Quality appraisal scores for 17 articles (a random sample of 10% of articles eligible for data extraction and quality appraisal) were independently assessed by the RNAO BPG Program Research Assistants. Strong inter-rater agreement (kappa statistic, K=0.67) justified proceeding with quality appraisal and data extraction by dividing the remaining studies equally between the two RNAO BPG Program Research Associates (Fleiss, 2003). A final summary of literature findings was completed. The comprehensive data tables and summary were provided to all panel members. In September 2012, the RNAO expert panel convened to achieve consensus on the need to update the original guideline recommendations and discussion of evidence.

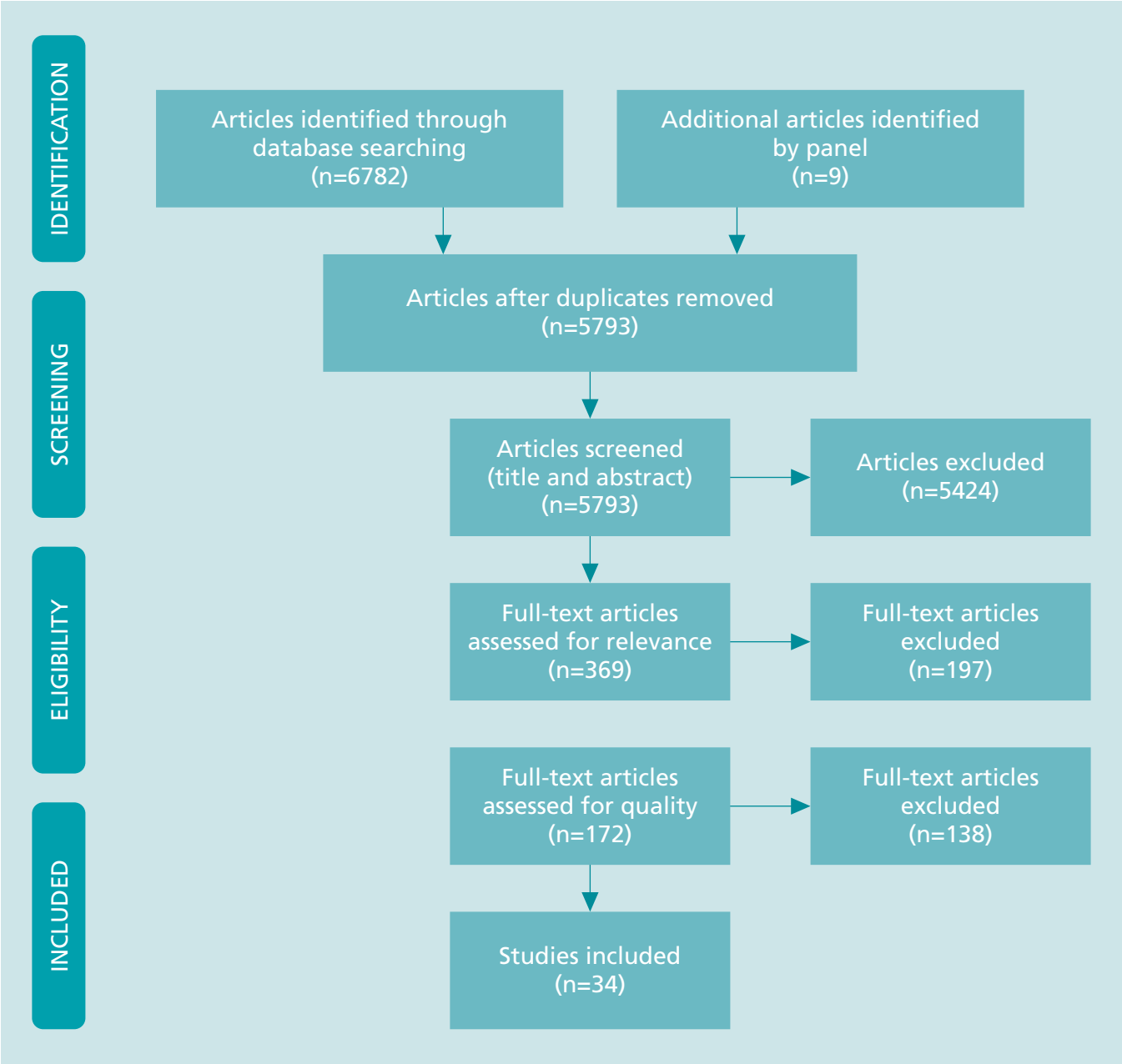
A review of the most recent literature and relevant guidelines published between 2004 and 2012 resulted in refinements to existing recommendations, as well as inclusion of stronger evidence for the recommendations. This second edition of the guideline is a culmination of the original work and the new literature. The following flow diagrams of the review process for guidelines and articles are presented according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher, Liberati, Ttzlaff, Altman & The PRISMA Group, 2009).

Guideline Review Process Flow Diagram



Flow diagram adapted from D. Moher, A. Liberati, J. Tetzlaff, D.G. Altman, & The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. BMJ 339, b2535, doi: 10.1136/bmj.b2535

Article Review Process Flow Diagram



Flow diagram adapted from D. Moher, A. Liberati, J. Tetzlaff, D.G. Altman, & The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. BMJ 339, b2535, doi: 10.1136/bmj.b2535

Appendix D: University of Texas Foot Classification System – Categories 4-6: Risk Factors for Amputation

CATEGORY 4A: NEUROPATHIC WOUND

- Protective sensation absent
- Ankle Brachial Pressure Index (ABPI) > 0.80 and toe systolic pressure >45 mmHg
- Foot deformity normally present
- Non-infected neuropathic ulceration **(ALL UT* STAGE A wounds)**
- No acute diabetic neuropathic osteoarthorpathy (Charcot's joint) present

POSSIBLE TREATMENT FOR CATEGORY 4A

Same as Category 3 plus:

- Pressure reduction program instituted
- Wound care program instituted

CATEGORY 4B: ACUTE CHARCOT'S JOINT

- Protective sensation absent
- Ankle Brachial Pressure Index (ABPI) > 0.80 and toe systolic pressure >45 mmHg
- Non-infected neuropathic ulceration may be present
- Diabetic neuropathic osteoarthropathy (Charcot's joint) present

POSSIBLE TREATMENT FOR CATEGORY 4B

- Pressure reduction program instituted
- Thermometric and radiographic monitoring
- If ulcer is present, treatment same as Category 4A

CATEGORY 5: THE INFECTED DIABETIC FOOT

- Protective sensation may or may not be present
- Infected wound
- Charcot's Joint may be present
- **ALL UT* STAGE B wounds**

POSSIBLE TREATMENT FOR CATEGORY 5

- Debridement of infected, necrotic tissue and/or bone, as indicated
- Possible hospitalization, antibiotic treatment regimen
- Medical management

CATEGORY 6: THE ISCHEMIC LIMB

- Protective sensation may or may not be present
- Ankle Brachial Pressure Index (ABPI) <0.80 and toe systolic pressure <45 mmHg or Pedal Transcutaneous Oxygen Tension < 40 mmHg
- Ulceration may be present
- **ALL UT* STAGE C AND D wounds**

POSSIBLE TREATMENT OF CATEGORY 6

- Vascular consult, possible revascularization
- If infection present, treatment same as for Category 5. Vascular consultation concomitant with control of sepsis.

Legend: *UT = University of Texas

** See **Appendix E** UT Foot Classification System – Categories 0-3: Risk Factors for Ulceration

Note. From "Practical criteria for screening patients at high risk for diabetic foot ulceration," by L.A. Lavery, D.G. Armstrong, S.A. Vela, T.L. Quebedeau and J.G. Fleishchli, 1998, *Archives of Internal Medicine,158*(2), p. 157-162. Reprinted with permission of Dr. D.G. Armstrong.

Appendix E: University of Texas Foot Classification System – Categories 0-3: Risk Factors for Ulceration

CATEGORY 0: NO PATHOLOGY	CATEGORY 1: NEUROPATHY, NO DEFORMITY
■ Patient diagnosed with diabetes mellitus ■ Protective sensation intact ■ Ankle Brachial Pressure Index (ABPI) > 0.80 and toe systolic pressure >45 mmHg ■ Foot deformity may be present ■ No history of ulceration **POSSIBLE TREATMENT FOR CATEGORY 0** ■ Two to three visits a year to assess neurovascular status, dermal thermometry, and foci of stress ■ Possible shoe accommodations ■ Patient education	■ Protective sensation absent ■ Ankle Brachial Pressure Index (ABPI) > 0.80 and toe systolic pressure >45 mmHg ■ No history of ulceration ■ No history of diabetic neuropathic osteoarthropathy (Charcot's joint) ■ No foot deformity **POSSIBLE TREATMENT FOR CATEGORY 1** Same as Category 0 plus: ■ Possible shoe gear accommodation (pedorthic/orthotist consultation) ■ Quarterly visits to assess shoe gear and monitor for signs of irritation

CATEGORY 2: NEUROPATHY WITH DEFORMITY	CATEGORY 3: HISTORY OF PATHOLOGY
■ Protective sensation absent ■ Ankle Brachial Pressure Index (ABPI) >0.80 and toe systolic pressure >45 mmHg ■ No history of neuropathic ulceration ■ No history of Charcot's joint ■ Foot deformity present (focus of stress)	■ Protective sensation absent ■ Ankle Brachial Pressure Index (ABPI) >0.80 and toe systolic pressure >45 mmHg ■ History of neuropathic ulceration ■ History of Charcot's joint ■ Foot deformity present (focus of stress)
POSSIBLE TREATMENT FOR CATEGORY 2 Same as Category 1 plus: ■ Pedorthic/orthotist consultation for possible custom molded/extra depth shoe accommodation ■ Possible prophylactic surgery to alleviate focus of stress (e.g., correction of hammer toe or bunion deformity)	**POSSIBLE TREATMENT OF CATEGORY 3** Same as Category 2 plus: ■ Pedorthic/orthotist consultation for custom molded/extra depth shoe accommodation ■ Possible prophylactic surgery to alleviate the focus of stress (e.g., correction of bunion or hammer toe) ■ More frequent visits may be indicated for monitoring

Note. From "Practical criteria for screening patients at high risk for diabetic foot ulceration," by L.A. Lavery, D.G. Armstrong, S.A. Vela, T.L. Quebedeau and J.G. Fleishchli, 1998, *Archives of Internal Medicine,158*(2), p. 157-162. Reprinted with permission of Dr. D.G. Armstrong.

Appendix F: University of Texas Health Science Center San Antonio Diabetic Wound Classification System

	GRADES			
	O	I	II	III
A	Pre- or post-ulcerative lesion	Superficial wound, not involving tendon, capsule or bone	Wound penetrating to tendon or capsule	Wound penetrating to bone or joint
B	Pre- or post-ulcerative lesion, completely epithelialized with infection	Superficial wound, not involving tendon, capsule or bone with infection	Wound penetrating to tendon or capsule with infection	Wound penetrating to bone or joint with infection
C	Pre- or post-ulcerative lesion, completely epithelialized with ischemia	Superficial wound, not involving tendon, capsule or bone with ischemia	Wound penetrating to tendon or capsule with ischemia	Wound penetrating to bone or joint with ischemia
D	Pre- or post-ulcerative lesion, completely epithelialized with infection and ischemia	Superficial wound, not involving tendon, capsule or bone with infection and ischemia	Wound penetrating to tendon or capsule with infection and ischemia	Wound penetrating to bone or joint with infection and ischemia

Note. From "Validation of a diabetic wound classification system: The contribution of depth, infection and ischemia to risk of amputation," by D.G. Armstrong, L.A. Lavery and L.B. Harkless, 1998, *Diabetes Care, 21*(5), p. 855-859. Reprinted with permission.

Appendix G: PEDIS: Diabetic Foot Ulcer Classification System

In 2003, the International Working Group of the Diabetic Foot (IWGDF) introduced its classification system (PEDIS) for research purposes. On the basis of the scientific literature and expert opinion, five categories were identified:

Perfusion
Extent/Size
Depth/Tissue Loss
Infection
Sensation

The 2011 International Consensus on the Diabetic Foot & Practical and Specific Guidelines on the Management and Prevention of the Diabetic Foot continues to support the use of the PEDIS system as a diabetic foot ulcer classification system. For each category within this system, a grading system is provided, describing the severity within each category.

Perfusion

GRADE 1 No symptoms or signs of PAD in the affected foot, in combination with:

- Palpable dorsal pedal and posterior tibial artery **or**
- Ankle Brachial Index 0.9 to 1.10 **or**
- Toe Brachial Index > 0.6 **or**
- Transcutaneous oxygen pressure (TcPo2) > 60 mmHg

GRADE 2 Symptoms or signs of PAD, but not of critical limb ischemia (CLI)

- Presence of intermittent claudication*, as defined in the document of the International Consensus on the Diabetic Foot **or**
- Ankle Brachial Index < 0.9, but with ankle pressure > 50 mmHg **or**
- Toe Brachial Index < 0.6, but systolic toe blood pressure > 30 mmHg **or**
- TcPo2 30 - 60 mmHg **or**
- Other abnormalities on non-invasive testing, compatible with PAD (but not with CLI).

Note: If tests other than ankle or toe pressure or TcPo2 are performed, they should be specified in each study.

GRADE 3 Critical limb ischemia, as defined by:

- Systolic ankle blood pressure < 50 mmHg **or**
- Systolic toe blood pressure < 30 mmHg **or**
- TcPo2 < 30 mmHg

* In case of claudication, additional non-invasive assessment should be performed

Extent/Size

Wound size (measured in square centimetres) should be determined after debridement, if possible. The outer border of the ulcer should be measured from the intact skin surrounding the ulcer. If wound healing is one of the end-points in a study, tracing of the wound, planimetry or the grid technique should be used for sequential measurements of the wound area. If, on the other hand, wound size is measured only at the time of recruitment into a study and intact skin is the primary end-point, the surface area can also be estimated by multiplying the largest diameter by the second largest diameter measured perpendicular to the first diameter. However, this technique is clearly less precise. The frequency distribution of the size of the ulcers should be reported in each study as quartiles.

Depth/Tissue Loss

Depth is difficult to determine and relative; an ulcer which is only a few millimeters deep on a toe can penetrate into bone or a joint, but, in other regions, ulcers can be several centimeters deep without involvement of deeper structures. Therefore, ulcers are divided into lesions confined to the skin and those deeper than the skin. Even if an ulcer does not seem to penetrate below the skin, clinical infection in subcutaneous tissues (e.g., an abscess or osteomyelitis) means it is a "deep" ulcer. The extent of tissue loss should be evaluated after initial debridement, but this should be performed judiciously when critical limb ischemia (Grade 3) is suspected.

GRADE 1	Superficial full thickness ulcer, not penetrating any structure deeper than the dermis.
GRADE 2	Deep ulcer, penetrating below the dermis to subcutaneous structures, involving fascia, muscle, or tendon.
GRADE 3	All subsequent layers of the foot involved, including bone and/or joint (exposed bone, probing to bone).

Infection

Infection of a diabetic foot ulcer is defined as invasion and multiplication of microorganisms in body tissues associated with tissue destruction or a host inflammatory response. Infection is defined clinically, by the symptoms and signs of inflammation as described below, regardless of the results of any wound culture.

Studies on accuracy and validity of different tests for diagnosing infection in diabetic foot disease are scarce. Therefore, the scheme described below is based mainly on expert opinion.

In grading infection, three parameters, in particular, are relevant to clinical management and possibly to outcome: the involvement of skin only; the involvement of deeper structures and the systemic inflammatory response of the patient. In daily practise the term a "limb-threatening" infection is also frequently used. However, this category is very difficult to define and overlaps with the other categories.

GRADE 1	No symptoms or signs of infection
GRADE 2	Infection involving the skin and the subcutaneous tissue only (without involvement of deeper tissues and without systemic signs as described below). At least 2 of the following items are present: ■ local swelling or induration; ■ erythema > 0.5 to 2 cm around the ulcer; ■ local tenderness or pain; ■ local warmth; and/or ■ purulent discharge (thick, opaque to white or sanguineous secretion). Other causes of an inflammatory response of the skin should be excluded (e.g., trauma, gout, acute Charcot neuro-osteoarthropathy, fracture, thrombosis, venous stasis).
GRADE 3	Erythema > 2 cm plus one of the items described above (swelling, tenderness, warmth, discharge) **or** Infection involving structures deeper than skin and subcutaneous tissues such as abscess, osteomyelitis, septic arthritis, fasciitis. No systemic inflammatory response signs, as described below.
GRADE 4	Any foot infection with the following signs of a systemic inflammatory response syndrome (SIRS). This response is manifested by two or more of the following conditions: ■ Temperature > 38 or < 36 Celsius; ■ Heart rate > 90 beats/min; ■ Respiratory rate > 20 breaths/min; ■ PaCO2 < 32 mmHg; ■ White blood cell count > 12.000 or < 4.000/cu mm; and/or ■ 10% immature (band) forms.

Sensation

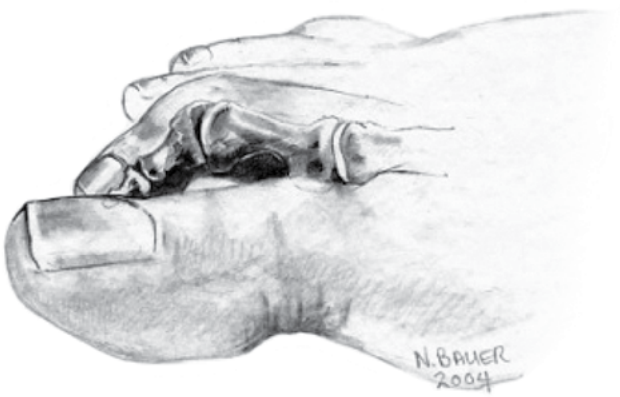
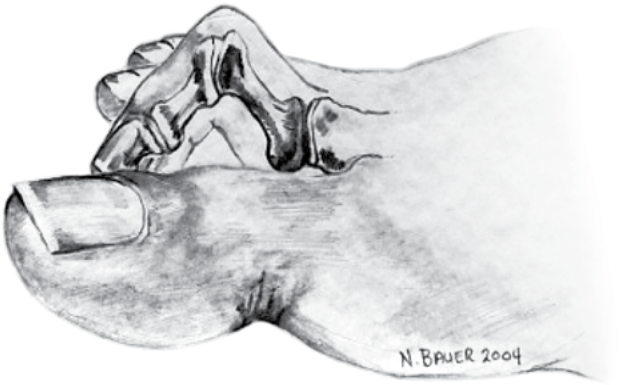
The system categorizes patients as having present or absent protective sensation in the affected foot. The system does not categorise patients as having (diabetic) polyneuropathy, and additional information is needed for this diagnosis. Moreover, it does not provide information on the cause of the loss of protective sensation, nor is the severity of the sensory loss graded. Both pressure and vibration sensation should be determined in each patient.

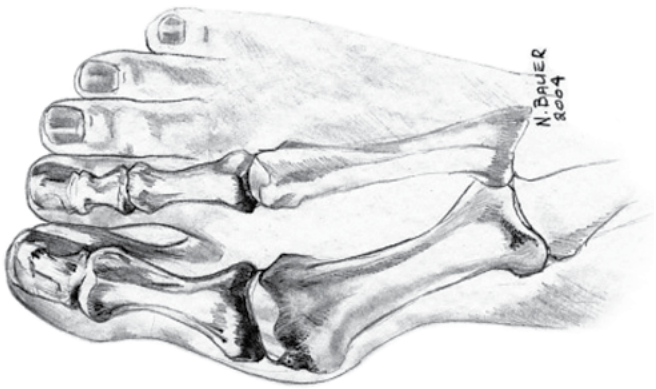
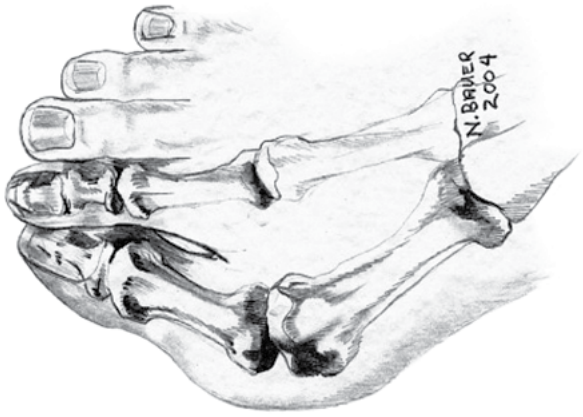
GRADE 1	No loss of protective sensation on the affected foot detected, defined as the presence of sensory modalities described below.
GRADE 2	Loss of protective sensation on the affected foot is defined as the absence of perception of the one of the following tests in the affected foot: ■ Absent pressure sensation, determined with a 10 gram Monofilament, on 2 out of 3 sites on the plantar side of the foot, as described in the International Consensus on the Diabetic Foot; and/or ■ Absent vibration sensation, (determined with a 128 Hz tuning fork) or vibration threshold > 25 V, (using semi-quantitative techniques), both tested on the hallux.

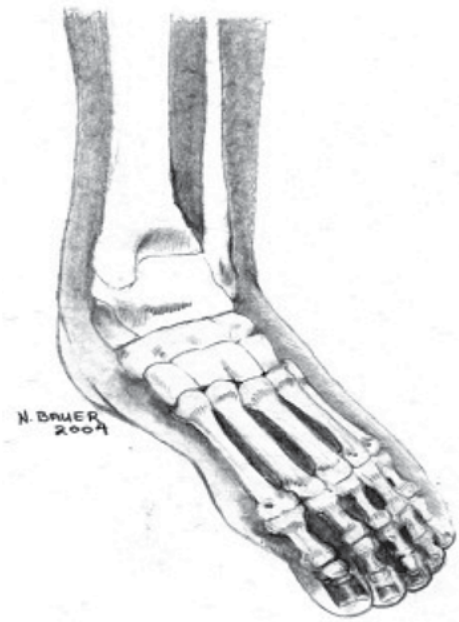
Note. From "Classification of diabetic foot ulcers for research purposes," by N.C. Schaper, 2004, *Diabetes/Metabolism Research and Reviews, 20*(Suppl 1), S90-S95. Reprinted with permission.

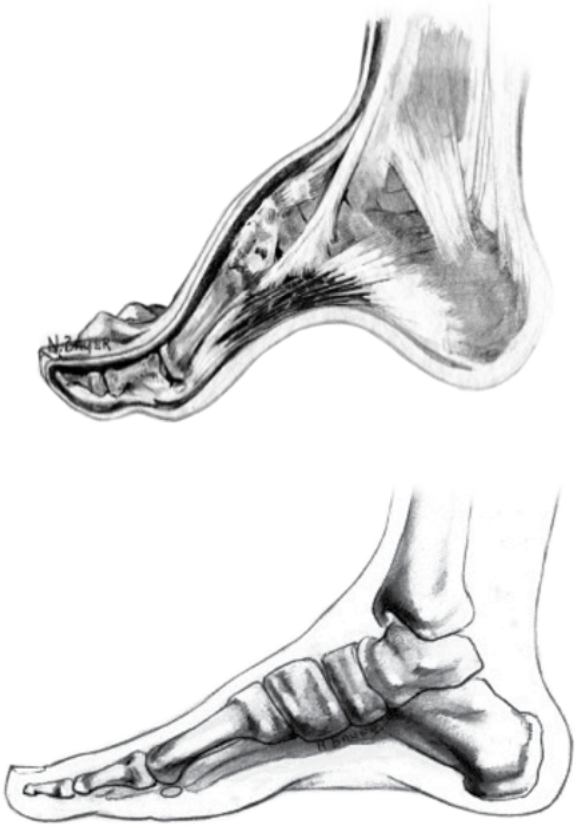
Appendix H: Description of Foot Deformities

The following table provides the description for several foot deformities: hammer toe, claw toe, hallux deformity, pes planus, pes cavus and charcot arthropathy.

DEFORMITY	DESCRIPTION
* Hammer Toe – bent middle joint  	With atrophy of the intrinsic muscles of the foot, especially the toe plantar flexors, the flexor/extensor balance at the metatarso-phalangeal joints is altered. This causes clawing at the toe and possible subluxation of the metatarso-phalangeal joints. As a result, the submetatarsal fat pads are displaced and there is reduced pressure absorbing subcutaneous tissue at the metatarsal heads. In addition, glycosalation of collagen from hyperglycemia results in thickened, waxy skin that affects joint mobility. All these factors contribute to foot deformity and ulcer risk (Bennett, Stocks & Whittam, 1996; Shaw & Boulton, 1997).
* Claw Toe – joint at base of toe is bent up and middle joint is bent down  	

DEFORMITY	DESCRIPTION
* Halgus Valgus or Small Bunion (Mild/ Moderate) – joint at the base of big toe is pushed to the side 	
** Hallus Valgus or Large Bunion (Severe) – big toe may move under second toe 	

DEFORMITY	DESCRIPTION
Pes Planus (vs normal arch):  	Pes planus produces flattening of the foot. Pes planus feet have increased lateral talometatarsal angle and increased second metatarsal length (Ledoux et al., 2003). There are many reasons for this condition, the first of which is heredity. Many have this condition and never experience problems of any kind. However, others will have this condition created through years in soft, unsupportive shoes on hard surfaces, injury, pregnancy, or other factors. A broad band of fibrous connective tissue, called the longitudinal ligament, causes the arch in the foot. A ligament is nothing more than connective tissue that connects bone to bone. The longitudinal ligament connects the metatarsal phalangeal joints to the os calcis or heel bone. Like a string on a bow, they hold the two ends together and create an arch. This arch is a shock absorption structure and it also helps to maintain all the tarsals in proper erect anatomic position. As this arch decreases, impact from the concrete becomes worse. When the arch ligament stretches or tears, the arch falls. If it falls far enough, the tarsals may begin to shift to the inside or create pronation or a valgus (greater than 90 degree erect) position at the ankle. This can cause problems in the origin area (the metatarsals) or in the heel. It also may cause pressure on the medial (inner) knee and perhaps the hip and back. It is like pulling the string on a marionette too tight, the result is a kinked mass on one side. The human body is much the same; place too much tension on major muscle groups and the joints kink and yell back.

DEFORMITY	DESCRIPTION
Pes Cavus (vs normal arch): 	In pes cavus, the arch is abnormally high on weight bearing. The heel is often tilted inwards at the ankle (but not always). In many, the toes will appear clawed. When not standing, the front half of the foot (forefoot) will appear to be dropped below the level of the rear foot. Ledoux et al. (2003) identified biomechanical differences among pes planus and pes cavus feet in persons with diabetes. They found pes cavus feet had more prominent metatarsal heads, bony prominences, hammer/claw toes, increased hallux dorsiflexion and pes cavus decreased hallux plantarflexion.

DEFORMITY	DESCRIPTION
*Charcot Arthropathy (vs normal arch):    	One in 680 people with diabetes develop Charcot joint with an incidence of 9 to 12% individuals with documented diabetic peripheral neuropathy (Royal Melbourne Hospital, 2002). Charcot joint is a form of neuroarthropathy that occurs most often in the foot. Nerve damage from diabetes causes decreased sensation, muscle and ligamental atrophy and subsequent joint instability. The charcot joint process can affect many areas of the foot. Most commonly it affects the Lisfranc joint (tarsometatarsal) region. The deformity in this area manifests as the typical rocker bottom type foot. The second most commonly affected area is the rear foot, or the talar-navicular region. The ankle joint and forefoot are more rarely involved. It is also important to note that charcot may affect more than one region of the foot, and these different areas may each be at a different stage of the progression of the deformity. Walking on this insensitive and weakened joint can cause even more damage to the foot structure. In the acute stage there is inflammation and bone reabsorption that destroys the bone. In later stages, the arch falls and the foot may develop a rocker bottom appearance. Weight distribution of the sole is altered causing deformities leading to pressure points that enhance ulcer development. Signs of charcot arthopathy include swelling of the foot and leg, changes in the shape of the foot or ankle, feeling of instability, crunching feelings or sounds, and marked increase in temperature of the foot. Symptoms include pain or discomfort, pain at rest and burning sensations. It is important that the charcot foot is recognized early so that appropriate treatment of the foot can be provided to prevent further injury and promote a stable foot (Lavery et al., 1998). For patient information on charcot arthropathy, visit http://rnao.ca/bpg/guidelines/assessment-and-management-foot-ulcers-people-diabetes

DEFORMITY	DESCRIPTION
Limited Joint Mobility	Progressive stiffening of collagen-containing tissues leads to thickening of the skin, loss of joint mobility, and potential fixed flexor deformity. Up to 30% of people with diabetes may have limited joint mobility. Reduction in mobility of the ankle joint may cause increased plantar pressure when walking and be a major risk factor in the pathogenesis of diabetic foot ulcers (Fernando, Masson, Veves & Boulton, 1991; Zimny, Schatz & Pfohl, 2004). Achilles tendon contracture is a common cause of limited joint mobility causing increased pressure on the forefoot during ambulation (Armstrong, Lavery & Bushman, 1998; Mueller, Sinacore, Hastings, Strube & Johnson, 2004).

Above illustrations provided by Nancy A. Bauer, BA, Bus Admin, RN, ET.
* Reference: Diabetes Nursing Interest Group & RNAO, (2004). Diabetes foot: Risk assessment education program. Images of the diabetic foot. Toronto: Registered Nurses' Association of Ontario. Retrieved from: http://rnao.ca/bpg/guidelines/resources/diabetes-foot-risk-assessment-education-program

Appendix I: Diagnostic Tests to Determine Vascular Supply

DIAGNOSTIC TEST	DESCRIPTION
Arterial Duplex Scan	■ Non-invasive ultrasound test that can identify macro- and microvascular changes in the arterial tree. ■ Used to diagnose aneurysm and large vessel stenosis >50%. ■ Patients with suspected superficial artery stenosis and claudication may undergo duplex scanning to identify a lesion that is amenable to angioplasty, before subjected to angiogram (Sales, Goldsmith & Veith 1994; Cao et al., 2011). ■ Non-invasive arterial duplex scan as having sensitivity[G] and specificity rates greater than 90% (Kravitz, McGuire & Shanahan, 2003).
Continuous Wave Doppler	■ Old technology. It is highly recommended to use in conjunction with duplex imaging to visualize the arteries (Cao et al., 2011).
Plethysmography	■ Records the "pulse volume recording" – another old tool that can establish diagnosis with limited accuracy (Cao et al., 2011). ■ May be a initial diagnostic tool for persons with diabetes that do not have compressible arteries but should be used in conjuction with duplex scan (Cao et al., 2011).

DIAGNOSTIC TEST	DESCRIPTION
Transcutaneous Oxygen (T_cpO_2)	■ Measures absolute oxygen partial pressure in the dermis. According to Goldman and Salcido (2002), T_cpO_2 less than 20 mmHg gives a guarded prognosis for healing. ■ 40 mmHg is a good indication for healing (Goldman & Salcido, 2002). ■ T_cpO_2 should be measured on upper leg and dorsum of the foot for best results. ■ Areas of callus, edema or bony prominences produce inaccurate results. ■ Valuable for evaluating perfusion and is a good predictor of amputation in the lower limbs (Adler, Boyko, Ahroni & Smith, 1999; Ballard, Eke, Bunt & Killeen, 1995; Lehto, Ronnemaa, Pyorala & Laakso, 1996; Mayfield, Reiber, Sanders, Janisse & Pogach, 1998; Pecoraro, Ahroni, Boyko & Stensel, 1991; Reiber, Pecoraro & Koepsell, 1992). ■ T_cpO_2 < 30 mmHg was an independent predictor of diabetic foot ulceration (McNeely et al., 1995).
Toe and Ankle Pressures	■ Systolic toe and ankle pressures are measured with a fitted occluding cuff placed most often around the base of the first toe and around both ankles. ■ Toe pressure of > 45 mmHg is necessary for optimal healing (Apelqvist, Castenfors, Larsson, Stenstrom & Agardh, 1989; Frykberg et al., 2000). ■ Most patients with toe blood pressures > 30mmHg healed with conservative management (Apelqvist et al., 1989; Kalani, Brismar, Fagrell, Ostergren & Jorneskog, 1999; Royal Melbourne Hospital, 2002). ■ With ankle pressures < 80mmHg, most patients had an amputation or died before healing occurred (Apelqvist et al., 1989). ■ Kalani et al. (1999) suggests a cut-off of 25mmHg for T_cpO_2 and 30mmHg for toe blood pressure as predictors of wound healing, with T_cpO_2 being the better predictor in patients with diabetes and chronic foot ulcers. Toe pressures, however, may be more technically and economically feasible. ■ Toe pressures for persons with diabetes were more reliable than persons with false negative ABPI's and lower limb neuropathy (Cao et al., 2011).

DIAGNOSTIC TEST	DESCRIPTION
Ankle-Brachial Pressure Index (ABPI)	■ ABPI or ratio of systolic blood pressure in the lower extremity to blood pressure in the arm is a common clinical measure of reduced circulation (Boyko et al., 1999; Cao et al., 2011). ■ First line of assessment for diagnosing vascular status though insensitive to determine the extent of occlusive disease compared to angiography (Cao et al., 2011). ■ This should not be the sole diagnostic test performed (Cao et al., 2011). ■ In the diabetic population, ABPI results can be unreliable (falsely negative; for example ABPI > 1.2) due to calcification of the arterial vessels (Apelqvist et al., 1989; Cao et al., 2011). **CAUTION:** This should not be the sole diagnostic test performed. ■ In persons with diabetes, ABPI results can be unreliable (falsely negative) due to calcification of the arterial vessels (Apelqvist et al., 1989; Cao et al., 2011). Sensitivity (63-100%) and specificity (85-97%) were reported for persons with diabetes (Cao et al., 2011).
Angiography	■ Sensitivity (92-98%) and specificity (88-98%) is high for all 3 types of angiography (Cao et al., 2011). ■ **Diagnosing magnetic resonance angiography (MRA)** Contraindicated for persons with metal foreign implants (ie. pacemaker, aneurism clips, orthopedic screws, pin, etc.) ■ **Computed tomography, angiography (CTA)** Exposure to nephrotoxic contrast medium (Cao et al., 2011). ■ **Digital subtraction angiography (DSA)** Gold standard and traditional diagnostic tool. Potential for catheter puncture complications though risk is low – 0.7% risk (Cao et al., 2011).

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Appendix J: Wound Swabbing Technique

Collecting swab specimens using Levine's technique provides a reasonably accurate measure of wound bioburden (Gardner et al., 2006). **Obtain a wound culture when clinical signs and symptoms of infection are present.**

Technique:

- Use sterile cotton-tipped swab and culture medium in a pre-packaged collection and transport system. Community nurses should not allow transport medium to freeze or become overheated in the car before using it.
- Thoroughly rinse wound with normal saline (non-bacteristatic).
- Do not swab pus, exudate, hard eschar or necrotic tissue.
- Rotate the swab tip in a 1cm^2 area of clean granulation tissue for a period of 5 seconds, using enough pressure to release tissue exudate. *This may be painful so warn the patient of the possibility of pain and pre-medicate with analgesia if possible.*
- Remove protective cap from culture medium and insert cotton-tipped applicator into the culture medium without contaminating the applicator.
- Transport to the laboratory at room temperature within 24 hours.

Note: In Ontario, the Ontario *Medical Laboratories Technologies Act, 1991* requires a health-care practitioner's order to process the culture.

Note. From "Clinical Practice Policy and Procedure 16.2.3. Semi Quantitative Wound Swab Sample Culturing Technique," by C. Harris and Care Partners/ET NOW, 2000. Reprinted with permission.

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Appendix K: Use of the Semmes-Weinstein Monofilament

Directions for use of Semmes-Weinstein Monofilament

1. Assess integrity of monofilament (no bends/breaks).
2. Show the monofilament to the client. Place the end of the monofilament on his/her hand or arm to show that the testing procedure will not hurt.
3. Ask the client to turn his/her head and close his/her eyes or look at the ceiling.
4. Hold the monofilament perpendicular to the skin

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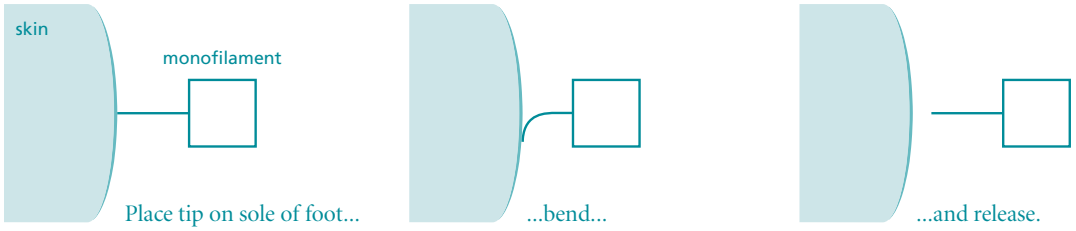

5. Place the end of the monofilament on the sole of the foot. Ask the client to say 'yes' when he/she feels you touching his/her foot with the monofilament. DO NOT ASK THE CLIENT "did you feel that?" If the client does not say 'yes' when you touch a given testing site, continue on to another site. When you have completed the sequence, RETEST the area(s) where the client did not feel monofilament.
6. Push the monofilament until it bends, then hold for 1 to 3 seconds.
7. Lift the monofilament from the skin. Do not brush or slide along the skin.
8. Repeat the sequence randomly at each testing site on the foot (see pictures below).

Sites on the sole of the foot for monofilament testing

Loss of protective sensation = absent sensation at one or more sites

Notes

Apply only to intact skin. Avoid calluses, ulcerated or scarred areas. DO NOT use a rapid or tapping movement.

- If the monofilament accidentally slides along the skin, retest that area later in the testing sequence.
- Store the monofilament according to the manufacturer's instructions.
- Clean the monofilament according to agency infection control protocols.

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Appendix L: Suggestions for Assessing and Selecting Shoes and Socks

Shoes

- Shoes should be comfortable and should match the shape of your foot.
- Have both feet measured each time shoes are bought. Feet will get longer and wider with age.
- Buy new shoes late in the day since feet often swell or enlarge during the day. Buy shoes to fit the larger foot if there is a difference.
- Shoes should fit 10 to 12 mm beyond the longest toe.
- Choose shoes with a wide and deep toe box.
- When buying shoes, wear the type of socks that you will be wearing with those shoes.
- Buy shoes with laces or velcro closures. These provide more support, distribute pressure around the sides and top, and allow adjustment for swelling.
- Shoes should have good non-skid soles, closed toes and heels, with no ridges, wrinkles or seams in the linings (good running shoes or walking shoes are recommended).
- Avoid slip-on shoes, shoes with pointed toes and sandals, especially sandals with thongs between the toes.
- Do not wear shoes with heels higher than 1 inch (2.5 cm) as they increase pressure on the metatarsal heads.
- Begin wearing new shoes gradually. Inspect the feet after each hour of wearing time for areas of redness that indicate potential problems.
- Do not wear any shoes longer than 6 hours without removing. Each pair of shoes fits differently and distributes pressure differently.
- Check shoes before wearing for small stones or puckered or bunched up areas.
- If shoes have caused a foot problem, they should no longer be worn.

Socks

- Wear clean socks everyday. Cotton or wool is best to absorb perspiration.
- Socks should fit well. Avoid tight elastic at the top.
- If wearing knee-high hosiery, ensure it has a wide band at the top.
- Check socks for irritation or bunching. Avoid seams if possible.
- Do not wear mended socks as they may cause an area of pressure.
- Do not wear socks with holes as they may cause an area of friction.

Adapted from:

International Diabetes Federation (2005). Diabetes and Foot Care – A Time to Act. Retrieved from http://www.idf.org/webdata/docs/T2A_Introduction.pdf
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Appendix M: Offloading Devices

The selection of the appropriate offloading device is based on the following considerations:

- The ability to effectively remove all pressures from the ulcer site;
- Cost-effectiveness of the device;
- Ease and skill required for the application of the device;
- Characteristics of the diabetic ulceration; and
- The ability to encourage client adherence.

All offloading devices will alter the client's gait. This may place them at high risk for falling. It is very important to provide the client with an appropriate gait aid and proper gait training to ensure this risk is minimized. There are also devices available to place on the opposite shoe in order to correct any leg length discrepancy that often occurs with the application of a Total Contact Cast, Air Cast or other offloading shoes.

OFFLOADING DEVICE	ADVANTAGES	DISADVANTAGES
TOTAL CONTACT CAST (TCC) A well-molded minimally padded cast that maintains contact with the entire aspect of the foot and lower leg	■ Highest healing rates (gold standard) ■ Distributes pressure over the entire plantar surface ■ Completely offloads ■ Protects foot from infection ■ Controls edema ■ Maintains patient adherence as it is non-removable	■ Requires trained technician ■ Cannot assess foot on a daily basis ■ Affects sleeping and bathing ■ Exacerbates postural instability or causes poor balance ■ Cannot use if wound infected ■ Cannot be used in the neuro-ischemic limb
SCOTCHCAST BOOT A fiberglass boot that reduces pressure over the wound	■ Lighter with high integral strength ■ Removable for examination ■ Can be non-removable for poorly adherent patients ■ Promotes continued ambulation	■ If removable – poor adherence ■ Has not yet been compared in studies to other forms of offloading for efficacy

OFFLOADING DEVICE	ADVANTAGES	DISADVANTAGES
REMOVABLE WALKER A commercially available removable boot that reduces plantar pressures	■ Easily removable allowing wound inspection and treatment ■ Allows more comfortable bathing and sleeping ■ Can be used for infected wounds and superficial ulcers ■ Can be made irremovable	■ Removable nature of cast reduces adherence ■ No clinical data to support its efficacy compared to TCC
HALFSHOES Offer support only under the rear and mid-foot	■ Inexpensive ■ Easy to apply	■ Less effective than TCC ■ Hampers gait
HEALING SANDALS	■ Limit dorsiflexion, therefore distributes pressure of metatarsal heads ■ Lightweight and stable ■ Reusable	■ Not as efficient compared to other methods of offloading
MABAL SHOE Cross between healing sandal and TCC	■ Removable (inspection) ■ Better contact with foot than healing sandal ■ Comparative rates of healing with TCC	■ Removable (reduces adherence) ■ Expertise required to make and apply
FELTED FOAM Bilayered felted foam over the plantar surface with opening for the wound	■ Inexpensive ■ Accessible	■ Requires skilled health professional ■ Can increase pressure and shear at wound edges if not properly applied and monitored ■ Frequent changes ■ No studies to suggest its efficacy in offloading

OFFLOADING DEVICE	ADVANTAGES	DISADVANTAGES
CRUTCHES, WALKERS, AND WHEELCHAIRS	■ If used consistently will offload pressure ■ Rentable	■ Requires upper body strength and endurance ■ May not be used all the time ■ Difficulty in navigating indoors ■ Can increase pressures on contralateral side
THERAPEUTIC FOOTWEAR DEPTH INLAY SHOES	■ Beneficial in *preventing* ulcerations, **NOT** healing	■ No proof of efficacy in healing ulcers ■ Allow up to 900% more pressure in forefoot than TCC and removable walker
CROW – CHARCOT RESTRAINT ORTHOTIC WALKER	■ Can be used in feet with severe Charcot deformity to accommodate rocker bottom foot	■ Costly ■ Removable ■ Requires physician/specialist to prescribe

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Appendix N: Clinic Assessment Tool

The following is an example of an interprofessional assessment tool that may be used within a clinic setting.

Date: _____

Interprofessional Diabetes Foot Ulcer Team
310 Wellington Road, London N6C 4P4

Initial Assessment Form - Clinic

Patient name:_____

Date of birth:_____

PRESENTING PROBLEM
Site: _____
Duration (weeks):_____

Cause: _____
_____

PERIPHERAL VASCULAR SUPPLY

History of vascular symptoms: ☐ None
☐ Intermittent claudication
☐ Rest pain
☐ Insufficient activity to elicit symptoms
☐ Edema
☐ Previous hospitalizations for vascular specific issues

Colour: ☐ Normal
☐ Cyanosis ☐ Erythema
☐ Pallor on limb elevation ☐ Rubor on limb dependency
☐ Mottling

Temperature gradient: ☐ Normal
R/prox – distal _____
L/prox – distal _____

Pulses palpable (tick if yes) :
Left foot: ☐ DP ☐ PT Right foot: ☐ DP ☐ PT
☐ Vascular risk/PAD

	PT	DP	PPG	Brachial	ABI	TBI
R/F						
L/F						

Capillary refill:
R/great toe ☐ <1sec ☐ 1-3 sec ☐ >3 sec
L/great toe ☐ <1sec ☐ 1-3 sec ☐ >3 sec

Integumentary changes: ☐ Normal
☐ Skin atrophy ☐ Abnormal wrinkling
☐ Absence of hair growth ☐ Nail growth abnormal:_____
☐ Dry gangrene

Skin examination:
Appearance *(colour, texture, turgor, quality, dryness)*:
_____ ☐ Normal
Presence of callus *(discoloration/sub callus bleeding)*:
_____
☐ Interdigital lesions ☐ Tinea pedis
☐ Other_____

REFERRAL CRITERIA FOR VASCULAR SURGERY CONSULT:
☐ Foot ulcer
☐ Pulses impalpable
☐ ABI< 0.9; TBI< 0.6
Date contacted Dr. De Rose:_____
Next step: _____

Collected by Clinician: _____ Signed:_____

NEUROLOGICAL ASSESSMENT

Sensory:
Monofilament(10g, /4): L:_____R: _____
Graduated Tuning Fork: L:_____R:_____
☐ Neurological risk/LOPS

Autonomic: ☐ Normal
☐ Dry scaly skin
☐ Maceration between toes
☐ Loss of hair growth
☐ Thickened toenails

Motor: ☐ Normal
Range of motion: tick if abnormal
☐ Ankle ☐ Sub talar joint ☐ R/ 1st ray
☐ L/ 1st ray
☐ R/Big toe ☐ L/Big toe ☐
Other_____

Deep tendon reflexes: tick if absent ☐ Normal
☐ Patellar ☐ Achilles

FOOTWEAR EXAMINATION:
Type of shoe *(athletic, oxford, comfort etc..)*: _____
Fit:_____
Depth of toe box:
☐ Enough room for toes ☐ Not enough depth
_____
Shoewear:_____
Lining wear: _____
Foreign bodies inside shoe:_____
Devices eg. orthotics:_____

MUSCULOSKELETAL EXAMINATION:
Biomechanical assessment:
Clinician:_____ Signed:_____

Heel Contact:
Mid Stance:
Heel lift:
Toe off:
Description:

APPENDICES

PATIENT NAME	Date:

FOOT FUNCTION: ☐ High foot pressures (>6kg/cm) ☐ Limited joint mobility ☐ Normal

Foot deformity: ☐ None

☐ Nail:_____

☐ Joint:_____

Muscle Group strength testing *(Passive, active, weight bearing and non-weight bearing)* ☐ Abnormalities: _____

_____

☐ Prior amputation ☐ Tendo-achilles contractures/equinus ☐ Foot drop ☐ Intrinsic muscle atrophy

☐ Other_____

ULCER CLASSIFICATION: ☐ Neuropathic ☐ Neuroischemic ☐ Ischemic ☐ Other _____

Comments:

MENTAL/PSYCHOSOCIAL STATUS: Capable of Consent? ☐ Yes ☐ No

Are you currently experiencing any difficulties in your personal or family life *(e.g., relationship problems, depression, eating disorder, or other health problems)* that might interfere with your ability to manage your foot care?

During the past month. Have you been often been bothered by feeling down, depressed or hopeless? ☐ YES ☐ NO

Have you often been bothered by little interest or pleasure in doing things? *(note: "often" means almost every day)* ☐ YES ☐ NO

If yes to either question refer to psychology

ULCER ASSESSMENT:

Location:_____

Length _____cm Width_____cm Depth_____ cm

Wound base:

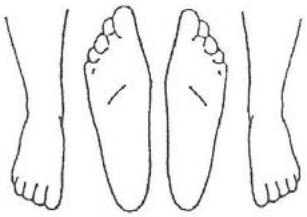
Granulation Tissue ____ %; Necrotic (Slough/eschar) _____ % Epithelium _____ %

Necrotic tissue type (*hard black, soft grey eschar, yellow slough*):_____

Integrity of Granulation tissue (*bright red, pale, friable, dull dusky red*):_____

Edges *(advancing, attached, not attached, rolled, fibrotic, callus):* _____

Exudate: ☐None ☐ Light ☐ Moderate ☐ Heavy



PAIN: Numerical Rating Scale (0 – 10): RF___/10 LF ___/10

What triggers pain_____

What soothes pain: _____

Location:_____

Describe: ☐ Sharp shooting ☐ dull, aching ☐ burning ☐ Other _____

WOUND TRACING

TEMPERATURES:

Location:_____ L _____°C R _____ °C Diff:_____ °C

Location:_____ L _____°C R _____ °C Diff:_____ °C

Location:_____ L _____°C R _____ °C Diff:_____ °C

Location:_____ L _____°C R _____ °C Diff:_____ °C

Clinician:_____ Signed:_____

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PATIENT NAME	Date:

SOFT TISSUE INFECTION:

☐ No clinical signs or symptoms

☐ Clinical signs and symptoms of mild (PEDIS level 2) infection:

☐ Clinical signs and symptoms of moderate (PEDIS level 3) infection.

☐ Severe (PEDIS level 4) infection

POTENTIAL FOR ULCER TO HEAL:

PEDIS WOUND CLASSIFICATION:

P: Grade: ☐ 1 ☐ 2 ☐ 3

E: Area: _____cm^2

D: Grade: ☐ 1 ☐ 2 ☐ 3

I: Grade: ☐ 1 ☐ 2 ☐ 3 ☐ 4

S: Grade: ☐ 1 ☐ 2

TREATMENTS:

☐ Cut and filed nails: _____

☐ Debridement: _____

☐ Other: _____

Clinician: _____ Signed:_____

Physiotherapist notes:

Print name:_____Signed:_____

Orthotist notes:

Print name:_____Signed:_____

DRESSINGS:

Primary: _____

Secondary: _____

Fixation: _____

FREQUENCY OF DRESSING CHANGES:

☐ daily ☐ every 2nd day ☐ twice a week ☐ once a week

DRESSINGS TO BE CHANGED BY:

☐ patient ☐ family member _____ ☐ nurse

PRESSURE REDISTRIBUTION:

☐ Felt to foot: describe: _____

☐ Post op rocker sole slipper

☐ Walker. Type _____

☐ TCC

☐ Other _____

Clinician: _____ Signed:_____

Notes:

Clinician: _____ Signed:_____

INSTRUCTIONS GIVEN RE: WOUNDCARE ☐ Patient information brochure provided

☐ Dressing changes ☐ Reducing weight bearing activity ☐ How to identify if infection develops & what to do

☐ Keeping wound dry ☐ Other_____

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PATIENT NAME	Date:

REFERRALS: ☐ Orthopaedic surgeon ☐ Vascular Surgeon ☐ Social Work ☐ Psychology
☐ CCAC for wound care ☐ Other _____

EDUCATION: _____

CORRESPONDENCE:	**FOLLOW-UP:** ☐ Next Available ☐ ____ weeks
Family Physician:_____	☐ _____months ☐ PRN ☐ D/C
Wound Nurse:_____	Notes:
Other: _____	
By clinician_____Signed_____	

Clinician: _____ Signed:_____

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Note. From "*Interprofessional Diabetes Foot Ulcer Team Foot specific Initial Assessment Form,*" by R. Ogrin and Interprofessional Diabetes Foot Ulcer Team, 2009. Reprinted with permission.

Appendix O: Optional Treatment Modalities

The RNAO expert panel has identified biological agents, adjunctive therapies and surgery as treatment options for foot ulcers that do not heal at the expected rate. While many of the suggested treatment options are beyond of scope of nursing, the RNAO expert panel was inclusive of potential treatment options available in an interprofessional environment.

Biologic Agents and Associated Evidence

BIOLOGIC AGENTS	DESCRIPTION AND EVIDENCE
Growth Factors	**RECOMBINANT HUMAN PLATELET DERIVED GROWTH FACTOR (BB/PDGF) REGRANEX®** ■ Becaplermin gel, also known as Regranex®, is a type of growth factor. ■ The biological activity of becaplermin is similar to that of naturally-occurring PDGF, which promotes chemotaxis and the proliferation of cells involved in the wound repair process (Smiell, 1998). ■ Topical application of becaplermin gel promotes wound bed vascularization. **EVIDENCE:** *Four multicentre, randomized group studies found that one topical application of becaplermin gel daily in conjunction with appropriate ulcer care was effective and well-tolerated in clients with full-thickness, lower extremity diabetic ulcers* (Smiell et al., 1999).
Bioactive Agents/ Emerging Pharmacotherapeutics **(not publicly available at the time of guideline publication)**	**CHRYSALIN® (RUSALATIDE ACETATE OR TP508)** ■ Chrysalin, or TP508, is a 23-amino acid peptide similar to the sequence of amino acids in human thrombin, a clotting factor (Fife et al., 2007). ■ Unlike thrombin, Chrysalin does not have enzymatic properties and is not involved with blood coagulation (Fife et al., 2007). ■ Chrysalin may improve the rate of wound healing and closure in chronic ulcers (Fife et al., 2007). **EVIDENCE:** *In a phase I and phase II placebo-controlled trial of 60 people with diabetic foot ulcers, 10 µg of Chrysalin applied topically, twice weekly, improved tissue repair and increased wound closure* (Fife et al., 2007).

BIOLOGIC AGENTS	DESCRIPTION AND EVIDENCE
	IMMUNOKINE (WF10) ■ Immunokine, or WF10, is an aqueous solution of the chlorite drug OXO-K993 given intravenously to treat chronic inflammatory disorders (Yingsakmongkol, Maraprygsavan & Sukosit, 2011). ■ Topical application of WF10 has been shown to improve wound healing and enhance granulation tissue formation in various types of wounds (Yingsakmongkol et al., 2011). **EVIDENCE:** *Yingsakmongkol et al. (2011) conducted a randomized controlled trial to evaluate the effect of WF10 as an adjunct to the standard treatment of diabetic foot ulcers. The addition of WF10 to standard wound care significantly enhanced the formation of granulation tissue, and reduced infection, inflammation, necrotic tissue, and overall wound severity score* (Yingsakmongkol et al., 2011).

Adjunctive Therapies and Associated Evidence

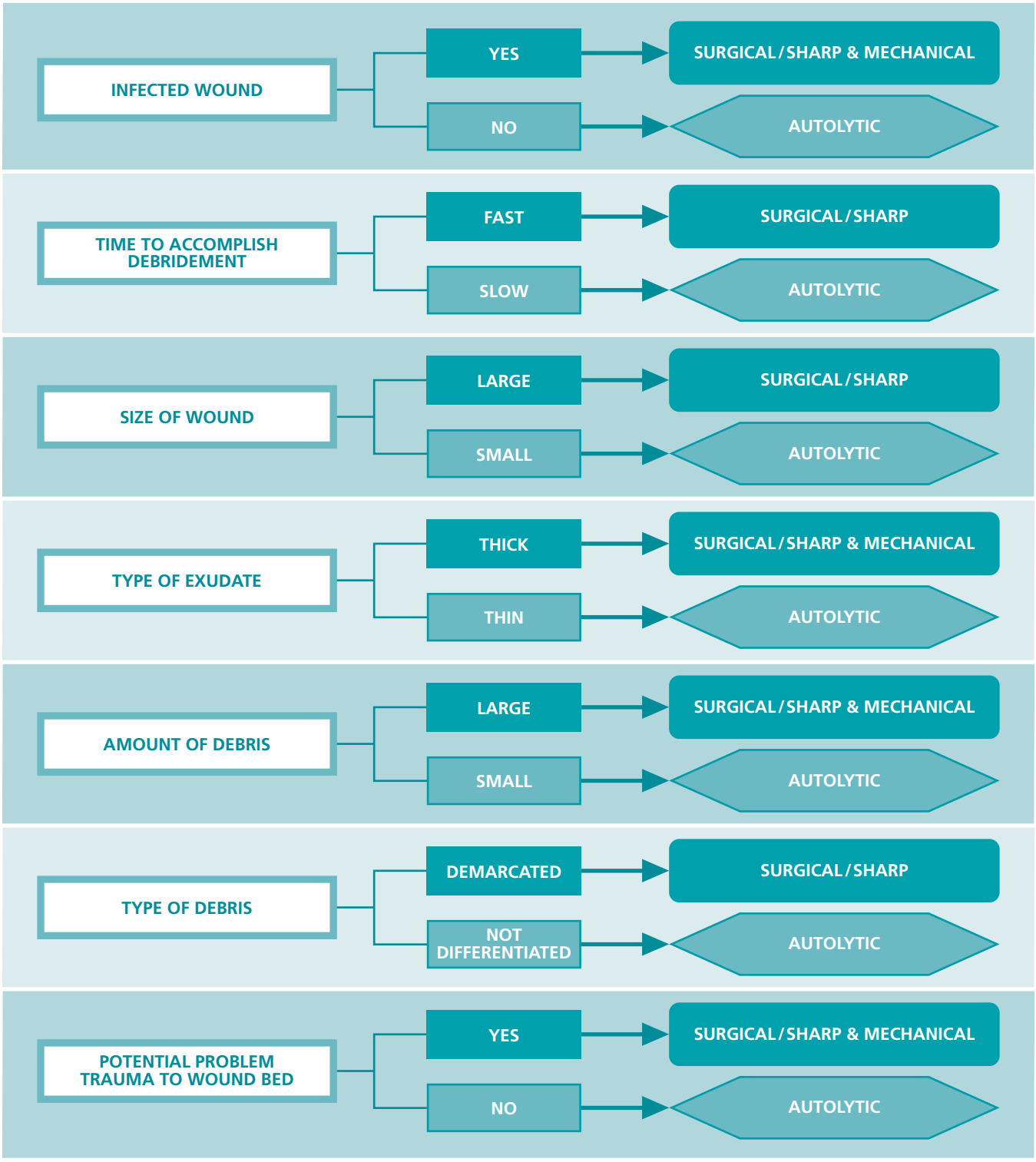
TYPE OF ADJUNCTIVE THERAPY	DESCRIPTION AND EVIDENCE
Electric Stimulation	■ Electrical stimulation involves applying a low level electrical current to the base of the wound or peri-wound using conductive electrodes. ■ This procedure should be performed by trained health-care professionals. **EVIDENCE:** *A meta-analysis by Foster, Smith, Taylor, Zinkie and Houghton (2004) of 17 randomized controlled trials showed that electrical stimulation was effective in treating chronic wounds. Included in this analysis were three trials with clients with diabetic foot ulcers.*
Extracorporeal Shock Wave Treatment (ESWT)	■ ESWT is a new technology using shockwaves to treat chronic, painful conditions of the musculoskeletal system. ■ A shockwave is an intense and short energy wave traveling faster than the speed of sound. **EVIDENCE:** *Wang et al. (2009) conducted a prospective randomized controlled trial to evaluate the efficacy of ESWT in chronic diabetic foot ulcers compared to hyperbaric oxygen therapy. The ESWT group showed 31% healing versus 22% in the hyperbaric oxygen therapy group.*
Hyperbaric Oxygen Therapy (HBOT)	■ Subatmospheric oxygen is delivered through a hyperbaric chamber and inhaled by the client. ■ HBOT increases oxygen tension in the tissues. **EVIDENCE:** *The routine management of diabetic foot ulcers with HBOT is not justified by the evidence found in the systematic review conducted by Kranke, Bennett and Roeckl-Wiedmann (2004). Although HBOT significantly reduced the risk of major amputation and may improve the probability of wound healing at 1 year, economic evaluations should be undertaken. With methodological shortcomings and poor reporting of the studies that were reviewed, Kranke et al. (2004) caution that any benefit from HBOT will need to be examined further using rigorous randomized trials.*

TYPE OF ADJUNCTIVE THERAPY	DESCRIPTION AND EVIDENCE
Negative Pressure Wound Therapy (NPWT)	■ Subatmospheric pressure is delivered to the wound by a dressing covered with a clear membrane. ■ The dressing is attached to a pump that delivers intermittent or continuous suction within a prescribed range of settings. **EVIDENCE:** *The RNAO expert panel reached consensus to support the Health Quality Ontario: Ontario Health Technology Advisory Committee (OHTAC, 2010) in recommending NPWT as an effective treatment option in the management of diabetic foot ulcers. The OHTAC (2010) review of randomized controlled trials found evidence that:* ■ *The proportion of clients who achieved complete wound closure was significantly higher in the NPWT group than the control group.* ■ *The duration of therapy and median time to complete ulcer closure was shorter in the NPWT group than the control group.* ■ *The decrease in wound area from baseline was significantly greater in the NPWT group than the control group.*

Surgeries and Associated Evidence

SURGERY	DESCRIPTION AND EVIDENCE
Achilles Tendon Lengthening	■ Achilles Tendon Lengthening is a surgical procedure that involves lengthening the tendon or attached calf muscle to reduce stress on the foot. ■ This procedure is effective at reducing ulcer recurrence in people with diabetes, peripheral neuropathy and a plantar ulcer (Mueller et al., 2004). **EVIDENCE:** *In a randomized clinical trial, Mueller et al. (2004) compared the effect of total contact casting alone to total contact casting combined with Achilles tendon lengthening in clients with diabetic foot ulcers. Outcome measures included healing rates and ulcer re-occurrence at the 7-month and 2-year follow-up. Although initial wound healing outcomes were similar, a significant reduction in ulcer re-occurrence was noted in the group with Achilles tendon lengthening at subsequent follow-up visits.*
Other surgical procedures	■ Surgery for foot deformities in clients with diabetes can be beneficial in preventing the re-occurrence of ulcers. ■ Options include: arthroplasty, digital amputation, bunionectomy, metatarsal osteotomy, ray resection, tendon tenotomy or skin grafting. ■ Surgery may not be a viable option for select populations with impaired vascular supply. **EVIDENCE:** *To date, only anecdotal results are available.*

Appendix P: Debridement Decision-Making Algorithm



Rodd-Nielsen, E., Brown, J., Brooke, J., Fatum, H., Hill, M., Morin, J., St-Cyr, L., in Association with the Canadian Association for Enterostomal Therapy (CAET). Evidence-Based Recommendations for Conservative Sharp Debridement (2011).

Appendix Q: Topical Antimicrobial Agents

TOPICAL ANTIMICROBIAL AGENTS									
	AGENT	SPECTRUM							COMMENT
		SA	MRSA	Strep	PS	F	Anaerobic	VRE	
SAFE AND EFFECTIVE	A. Cadexomer iodine paste/ ointment B. Iodine in polyethylene glycol base – Tulle	✓	✓	✓	✓	✓	✓	✓	■ Broad spectrum, lower cytotoxicity ■ Effective for fungi, virus, bacteria* ■ Widely available* ■ Requires wound contact* ■ Caution if thyroid medication*
	Ionized Silver (NB. Silver dressings are anti-inflammatory)	✓	✓	✓	✓	✓	✓	✓	■ Broad spectrum, lower cytotoxicity ■ Effective for fungi, virus, bacteria ■ Widely available ■ Requires wound contact
	Silver Sulphadiazine cream	✓	✓	✓	✓		✓		■ Limited potential for resistance ■ Pseudo-eschar may delay healing (re-epithelialization) ■ Requires wound contact ■ Do not use if sulfa sensitive
	Polymyxin B Bacitracin cream/ ointment	✓	✓	✓	✓		✓		■ Requires wound contact ■ Either antibiotic may be an allergen

TOPICAL ANTIMICROBIAL AGENTS									
	AGENT	SPECTRUM							COMMENT
		SA	MRSA	Strep	PS	F	Anaerobic	VRE	
SELECTIVE USE	Metronidazole Gel/lotion/cream (anti-inflammatory)						✓		■ Reserve for anaerobes and odour control
	Benzyl Peroxide gel/lotion	✓		✓	✓		✓		■ Reserve for MRSA/ other resistant Gram positive organisms ■ May be allergen
	Acetic Acid				✓				■ Use 0.5% /1% short contact (5-10min) ■ Especially pseudomonas/other Gram negative
	Mupuricin cream/ointment	✓	✓	✓					■ Should be reserved for MRSA
	Povidine Iodine solution	✓	✓	✓	✓	✓	✓	✓	■ Use with caution. This agent has moderate cytotoxic activity ■ Use for maintenance non healable wounds *see other properties above*
	Chlorhexidine solution	✓	✓	✓	✓	✓	✓	✓	■ Use for maintenance, non healable wounds

	AGENT	SPECTRUM							COMMENT
		SA	MRSA	Strep	PS	F	Anaerobic	VRE	
CAUTION	PolyHexaMethalen Biguanide (PHMB) foam, gauze, ribbon	✓	✓	✓	✓	✓	✓	✓	■ Safer than chlohexadine
	Gentamycin cream/ointment	✓		✓	✓				■ Caution resistance: Reserve for IV use
	Fucidic Acid cream/ointment	✓	✓	✓					■ May sensitize, especially the ointment (lanolin base)
	Polymixin B Bacitracin Neomycin ointment	✓	✓	✓	✓		✓		■ Potential sensitizer, especially neomycin ■ Cream formulations contain gramicidin instead of bacitracin
NOT RECOMMENDED	Alcohol Hydrogen Peroxide Hypochlorite solution (Dakin's/Hygeol)								■ Cytotoxic with antimicrobial action ■ Weaker than other product choices

Legend: (SA=Staphlococcus Aureus), (MRSA=Methicillin Resistant Staph Aureus), (Strep=Streptococci), (PS=Pseudomonas), (F=Fungi –Mucor, Aspergillus, Candida Albicans, Candida Topicalis, Candida Glabrata, & Saccharomyces), (VRE=Vancomycin- Resistant Enterococci).
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Appendix R: A Guide to Dressing Foot Wounds

There is limited evidence demonstrating that any specific dressing type enhances the rate of wound healing for diabetic foot ulcers. It is known, however, that a moist wound environment encourages rapid wound healing. Dressing selection depends on a variety of factors, and may change as the wound and skin at the ulcer site changes. Factors influencing dressing selection include wound type, wound depth, presence and volume of exudates, presence of infection, surrounding skin conditions, likelihood of re-injury and cost. Dressings should not be applied in isolation, but should be a part of a care plan consisting of debridement, pressure off-loading and when indicated, antibiotic medications. It is important to note that dressings themselves can be a source of pressure. Care and caution should be taken to ensure that the selected dressing does not increase pressure at the ulcer site. Furthermore, big and bulky dressings, and donut-type devices should be avoided as they can decrease circulation to the area.

The following list of dressings is not exhaustive and are products commonly used in Ontario.

Note: Read the product monographs for specific details.

CLASS	DESCRIPTION	TISSUE DEBRIDEMENT	INFECTION	MOISTURE BALANCE	INDICATIONS/ CONTRAINDICATIONS
1. Films/ membranes	■ Semipermeable adhesive sheet; impermeable to water molecules and bacteria	+	–	–	■ Moisture vapour transmission rate varies from film to film ■ Should not be used on draining or infected wounds* ■ Create an occlusive barrier against infection
2. Nonadherent	■ Sheets of low adherence to tissue ■ Nonmedicated tulles	–	–	–	■ Allow drainage to seep through pores to secondary dressings ■ Facilitate application of topical medications
3. Hydrogels	■ Polymers with high water content ■ Available in gels, solid sheets or impregnated gauze	++	–/+	++	■ Should not be used on draining wounds ■ Solid sheets should not be used on infected wounds

CLASS	DESCRIPTION	TISSUE DEBRIDEMENT	INFECTION	MOISTURE BALANCE	INDICATIONS/ CONTRAINDICATIONS
4. Hydrocolloids	■ May contain gelatine, sodium carboxymethylcellulose, polysaccharides and/or pectin; sheet dressings are occlusive with a polyurethane film outer layer	+++	–/+	++	■ Use with care on fragile skin ■ Should stay in place for several days ■ Should not be used on heavily draining or infected wounds* ■ Create an occlusive barrier to protect the wound from outside contamination ■ Odour may accompany dressing change and should not be confused with infection
5. Acrylics	■ Clear acrylic pad enclosed between 2 layers of transparent adhesive film	+++	–/+	++	■ Use on low- to moderately draining wounds where the dressing may stay in place for an extended time ■ May observe wound without changing
6. Calcium alginates	■ Sheets or fibrous ropes of calcium sodium alginate (seaweed derivative); have hemostatic capabilities	++	+	+++	■ Should not be used on dry wounds ■ Low tensile strength – avoid packing into narrow, deep sinuses ■ Bioreabsorbable
7. Composite	■ Multilayered, combination dressings to increase absorbency and autolysis	+	–	+++	■ Use on wounds where dressings may stay in place for several days*
8. Foams	■ Nonadhesive or adhesive polyurethane foam; may have occlusive backing; sheets or cavity packing; some have fluid lock	–	–	+++	■ Use on moderately to heavily draining wounds ■ Occlusive foams should not be used on heavily draining or infected wounds*
9. Charcoal	■ Contains odour-absorbing charcoal within product	–	–	+	■ Some charcoal products are inactivated by moisture ■ Ensure dressing edges are sealed

CLASS	DESCRIPTION	TISSUE DEBRIDEMENT	INFECTION	MOISTURE BALANCE	INDICATIONS/ CONTRAINDICATIONS
10. Hypertonic	■ Sheet, ribbon or gel impregnated with sodium concentrate	+	+	++	■ Gauze ribbon should not be used on dry wounds ■ May be painful on sensitive tissue ■ Gel may be used on dry wounds
11. Hydrophilic fibres	■ Sheet or packing strip of sodium carboxymethylcellulose; converts to a solid gel when activated by moisture (fluid lock)	+	–	+++	■ Best for moderate amount of exudates ■ Should not be used on dry wounds ■ Low tensile strength – avoid packing into the narrow, deep sinus
12. Antimicrobials	■ Silver, iodides, PHMB, honey aniline dyes with vehicle for delivery: sheets, gels, alginates, foams or paste	+	+++	+	■ Broad spectrum against bacteria ■ Should not to be used on patients with known hypersensitivities to any product component
13. Other devices	■ Negative-pressure wound therapy applies localized negative pressure to the surface and margins of wound	–	+	+++	■ This negative pressure-distributing dressing actively removes fluid from wound and promotes wound edge approximation ■ Advanced skill required for patient selection
14. Biologics	■ Living human fibroblasts provided in sheets at ambient or frozen temperature; extracellular matrix ■ Collagen-containing preparations; hyaluronic acid, platelet-derived growth factor	–	–	–	■ Should not be used on wounds with infection, sinus tracts or excessive exudate or with patients known to have hypersensitivity to any of the product components ■ Cultural issues related to source ■ Advanced skill required for patient selection

Adapted from the CAWC.
* Use with caution if critical colonization is suspected.
– no activity. + minimal activity. ++ moderate activity. +++ strong activity.

Note. From "Special considerations in wound bed preparation 2011: An update (Part 2)," by R.G. Sibbald, L. Goodman, K.Y. Woo, D. Krassner and H. Smart, 2012, *Wound Care Canada, 10*(3), p. 25-33. Reprinted with permission.

Appendix S: Diabetes, Healthy Feet and You – Brochure

People with diabetes should take care of their feet and be aware of any changes. The Canadian Association of Wound Care has developed the following tool (available in 16 languages) for people with diabetes to use.

Steps for Healthy Feet

General Health

1. Control your blood glucose levels.
2. If you smoke, quit.
3. Exercise daily as directed by your healthcare professional.

Caring for Your Feet

1. Look for signs of redness or blisters on your feet. This shows your shoe may not fit properly.
2. Wash your feet daily. Dry well, especially between your toes. Apply a moisturizer to your feet but not between your toes.
3. Do not soak your feet.
4. If you are unable to reach your toes or do not have feeling in your feet, have a healthcare professional trim your toenails for you.

Footwear

1. Shake out your shoes before you put them on.
2. Wear shoes at all times, indoors and out.
3. Buy shoes with closed toes as they protect your feet from injury.
4. Change your socks every day.
5. Buy shoes late in the day as feet tend to swell.
6. Have your shoes professionally fitted by a footwear specialist.

I will take care of my feet and make the changes needed to help keep my feet healthy!

DATE SIGNATURE

This section is perforated for your personal reference.

Make the most out of your visit with your healthcare professional by asking these 3 questions:

1. What is my main problem?
2. What do I need to do?
3. Why is it important for me to do this?

National Patient Safety Foundation

Sign up online at www.cawc.net/diabetesandhealthyfeet to receive your FREE monthly tip.

Visit us to read personal stories about foot care for people with diabetes, find a foot care professional, find the answers to frequently asked questions and more!

Canadian Association of Wound Care / Association canadienne du soin des plaies

Canadian Association of Wound Care
642 King St., West Suite 200
Toronto, ON M5V 1M7
Tel: 416-485-2292 Toll-Free: 1-866-474-0125
Email: healthyfeet@cawc.net
Web site: www.cawc.net/diabetesandhealthyfeet

Production of materials has been made possible through a financial contribution from the Public Health Agency of Canada. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada.

This brochure is a guide only and should not be used for any diagnostic or therapeutic decisions. Specific medical concerns should be directly handled by a qualified healthcare professional.

Canadian Association of Wound Care / Association canadienne du soin des plaies

Diabetes, Healthy Feet AND You

How healthy are YOUR feet?

Know the signs.

Are your feet…

What can I do?

Numb, painful or tingling?

Do your feet feel like blocks of wood?

IF YES

- ☐ Control your blood glucose levels.
- ☐ Have a healthcare professional trim your toenails and care for the skin on your feet.
- ☐ Have your shoes professionally fitted.

Changing shape?

Is one foot different than the other?

Any change is important.

IF YES

- ☐ Avoid too much walking.
- ☐ Visit your healthcare professional as soon as possible.
- ☐ Have your shoes professionally fitted.

Dry, callused or cracked?

Do they have sores or blisters?

IF YES

- ☐ Changes to your skin should be seen by a healthcare professional.
- ☐ Wash a sore or blister with warm water; dry well, and cover with a bandage. See a healthcare professional today.
- ☐ Avoid walking on your foot as it heals.

Please continue to check your feet every day for any changes or signs of injury.

If you have answered **YES** to any of these questions, please see a healthcare professional as soon as possible. Be sure to tell him/her that you have diabetes. Avoid using over-the-counter treatments unless directed to by a healthcare professional.

Have your healthcare professional check your feet AT LEAST 1-2 times per year or more if required.

Your Healthcare Professional Team

Chiropodists or Podiatrists: specialize in treating foot diseases, disorders and dysfunctions

Diabetes Educators: provide education on diabetes, including foot care

Doctors: assist in diabetes management, and some have specialized training in foot care

Nurses: some have specialized training in foot care

Orthotists / Prosthetists: specialize in orthotic and prosthetic devices

Pedorthists: specialize in orthotics, footwear and footwear modifications

Key Phone Numbers:

Chiropodist or Podiatrist .....

Diabetes Educator .....

Doctor .....

Nurse .....

Orthotist / Prosthetist .....

Pedorthist .....

For more information, visit
www.cawc.net/diabetesandhealthyfeet

Note. From "*Diabetes, Healthy Feet and You,*" by the Canadian Association of Wound Care, 2012, [Brochure]. Copyright 2012 by Canadian Association of Wound Care. Reprinted with permission.

Appendix T: Pressure Ulcer Scale for Healing (PUSH) Tool 3.0

The Pressure Ulcer Scale for Healing tool (PUSH tool), which measures wound size, exudate and tissue type, has recently been validated for diabetic foot ulcer healing by Gardner et al. (2009) and Hon et al. (2010). Gardner et al. (2009) demonstrated that a person with a PUSH score of 10 would be expected to heal in 8.8 weeks versus a PUSH score of four where healing was noted at 2.6 weeks. The tool is provided below.

Directions: Observe and measure the pressure ulcer. Categorize the ulcer with respect to surface area, exudate and type of wound tissue. Record a sub-score for each of these ulcer characteristics. Add the sub-scores to obtain the total score. A comparison of total scores measured over time provides an indication of the improvement or deterioration in pressure ulcer healing.

LENGTH X WIDTH (in cm^2)	**0** 0	**1** < 0.3	**2** 0.3 – 0.6	**3** 0.7 – 1.0	**4** 1.1 – 2.0	**5** 2.1 – 3.0	**Sub-score**
		6 3.1 – 4.0	**7** 4.1 – 8.0	**8** 8.1 – 12.0	**9** 12.1 – 24.0	**10** > 24.0	
EXUDATE AMOUNT	**0** None	**1** Light	**2** Moderate	**3** Heavy			**Sub-score**
TISSUE TYPE	**0** Closed	**1** Epithelial Tissue	**2** Granulation Tissue	**3** Slough	**4** Necrotic Tissue		**Sub-score**
							TOTAL SCORE

Length x Width: Measure the greatest length (head to toe) and the greatest width (side to side) using a centimeter ruler. Multiply these two measurements (length x width) to obtain an estimate of surface area in square centimeters (cm^2). Caveat: Do not guess! Always use a centimeter ruler and always use the same method each time the ulcer is measured.

Exudate Amount: Estimate the amount of exudate (drainage) present after removal of the dressing and before applying any topical agent to the ulcer. Estimate the exudate (drainage) as none, light, moderate or heavy.

Tissue Type: This refers to the types of tissue that are present in the wound (ulcer) bed. Score as a "4" if there is any necrotic tissue present. Score as a "3" if there is any amount of slough present and necrotic tissue is absent. Score as a "2" if the wound is clean and contains granulation tissue. A superficial wound that is reepithelializing is scored as a "1". When the wound is closed, score as a "0".

4 – Necrotic Tissue (Eschar): black, brown or tan tissue that adheres firmly to the wound bed or ulcer edges and may be either firmer or softer than surrounding skin.
3 – Slough: yellow or white tissue that adheres to the ulcer bed in strings or thick clumps, or is mucinous.
2 – Granulation Tissue: pink or beefy red tissue with a shiny, moist, granular appearance.
1 – Epithelial Tissue: for superficial ulcers, new pink or shiny tissue (skin) that grows in from the edges or as islands on the ulcer surface.
0 – Closed/Resurfaced: the wound is completely covered with epithelium (new skin).

Directions: Observe and measure pressure ulcers at regular intervals using the PUSH Tool. Date and record PUSH Sub-scores and Total Scores on the Pressure Ulcer Healing Record below.

PRESSURE ULCER HEALING RECORD														
DATE														
LENGTH x WIDTH														
EXUDATE AMOUNT														
TISSUE TYPE														
PUSH TOTAL SCORE														

Graph the PUSH Total Scores on the Pressure Ulcer Healing Graph below.

PUSH TOTAL SCORE	PRESSURE ULCER HEALING GRAPH													
17														
16														
15														
14														
13														
12														
11														
10														
9														
8														
7														
6														
5														
4														
3														
2														
1														
HEALED = 0														
DATE														

Note. From "*Pressure Ulcer Scale for Healing tool (PUSH tool) 3.0,*" by National Pressure Ulcer Advisory Panel, 2012. Retrieved from http://www.npuap.org/wp-content/uploads/2012/02/push3.pdf. Reprinted with permission

Appendix U: Resources for Diabetic Foot Ulcer Information

The following websites provide information on diabetic foot ulcer. These are examples only and are not intended to be a comprehensive listing.

Organizations

American Academy of Wound Management – www.aawm.org

American Physical Therapy Association – www.apta.org

Association for the Advancement of Wound Care – http://aawconline.org/

Australian Wound Management Association – www.awma.com.au

Canadian Association of Enterostomanal Therapy – www.caet.ca

Canadian Association of Wound Care – www.cawc.net

Canadian Diabetes Association – http://www.diabetes.ca/

Canadian Federation of Podiatric Medicine – http://www.podiatryinfocanada.ca/Public/Home.aspx

Canadian Nurses Association – http://www.cna-aiic.ca/en/

Canadian Podiatric Medical Association – http://www.podiatrycanada.org/

Centres for Disease Control and Prevention – www.cdc.gov/

IDF Consultative Section on the Diabetic Foot/IWGDF – http://www.iwgdf.org/

Journal of Wound Care – www.journalofwoundcare.com

National Coalition of Wound Care – see Association for the Advancement of Wound Care

Tissue Viability Society – www.tvs.org.uk

Wound Care Information Network – www.medicaledu.com/wndguide.htm

Wound Healing Society – www.woundheal.org

Wound, Ostomy and Continence Nurses Society – www.wocn.org

Service Providers

- **Chiropodists/Podiatrists**

  - Sharp debridement, gait assessment, orthoses, shoes, shoe modifications soft tissue management, wound healing modalities
  - Ontario: www.cocoo.on.ca
  - http://www.ontariochiropodist.com/
  - Canada: www.podiatrycanada.org
  - http://www.podiatryinfocanada.ca/

- **Occupational Therapists**

  - Assistive devices, orthoses, activities of daily living and cognition.
  - Canada: www.caot.ca
  - U.S.: www.aota.org

- **Orthotists**

  - Othoses, braces, total contact casting and shoe modifications.
  - Canada: www.pando.ca
  - U.S.: www.oandp.org

- **Pedorthists**

  - Orthoses, shoes and shoe modifications.
  - Canada: www.pedorthic.ca
  - U.S: www.pedorthics.org

- **Physical Therapists**

  - Sharp debridement, gait assessment, orthoses, assistive devices, wound healing modalities, exercise prescription, mobility and offloading.
  - Canada: http://www.physiotherapy.ca/Home
  - U.S.: http://www.apta.org/

Appendix V: Description of the Toolkit

BPGs can only be successfully implemented if there are adequate planning, resources, organizational and administrative supports, as well as appropriate facilitation. In this light, the Registered Nurses' Association of Ontario, through a panel of nurses, researchers and administrators, has developed the *Toolkit: Implementation of Best Practice Guidelines (2nd ed.)* (2012b). The *Toolkit* is based on available evidence, theoretical perspectives and consensus. The *Toolkit* is recommended for guiding the implementation of any clinical practice guideline in a health-care organization.

The *Toolkit* provides step-by-step directions to individuals and groups involved in planning, coordinating and facilitating the guideline implementation. These steps reflect a process that is dynamic and iterative rather than linear. Therefore, at each phase, preparation for the next phases and reflection on the previous phase is essential. Specifically, the *Toolkit* addresses the following key steps, as illustrated in the "Knowledge to Action" framework (RNAO, 2012b; Straus et al., 2009) when implementing a guideline:

1. Identify problem: identify, review, select knowledge (Best Practice Guideline).
2. Adapt knowledge to local context:
   - Assess barriers and facilitators to knowledge use; and
   - Identify resources.
3. Select, tailor and implement interventions.
4. Monitor knowledge use.
5. Evaluate outcomes.
6. Sustain knowledge use.

Implementing guidelines that result in successful practice changes and positive clinical impact is a complex undertaking. The *Toolkit* is a key resource for managing this process and can be downloaded at http://rnao.ca/bpg.

INTERNATIONAL AFFAIRS & BEST PRACTICE GUIDELINES

TRANSFORMING NURSING THROUGH KNOWLEDGE

Clinical Best Practice Guidelines

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