EDITORIAL (SEE ADA STATEMENT, P. 596)

# The Economic Imperative to Conquer Diabetes

The new data presented in this issue (1) estimating the 2007 economic cost of diabetes in the U.S. at $174 billion are sobering. One in five health care dollars is spent caring for someone with diabetes, and one in ten dollars spent on health care is attributable to diabetes and its complications. In addition to the $116 billion in excess medical expenditures, the loss to the nation in economic productivity is $58 billion. Yet, even these staggering totals are incomplete because the American Diabetes Association (ADA)-commissioned study excludes unknown costs such as those associated with undiagnosed diabetes (about one in four people with diabetes) and the unpaid care and associated loss of productivity of family members.

This study also does not consider the costs of pre-diabetes, which affects 54 million Americans (2) and modestly increases cardiovascular disease risk (3), because there is inadequate information to assess its impact on medical costs or productivity. Nonetheless, the looming risk of diabetes (up to 70% of individuals with pre-diabetes will progress to diabetes) (3) and longitudinal data demonstrating an association between glucose level in middle age and future Medicare charges (4) portend even higher future economic costs. In today's U.S. population, about one in five individuals over age 60 years has diabetes, but one in three Americans born in 2000 is projected to develop diabetes over their lifespan (5).

Increased prevalence of overweight and obesity and sedentary lifestyle are well-recognized drivers of the epidemic of type 2 diabetes in the U.S. and worldwide, together with an aging and more diverse American population. While attention has focused on increasing rates of obesity and, consequently, type 2 diabetes in children and young adults, the incidence of type 1 diabetes is also rising and the age of onset falling in the U.S. and Europe (6). Earlier onset and longer duration of diabetes can be expected to increase morbidity, raising the economic and human toll of the disease. Although people under age 45 years account for only 9% of the economic costs attributed to diabetes in the ADA study (1), the relative increase in costs is much higher in the younger population. This is illustrated in data on hospitalization, which accounts for about one-half the excess medical costs of diabetes, due to increased rates and stays. The study found that, compared with their peers without diabetes, men with diabetes age 60–64 years have eight times the number of inpatient days, while those age 35–44 years have 15-fold more inpatient days. While the ADA study provides cross-sectional data, a longitudinal study found that hospitalizations for diabetes in young adults increased substantially from 1993 to 2004, with inflation-adjusted hospital costs more than doubling (7).

In the 5 years since a similar analysis was published in *Diabetes Care* (8), the number of Americans with diagnosed diabetes rose from 12.1 to 17.1 million and the economic cost of diabetes increased to $174 billion from $132 billion (equivalent to $153 in 2007 dollars). The increased prevalence of diabetes and general medical inflation are sufficient to explain the increase in excess medical expenditures. After adjusting for age and other demographic factors, annual health care expenditures are 2.3-fold higher for those with diabetes or $6,649 in excess costs per year per person with diabetes. This disparity is similar to the finding of 2.4-fold higher health care costs in the earlier study.

The ADA economic study also illuminates diabetes' harshest toll, with 284,000 deaths attributed to diabetes in 2007. While diabetes is ranked the sixth leading cause of death in the U.S. based on death certificates, this ranking underestimates the real contribution of diabetes to premature mortality because diabetes per se is usually not the listed cause of death. For only 77,000 of the 284,000 deaths attributed to diabetes in the economic study was diabetes listed as the primary cause on death certificates. Sixty-five percent of deaths in people with diabetes are due to cardiovascular disease, which is increased two- to fourfold, with higher case fatality after myocardial infarction (9). Unfortunately, people with diabetes, particularly women, are not fully benefiting from the overall improvements in cardiovascular disease mortality in America (10), and diabetes is increasing in importance as a contributor to cardiovascular disease rates (11). In the ADA economic study, 123,000 deaths attributed to diabetes list cardiovascular disease as the primary cause, with 16.5% of U.S. cardiovascular disease deaths attributed to diabetes. The study found that the contribution from diabetes to stroke and kidney disease death rates is even higher, accounting for 37.5% of cerebrovascular deaths and 57.4% of kidney disease deaths.

Despite the enormous contribution of diabetes to health care costs, premature death, and disability in the U.S., there is some reason for optimism. Effective medications are available to help achieve blood glucose, blood pressure, and lipid control, and compelling research has proven that these interventions are highly effective in reducing diabetes complications (9) Fifteen years after the Diabetes Control and Complications Trial demonstrated dramatic reductions in the eye, kidney, and nerve complications of type 1 diabetes with improved glycemic control (12) and 10 years after the National Diabetes Education Program (NDEP) was established to promulgate the message that diabetes control can improve outcomes for people with diabetes, recent data have demonstrated the first meaningful nationwide improvements in glycemic control (13,14). Nationwide data (15) also demonstrate improvement in cholesterol control in people with diabetes; yet, there remains substantial room for further improvement in control of risk factors, particularly blood pressure. The strong proof from rigorous clinical trials of the importance of risk factor control spurred vigorous efforts by the NDEP, ADA, American Heart Association, and numerous other groups to disseminate the research findings and promote comprehensive care. These efforts, together with Medicare coverage of diabetes self-management training beginning in 1999 and of medical nutrition therapy for people with diabetes since 2002, should contribute to further improvements in control of blood glu-

cose, blood pressure, and cholesterol in the U.S. population with diabetes.

Preventing the development of diabetes in people with pre-diabetes is a particularly attractive strategy. Since publication of the previous ADA cost study 5 years ago, the Diabetes Prevention Program (DPP) has established that the incidence of type 2 diabetes can be reduced by 58% with an intensive lifestyle intervention targeting a 7% weight loss in people with impaired glucose tolerance; metformin therapy delayed or prevented diabetes by 31% (16). These therapies were effective in all racial and ethnic groups, and the effect of lifestyle modification was particularly potent in the elderly, while metformin showed the greatest effect in younger, more obese participants. Similar success in preventing diabetes has been reported in studies in Finland (17), China (18), and India (19). To disseminate the DPP findings, the NDEP launched the first national diabetes prevention campaign: "Small Steps. Big Rewards. Prevent type 2 Diabetes." The National Institutes of Health has extended follow-up of the DPP participants for an additional 5 years to assess the durability of the prevention effect and the longer-term benefits that may ensue from the interventions. The National Institute of Diabetes and Digestive and Kidney Diseases has also established a program of translational research grants for the prevention and control of diabetes and obesity to develop cost-effective and sustainable interventions that can be adopted in real-world settings. An example of a project funded through this mechanism involves delivering the DPP lifestyle intervention in a group setting in YMCAs as an approach that may reduce costs and increase accessibility of the lifestyle change program (20).

Diabetes is a huge and growing problem that creates enormous burdens for patients, families, insurers, and society at large. Ultimately, primary prevention and population-based approaches will be essential to contain the explosive growth in the prevalence of diabetes and associated health care costs. Economic analyses suggest that the DPP lifestyle intervention can provide considerable benefits at reasonable costs, but it is unclear how the intervention could be financed. Private insurers, who cover most Americans aged <65 years, will be hesitant to cover a costly preventive intervention with delayed benefits, and Medicare does not pay for such interventions, although implementation before age 65 years might reduce costs as well as morbidity in later years.

Arguments have been made for hybrid funding by Medicare and employers who would stand to benefit because during the DPP, fewer days of work or school were lost to illness or death for those who underwent lifestyle change compared with control subjects (21). Meanwhile, ongoing research to establish less costly population-based approaches and demonstrate prolonged benefits from an initial investment will further the goal of ending the diabetes epidemic and reducing health care costs.

While primary prevention is the long-term solution, the immediate problem of health care costs associated with diabetes is daunting. Co-payments and caps on medications have been employed as cost containment strategies, but a recent study suggests that these strategies may be counterproductive in chronic diseases such as diabetes. Hsu et al. (22) found that caps on drug benefits result in worse outcomes—with nonadherence to medication and poorer control of blood pressure, lipid, and glucose levels—and do not reduce spending because savings in drug costs from the cap are offset by increases in the costs of hospitalization and emergency room care. This study suggests that where benefits of therapy are clearly established for a chronic disease such as diabetes, we should be reducing the barriers to treatment and encouraging patients to use appropriate therapy. Reducing barriers to recommended care may not only result in better outcomes for patients but also be cost neutral or actually reduce health care costs.

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