COMMENTARY

Insights Offered by Economic Analyses

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Economic analyses may be used to describe the costs of health care programs and to ensure that value is obtained for the money spent. This issue of *Diabetes Care* includes three economic analyses. The first describes the incremental costs of diabetes over a lifetime and highlights how interventions to prevent diabetes may reduce lifetime costs (1). The second demonstrates that although an expensive, intensive lifestyle intervention for type 2 diabetes does not reduce adverse cardiovascular outcomes over 10 years, it significantly reduces the costs of non-intervention–related medical care (2). The third demonstrates that although the use of the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria for the screening and diagnosis of gestational diabetes mellitus (GDM) results in a threefold increase in the number of people labeled as having GDM, it reduces the risk of maternal and neonatal adverse health outcomes and reduces costs (3). The first report highlights the enormous potential value of intervening in adults at high risk for type 2 diabetes to prevent its development. The second illustrates the importance of measuring economic outcomes in addition to standard clinical outcomes to fully assess the value of new treatments. The third demonstrates the importance of rigorously weighing the costs of screening and treatment against the costs of health outcomes when evaluating new approaches to care.

Zhuo et al. (1) linked data from the National Health Interview Survey (NHIS) and the Medical Expenditure Panel Survey with data describing survival to calculate and compare lifetime health care expenditures for people with and without diabetes. Because the NHIS includes information on age at diagnosis of diabetes, the authors were able to estimate diabetic patients' medical spending and the incremental lifetime medical expenditures of people with diabetes compared with those without diabetes by age at diagnosis of diabetes. The costs of diabetes monitoring and treatment accrue as of function of the duration of diabetes, so adults who are younger at diagnosis are more likely to survive to develop the late, expensive complications of diabetes, thus they incur higher lifetime costs attributable to diabetes. Zhuo et al. report that people with diabetes diagnosed at age 40 spend approximately $125,000 more for medical care over their lifetimes than people without diabetes. For people diagnosed with diabetes at age 50, the discounted lifetime excess medical spending is approximately $91,000; for those diagnosed at age 60, it is approximately $54,000; and for those diagnosed at age 65, it is approximately $36,000 (1).

These results are very consistent with results reported by the Diabetes Prevention Program (DPP) Research Group, which assessed the cost-effectiveness of diabetes prevention. In the DPP, the intensive lifestyle intervention was more effective in preventing diabetes in participants ≥60 years of age (71% relative risk reduction [RRR] vs. placebo) than in participants <45 years of age (48% RRR vs. placebo) (4). In the simulated lifetime economic analysis, however, the lifestyle intervention was more cost-effective in younger participants than in older participants (5). By delaying the onset of type 2 diabetes, the lifestyle intervention delayed or prevented the need for diabetes monitoring and treatment, surveillance of diabetic microvascular and neuropathic complications, and treatment of the late, expensive complications and comorbidities of diabetes, including end-stage renal disease and cardiovascular disease (5). Although this finding was controversial at the end of the randomized, controlled clinical trial, all but 1 of 12 economic analyses published by 10 research groups in nine countries have demonstrated that lifestyle intervention for the prevention of type 2

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diabetes is very cost-effective, if not cost-saving, compared with a placebo intervention (6).

Empiric, within-trial economic analyses of the DPP have now demonstrated that the incremental costs of the lifestyle intervention are almost entirely offset by reductions in the costs of medical care outside the study, especially the cost of self-monitoring supplies, prescription medications, and outpatient and inpatient care (7). Over 10 years, the DPP intensive lifestyle intervention cost only ~$13,000 per quality-adjusted life-year gained when the analysis used an intent-to-treat approach (7) and was even more cost-effective when the analysis assessed outcomes and costs among adherent participants (8).

In their prospective and painstakingly detailed economic analyses, the Look AHEAD (Action for Health in Diabetes) Research Group (2) found that an intensive lifestyle intervention designed to achieve and maintain weight loss and enhance physical fitness for overweight and obese adults with type 2 diabetes, when compared with a diabetes support and education intervention, resulted in significantly fewer hospitalizations, less medication use, and lower health care costs over 10 years. Despite having no impact on the trial's primary end point, a composite of death from cardiovascular disease, nonfatal myocardial infarction, nonfatal stroke, and hospitalization for angina, the intensive lifestyle intervention had myriad health benefits and produced a mean, relative, 10-year cost saving of $5,280 per participant (2). Although small compared with the potential savings associated with delaying or preventing the development of type 2 diabetes for 10 years and unlikely to entirely offset the cost of the lifestyle intervention, these savings are not trivial. The American Diabetes Association has reported that although institutional care (hospital, nursing home, and hospice care) still account for 52% of annual per capita health care expenditures for people with diabetes, outpatient medications and supplies now account for 30% of expenditures (9). Between 2007 and 2012, annual per capita expenditures for inpatient care increased by 2%, while expenditures for medications and supplies increased by 51% (9). As the costs of diabetes medications and supplies continue to increase, it will be even more important to consider cost savings arising from the less frequent use of medications when evaluating the benefits of nonpharmacologic interventions.

Finally, Duran et al. (3) described the 1-year costs and outcomes of two alternative strategies for diagnosing and treating GDM at the St. Carlos Hospital in Madrid, Spain. Between April 2011 and March 2012, they screened 1,750 pregnant women at 24 to 28 weeks' gestation using the two-step Coustan and Carpenter criteria. Subsequently, between April 2012 and March 2013, they screened 1,526 pregnant women using the one-step IADPSG criteria. During both study periods, women diagnosed with GDM received the same lifestyle and self-monitoring recommendations, had the same capillary blood glucose targets, and were managed according to the same insulin treatment protocols. Outcomes and costs were assessed for both women diagnosed with GDM and those not diagnosed with GDM.

The prevalence of GDM was 11% (185/1,750) when Coustan and Carpenter criteria were used for screening and diagnosis and 36% (542/1,526) when IADPSG criteria were used (3). Despite a more than threefold higher prevalence of GDM and greater treatment costs when IADPSG criteria were used, the prevalence of gestational hypertension, premature deliveries, cesarean deliveries, small- and large-for-gestational-age deliveries, and neonatal intensive care unit admissions were reduced. Cost savings were modest, approximately €14,360 for every 100 pregnant women evaluated or €144 per pregnancy over 1 year, but the remarkable finding was that diagnosing over one-third of pregnant women as having GDM and treating all of them reduced costs. Duran et al. speculated that these clinical and economic benefits arose from treating a greater number of women at risk for pregnancy-related complications. Indeed, previous studies have found that women with one abnormal glucose value using the Coustan and Carpenter criteria, who are not diagnosed as having GDM, have similar pregnancy outcomes as women diagnosed with GDM (10). Other studies have demonstrated that interventions in this group with "mild GDM" can reduce adverse outcomes (11). So perhaps paradoxically, universal screening to identify women with lesser degrees of glucose intolerance, and systematic interventions for the larger target population, improves outcomes and reduces costs.

The three articles included in this issue clearly illustrate how economic analyses of health care programs may help to identify opportunities for interventions and prioritize intervention strategies. The results compliment the so-called hard outcomes reported in clinical trials and provide a basis for weighing the costs of screening and treatment against the costs of associated health outcomes on a population basis. Economic analyses offer important insights in clinical research and should be more widely embraced by the research community.

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