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 following 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 System[4]

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

Reprinted with permission from RB Hopkins.

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, 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.

Table 2: Average Three-year Cumulative Cost for Incident DFU Cases[4]

	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

Reprinted with permission from RB Hopkins.

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 compared 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 support 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-

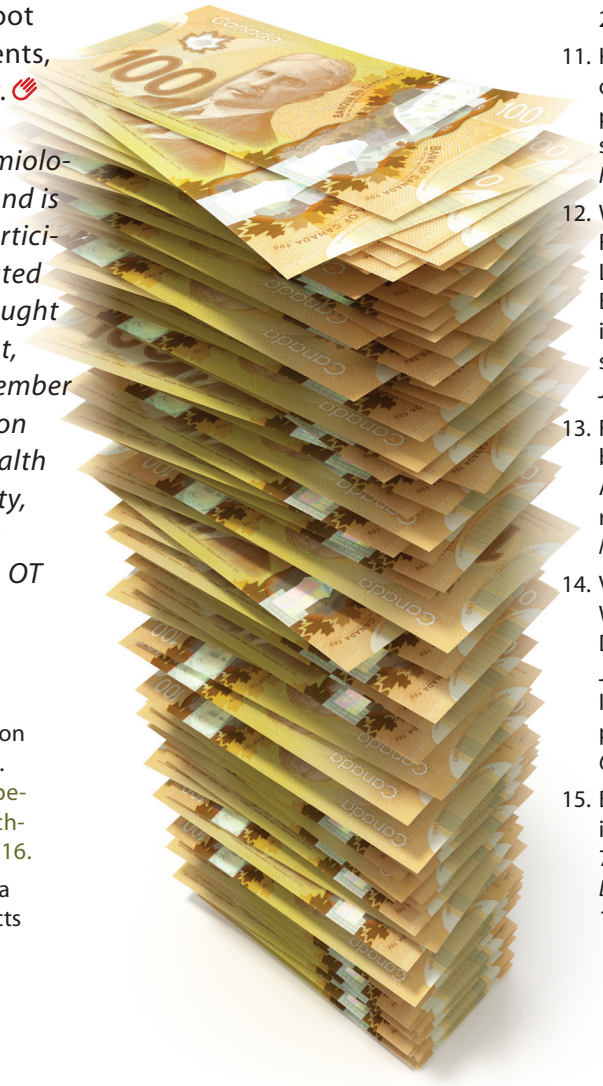
style choices for prevention and management in PWD of DFUs. This education would be directed toward both the patients and health-care providers.

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.*



References

1. International Diabetes Federation (IDF). IDF Diabetes Atlas, 7th ed. 2015. Available from: www.diabetesatlas.org/component/attachments/?task=download&id=116.
2. Public Health Agency of Canada (PHAC). Diabetes in Canada: Facts and figures from a public health perspective. 2011. Available from: www.phac-aspc.gc.ca/cd-mc/publications/diabetes-diabete/facts-figures-faits-chiffres-2011/index-eng.php.
3. Canadian Association of Wound Care. Facts, Stats, Tools: Statistics. Available from: http://cawc.net/en/index.php/public/facts-stats-and-tools/statistics/.
4. Hopkins RB, Burke N, Harlock J, Jgathisawaran J, Goeree R. Economic burden of illness associated with diabetic foot ulcers in Canada. *BMC Health Services Research.* 2015;15:13.
5. Hicks CW, Selvaajah S, Mathioudakis N, Sherman RL, Hines KF, Black JH, Abularrage CJ. Burden of infected diabetic foot ulcers on hospital admissions and costs. *Ann Vasc Surg.* 2016;33:149–158.
6. de Meneses LC, Blanes L, Veiga DF, Gomes HC, Ferreira LM. Health-related quality of life and self-esteem in patients with diabetic foot ulcers: Results of a cross-sectional comparative study. *Ostomy Wound Management*. 2011;57(3):36–43.
7. Goodridge D, Trepman E, Sloan J, Guse L, Strain LA, McIntyre J, Embil JM. Quality of life of adults with unhealed and healed diabetic foot ulcers. *Foot & Ankle International.* 2006;27(4):274–280.
8. Meijer JWG, Trip J, Jaegers SMHJ, Links TP, Smits AJ, Groothoff JW, Eisma WH. Quality of life in patients with diabetic foot ulcers. *Disability and Rehabilitation.* 2001;23(8):336–340.
9. Ribu L, Hanestad BR, Moum T, Birkeland K, Rustoen T. A comparison of the health-related quality of life in patients with diabetic foot ulcers, with a diabetes group and a nondiabetes group from the general population. *Quality of Life Research.* 2007;16:179–189.
10. Nasiriziba F, Rasouli D, Safaei Z, Rokhafrooz D, Rahmani A. Factors associated with quality of life in patients with diabetic foot ulcers. *Jundishapur J Chronic Dis Care.* 2015;4(1):e26598.
11. Kossioris A, Karousi T. Determinants of health-related quality of life in patients with diabetic foot ulcers: A systematic review and meta-analysis. *Health Science Journal.* 2015;9(6:5):1–7.
12. Williams LH, Rutter CM, Katon WJ, Reiber GE, Ciehanowski P, Heckbert SR, Lin EHB, Ludman EJ, Oliver MM, Young BA, Von Korff M. Depression and incident diabetic foot ulcers: A prospective cohort study. *The American Journal of Medicine.* 2010;123:748–754.
13. Foster DS and Lauver LS. When a diabetic foot ulcer results in amputation: A qualitative study of the lived experience of 15 patients. *Ostomy Wound Management.* 2014;60(11):16–22.
14. Vedhara K, Dawe K, Miles JNV, Wetherell MA, Cullum N, Dayan C, Drake N, Price P, Tariton J, Weinman J, Day A, Campbell R, Reps J, Soria D. Illness beliefs predict mortality in patients with diabetic foot ulcers. *PLoS One.* 2016;11(4):e0153315.
15. Bus SA, van Netten JJ. A shift in priority in diabetic foot care and research: 75% of foot ulcers are preventable. *Diabetes Metab Res Rev.* 2016;32(Suppl. 1):195–200.