COMMENTARY

Understanding the Economic Costs of Diabetes and Prediabetes and What We May Learn About Reducing the Health and Economic Burden of These Conditions

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Over 30 million people suffered from diabetes in 2015, representing 9.4% of the entire U.S. population and 12.2% of all adults (1). One in four of these people did not know they had diabetes (1). Furthermore, in the same year, approximately 84.1 million U.S. adults—over a third of U.S. adults (33.9%)—were believed to have prediabetes, 90% of whom were also unaware of their condition (1). The high prevalence of gestational diabetes mellitus (GDM) (6.0%) among women who gave birth in 2016 further underscores the seriousness of this epidemic (2).

The burden of diabetes is not uniformly shared, varying by age, education, income, location, race/ethnicity, and other social determinants of health (SDOH) (1–6). Greater burden is evident among adults with lower educational attainment and household income than among adults of higher socioeconomic status (1,3), disparities that have widened over time (3). In 2015, compared with non-Hispanic whites (7.4%), the age-adjusted prevalence of diagnosed diabetes was higher among American Indian and Alaska Native adults (15.1%), non-Hispanic black adults (12.7%), adults of Hispanic ethnicity (12.1%), and Asian adults (8.0%) (1). The prevalence of undiagnosed diabetes (4,5), prediabetes (7), and GDM (2,6) also varied by SDOH.

Federal, state, and local governments—ultimately, taxpayers—bear the brunt of diabetes-related costs. For example, Medicare's diabetes-related burden increased during recent years as the prevalence of diabetes increased (8). Updated, comprehensive information on the economic burden of diabetes-related conditions is critical for governments, employers, other health payers, and health care providers to assess opportunities for improving service delivery and, ultimately, health outcomes.

Dall et al. (9) updated and expanded the American Diabetes Association (ADA) 2012 estimates of such burden, and the 2017 estimates presented in this issue of *Diabetes Care* (10) account for changes in population risk and direct and indirect costs. The ADA placed the cost of diagnosed diabetes in 2017 at $327.2 billion (11). Undiagnosed diabetes (7.9%, $31.7 billion), prediabetes (10.7%, $43.4 billion), and GDM (0.4%, $1.6 billion) combine with the prior estimate for diagnosed diabetes to total $403.9 billion annually (10). Diagnosed diabetes accounted for 81.0% of this total (10). The average economic cost per person was projected to be $13,240 for diagnosed diabetes, $4,250 for undiagnosed diabetes, $500 for prediabetes, and $5,800 for GDM. These estimates included medical expenditures that exceed levels occurring in the absence of diabetes or prediabetes as well as indirect costs due to productivity losses associated with related morbidity and mortality. It is no surprise, then, that medical spending for diagnosed diabetes is among the highest for all conditions (12,13). To situate the 2017 total medical and indirect costs within the U.S. economy we compared those costs to the U.S. gross domestic product; the $403.9 billion economic costs of diabetes and prediabetes are approximately 2.1% of the 2017 U.S. gross domestic product (14).

In light of these circumstances, increasing access to programs to prevent diabetes, prediabetes, and risk factors associated with these conditions (e.g., obesity, insufficient exercise) becomes even more crucial. The National Diabetes Prevention Program (DPP), specifically the lifestyle individual intervention and metformin use, were both effective in preventing diabetes and cost-effective (15). Subsequent studies found DPP lifestyle group programs to be cost-effective

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(16). In fact, a Medicare study of such programs revealed they were associated with significant reductions in Medicare spending, inpatient admissions, and emergency department visits in the intervention group relative to the comparison group (17). DPP programs may qualify for reimbursement by Medicare, leading many private health plans and some state Medicaid agencies to support their expansion. Such expansion, particularly among high-risk populations, may have a sizable impact on diabetes prevalence and associated costs.

Information about the economic burden of diabetes may be used to assess the value of programs and policies implemented to prevent and treat these conditions. For example, state policy makers may consider ADA estimates of a state's diabetes-related medical costs to assess the value of Medicaid reimbursement for DPP services. An employer faced with a similar decision may wish to consider ADA estimates of medical costs and costs associated with lost productivity. Note, however, that data on the economic burden may only be "considered" in such evaluations, since neither all cases of nor complications from diabetes and prediabetes are preventable.

The high cost of treating undiagnosed diabetes highlights the need to increase early detection and management. The ADA recommends type 2 diabetes screening for adults aged 45 years and older and high-risk younger adults every 3 years (18). Yet, 2005–2012 data showed that less than half of these individuals were screened; failure in this regard was largely attributed to SDOH (5,19). Addressing such barriers is especially important given that early diagnosis and treatment of diabetes improve clinical outcomes and prevent costly complications, such as cardiovascular disease and end-stage renal disease (20–22). Likewise, diabetes self-management and support programs (23), participation in which is similarly affected by SDOH, can be cost-effective, even cost-saving (20,22,24,25). Data of the type reported by Dall et al. (10) may be used to situate and interpret the short- and long-term costs of such programs.

The models used to estimate the burden of diabetes and prediabetes (10,11) are the most comprehensive cost of illness models specific to diabetes and prediabetes, incorporating recent data from an array of sources. Data for commercially insured persons and Medicare beneficiaries were used to model health service utilization patterns, and Medical Expenditure Panel Survey (MEPS) data were included in the medical cost estimates. Productivity losses were derived from National Health Interview Survey (NHIS) data on labor force participation and missed workdays. The reports of economic burden (10,11) include detailed information on disease prevalence, medical service use, treatment costs, and productivity losses that improve our understanding of these costs by age and other patient characteristics. This information serves as a reference for comparison with other data on similar measures. Indeed, these models contribute to the development of diabetes-related economic cost models in other countries and economic cost models for other conditions.

Dall et al. (10) describe limitations associated with their model's assumptions, exclusion of some costs, and other factors that influenced their results. For example, the current model did not include indirect costs of prediabetes or GDM. However, they offered a preliminary estimate of the indirect costs of prediabetes and encouraged inclusion of such costs in future work. Drawing on data for commercially insured persons, the authors modeled utilization patterns for persons less than 65 years old who had Medicaid coverage compared with no health coverage. They argued that improvements in access to Medicaid data through the Centers for Medicaid and Medicare Services' national reporting system may allow the future inclusion of such data.

Additional model enhancements could include accounting for nonmedical direct costs (e.g., travel, childcare), long-term care costs, and indirect costs of persons aged 65 years and older. The authors noted the challenges of modeling service utilization patterns using multivariate regressions (i.e., use of Poisson compared with negative binominal models). Future research should address these challenges, as regression findings influence service utilization estimates and, therefore, cost projections.

Diabetes prevention and treatment services have difficulty reaching high-risk populations. An important future direction is to broaden the models referenced here to estimate the economic burden introduced by SDOH. Evaluations of programs and policies designed to reduce the burden in high-risk populations may then better describe the economic burden of diabetes and prediabetes as well as the direct costs, effectiveness, and cost-effectiveness of the programs and policies that target high-risk populations.

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