

The Economic Costs of Diabetes: Is It Time for a New Treatment Paradigm?

In a series of rigorous and exhaustive descriptive cost analyses conducted over the past decade, the American Diabetes Association (ADA) has documented an inexorable increase in the cost of diabetes in the U.S. and its detrimental impact on productivity (1–3). For the 2012 study, the ADA estimated that there were 22.3 million Americans diagnosed with diabetes (3). These patients incurred \$306 billion in direct medical costs, more than 1 of 5 dollars spent on medical care in the U.S. (3). The direct medical costs attributed to diabetes, that is, the costs of medical care for people with diabetes in excess of those that would be expected in the absence of diabetes, were \$176 billion or approximately 1 of 8 dollars spent on medical care in the U.S. (3). Americans with diagnosed diabetes have annual medical expenditures that are \$7,900 or approximately 2.3 times higher than they would be in the absence of diabetes (\$13,700 vs. \$5,800) (3). Americans with diabetes also incur \$69 billion in costs related to absenteeism, reduced productivity while at work or at home, diabetes-related disability, and premature mortality (3). The increasing economic burden of diabetes is due in large part to the increase in the number of people with diagnosed diabetes. The estimated number of Americans with diagnosed diabetes increased from 12.1 million in 2002 to 17.5 million in 2007 to 22.3 million today (1–3). The increased frequency of chronic complications, particularly cardiovascular and renal disease, changing health care practices, and the wider application of new and expensive technologies and treatments have also contributed to the increasing cost of diabetes. Whatever the causes, diabetes is a major burden to the U.S. health care system and to society.

One of the major limitations of descriptive cost analyses such as those conducted by the ADA is that they do not provide an indication of the value obtained for the money spent. Some insights can, however, be gleaned by looking at where health care dollars are being spent. Fifty-nine percent of health care expenditures attributed to diabetes in the U.S. are incurred by the population ≥ 65 years of age

with diagnosed diabetes, including 65% of health care expenditures attributed to hospital inpatient, nursing/residential facility, hospice, and home health care (3). The population ≥ 65 years of age also incurs 60% of expenditures for prescription medications used to treat diabetes complications (3). Hospital inpatient care, nursing/residential facility stays, hospice care, home health services, and prescription medications to treat diabetes complications account for nearly three-quarters of all health care expenditures attributed to diabetes (3). Outpatient care delivered in physicians' offices and hospital outpatient clinics, antidiabetic medications, and diabetic supplies account for less than one-quarter of the health care expenditures attributed to diabetes (3). These findings indicate that the vast majority of health care dollars are being spent for older patients with longstanding diabetes and advanced complications. Fewer health care dollars are being spent for the outpatient management and treatment of diabetes.

The increase in health care expenditures related to the increase in the size of the population with diagnosed diabetes, the large proportion of expenditures incurred by the population ≥ 65 years of age, and the large proportion of expenditures related to late diabetes complications suggest that interventions to delay or prevent the development of diabetes in at-risk Americans, and treatments to delay or prevent the development of complications and comorbidities in Americans with diagnosed diabetes, may be most effective in stemming the growing economic burden of diabetes.

Randomized controlled clinical trials have clearly demonstrated the efficacy of lifestyle interventions in delaying the onset of type 2 diabetes (4–7). Observational follow-up studies of clinical trials have demonstrated that the benefits of lifestyle interventions persist for 7–20 years (8–10). Translational studies have demonstrated that lifestyle interventions can be adapted and translated into primary care and can achieve short-term weight loss outcomes comparable to those observed in clinical trials (11–13). Lifestyle interventions can also be successfully translated

into community practice through organizations such as YMCAs (14,15) and diabetes self-management education programs (16). In Finland, lifestyle interventions for diabetes prevention have been successfully translated into a National Diabetes Prevention Program and a 1-year follow-up study has demonstrated effectiveness (17). Randomized controlled clinical trials of pharmacologic interventions have demonstrated that at least 3 classes of oral antidiabetic medications are effective in delaying the onset of type 2 diabetes (6,18,19). By delaying the onset of diabetes, such interventions reduce the cumulative incidence of diabetes complications and result in longer lives and improved quality of life (20).

A recent review of 12 economic analyses conducted by 10 research groups in 9 countries also demonstrated that in 11 of 12 analyses, lifestyle interventions were cost-effective (20). A recent within-trial analysis of resource utilization and outcomes from the Diabetes Prevention Program/Diabetes Prevention Program Outcomes Study confirmed that an intensive lifestyle intervention is extremely cost-effective and metformin treatment is possibly cost-saving over 10 years (21).

Randomized controlled clinical trials have also demonstrated that intensive glycemic management can delay the onset of microvascular, neuropathic, and cardiovascular complications in people with both type 1 and type 2 diabetes, and that the benefits of early intensive treatment persist over time (22,23). Randomized controlled clinical trials have also demonstrated that blood pressure management (target blood pressure 135/80 mmHg) and lipid management using statin medications can delay or prevent the development of adverse cardiovascular outcomes (24,25).

The growing economic and societal burden of diabetes as documented by the ADA in this issue of *Diabetes Care* highlights the urgent need to implement interventions to delay the development of type 2 diabetes (3). Both intensive lifestyle and pharmacologic interventions are proven-effective and cost-effective. Health policy should support their implementation. Complimentary societal interventions to

