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Incorporating Indirect Costs into a Cost-Benefit Analysis of Laparoscopic Adjustable Gastric Banding

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ABSTRACT

Objectives: The objective of this study was to estimate the time to breakeven and 5-year net costs of laparoscopic adjustable gastric banding (LAGB) taking both direct and indirect costs and cost savings into account. **Methods:** Estimates of direct cost savings from LAGB were available from the literature. Although longitudinal data on indirect cost savings were not available, these estimates were generated by quantifying the relationship between medical expenditures and absenteeism and between medical expenditures and presenteeism (reduced on-the-job productivity) and combining these elasticity estimates with estimates of the direct cost savings to generate total savings. These savings were then combined with the direct and indirect costs of the procedure to quantify net savings. **Results:** By including indirect costs, the time to breakeven was reduced by half a year, from 16 to 14 quarters. After 5 years, net savings in medical expenditures from a gastric banding procedure were estimated to be \$4970 (±\$3090). Including absenteeism increased savings to \$6180 (±\$3550). Savings were further increased to \$10,960 (±\$5864) when both absenteeism and presenteeism estimates were included. **Conclusions:** This study presented a novel approach for including absenteeism and presenteeism estimates in cost-benefit analyses. Application of the approach to gastric banding among surgery-eligible obese employees revealed that the inclusion of indirect costs and cost savings improves the business case for the procedure. This approach can easily be extended to other populations and treatments.

Keywords: bariatric surgery, business case, obesity, return on investment.

Introduction

Recent evidence reveals that the direct (medical) and indirect (productivity loss) burden of severe obesity, defined as having a body mass index (BMI) greater than 40 kg/m^2, is substantial [1]. Bahr et al. [2] showed that annual obesity-attributable medical expenditures for the severely obese could be as high as \$1270 for males and \$2530 for females. Furthermore, they showed that the indirect costs resulting from severe obesity, which include increased absenteeism and health-related reductions in productivity while at work (termed presenteeism), comprised an even larger share of total obesity-attributable costs. They estimated annual indirect obesity-attributable costs of \$6090 for severely obese male employees and \$6690 for severely obese female employees.

Because of the high costs resulting from severe obesity, effective obesity interventions have the potential to generate significant savings. To date, the most effective intervention for severe obesity is bariatric surgery; the two most common types of bariatric surgery are gastric bypass surgery and gastric banding. Both procedures have been shown to be cost-effective when focusing on direct medical expenditures [3–8].

Estimating changes in direct medical expenditures after a medical/surgical intervention is easily accomplished because of readily available longitudinal medical claims data. Similar data do not exist for estimating indirect costs. As a result, nearly all cost-effectiveness and cost-benefit studies focus solely on direct costs. Given that a bariatric procedure not only generates short-term work loss but also has the potential to reduce subsequent absenteeism and presenteeism, the largest components of obesity-related costs, and because employers are ultimately responsible for making coverage decisions for their employees, a lack of information on potential indirect cost implications resulting from bariatric procedures is a significant limitation.

The objective of this study was to estimate the time to breakeven and 5-year net costs of laparoscopic adjustable gastric banding (LAGB) taking both direct medical and indirect absenteeism and presenteeism costs and cost savings into account. Although longitudinal data on indirect cost savings are not available, indirect cost savings were generated by estimating the relationship between medical expenditures and absenteeism and between medical expenditures and presenteeism and combining these estimates with estimates of the direct cost savings. Although the analysis focuses on LAGB as a treatment for severe obesity, this approach can easily be applied to gastric bypass or extended to other populations and treatments.

Methods

Methodological overview

The estimation strategy occurred in four steps. First, estimates of quarterly percentage reductions in direct medical cost savings

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post-LAGB (termed α_i, where i denotes the quarter postprocedure) were derived from published literature [9]. Second, an elasticity was calculated that quantifies the percentage change in absenteeism for a given percentage change in medical expenditures (termed β). Multiplying each α_i times β allows for estimating quarterly percentage reductions in absenteeism postbanding. Third, because no data set exists that allows for directly estimating the percentage change in presenteeism for a given percentage change in medical expenditures, this estimate was calculated indirectly by quantifying the percentage change in presenteeism for a given percentage change in absenteeism, termed δ. This estimate was then multiplied by β and then by each α_i to estimate quarterly percentage savings in presenteeism postprocedure. Fourth, all savings were monetized and then combined with the direct and indirect costs of the procedure to quantify net costs. The data and a more detailed estimation approach are described below.

Data

The medical expenditure/absenteeism elasticity (β) was estimated by using the publicly available Medical Expenditure Panel Survey (MEPS)—a nationally representative survey of the civilian noninstitutionalized population that quantifies an individual's total annual medical spending by type of service and source of payment. This includes all expenditures for office-based visits, hospital outpatient visits, emergency room visits, hospital inpatient stays, home health care, dental care, vision aids, other medical equipment and services (e.g., orthopedic items, medical equipment, disposable supplies), andprescription medicines. The survey also includes the following question in each interview round that allows for quantifying annual work loss due to illness or injury: "How many days did [respondent] miss a half day or more of work due to health problems?"

Other questions capture employment status, self-reported weight and height, and sociodemographic characteristics of respondents. The MEPS sample was limited to full-time, nonpregnant employees between the ages of 18 and 64 years (N = 18,143). For the primary analysis, the sample was further limited to those eligible for bariatric surgery, which includes those with a BMI of more than 40 or between 35 and 40 with a significant comorbidity, including sleep apnea, cardiovascular disease, osteoarthritis, or diabetes (n = 876), and to those respondents with data in both 2005 and 2006 (n = 134 individuals representing 268 observations). To gauge the sensitivity of the elasticity estimate to sample selection, supplemental analyses were conducted on the larger samples.

MEPS does not include questions on presenteeism. Both absenteeism and presenteeism, however, are included in the proprietary National Health and Wellness Survey (NHWS), although it does not capture medical expenditures. Therefore, the 2008 NHWS cross-sectional data set was used to quantify the absenteeism/presenteeism elasticity (δ). NHWS is a self-administered, Internet-based questionnaire that focuses on the health status and healthcare attitudes, behaviors, and outcomes of adults aged 18 years or older. It is fielded to 63,000 members of an Internet-based consumer panel and is designed to be representative of the US adult population. NHWS captures absenteeism and presenteeism by using the Work Productivity and Activity Impairment (WPAI) index.

The WPAI index is a validated questionnaire, commonly used across various occupations and disease areas to assess employee productivity losses related to health [10]. Absenteeism is measured by using the following question: "During the past seven days, how many hours did you miss from work because of your health problems?" Presenteeism is assessed with the following question, "During the past seven days, how much did your health problems affect your productivity while you were working?" Participants indicate their level of work impairment via a rating scale ranging from 0 to 10, with 0 indicating that "health problems had no effect on my work" and 10 indicating that "health problems completely prevented me from working." Each response is assumed to represent a percentage reduction in productive work due to health problems (e.g., a respondent reporting a value of 3 is assumed to have a 30% reduction in productive work, whereas a respondent reporting a 10 is assumed to be completely unproductive while at work).

NHWS also includes questions similar to those in MEPS that capture self-reported height and weight, employment status, and other sociodemographic characteristics. Other than the requirement of being in two consecutive years of data (data for only 1 year were available for the analysis), the same sample restrictions were applied as for the MEPS data. The primary analysis sample included 2164 individuals who were full-time employees and eligible for LAGB; supplemental analyses were run on the larger sample.

Estimation of indirect costs

MEPS provides annual estimates for medical expenditures and absenteeism. To annualize the WPAI index data, each respondent's absenteeism estimate was divided by 8 (to convert it from hours to days) and multiplied by 50, the estimated number of workweeks in a year. The presenteeism percentage was multiplied by 250 (the number of workdays per year) to estimate the number of workdays per year that the individual was unproductive at work due to health problems.

Using the annualized values for medical expenditures, absenteeism, and presenteeism, regression modules of the following form were used to estimate the elasticities:

$$\log(\mathrm{ABS}_i) = \beta \log(\mathrm{MED}_i) + \lambda Z_i + \varepsilon_i$$
$$\log(\mathrm{PRES}_i) = \delta \log(\mathrm{ABS}_i) + \eta Z_i + \nu_i$$

The log-log specification has the advantage that the coefficients on log(MED_i) and log(ABS_i) are estimated elasticities. In the MEPS model, with annual absenteeism days as the dependent variable and annual medical expenditures as the key independent variable, this coefficient is a direct estimate of β, the percentage change in absenteeism for a given percentage change in medical expenditures. In the NHWS model, with annual presenteeism days as the dependent variable and annual absenteeism days as the key independent variable, this coefficient provides an estimate of δ; multiplying this estimate times β provides an estimate of the percentage change in presenteeism for a given percentage change in medical expenditures.

Although the log-log model is a convenient method for estimating elasticities, it is problematic when the logged variables include a large percentage of zeros, as was the case for the medical expenditures, absenteeism, and presenteeism variables. To ensure that individuals with zeros for these variables were not dropped from the models, in the primary specification 0.1 days were added to all zero absenteeism and presenteeism days and $1 was added for all individuals who had no medical expenditures during the year. Supplemental analyses—which included 1) analyses on only those with positive values for these variables, 2) generalized linear models that did not require log transformations, and 3) larger adjustment factors—tested the robustness of this approach. We also explored the effects of not restricting the regressions to the surgery-eligible population.

All regressions also included the following control variables: age, sex (female indicator), and race/ethinicity (non-Hispanic white, Hispanic white, black [Hispanic and non-Hispanic], other). For the MEPS regression, individual fixed-effects models were used to control for unobservable time-invariant characteristics of individuals. Because only 1 year of data were available for the NHWS regression, a traditional ordinary least squares model was used to estimate δ.

The estimates of β and δ and estimates of α_i were combined as noted in the "Methodological Overview" section to generate quar-