

The Right to Bear Legs—An Amendment to Healthcare: How Preventing Amputations Can Save Billions for the US Health-care System

To the Editor:

Current prevalence estimates suggest that 20.8 million US residents have diabetes, and this number is predicted to more than double to 43 million by the year 2040.^{1, 2} As a chronic disease, diabetes is extremely costly. Direct medical expenditures totaled \$92 billion in 2002. Indirect expenditures resulting from lost workdays and disability totaled \$40 billion.³ The cost burden of diabetes accounted for 18% of all US health expenditures (\$865 billion in 2002). Adjusting for health-care inflation, we estimate the totals for diabetes-related expenditures to escalate to \$122 billion and \$54 billion in 2007 for direct and indirect costs, respectively. It has been estimated that “health-care inflation” is twice the average economic inflation rate.⁴ To adjust for health-care inflation, we used the inflation calculator available from the US Department of Labor/Bureau of Labor Statistics⁵ and doubled the rate.

Up to 25% of individuals with diabetes will develop a foot ulcer during their lifetime.⁶ Foot ulcers and infections are the most common reason for hospital admission of individuals with diabetes.⁷ Foot ulcers cost between \$7,439⁸ and \$20,622⁹ per episode (adjusting for health-care inflation in 2007). The annual incidence of foot ulcerations in people with diabetes is between 2% in a retrospective cohort¹⁰ and 6.8% in prospective clinical data.¹¹ Gordois et al estimated that \$9 billion were spent on the treatment of diabetic foot ulcers in 2001.¹² These authors’ calculations were based on an estimate of 11.1 million people with diabetes in the US and the cost was based on gauze dressings twice daily. Our calculations are based on the American Diabetes Association estimate that there are 20.8 million people with diabetes and the cost data presented above.¹ Considering these new data on increasing incidence and cost inflation, we estimate that up to

\$19 billion was spent on care of diabetic foot ulcers in 2007 (Table 1).

Eighty-five percent of diabetes-related lower extremity amputations (DRLEA) are preceded by a foot ulcer.¹³ The direct costs of major limb amputation are estimated to be \$70,434 (adjusting for health-care inflation in 2007), which includes the cost of a prosthetic limb.¹² The lifetime projected cost of a major amputation, considering rehabilitation and future prostheses, can be as much as \$500,000.^{14, 15} The annual incidence of lower-extremity amputation is 5 to 8 per 1,000 people with diabetes.¹⁶⁻¹⁸ We estimate that expenditures for amputations in those with diabetes to be approximately \$11.7 billion (Table 1).

Diabetic foot ulcerations and amputations are largely preventable. In pivotal trials, foot ulcer recurrence rates were found to decrease by 48% with a multidisciplinary approach and four podiatry visits yearly,¹⁹ by 53% with custom off-loading footwear,²⁰ and by 73% with the use of a dermal thermometer and education.²¹ The potential cost savings if these initiatives were implemented nationally could be \$9 billion to \$14 billion annually (Table 2).

Pecoraro reported that roughly 86% of amputations were preceded by an identifiable and preventable pivotal event.¹³ Similarly, the International Diabetes Federation²² and World Health Organization²³ launched a campaign in 2005 highlighting that 85% of DRLEAs are preventable. In practice, comprehensive amputation-prevention programs have reduced the rates of amputation by 50% to 69%.^{17, 24, 25} That could translate to a cost savings of up to \$8 billion annually (Table 2).

Together, effective diabetic foot ulcer and amputation prevention could realistically save the US health-care system up to \$21.8 billion annually. Relatively low-cost preventative measures could be adopted quickly and result in this significant cost savings. Unfortunately, diabetic foot complications are overlooked and neglected. Diabetic foot ulcer and amputation-prevention measurements need to be added to the Healthcare Effectiveness Data and Information Set (HEDIS).²⁶ Pivotal prevention services are not reimbursed adequately. Physicians should have ade-

Table 1. Adjusted Health-care Expenditures for Diabetic Foot Ulcers and Amputations

	Incidence	Number of Patients ^a	Cost per Episode	Total
Diabetic foot ulceration	4.4% ^b	915,200	\$20,622 ^c	\$18.9 billion
Lower-extremity amputation	0.8%	166,400	\$70,434 ^c	\$11.7 billion

^aBased on 20.8 million people with diabetes in the US (American Diabetes Association).

^bAverage incidence of retrospective and prospective studies.^{10, 11}

^cAdjusted for health-care inflation.

Table 2. Projected Cost Savings from Amputation-Prevention Strategies

	Estimated 2007 Costs	Practical Reduction	Potential Annual Cost Savings (in billions)
Diabetic foot ulceration	\$18.9 billion	48–73% ¹⁹⁻²¹	\$9.1–\$13.8
Lower-extremity amputation	\$11.7 billion	50–69% ^{17, 24, 25}	\$5.8–\$8
Total	\$30.6 billion	N/A	\$14.9–\$21.8

Abbreviation: N/A, not applicable.

quate reimbursement and access to high-risk patients for comprehensive prevention. Only then can we attain realistic estimates of the scope of the problem and encourage proper prevention.

Third-party payors need to reimburse for a preventative comprehensive diabetic foot screening at a frequency that depends on the overall risk category of the patient (more frequent for higher risk, less frequent for lower risk). Similarly, inexpensive tools might play a substantive role. As an example, skin temperature monitoring has been shown in three randomized controlled trials²⁷⁻²⁹ to drastically reduce the risk of foot ulceration in high-risk patients. There are several studies that support the benefit of therapeutic shoes and insoles²⁰; and while the benefit of protective shoes and insoles is occasionally questioned, the fact that poor footwear causes ulcerations is not.³⁰ We suggest that keeping one's limbs is a right, not a privilege. Urgent attention is needed to this debilitating consequence of diabetes. The above measures constitute a start on the right foot.

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References

- CENTERS FOR DISEASE CONTROL AND PREVENTION: National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2005. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, 2005.
- VENKAT NARAYAN KM, BOYLE JP, GEISS LS, ET AL: Impact of recent increase in incidence on future diabetes burden; US 2005–2050. *Diabetes Care* **29**: 2114, 2006.
- AMERICAN DIABETES ASSOCIATION: Economic costs of diabetes in the US in 2002. *Diabetes Care* **26**: 917, 2003.
- CATLIN A, COWAN C, HEFFLER S, ET AL: National health spending in 2005. *Health Affairs* **26**: 142, 2006.
- BUREAU OF LABOR STATISTICS: Inflation calculator. Available at: <http://www.bls.gov/cpi/home.htm>. Accessed December 30, 2007.
- SINGH N, ARMSTRONG DG, LIPSKY BA: Preventing foot ulcers in patients with diabetes. *JAMA* **293**: 217, 2005.
- LIPSKY BA, BERENDT AR, EMBIL J, ET AL: Diagnosing and treating diabetic foot infections. *Diabetes Metab Res Rev* **20**: S56, 2004.
- HOLZER SE, CAMEROTA A, MARTENS L, ET AL: Costs and duration of care for lower extremity ulcers in patients with diabetes. *Clin Ther* **20**: 169, 1998.
- STOCKL K, VANDERPLAS A, TAFESSE, E, ET AL: Costs of lower-extremity ulcers among patients with diabetes. *Diabetes Care* **27**: 2129, 2004.
- RAMSEY SD, NEWTON K, BLOUGH D, ET AL: Incidence, outcomes, and cost of foot ulcers in patients with diabetes. *Diabetes Care* **22**: 382, 1999.
- LAVERY LA, PETERS EJ, WILLIAMS JR, ET AL: Reevaluating the way we classify the diabetic foot: restructuring the diabetic foot risk classification system of the International Working Group on the Diabetic Foot. *Diabetes Care* **31**: 154, 2008.
- GORDOIS A, SCUFFHAM P, SHEARER A, ET AL: The health care costs of diabetic peripheral neuropathy in the US. *Diabetes Care* **26**: 1790, 2003.
- PECORARO RE, REIBER GE, BURGESS EM: Pathways to diabetic limb amputation: basis for prevention. *Diabetes Care* **13**: 513, 1990.
- MACKENZIE EJ, JONES AS, BOSSE MJ, ET AL: Health-care costs associated with amputation or reconstruction of a limb-threatening injury. *J Bone Joint Surg (Am)* **89**: 1685, 2007.
- WILLIAMS MO: Long-term cost comparison of major limb salvage using the Ilizarov method versus amputation. *Clin Orthop Relat Res* **301**: 156, 1994.
- OLLENDORF DA, KOTSANOS JG, WISHNER WJ, ET AL: Potential economic benefits of lower-extremity amputation prevention strategies in diabetes. *Diabetes Care* **21**: 1240, 1998.

17. CANAVAN RJ, KELLY WF, CONNOLLY VM: Diabetes and non-diabetes related lower extremity amputation incidence before and after the introduction of better organized diabetes foot care. *Diabetes Care* [Published online ahead of print December 10, 2007].
18. JEFFCOATE WJ: The incidence of amputations in diabetes. *Acta Chir Belg* **105**: 140, 2005.
19. DARGIS V, PANTELEJEVA O, JONUSHAITE A, ET AL: Benefits of a multidisciplinary approach in the management of recurrent diabetic foot ulceration in Lithuania: a prospective study. *Diabetes Care* **22**: 1428, 1999.
20. UCCIOLI L, FAGLIA E, MONICONE G, ET AL: Manufactured shoes in the prevention of diabetic foot ulcers. *Diabetes Care* **18**: 1376, 1995.
21. LAVERY LA, HIGGINS KR, LANCTOT DR, ET AL: Preventing diabetic foot ulcer recurrence in high-risk patients: use of temperature monitoring as a self-assessment tool. *Diabetes Care* **30**: 14, 2007.
22. INTERNATIONAL DIABETES FEDERATION: The diabetic foot: amputations are preventable. Position Statement. May 2005. Available at: <http://www.idf.org/home/index.cfm?node=1408>. Accessed January 7, 2008.
23. WORLD HEALTH ORGANIZATION: World Diabetes Day: too many people are losing lower limbs unnecessarily to diabetes [press release]. Available at: <http://www.who.int/mediacentre/news/releases/2005/pr61/en/>. Accessed January 7, 2008.
24. LAVERY LA, WUNDERLICH RP, TREDWELL J: Disease management for the diabetic foot: Effectiveness of a diabetic foot prevention program to reduce amputations and hospitalizations. *Diabetes Res Clin Pract* **70**: 31, 2005.
25. KRISHNAN S, NASH F, BAKER N, ET AL: Reduction in diabetic amputations over 11 years in a defined UK population: benefits of multidisciplinary team work and continuous prospective audit. *Diabetes Care* **31**: 99, 2008.
26. NATIONAL COMMITTEE FOR QUALITY ASSURANCE: Healthcare Effectiveness Data and Information Set. Available at: <http://web.ncqa.org/tabid/59/Default.aspx>. Accessed January 7, 2008.
27. LAVERY LA, HIGGINS KR, LANCTOT DR, ET AL: Home monitoring of foot skin temperatures to prevent ulceration. *Diabetes Care* **27**: 2642, 2004.
28. LAVERY LA, HIGGINS KR, LANCTOT DR, ET AL: Preventing diabetic foot ulcer recurrence in high-risk patients: use of temperature monitoring as a self-assessment tool. *Diabetes Care* **30**: 14, 2007.
29. ARMSTRONG DG, HOLTZ-NEIDERER K, WENDEL C: Skin temperature monitoring reduces the risk for diabetic foot ulceration in high-risk patients. *Am J Med* **120**: 1042, 2007.
30. NIXON BP, ARMSTRONG DG, WENDELL C, ET AL: Do US veterans wear appropriately sized shoes?: the Veterans Affairs shoe size selection study. *J Amer Podiatr Med Assoc* **96**: 290, 2006.