

Wound Care

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C A N A D A

THE OFFICIAL PUBLICATION OF THE CANADIAN ASSOCIATION OF WOUND CARE

**Foot
Complications:
Risking Limbs,
Wasting Money**

Medical Honey:
A Low-cost Option for
Patient Self-care

**The Role of Zinc in
Wound Healing**

**Highlights
from the 2016
Conference**

**Technology to
Support Healing of
Venous Leg Ulcers**

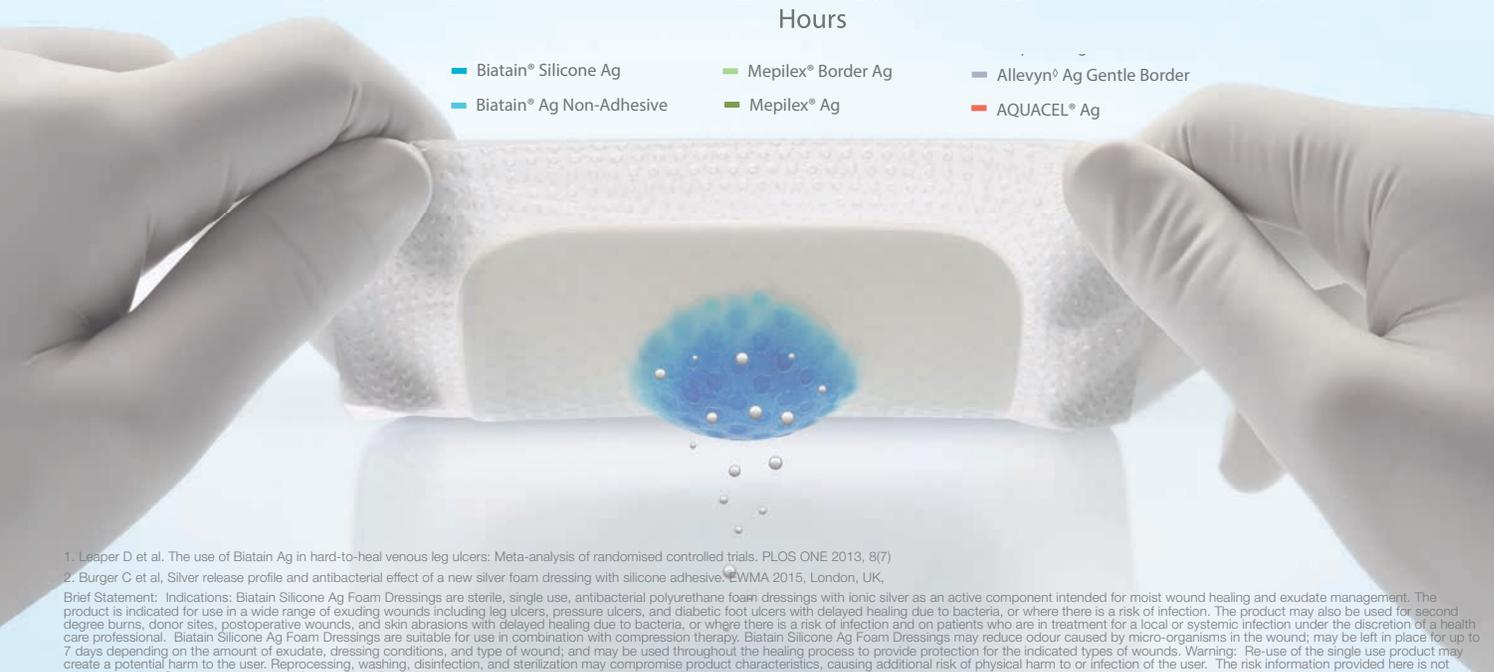
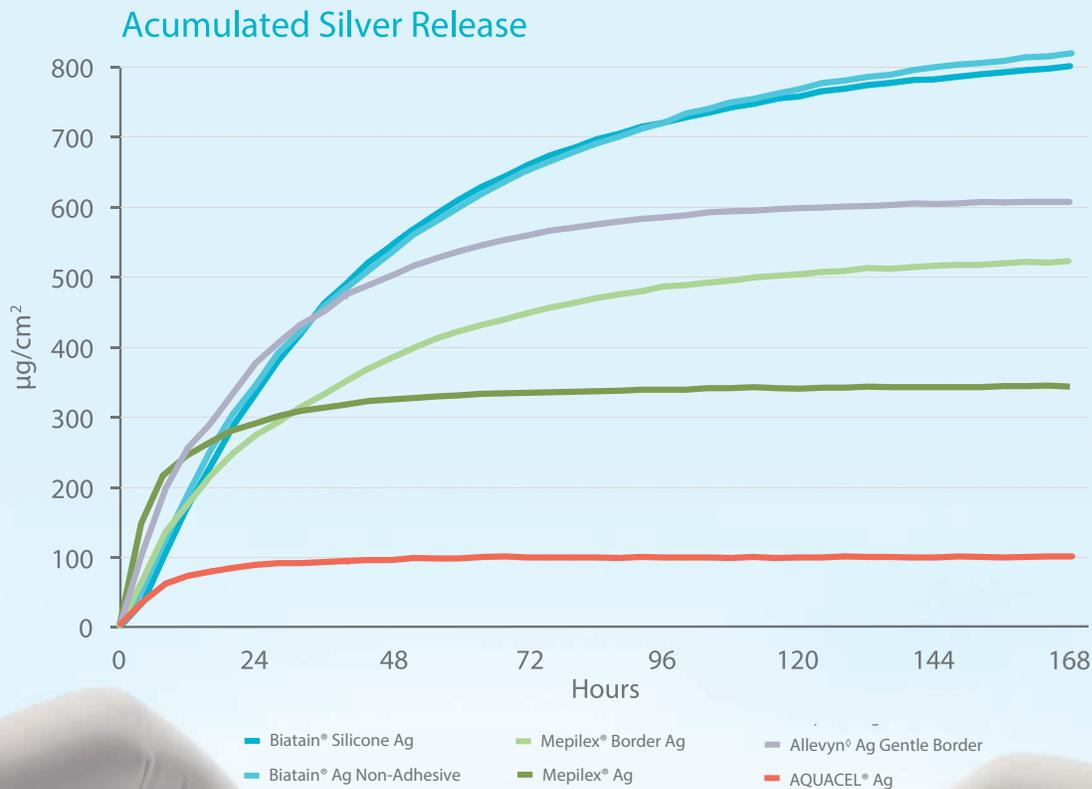
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The Canadian Association of Wound Care (www.cawc.net) is a non-profit organization of health-care professionals, industry participants, patients and caregivers dedicated to the advancement of wound prevention and care in Canada.

The CAWC was formed in 1995, and its official meeting is the CAWC annual conference held in Canada each year. The association's efforts are focused on four key areas: education, research, advocacy and awareness, partnerships.

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CAWC News

December 2016

As we draw to the close of 2016, we can reflect back on the impact the CAWC has had across the country on the delivery of best-practice-based wound prevention and management. It was one of our busiest years ever in terms of numbers of events and numbers of people reached by us and reaching out to us. Here are just some of the highlights.

The Conference at Niagara Falls

We're still catching our breath from the CAWC conference in Niagara Falls, ON, November 3 – 6, 2016. For those of you who were in attendance we would like to extend a thank you to you for helping us make it so. For those who missed it, we'd love to see you next year, in either Kamloops, BC, in May or Mississauga, ON, in November.

This year's six-day mega event included a two-day Changing Practice through Applied Knowledge workshop for wound novices followed by 3.5 days of learning and networking at the main conference. We had over 600 conference delegates, from nine provinces and two territories, and 230 industry representatives. A total of 59 speakers delivered 100 sessions on the challenges and solutions in wound prevention and care. We learned about the latest technology, networked with colleagues and enjoyed the beautiful scenery around the Falls.



The buzz through both events was electric and our formal and informal feedback has provided us with many accolades and much food for thought for future event planning.

Social Media

Using the hashtag #WoundsCanada our social media team, made up of 11 enthusiastic wound-care and social media experts from across Canada,



engaged wound carers across the country and around the world in deeper conversations about the information shared at the conference. As a result, we earned more followers, increased engagement and saw many hundreds of retweets. If you are not following us yet on Twitter, check us out at @WoundCareCanada and @DiabeticFootCa.

Onsite Educational Events

In 2016 the CAWC delivered eight onsite educational events (not including conference) from early spring right through December.

Changing Practice Through Applied Knowledge

This two-day, case-based, wound care basics course was delivered five times over the course of the year, in Cobourg, ON; Moose Factory, ON; White Point, NS; Stratford, ON, and Niagara Falls, ON. In total, 336 individuals attended.



Best Practices in Wound Prevention and Care: Celebrating Successes and Addressing Challenges

This December the CAWC delivered its first follow-up course for the Changing Practice workshop. This one-day event catered to 100 individuals who had previously attended the two-day workshop. The event focused on celebrating successes while also addressing barriers that have prevented health-care professionals from implementing best practice in their care setting since the first workshop.

Advances for the Management of Diabetic Foot Complications

In 2016, the CAWC delivered this one-day workshop in London, ON, and Mississauga, ON, to a total of 175 advanced health-care practitioners.

Stay tuned for more information about how to register for educational workshops in 2017!

Publications and Other Online Education

Face-to-face education has been a key strength of the CAWC and we're building on that strength every year. In addition, we use technology to reach an even greater number of individual in all areas relating



to wound prevention and care, including patients and their families, government decision makers, the media and, of course, HCPs.

This year we released five publications (three *Wound Care Canada* and two *Diabetic Foot Canada e-Journal*), produced four webcasts and delivered 75 eblasts.

CAWC in the News and in the Corridors of Power

Because of the number, variety and quality of our programs, we have become recognized as the go-to organization for Canadians regarding wound prevention and care. We regularly receive requests for commentary on wound-related issues



by media outlets, patients, government decision-makers and HCPs. This year we were featured in *Maclean's* magazine, became involved in providing commentary for Healthy Debate regarding pressure injuries and received media exposure for our advocacy initiatives relating to offloading for diabetic foot ulcers. Our personnel became valued advisors to governments and key individuals in areas of wound-related policy and continue to offer counsel when asked. As well, we are proactive in advancing the issues related to improving patient care across the country, both publicly and behind closed doors.



improved functionality. Over time, it will grow to have much more information for all our audiences, including patients, HCPs, media, industry partners and government decision makers. Stay tuned for an announcement of the official launch date.

2017: Looking Ahead

New Faces

Incoming President of the Board, Dr. Morty Eisenberg

The CAWC would like to extend a warm welcome to the new President of the Board of Directors, Dr. Morty Eisenberg, who will take over from Dr. Greg Archibald January 1.



Morty is a hospitalist and wound consultant at St. John's Rehab, a division of Sunnybrook Health Sciences Centre in Toronto. He is a graduate of the University of Toronto's Masters Program in Advanced Wound Care and is presently the co-director of that program. He is a member of the educational faculty for the University of Toronto's International Interprofessional Wound Care Course and has presented seminars on the foundations of advanced wound care to health professionals across Canada. He is an assistant professor in the Department of Family and Community Medicine and the Dalla Lana School of Public Health, Faculty of Medicine, University of Toronto. Morty has been a CAWC board member since 2012 and the treasurer of the board since 2014.

Our New Website

The new website will be launched in January. It will have a new name, face and branding. Wounds Canada will be found at www.woundscanada.ca. This completely redesigned site will allow quicker and easier navigation, more content and



2017 Conferences

Because our conferences have proved to be such an important part of the Canadian wound scene, we have decided to expand and deliver two each year, starting in 2017. This will allow us to bring education to more clinicians than ever, and within their own areas.



Spring Conference: Kamloops, BC, May 12 – 13, 2017

We are happy to announce that in 2017 we will be introducing a two-day spring wound-care conference, in Kamloops, BC, at the Thompson Rivers University and Conference Centre. This conference, entitled "Exploring Evidence in Wound Care: Different Types of Evidence that Inform Optimum Care for Persons



Kamloops 2017

Spring Conference

Living with or at Risk of Wounds," will look at what evidence is and how we can optimize research to better serve patients at risk for or living with acute and chronic wounds. The two-day Changing Practice Through Applied Knowledge workshop will be held before this conference.



**Fall Conference:
Mississauga, ON,
November 16 – 19, 2017**
Next year's fall conference will be held in Mississauga, ON, November 16 – 19 at the International Centre. The conference will offer 3.5 days of learning and networking opportunities in the largest wound-related event in the country. The two-day Changing Practice Through

Applied Knowledge workshop will be held before this conference, at the Hilton Toronto Airport Hotel & Suites.

Best Practice Recommendations

Starting in 2016, the CAWC began a complete review and update of all the previously published Best Practice Recommendation articles. The first six papers are complete and currently undergoing final stakeholder review. They will be published in a special section of the new website starting in January.

Additional BPRs will be updated and/or created in 2017.



The revised (and new) best practice recommendation articles will continue to assist clinicians in providing the best possible care to their patients and form the informational framework for all CAWC programs and tools.

There's a lot more to come in 2017. Stay tuned for details!

Stay connected!



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Foot Complications: Risking Limbs, Wasting Money

By M. Gail Woodbury, BScPT, MSc, PhD

This paper summarizes a presentation given at the Canadian Association of Wound Care conference in November 2016. The objectives of the presentation were as follows:

- *to describe the economic burden of diabetes-related foot complications in Canada*
- *to discuss the personal burden of diabetes-related foot complications for patients*
- *to review suggested methods to reduce foot complications and thereby stop risking limbs and wasting money*

Worldwide diabetes prevalence was estimated to be 415 million in 2015 and projected to be 642 million by 2040.¹ The population is aging, and with age, more people develop diabetes. The prevalence of diabetes for people in their 20s is approximately 1%, while for people over 75 years, it is almost 20%.¹ Diet and lifestyle contribute to the development of diabetes. On the news and

in the press we hear frequently about the risks associated with sugar intake, obesity and lack of exercise.

We know several things about diabetes and its complications in Canadians. We know that approximately 2.4 million Canadians have diabetes.² Of these, 15% (345,000) will develop a foot ulcer.³ Approximately 50% of all lower-extremity amputations in Ontario are directly related to diabetes.³ People with diabetes are 20 times more likely to be

hospitalized for non-traumatic lower extremity amputations than those without diabetes.²

Diabetes-related Financial Cost in Canada

Canada is not listed among the top 10 countries for number of people with diabetes, but it is among the top 10 for diabetes-related health expenditures, with the cost estimated to be \$23 billion.¹ This cost is projected to rise to almost \$30 billion in 2040.



Be Vigilant

Diabetic foot ulcers are a significant cause of lower extremity amputation, which in turn is an indicator for high mortality. Thorough assessments and early interventions are necessary for the prevention and/or management of this serious health issue.

DFU-related Financial Cost in Canada

Much of the great cost of diabetes care is related to the multitude of complications associated with the disease, and one of the most frequent complications is diabetic foot ulcers (DFU) and their sequelae. Hopkins et al. have conducted the recent definitive study on the economic burden of illness associated with diabetic foot ulcers in Canada, and the fol-

lowing information is from their excellent study.⁴

To put the cost of DFU in perspective, the prevalence of DFU in Canada was estimated (based on data collected in 2011) to be 75.1 per 100,000 population (25,597 cases), with 63% occurring in men and 37% in women. The number of cases of DFU increased from 19,740 in 2007 to 25,597 in 2011, an increase of 7.4% per year over the five-year period.⁴

The incidence of DFU in Canada was estimated to be 42.4 per 100,000 population (14,449 cases), with 52.4 per 100,000 occurring in men and 32.5 per 100,000 in women.⁴

The financial cost of DFU to the Canadian health-care system was determined by Hopkins et al. from the payer perspective, i.e., the total direct health-care costs based on hospital budget, physician fees, drugs in home care (HC) and long-term care (LTC) settings for infections, wounds and dressings, and wages for HC and LTC.⁴ To collect this information, databases were linked:

- Acute-care admissions: CIHI data DAD (Discharge Abstract Database) emergency visits: NACRS (National Ambulatory Care Reporting System)
- same-day surgery: NACRS for Ontario, DAD for rest of Canada
- home care for Ontario: HCRS (Home Care Reporting System)
- LTC for Ontario: CCRS (Continuing Care Reporting System)

Caregiver costs were determined as the cost of lost time for the caregiver or the patient with DFU. Resource Intensity Weights (RIW) were determined, and costs were based on these. In addition, a cohort of incident cases was identified and followed for three years to determine the cost reported as three-year cumulative cost.

The DFU-related cost to the Canadian health-care system was found to be \$547 million based on 2011 Canadian dollars, with the greatest cost being for admissions to acute care, as shown in Table 1. The average cost per prevalent case was \$21,371.⁴

Table 1: DFU-related Cost to the Canadian Healthcare System⁴

Setting	Cost (2011 \$)
Acute care	\$358.6 M
Admissions	\$320.5 M
ER/Clinic visits	\$19.1 M
Interventions	\$19.0 M
Home care	\$125.4 M
LTC	\$63.1 M
LTC Current residents	\$51.7 M
LTC New residents	\$11.4 M
Total Cost	\$547.0 M

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Some 5,015 incident DFU cases (age 68 +14 years) were identified and followed for three years (2009–2011). There were 1,325 deaths, which represent a mortality rate of 26.4%. The average three-year cumulative cost for incident DFU cases,

Table 2: Average Three-year Cumulative Cost for Incident DFU Cases⁴

	Year 1	Year 2	Year 3	Three-year Cost
Total acute care	\$13,031	\$5,314	\$3,040	\$20,758
Admissions	\$11,492	\$4,766	\$2,699	\$18,957
ER visits	\$370	\$122	\$88	\$580
Procedures	\$746	\$321	\$154	\$1,221
Total Non-acute care	\$13,349	\$9,749	\$8,504	\$31,602
At home, no home care	\$0	\$0	\$0	\$0
New to LTC	\$3,568	\$2,505	\$1,761	\$7,835
Resides in LTC	\$1,245	\$1,237	\$1,104	\$3,584
Used home care	\$8,535	\$6,006	\$5,639	\$20,180
Direct medical	\$3,791	\$2,668	\$2,505	\$8,964
Informal caregiving	\$4,744	\$3,338	\$3,134	\$11,217
Total cost	\$26,380	\$15,063	\$11,544	\$52,360

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shown in Table 2, indicates that the greatest cost was in the first year after DFU development: \$26,380. The total three-year cost was \$52,360, with the majority (\$31,602) being non-acute care costs.⁴ The cost of informal caregiving is rarely reported, but in this study it was estimated to be \$11,217.

DFU-related Costs to the U.S. Health-care System

DFU-related costs to the U.S. health-care system are based on a recent study using data from the Healthcare Cost and Utilization Project's (HCUP) Nationwide Inpatient Sample (NIS) for people with a primary diagnosis of foot ulceration.⁵ In this study, the authors sought to determine the impact of diabetes on foot ulcer admissions. Data for people with foot ulcers and diabetes were com-

pared with those without diabetes from January 1, 2005, to December 31, 2010.

The ratio of diabetes mellitus (DM) versus non-DM admissions increased. Ninety percent (90%) of DM admissions were due to neuropathy and infection, while peripheral vascular disease (PVD) accounted for most of the non-DM admissions. Admissions related to infection rose significantly among DM patients, i.e., there were 39,682 admissions in 2005 versus 51,660 in 2010, while admissions due to infections remained stable among non-DM patients.⁵

There was a marked difference in the cost of treating people with DM versus non-DM. The cost in 2010 was US\$1.38 billion/year for DM compared with US\$0.13 billion/year for non-DM. The cost of treating a DFU was \$11,290 per DFU admission for infection and \$8,145 for all other causes. Eighty-three percent



Coming Soon!

Updated

Best Practice Recommendation articles from the Canadian Association of Wound Care

As part of a suite of resources called **Foundations of Best Practice for Skin and Wound Management**, and based on the new Wound Management Cycle, these articles provide a synthesis of Canadian and international guidelines and incorporate the latest evidence into easy-to-use resources for the bedside clinician.

Visit the CAWC website starting in January 2017 to view and download:

- Skin: Anatomy, Physiology and Wound Healing
- Best Practice Recommendations for the Prevention and Management of Wounds
- Best Practice Recommendations for the Prevention and Management of Pressure Injuries
- Best Practice Recommendations for the Prevention and Management of Diabetic Foot Ulcers
- Best Practice Recommendations for the Prevention and Management of Skin Tears
- Best Practice Recommendations for the Prevention and Management of Surgical Wound Complications





(83%) of major amputations and 96% of minor amputations result from non-healing DFUs.⁵

Hospital costs increased over time from 2005 to 2010. This is due at least in part to the DM population being sicker; it was noted that more people with diabetes had comorbidities, i.e., 7.7 per cent in 2005 versus 22.2 per cent in 2010. The per-patient costs related to comorbidities increased from US\$23,082 in 2005 to US\$30,278 in 2010. The per-patient costs related to ischemia increased from US\$34,695 in 2005 to US\$47,049 in 2010. However, the proportions of people with diabetes with critical limb ischemia and gangrene did not change.⁵

Human Cost

It is difficult to think about financial burden without considering the human burden of illness related to DM, DFUs and

amputation. More people with diabetes self-report that their health is fair to poor compared with people without diabetes.²

For people with DFUs compared with those without DFUs, quality of life (QoL) has been observed to be lower.^{6,7} In some

studies, the QoL physical function and/or mobility domain have been found to be lower.^{8,9} Variables found to be associated with negative QoL include age, unemployed status, income status, location and number of foot ulcers,¹⁰ ulcer duration (one



week to three months), cardiovascular complications, DM duration > 10 years and HbA1c levels > 58 mmol/mol.¹¹

A relationship has been observed between the development of the first DFU and depression.¹² Patients with a major depression had a two-fold increase in risk of incident DFU compared with patients without depression. This information was based on an analysis of 3,474 adults with type 2 diabetes and no prior DFU or amputations who were part of the Pathways Epidemiological Study, a population-based prospective study of 4,939 patients with diabetes from 2000 to 2007 whose mean follow-up was 4.1 years. Major and minor depression were assessed by Patient Health Questionnaire-9.¹²

A recent U.S. qualitative phenomenology study provides some understanding of the lived experience of amputation, which is often the result of a DFU. The study involved 15 people with diabetes and amputation who participated in 30- to 90-minute semi-structured interviews.¹³ From the interviews, five themes emerged: financial burden, powerlessness, social support, placing blame and uncertainty in one's continued ability.¹³

In a recent study, it was found that illness beliefs related to time to death.¹⁴ It was reported that ischemia and illness beliefs were significant predictors of time to death and that illness beliefs had a significant independent effect on survival. This information was obtained

in a prospective observational study conducted in the UK that involved 169 subjects with DM and DFU who were recruited from 2002 to 2007. The subjects' illness beliefs were collected at baseline 2002 to 2007 and their survival at November 1, 2011. Illness beliefs include patients' beliefs about their foot ulcer in relation to how they experience it, how it affects their life, their control of it, their control of treatment, their understanding about the ulcer and their emotional response to it. Data about illness beliefs were collected using the Brief Illness Perceptions Questionnaire (BIPQ), which is based on the self-regulatory model of illness.¹⁴

These glimpses into the lives of people with DFUs and amputations help us understand the patients' perspective, which should be considered in practising patient-centred care to sup-

port their coping in relation to

- living with diabetes
- risk of DFU development
- participation in treatment
- healing/non-healing of ulcer
- amputation

What Can Be Done?

The first and most obvious recommendation is to prevent DFUs. Bus and van Netten reported, "For every euro spent on ulcer prevention, ten are spent on ulcer healing, and for every randomized controlled trial conducted on prevention, ten are conducted on healing."¹⁵ The argument has been made to spend smaller amounts of funds on prevention to avoid spending larger amounts on treatment. This is intuitively appealing, and we need more research that illustrates effective prevention.

Education too is needed to encourage patients' life-



style choices for prevention and management in PWD of DFUs. This education would be directed toward both the patients and health-care providers.

Screening for foot complications goes hand in hand with prevention and education. Validated screening or diabetic foot-risk assessment tools exist and should be used as indicated.

It is important too to start earlier in addressing the consequences of the disease process, i.e., provide population-level education to prevent type 2 diabetes and screen for diabetes.

In summary, increasing public awareness of the risks for developing diabetes and the availability of screening, in addition to prevention of diabetic foot complications among patients, may save limbs and money. 🙌

Gail Woodbury is an epidemiologist whose clinical background is physical therapy. She has participated in various wound-related research projects and has taught in wound courses. At present, Gail is an Adjunct faculty member in the School of Rehabilitation Therapy in the Faculty of Health Sciences at Queen's University, Kingston, Ontario where she teaches and supervises both OT and PT students.

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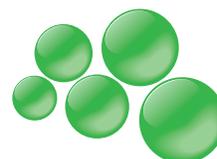
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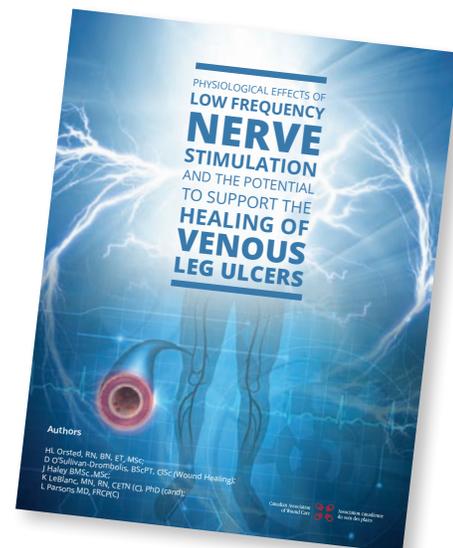
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The Effects of Low-frequency Nerve Stimulation to Support Healing of Venous Leg Ulcers

By Heather L Orsted, RN, BN, ET, MSc;
Deirdre O’Sullivan-Drombolis, BScPT, CISC (WH);
Jennifer Haley, BMSc, MSc; Kim LeBlanc, MN, RN, CETN (C),
PhD (cand), and Laurie Parsons, MD, FRCP (C)

With the support of an unrestricted educational grant from one of our industry partners the Canadian Association of Wound Care initiated a review of the literature regarding the use of low-frequency nerve stimulation in the management of venous leg ulcers. The goal of the document was to provide an overview of the existing literature and establish protocols for the use of this therapy in the treatment and management of diabetic foot ulcers. The full document has been published as a supplement to Wound Care Canada and is available at www.woundcarecanada.ca/wp-content/uploads/CAWC-LFNS-Final-110316.pdf. A summary of the article is provided here.*

*Perfuse Medtec Inc.



There is a complex interplay of factors at the core of the development of venous leg ulceration. Central to this are edema, pain and decreased blood flow. Electrical stimulation has long been used to address these impairments. The use of this technology is now being investigated to see what effect it can have on supporting healing in venous leg ulcers.

There are many ways to deliver electrical stimulation to the body with varying physiological effects, challenges and benefits in application. It can be deliv-

ered directly to the wound bed to help heal ulcers, and this treatment has significant literature to support its use. This review does not focus on the use of electrical stimulation in this manner, but rather as a way to augment healing indirectly by affecting the body through low-frequency nerve stimulation (LFNS). The modality investigated applies stimulation at 1 Hz over the common peroneal nerve in the lower leg to elicit an involuntary muscle twitch. This is enough of an action that early investigators have

demonstrated it to have a positive impact on blood flow and reduce edema and pain.

Overall, the literature is limited at this time, and further study is warranted. Early investigations suggest the cumulative effects of using LFNS—improving circulation as well as reducing pain, and associated improved mobility—have shown a positive impact on wound healing. Use of this device may be a comfortable and practical method to support healing of venous leg ulcers. 🤖

The Role of Zinc in Wound Healing

By Rebecca Marriage-Arcari, RN, BScN, MCISc (WH)

The importance of nutrition in the management of a patient with a wound should never be underestimated. Zinc, a trace mineral, plays a fundamental role in the overall success of many body functions. Because zinc deficiency can negatively affect wound healing, it is an issue clinicians need to consider in the overall care of patients with wounds.

Testing for zinc deficiency is a challenge, as the serum zinc levels may not be indicative of the microcellular state.¹ As well, zinc levels fluctuate with serum albumin, further muddying the significance of the blood levels. Significant zinc deficiency is most likely to be of concern in patients with excessive GI losses, heavily draining wounds, malnutrition,² burns, psoriasis, chronic alcoholism and severe surgical trauma.³

This article reviews zinc deficiency, exploring the cellular effects of zinc on wound healing during each phase and highlighting the clinical observations

to be made at the macroscopic level when zinc levels are diminished. The wound healing phases are hemostasis, inflammation, proliferation and maturation.⁴ Current clinical practice recommendations for zinc supplementation are discussed.

Hemostasis

Immediately after skin injury, the hemostasis phase begins, with platelet adhesion to form the fibrin clot that will stop blood loss.⁵ Activation of the platelets by the intrinsic pathway causes the platelets to change shape, allowing them to aggregate together.⁶ In a patient with a low zinc level, the platelets have a decreased ability to aggregate as described, resulting in increased bleeding time. It is believed that this is related to the role of zinc in thrombotic factors in the platelet and endothelium. It has been shown that this bleeding problem can be reversed with appropriate zinc levels.⁶ Delayed platelet aggregation and prolonged bleeding times will delay the onset and strength of inflammation.

Inflammation

During the inflammation phase, a number of important factors align for wound healing and appropriate immune response.⁷ Zinc is a required component of proliferating cells, including the cells of inflammation, neutrophils and macrophages.⁸ Zinc is partially responsible for synthesis of protein, DNA, RNA and cell proliferation.² Neutrophils, simply speaking, clear the wound of debris and signal the inflammatory cytokines, growth factors and enzymes.⁹ Macrophages clean the wound through phagocytosis, secrete growth hormones, recruit fibroblasts, create an initial framework for granulation and secrete nitric oxide, which has many functions, including vasodilation, thrombolysis, angiogenesis and cell regulation.^{4,8} Both neutrophils and macrophages are affected by low zinc levels that can cause disturbance in their functions. The result could be increased bacterial burden, wound debris, weakened immune response by



the pro-inflammatory cytokines, reduced cell signalling, poor framework creation and slowed angiogenesis.

Also occurring during the inflammation phase is free-radical action. Free radicals are effective in killing pathogens but also need to be kept in balance by antioxidants. Zinc is an essential part of antioxidant function as part of the zinc-copper superoxide dismutase¹⁰; and a reduction of their action can prolong the inflammatory process in chronic wounds.² A prolonged inflammation phase will predispose the patient to infection and delayed healing.⁹

The need for zinc is greatest during the inflammation phase. A person with a zinc level on the low end of the normal range could dip into a sub-therapeutic range during this time, resulting in a negative effect on wound healing.⁷

Proliferation

During proliferation, fibroblasts play a major role in creating new tissue. This cannot happen unless angiogenesis has laid down a healthy network to support fibroblast proliferation. Fibroblasts are also responsible for collagen synthesis, which forms the scaffolding within the extracellular matrix among the capillary buds to build granulation tissue.¹¹ Over time, the disorganized collagen will break down with the help of metalloproteinases and rebuild in a more orderly fashion.⁴ Zinc is required to maintain cell wall stability, DNA, RNA and protein synthesis and to encourage proliferation of fibroblasts.^{1,2,7} An absence of adequate zinc at the cellular level would result in poor, delayed granulation and wound closure. The fibroblasts would likely be less numerous or effective. The

number of capillary buds would be reduced or not present, depending on the extent of deficit. Collagen deposition would be scarce. It has been shown that higher levels of zinc available to wound cells will stimulate and hasten the function of the enzymes repairing the wound.⁷

Maturation

The maturation phase of wound healing focuses on collagen and wound strength. There is a fine balance among the building, organizing and breakdown of collagen to reach the final tensile strength over approximately two years. This work is done by fibroblasts, metalloproteinases, epidermal cells and endothelial cells.¹¹ The maturation of collagen is dependent on adequate zinc levels.⁷ The metalloproteinases that help to digest collagen and stimulate the orderly growth of new collagen contain a zinc ion.⁴ A deficiency in zinc could cause reduced wound strength and increased risk of skin breakdown in the future.⁷

Macroscopic Perspective

The clinician should be alert to the clinical signs of ineffective hemostasis and control of bleeding at the wound site as well as the serum bleeding times. Another trigger for a

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clinician to consider a low zinc level may be a delayed, chronic inflammatory response in a wound prone to infection and lacking the usual presentation of inflammation expressions such as pain, heat, edema, loss of function and erythema. The wound may become stalled in the inflammatory phase, or the clinician may see slow granulation and cellular proliferation. The result could be a wound with poor tensile strength and easily damaged scar tissue when compared with other wounds. The signs of zinc deficiency overlap with signs of other wound healing problems such as use of anticoagulants or poorly controlled blood glucose and prolonged inflammation. It is the responsibility of the clinician to be aware of all potential causes of delayed wound healing and create a comprehensive plan of care to address the causes.

Zinc Supplementation

Current recommendations for the management of pressure injuries does not suggest zinc supplementation as a stand-alone treatment for poorly healing wounds.^{2,12} At the time of this publication, current best practices suggest that most balanced diets will include the recommended amount of zinc without supplementation¹³ and that evidence is lacking to support oral zinc supplementation in those with adequate dietary intake.¹² In order to determine the quality of the patient's diet,

it is recommended to consult with a registered dietitian who can provide a comprehensive review of the patient's nutritional status.

The patient should undergo a nutrition screening with a reliable and validated tool.¹² This will objectively determine if a balanced diet is being consumed to meet the body's macro- and micro-nutrient needs. If a balanced diet is not being consumed, it is recommended that a vitamin and mineral supplement be used to augment.^{2,12}

If a zinc deficiency is accurately diagnosed and needs to be treated, current recommendations state no more than 40 mg elemental zinc daily can be supplemented for a limited period, as deemed appropriate by a prescriber.² High zinc levels will adversely affect wound healing as well. Zinc at high levels is known to interfere with copper metabolism and may render additional problems with wound healing. Up-to-date, evidence-based information regarding nutrition and zinc supplementation can be found online through "PEN: Practice-based Evidence in Nutrition."¹³ Collaboration with a dietitian and the rest of the integrated team is essential to determine any special dietary needs of patients with wounds.

Conclusion

It has been determined that zinc plays a vital role throughout all wound healing phases. When

About Zinc

- Zinc is an essential trace mineral for wound healing.
- Zinc deficiency can negatively manifest in all four stages of wound healing.
- There is insufficient evidence to demonstrate that people without zinc deficiency benefit from zinc supplementation.
- All patients with wounds should have a nutritional screening completed, in consultation with a dietitian, to determine dietary needs.
- Vitamin and mineral supplements may be required for those with dietary deficiencies.
- An excellent resource for up-to-date, evidence-based nutrition information, "PEN: Practice-based Evidence in Nutrition," can be found at www.pennutrition.com/home.aspx.

zinc levels are low in the cellular environment, all four phases of healing are affected. In order to provide the highest quality patient care, the clinician should be alert to the possibility of zinc deficiency and collaborate with the team to investigate dietary adequacy and address deficiencies. 🍷

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An Innovative Technology for Healing Venous Leg Ulcers: geko™

This is an expert opinion piece by Keith Harding, CBE, FRCGP, FRCP, FRCS, Dean of Clinical Innovation, Cardiff University and Medical Director of the Welsh Wound Innovation Centre in Wales, UK. It is based on a presentation given at the annual conference of the Canadian Association of Wound Care, in Niagara Falls, Ontario, on November 5, 2016. It has been produced with the financial support of Perfuse Medtec.



Low frequency nerve stimulation of the common peroneal nerve (geko™ device) is a new technology in wound care that was first used in Canada in 2014. The intuitive idea was that stimulating this nerve generates muscle activity that results in improved blood flow in the limb. If one of the factors that leads to chronic ulcers is tissue having impaired blood flow forms then improving that blood flow would seem to be a logical approach to healing the wound. Ironically, the technology was never designed for treating wounds but rather to prevent blood clots from forming during long-haul flights.

A prestigious group of Canadian clinicians and academics have looked at the available data and have written a paper titled “Low-frequency Nerve Stimulation to Support the Healing of Venous Leg Ulcers.” The evidence continues to build and the science will continue to evolve. However, at present, the authors believe that low-frequency nerve stimulation (LFNS) may offer benefits in at least the following areas:

- Enhanced wound healing of chronic ulcers
- DVT prophylaxis
- Pain management
- Edema reduction
- Improved blood flow in a limb
- Potentially an ability to treat neuropathic symptoms

This technology would appear to have captured the imagination of a broad range of wound care professionals. While more research is surely needed, this takes time—and what do we do in the interim? The risk profile of the technology is such that the primary side-effect reported has been that of a skin rash under the site of application of the electrode. Compared with the potential benefit, this risk would probably be considered somewhat benign by comparison to the prolonged duration of compression therapy and risks (such as infection and amputation) associated with the healing process under current modalities.

Based on the content of the paper, new evidence that has



emerged since the group commenced their efforts and my own personal experience of using the technology, geko™ should be considered as an adjunctive therapy in the following groups of patients until the larger trials are completed:

- Fixed ankle joints or in those with limited mobility (i.e., <200 metres per day). Blood flow is known to be compromised in these patients due to a lack of muscle pump activity.
- When wounds have become or are suspected to become (based on history/risk factors) difficult to heal. This is typically thought of as wounds that have not reduced in size by 30% at 30 days of best practice therapy.
- When compression cannot be tolerated. Without compression, blood flow is compromised. In some patients, compression could be tolerated after LFNS for a period of time.
- Where edema is present. Edema impedes healing progress and this, of course, is also tied to blood flow.
- For the management of peripheral neuropathic symptoms.
- For patients that have pain associated with their wounds.

The main danger preventing wider adoption of this technology appears to be financial consideration.

However, when one considers the guiding principle of “treating the root cause” of all wounds it would seem reasonable that many wound patients would benefit from improved blood flow. If the technology exists to deliver this then it should be used where appropriate.

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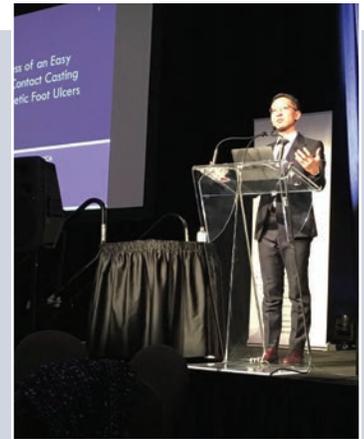
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Cost-Effectiveness of an Easy-to-apply Total Contact Cast System for DFUs

This is a brief summary of a presentation given at the annual conference of the Canadian Association of Wound Care, in Niagara Falls, Ontario, on November 3, 2016. It has been produced with the financial support of Derma Sciences.

Kevin Woo, PhD, RN, FAPWCA, is an Assistant Professor at Queen's University, School of Nursing and School of Rehabilitation in Kingston, Canada. He teaches in the Master of Science in Health Care Quality program, Master of Aging and Health program, as well as the Master and Bachelor of Nursing Science programs.



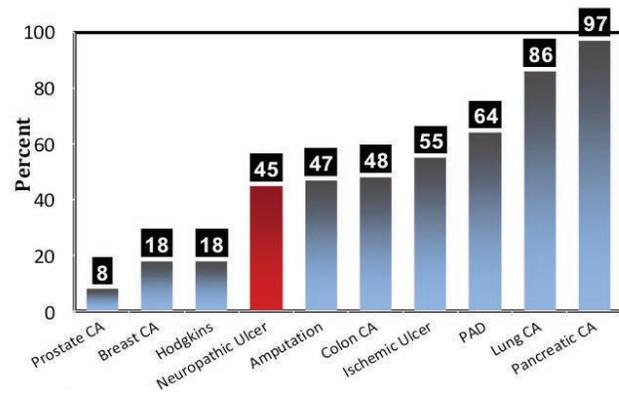
Diabetes can be described as one of the most critical health issues facing Canadians today. In 2015 it was estimated that 3.4 million of our population have diabetes and a further 5.7 million have prediabetes. Over the next 10 years the number of people with diabetes is expected to increase by 44%, a significant burden to individuals and our health-care system.

The complications associated with diabetes are many, due to the effects of elevated levels of glucose on cells of the body. Diabetic foot syndrome is one such complication—and it has profound effects on patients' lives. Diabetic foot syndrome includes the presence of several characteristic pathologies such as infection, diabetic foot ulcer and Charcot, resulting from neuropathy, peripheral arterial disease and immunopathy. As a result of this syndrome a person with diabetes has a 25% lifetime risk of developing a foot ulcer and is over 20 times more likely to be hospitalized for a non-traumatic lower limb amputation. Annual health-care costs range from \$11,710 to \$16,883 per patient with a foot

ulcer in the United States in 2014. Canadian figures are estimated to be \$21,371.¹

Mortality and morbidity are high for patients whose foot ulcers result in amputation. If diabetes is one of the most pressing health issues for Canadians, diabetic foot syndrome is undoubtedly just as critical.

5 year Mortality Risk



Armstrong DG, Wrobel J, Robbins JM. Are diabetes-related wounds and amputations worse than cancer? *Int Wound J.* 2007;4(4):286-7.

Take a Load Off

The most important part of addressing the management of a diabetic foot ulcer, without exception, is to redistribute pressure from the wound in order to minimize repetitive trauma to the area. The challenge for patients and clinicians is that being in a state of complete non-weight-bearing on the

A Sad Truth

When it comes to life expectancy it is better to have certain cancers than complications of diabetic foot syndrome.

area of ulceration can be very difficult to achieve in everyday life. As well, it can promote significant deleterious health effects, such as infections and amputations.

Total contact casting (TCC) has long been established as the gold standard to achieve offloading while still enabling patients to maintain some mobility.² The benefits are that TCC enables pressure to be transmitted to the cast wall or rearfoot, resulting in decreased forefoot pressure. The device also reduces gait speed and shortens stride length, resulting in reduction of pressure. Ankle movement and the propulsive phase of gait are reduced, resulting in a reduction in vertical loading forces. Unfortunately, traditional TCC typically requires skilled application, and access can be difficult. Other methods, such as removable cast walkers and therapeutic footwear, have been developed and are in common use.

A recent meta-analysis was done in 2016 by Elraiyah et al. that investigated the effectiveness of various offloading methods in the treatment of diabetic foot ulceration.³ The analysis included 19 interventional studies, of which 13 were randomized controlled trials and pooled the data of 1605 patients with diabetic foot ulcers using an offloading device. Improved wound healing was demonstrated with TCC over removable cast walkers, therapeutic shoes and conventional treatment. There was no advantage to irremovable cast walkers over TCC.

Adherence to offloading devices can be difficult. 57% of Canadians with diabetes report that they cannot adhere to prescribed treatments due to high out-of-pocket expenses; the average costs of these supports is greater than 3% of income.

While TCC appears to be the most effective method for offloading a diabetic foot ulcer, cost is often cited as a prohibitive reason for not adhering to an offloading device. Dr. Woo and his team sought to investigate this conundrum further by doing a cost-effectiveness study.

A retrospective investigation was done at the Quarry Foot Clinic in Kingston, Ontario, between 2014 and 2016. The charts of 15 patients were reviewed: 13 patients with type 2 diabetes, one patient with

type 1 diabetes and one patient with a chronic foot ulcer of unknown etiology. The final analysis was done on 11 of those patients, as two patients ended up with infection and two patients had issues with adherence. 60% were male. The mean age was 55. Cost analysis included dressing type and frequency, the cost of the TCC, labour and any antibiotics needed. The patients' treatment history prior to the initiation of the TCC was used as a comparator.

With the TCC treatment, costs ranged from \$251.84 to \$1236.08. Duration of treatment was 1–5 weeks. Surface reduction was 100%. Ten out of the 11 patients achieved closure. Cost for the patients' conventional treatment ranged from \$1090.95 to \$10,252.80. The duration of the wounds had been nine to 100 weeks, and surface reduction ranged between zero and 90%.

The total cost of treating 11 patients with TCC resulted in a savings of 75% when compared with conventional treatment.

TCC is effective in managing diabetic foot ulceration. Though the upfront costs of this device could be described as expensive, TCC has lower incremental costs and is far more efficient. Wounds heal faster, overall costs are kept down and patients' quality of life can be improved.

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Wound biofilm consensus – Recommendations from an expert panel

This is a brief summary of a presentation given at the annual conference of the Canadian Association of Wound Care, in Niagara Falls, Ontario, on November 5, 2016. It has been produced with the financial support of Smith & Nephew. The presenters were Garth James, PhD; Gregory Schultz, PhD, and Randall Wolcott, MD, CWS



The problem with biofilms

Biofilms are made up of microbial cells such as bacteria and fungi. In biofilms the microbial cells are surrounded by a polymer matrix that forms a protective coating and helps the micro-organisms adhere to natural surfaces, artificial surfaces or themselves. Biofilms are present in most chronic wounds (previous research showed ~60%; new meta analysis showed ~80% vs. 6% in acute wounds) and are likely to be located both on the surface and deeper tissue. They may not be present uniformly across the wound. All chronic non-healing wounds contain a biofilm.

Biofilms cause significant problems for patients and the clinicians who treat them. Not only do biofilms delay wound healing, but they are very difficult to identify as they cannot be seen with the naked eye. Slough, debris and exudate, which may be the result of the biofilm, are often visually mistaken for biofilm.

To confirm the presence of a biofilm so that effective treatment and faster healing can begin a number of tests are possible, but all have drawbacks in the average clinical setting. Tissue biopsies are better than swabs to reveal biofilm in wounds but do not necessarily identify biofilm presence; specialist knowledge of biofilm culture is required. Microscopic analysis is time-consuming and subjective.

In the absence of bedside diagnostic tests, specific signs and symptoms should be used to confirm biofilm presence. These include:

- Recurrent infection
- Recalcitrance to antibiotic treatment
- Antibiotic treatment failure
- Low-level chronic inflammation
- Low-level erythema
- Delayed healing

This presentation was based on recommendations made by 10 global experts with a goal to bridge the gap between scientific understanding and clinical practice addressing core issues in wound biofilm understanding, diagnosis and treatment variables. The team included Terry Swanson, Dr Matthew Malone, Prof Greg Schultz, Dr Randy Wolcott, Prof David Leaper, Prof Paul Stoodley, Prof Thomas Bjarnsholt, Dr Garth James, Dr Andrew McBain, and Prof Masahiro Tachi. Their full consensus document will be published in the February 2017 issue of *Wound Repair and Regeneration*.

Getting closer to zero

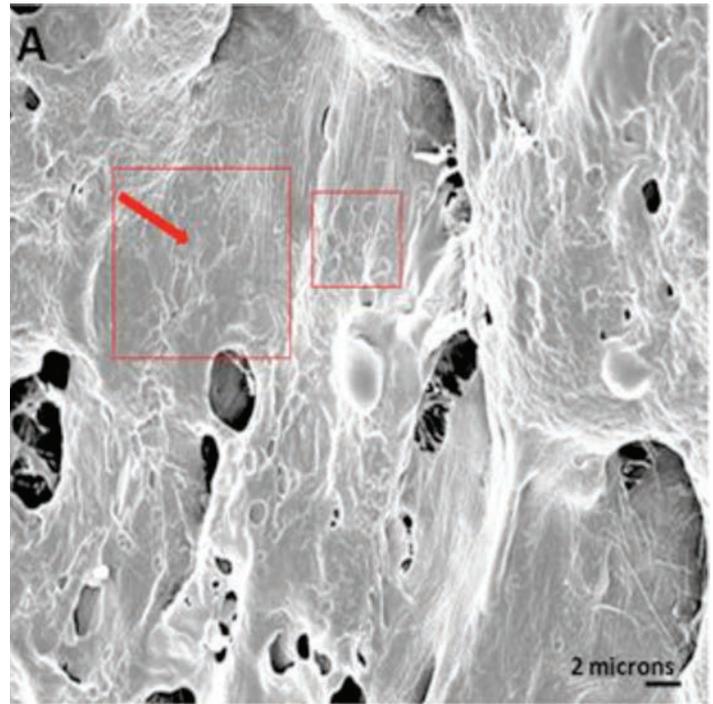
Any plan of care must address the challenges posed by the presence of biofilm, such as the inability of the host's immune system to destroy the biofilm and the poor outcomes from normal antibiotic therapy.

Debridement is one of the most important treatment strategies. It must be done frequently and aggressively. It does not, however, remove all biofilm and cannot be used alone. Biofilms can re-form within 24 hours post debridement. Therefore, **dressings** with strong evidence for effect against biofilms need to also be used, including iodine, Silver Methylene Blue. **Anti-biofilm agents** to consider include Lactoferrin, Xylitol, and Farnasol. **Antibiotic therapy** should be personalized and in general be long and strong in effect.

These strategies should be continued until the wound bed is visibly clean, displaying healthy granulation tissue and/or on a healing trajectory.

The bottom line

Biofilms cause chronic infections. Chronic wounds are chronically infected. Proper assessment and diagnosis enable proper and effective treatment. Biofilms require de-escalation and intervention. Implement multiple simultaneous strategies and then taper for successful treatment. Remember that when it comes to biofilms “for every mistake for not knowing, 10 are made for not looking.”



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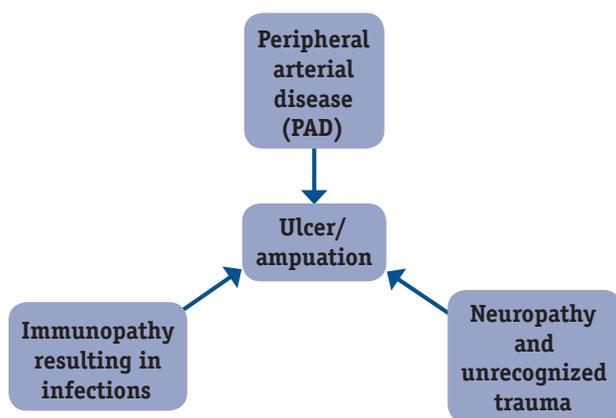
Canadian Limb Salvage: A Call to Action

This is a brief summary of a presentation given at the annual conference of the Canadian Association of Wound Care, in Niagara Falls, Ontario, on November 4, 2016. It has been produced with the financial support of Medtronic. The presenters were Tej Sahota, BSc, DPM, AACFAS; Sudhir Nagpal, MD, FRCSC; Christine Murphy, RN, BClinSc, MClInSc, PhD; Petra O'Connell, BSc, MHA. The session focused on a system-wide approach to limb salvage by reviewing the prevention and earlier detection of DFU in the community as well as exploring the benefits of a tertiary clinic model with a focus on limb salvage.

Introduction

Diabetes is the leading cause of non-traumatic lower limb amputation in Canadian adults. Persons with diabetes are over 20 times more likely to undergo non-traumatic lower limb amputations than those without diabetes.² Diabetes-related foot ulcerations are often the result of identifiable risks such as diabetic neuropathy and/or peripheral arterial disease. A non-healing foot ulcer precedes 85% of these amputations, but the good news is 85% of all amputations due to diabetes are preventable.³ According to the International Diabetes Federation, reductions in amputations can be achieved by well-organized diabetic foot care teams (limb salvage teams), good diabetes control and well-informed self-care.⁴

Figure 1: Diabetic foot pathology rendering the foot prone to ulcers and amputation



A Model for Early Risk Identification, Prevention and Intervention

The Alberta Diabetes, Obesity and Nutrition Strategic Clinical Network developed a clinical pathway for pa-

tients with diabetes who are at risk for developing a foot ulcer or who already have an ulcer. This pathway ensures that patients—regardless of where they live—receive the appropriate care from the right provider, at the right time. The pathway also helps providers identify foot problems and facilitate early intervention to prevent amputations. To view the pathway, please visit: www.albertahealthservices.ca/assets/about/scn/ahs-scn-don-info-graphic-diabetic-foot-care-clinical-pathway.pdf.

Limb salvage involves saving a lower extremity that would otherwise have been amputated.¹

Tools and resources are also being developed by the Network to support both providers and patients. A foot risk-assessment form will aid in identifying patients who have low, moderate, high or urgent risk. High-risk-foot teams have been developed to improve access to care for patients with a high-risk foot. These initiatives ultimately decrease the need for emergency care and over time will provide a 50% reduction in patients who require an amputation due to a diabetic foot ulcer.

A Model for a Limb Salvage Clinic

Efforts to prevent amputations in persons with diabetes have resulted in the development of limb salvage clinics in the U.S. and Europe. These clinical settings employ functional limb salvage techniques to provide optimal prevention and management of complications while maintaining an ulcer-free lower extremity. Limb salvage

clinics provide rapid access to service, diagnosis and treatment as well as long-term follow-up. The success experienced in these specialized clinics demonstrates the need to consider a similar approach in Canada.

Steps for Setting Up a Limb Salvage Clinic:

1. Create a business plan that provides a blueprint of the vision for the clinic and how it will run and secure funding.

2. Ensure support from facility/administration as well as buy-in by the local health authority.

3. Secure clinic space and assemble a team that may include membership from advanced podiatry services, revascularization teams, wound care teams and specialists in rehabilitation, infectious diseases, nephrology, endocrinology, prosthetics and orthotics, depending on clinical assessment.^{1,5}

4. Ensure that the clinic is able to perform the following activities:⁵

- Vascular assessment with revascularization, as necessary
- Biomechanical and podiatric assessment
- Wound assessment and staging/grading of infection and ischemia
- Site-specific bedside and intra-operative incision and debridement
- Culture-specific and patient-appropriate antibiotic therapy
- Screening to evaluate the risk of a foot for developing diabetic foot complications
- Reduction of risk of re-ulceration and infection by various protective mechanisms
- Collection of data to insure the following patient benefits:⁵
 - A reduction in time for assessment and intervention to improve vascular status
 - A reduction in time for assessment of wound healing potential
 - A reduction in time for medical and surgical intervention for infection

Conclusion

Diabetes-related foot amputations place a tremendous emotional and financial burden on patients, their families and health-care systems. It is becoming recognized that the cost, morbidity burden and demand for applying resources toward co-ordinated, affordable care of diabetic foot ulcers is comparable to that of several forms of cancer.

Early adopters of limb salvage models must provide evidence of the cost-effectiveness of limb salvage programs to demonstrate to funding agencies the usefulness of these highly specialized teams.

Limb salvage centres are currently rare in Canada despite the fact that incidence rates of PAD and diabetes are expected to rise. This combination of increased numbers of foot ulcers and lack of limb salvage centres will continue to place a major burden on the health-care system.

Limb salvage models that incorporate early vascular evaluation and treatments are essential for maximizing outcomes, saving limbs and lives and contributing to healthier, more productive individuals and communities.

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It's all about the outcome



QUOTABLE Quotes

We've been asking some of Canada's top wound care leaders a number of questions about their personal experiences in wound care. Their responses are both uniquely theirs and share common wisdom. Here are a few quotes. We hope they challenge and inspire you.

Q What is the most memorable thing a patient ever said or did?

"Doctor, you saved my life. Thank you.' That came from the two patients in the last month I had in my family medicine practice: one with acute leukemia, the other with renal cancer. That felt good."

—Richard Belley, MD, CMFC, BSc

"Making a donation to the hospital in my name seven years after we had provided her with care. It felt good to be remembered after all those years!"

—Sunita Coelho, RN

"There are so many patients I have been privileged to work with over the years, but the compliment I have received most often is 'thank you for being so thorough.' This is what I try to do every day regardless of how rushed I feel."

—Robyn Evans, MD, CCFP, IIWCC

"I have had many thank you cards and gifts. But what is most memorable are the everyday things. The smile you get from a patient who has been withdrawn. Spending time to get to know each patient as a person. The jokes and stories they tell you. Learning about who they were and are. Their history. Even when they trust you enough to tell you about the bad day they are having too."

—Deirdre O'Sullivan, BScPT, MCISC

"On the way out of the clinic, he stopped, looked down, straightened up, taller than when he came in. I never saw his face, but I know he was smiling inside and out. This truly is a positive outcome!"

—Brian Scharfstein, CPed (C)

"A patient told me that their whole life changed and that for the first time in years they had hope again after working with our team."

—Barbie Murray, BScN RN MCISC

"Just seeing people getting back to living is most memorable. Sometimes they don't have to say anything—you just know you have made a difference in their lives."

—Marlene Varga, MSc, BScN, IIWCC

"We named our boy after you."

—Kyle Goettl, RN, BScN, MEd, IIWCC

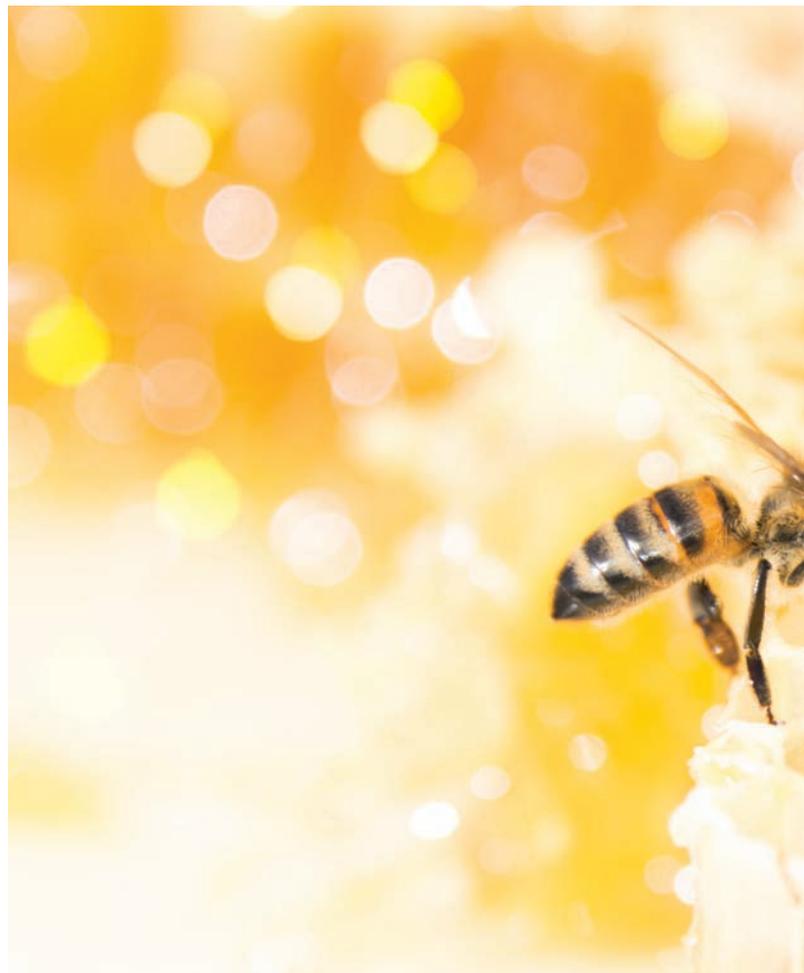
Honey of a Wound: The Use of Medical Honey to Heal Diabetic Foot Ulcers in a Low-resource Environment

By Katherine Kivi, BScN RN, CDE, CFCN; Cynthia Dwyer, BN RN, CFCN and Bradley Lance, RN

The following is a case report of two First Nations clients from remote, fly-in communities in northwest Ontario that illustrates the efficiency of medical honey and simple dressing methods in healing diabetic foot ulcers. Remote communities face significant health challenges, including limited access to specialty wound care and dressing supplies. In this case, the dressing choice, which can be administered at home or at a remote nursing station, resulted in complete closure of two serious foot ulcers.

Diabetes care can be accessed at Sioux Lookout Meno Ya Win Health Centre (SLMHC) in Sioux Lookout, Ontario. The hospital provides primary and preventative health care for a region that extends from Hudson Bay to Lake Superior. This vast area encompasses approximately 360,000 square kilometres of land and has the lowest population density in Ontario. More than two-thirds of the residents (77.8%) identify as First Nations people.¹ Most of the communities are accessible only by airplane or winter road. Type 2 diabetes has reached epidemic levels in First Nation populations, in which adults are three times more likely to have type 2 diabetes than non-indigenous Canadians.^{2,3} Two registered nurses at SLMHC provide wound care for the population of 29,000. Many of our clients arrive by plane from more than 300 kilometres north of SLMHC.

Clinical methods need to be practical and easily managed in our environment, where, due to



transportation limitations, we can only follow up with most patients every two weeks. Nursing station nurses and/or family members perform dressing changes and treatment in the interim. We have achieved success using medical honey as a diabetic foot ulcer (DFU) healing agent. Natural honey is a viscous, supersaturated sugar solution derived from nectar gathered and modified by the honeybee.⁴ Medical honey is natural honey gamma-irradiated to eliminate any *Clostridium botulinum* contamination. Honey is acidic (pH of 3.2–4.5), and its antimicrobial properties have resolved MRSA and *Staphylococcus aureus* infection in wounds.^{5,6} The anti-inflammatory effect of honey results in reduced wound exudate, edema and scarring.⁷ Our methods promote ease of dressing changes, wound closure and client stated satisfaction.

Adding Honey to the Mix

The key features of our wound care method are the use of medical honey, conservative sharp wound debridement (CSWD) and simple wound coverings. The dressing components are inexpensive, and the nurses in the diabetes programs are

qualified to perform CSWD. The use of medical honey at SLMHC was initially promoted in 2008 and implemented hospital-wide in 2010.

Two Cases

Two First Nations clients were asked to participate, and signed consents were obtained. Ethical approval was received by SLMHC Research Review and Ethics Committee. Names have been altered for confidentiality.

Lydia

“Lydia” is a 55-year-old First Nations woman with a right plantar DFU complicated by Charcot foot. She lives in a fly-in-only community north of SLMHC. Lydia has type 2 diabetes, hypertension and hyperlipidemia. She was experiencing pain and edema in her right foot with increased symptoms on ambulation. The doctor’s examination at the remote nursing station found a large mid-plantar callus, mild diffuse erythema of the forefoot and back pain. Oral clindamycin was prescribed.

Wound management began at SLMHC in November 2015. The callus was reduced with CSWD, revealing a diabetic foot ulcer 1.9 cm (length) x 0.9 cm (width) x 0.3 cm (depth). Local wound care included cleansing with normal saline, applying a small amount of honey and covering with an absorbent pad dressing (9 cm x 10 cm) secured with tape. A high, post-op, closed-toe offloading shoe was provided. Lydia returned home with orders for dressing changes every two days at the nursing station. With each return trip to SLMHC, CSWD was performed if required. Dressing supplies were sent home with Lydia each time. The wound on Lydia’s right Charcot foot was healed in March 2016.

Successful resolution of her DFU was achieved through early detection of a serious wound, timely retrieval of the client from a remote community, specialized wound care in a rural hospital and consistent follow-up. Lydia’s attendance at regular dressing changes and diligent offloading of the foot were significant contributions (see Figures 1 and 2).



Figure 1: “Lydia” – Before



Figure 2: “Lydia” – After



Joseph

“Joseph” is a 64-year-old First Nations man with a left first metatarsophalangeal joint ulcer. He lives in a community north of SLMHC. Joseph has type 2 diabetes, hypertension and peripheral neuropathy. Management of Joseph’s DFU began in February 2016. The wound was covered by a substantial callus over a pad of exposed fat and granular dermis. After CSWD, the wound measured 5 cm (length) x 3 cm (width) x 0.3 cm (depth). A cut-to-size piece of povidone-iodine-impregnated dressing was applied to the open area for two weeks, after which a thin application of medical honey was substituted. The choice of using 7 mm compressed felt to offload the plantar surface or a high, post-op, closed-toe offloading shoe was client-driven. The dressing was changed every two days at the remote nursing station. Joseph attended our wound clinic every second week as per travel allotment policy. CSWD was performed if required. Healing was evident at each visit, with the wound closing in April 2016.

How Honey Works in Wounds

The knowledge that *Klebsiella* and *Enterobacter* bacteria have been shown to be resistant to silver-impregnated dressings may indicate a need to return to natural antibacterial products that promote wound healing.^{8–10} Honey is a traditional medicine used since ancient times, and its place in the history of human healing practices is readily accepted by our clients.^{6,8} The antimicrobial properties of honey include high sugar concentration, low pH, the presence of hydrogen peroxide, methylglyoxal, antimicrobial peptide bee defensin-1 along with oxidase, and other compounds such as polyphenols and flavonoids from plant nectar.^{6,12,13}

The high sugar/low moisture content of honey causes osmotic stress to microbial cells. Low pH is unfavourable for the growth of many microorganisms. No bacteria are known to be completely resistant to the effects of honey.^{6,12,13} Research by Camplin and Maddocks did identify some honey resistance by *Pseudomonas aeruginosa* in biofilm.¹³ This illustrates the importance of periodic wound culturing to appropriately identify any pathogens in a wound. The authors’ advise, “where recalcitrant or chronic, infected wounds are present it remains vital to ensure that topical treatments such as manuka honey are appropriately applied for a suitable length of time in combination with other antimicrobials where necessary to ensure that infection is resolved and the likelihood for resistance is minimised.”¹³

Bowling et al. state that “the risk of MRSA infection and bacteremia in patients with colonized ulcers is recognized.”¹⁴

Topical honey use has no known systemic effects.

Conclusion

Our clients often welcome the possibility of returning home with a dressing routine using simple, effective supplies. Sood et al. observe that “there is an overwhelming amount of wound dressings available in the market [which] implies the lack of full understanding of wound care and management . . . honey can inhibit biofilms of

Self-care at Home

Each client and/or escort/family member is shown how to apply the dressing during the initial visit. Then the client is asked to demonstrate to the nurse how to apply the material to the wound. The client is given the time to reapply the dressing until comfortable with the process. Due to the simplicity of the dressing, most clients only require a one-time demonstration.



various species, is non-cytotoxic [and] a non-irritant with very low risk of client sensitization.”¹⁰

Complex and/or expensive dressings are not readily available in northern nursing stations.

A 10 g tube of medical honey costs about \$4. The absorptive adherent dressing we use costs less than \$3, and our most basic dressings are only 12 cents each. These items are of practical use in a low-resource environment.

The ability to effect wound closure in clients with a diabetic foot ulcer living in remote communities, relying on inexpensive supplies that are easy for the clients to use when away from professional care, is an important outcome in wound care provision. 🤝

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