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LIFETIME MEDICAL COSTS FOR WOMEN: CARDIOVASCULAR DISEASE, DIABETES, AND STRESS URINARY INCONTINENCE

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Purpose. To estimate the absolute and relative lifetime medical costs of treating women with cardiovascular disease (CVD), diabetes, or stress urinary incontinence (SUI).

Methods. Women under 65 years, treated for CVD, diabetes, or SUI, were identified using administrative medical claims data from a large employer (n >100,000). A case-control methodology was used to estimate the annual medical costs of these women. Based on these estimates and published government statistics, annual costs for women 65 years and older were calculated. An incidence-based methodology with steady-state assumptions was used to project to lifetime medical costs. Cost estimates are incremental, measured as the difference between costs of patients and their demographically similar controls without the condition. They therefore represent the additional costs of treating patients with the condition, beyond the average, baseline costs incurred by controls without the condition.

Findings. The incremental lifetime medical cost of treating a woman (in 2002 dollars) with CVD is $423,000, with diabetes is $233,000, and with SUI is $58,000. Including the baseline medical costs of the control, the total lifetime medical costs (i.e., sum of incremental and baseline lifetime medical costs) of treating a woman with CVD are 3.4 times greater than the costs of a woman without CVD. Similarly, a woman with diabetes has total costs on average, 2.5 times greater than the costs of her control, whereas a woman with SUI has total lifetime medical costs 1.8 times greater than the costs of a similar woman without SUI.

Conclusions. These substantial cost estimates suggest the need for further gender-specific research and policies addressing the long-term implications of health care financing, treatment, and preventive care.

Keywords: Cardiovascular disease, Diabetes, Stress urinary incontinence, Lifetime costs, Cost of illness

Background

Annual cost of illness studies have proliferated since the 1960s. Currently, there are over a thousand published annual cost of illness studies available on a variety of illnesses (Bloom, Bruno, Maman & Jayadevappa, 2001). A more recent area of research is the study of the lifetime cost of illness. The relatively limited research in this field incorporates a range of methodologies, including steady-state incidence-based estimation, Markov modeling, and probability-based analysis (Bagust, Hopkinson, Maier & Currie, 2001; Barnett, Birnbaum, Cremieux, Fendrick & Slavin, 2000; Caro, Ward & O'Brien, 2002; Hartunian, Smart & Thomson, 1980; Mathers & Penm, 1999; Policy Analysis Inc., 1981; Taylor, Davis, Torner, Holmes, Meyer & Jacobson, 1996). However, no standard methodology has yet become widely accepted. Moreover, while gender-specific, an-

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nual cost of illness research exists (Birnbaum, Leong & Greenberg, 2003; Hodgson & Cohen, 1999), a literature search revealed an absence of lifetime cost studies by gender. These studies have the potential to greatly enhance the depth of knowledge and understanding in this previously unexplored area.

This paper presents the first lifetime medical cost study conducted exclusively for women that we are aware of. By combining a case-control methodology to calculate annual medical costs and an incidence-based methodology with steady-state assumptions to project these costs over a person's lifetime, we estimate the lifetime medical costs of treating women with one of three common, chronic conditions: cardiovascular disease (CVD), diabetes, and stress urinary incontinence (SUI). The case-control methodology enabled us to estimate the total medical costs of women treated with one of these conditions, incorporating both the cost of treating the condition and any "additional" costs of treating comorbid (i.e., coexisting) conditions. For example, our estimate of the absolute lifetime cost of treating a woman with diabetes includes not only the costs of treating her diabetes, but also the additional costs associated with the treatment of her comorbid conditions (e.g., hypertension, retinopathy). "Additional" refers to medical costs that are above the average baseline costs experienced by a woman with similar demographic characteristics not suffering from the primary condition, in this example, diabetes. The patient-level, incremental cost estimates presented in this study provide patients and their payers with an understanding of the additional cost of suffering from a specific chronic condition. Furthermore, understanding these costs on a gender-specific, lifetime basis enriches the possibilities for policy and health care decision-making, as well as individual financial planning.

The Conditions

Cardiovascular disease, diabetes, SUI are three common, chronic conditions among women that exhibit a broad range of severity and cost. While CVD (defined here as ischemic heart disease, heart failure, stroke, and atherosclerosis) has historically been known to be widely prevalent and severe among men, it is becoming more widely understood that CVD is also common among women and significantly impacts their lives. According to the American Heart Association (2002), CVD is the leading cause of death among women, claiming more than 500,000 female American lives in 1999. However, heart disease often remains undetected and thus untreated in many women until the condition becomes severe. As a result, 39% of women who have heart attacks die within 1 year compared to 31% of male sufferers (Society for Women's Health Research, 2002).

Diabetes (Type 1 and 2) is a debilitating condition of increasing severity over time that requires lifelong treatment after diagnosis. Approximately 8.2% of American women, 20 years and older, suffer from diabetes (i.e., 8.1 million women) (National Center for Chronic Disease Prevention and Health Promotion, 2002). Type 1 diabetes is an autoimmune disease characterized by a lack of insulin production that onsets most often during adolescence. In contrast, Type 2 diabetes (accounting for over 90% of diabetes cases) (National Center for Chronic Disease Prevention and Health Promotion, 2002) is a progressive metabolic disorder mainly due to increased peripheral resistance to insulin that generally onsets after the age of 45 years. While the need for insulin treatment among patients with Type 1 diabetes is immediate and routine after diagnosis, Type 2 diabetes patients experience a greater range of treatment options depending on the severity of their case. Treatments can range from modified diet and exercise, to oral hypoglycemic agents and insulin therapies. A substantial amount of research has been conducted on the annual costs of diabetes in general (American Diabetes Association, 1998; Ramsey, Summers, Leong, Birnbaum, Kemner & Greenberg, 2002), but we are not aware of studies that have focused exclusively on the lifetime economic burden on women.

While SUI is not a life-threatening condition, urinary incontinence can have a significant impact on the quality of life of women experiencing incontinence symptoms (Hagglund, Walter-Engstrom, Larsson & Leppert, 2001; Hunskaar & Vinsnes, 1991). Symptoms of SUI include the involuntary leakage or loss of urine while coughing, sneezing, laughing, or during physical activity. The condition primarily afflicts women, especially those who are parous and postmenopausal. It is a highly prevalent condition—40% of women in the United States experience urinary incontinence with three-quarters of these experiencing some symptoms of SUI (Giovanni, 1999; Ramanzi, 2001). Treatment for SUI depends on the severity and frequency of leakages, and ranges from less costly behavioral management and exercises to surgical therapies.

Cardiovascular disease and diabetes were broadly defined in this analysis to provide a general estimate of the lifetime costs of these conditions for women. Comparing the costs of CVD, diabetes, and SUI among women allowed us to illustrate the variation of lifetime cost among three conditions with widely varying severities (i.e., SUI is much less severe than many forms of CVD and diabetes).

Methods

This research used a case-control design to separately estimate the annual incremental cost of treating a woman under 65 with CVD, diabetes, or SUI. For each condition, annual costs were estimated as the difference between the costs of patients and demographically similar controls not treated for the condition. The annual costs of women 65 years and older were estimated based on the costs for women under 65 years and published government statistics. An incidence-based approach with steady-state assumptions was used to project these annual costs over a patient's lifetime. Statistics were generated using the SAS software program, Version 8 (SAS Institute Inc., 1999).

Study population

To calculate annual costs, we used an administrative dataset with medical claims from 1996 through 1998. These claims are for beneficiaries of a large, national Fortune 100 company with worksites distributed across virtually all regions of the United States and including over 100,000 women (i.e., employees, spouses, and dependents) under 65 years. The company's employees work in a broad range of industrial, sales and marketing, technical, and support positions. The data include the actual payments made by the employer for medical (i.e., inpatient, outpatient, office, and other medical service) and prescription drug claims for beneficiaries who were continuously enrolled in one of the company-sponsored fee-for-service indemnity health insurance plans. Since the employer's health benefits are quite comprehensive, out-of-pocket costs are minor and coverage from outside sources is unlikely. Furthermore, patients in capitated plans (e.g., closed HMO systems), approximately 15% of the beneficiaries, were not included because of the potential for incomplete medical utilization. This helps ensure that the measured employer payments approximate the entire cost.

We identified women with one of these three conditions based on their medical claim diagnoses, using International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes. To identify diabetes patients, we also relied on prescription drug claims and National Drug Classification (NDC) codes, as described in Ramsey et al. (2002). Specifically, diabetes patients were identified by two or more medical claims with an ICD-9-CM code of 250.XX or by a prescription drug claim for a hypoglycemic agent. The CVD patients were identified by one or more medical claims with an ICD-9-CM code of 410.XX to 414.XX, 428.XX, 436.XX, or 440.XX. The SUI patients were identified by one or more medical claims with an ICD-9-CM code of 625.6X. Table 1 summarizes the demographic information of the identified patient samples. Note: We have chosen to use the term woman, interchangeably with the term female since most of the patients in our sample were adults. Use of the term woman, therefore, does not imply that the person is an adult female, but merely that the person is of the female gender.

Table 1. Demographic characteristics of CVD, diabetes, and SUI patient groups, under age 65

	CVD	Diabetes	SUI
Number of patients	6,528	3,759	931
Patient status			
Percent employees	18%	15%	23%
Percent retired	2%	3%	1%
Percent spouses/dependents	80%	82%	75%
Age			
Mean	53	52	51
Median	54	54	51
Mode	56	63	50
<18	1%	1%	<1%
18–35	3%	4%	3%
36–45	13%	12%	24%
46–55	41%	38%	42%
56–64	42%	44%	31%

Women under 65 years: case-control method

A case-control methodology was applied to the three patient samples to compute annual incremental costs. Annual incremental costs are defined as the difference between the annual cost of patients and their demographically similar controls, reflecting the additional medical cost of treating women with each condition. Using a case-control methodology described in Barnett et al. (2000), we matched each patient to a beneficiary not treated for that condition, based on five criteria: gender, age, employment status, health plan, and residential zip code. Data on race and income, potentially important variables, were not available for this analysis. We successfully matched 90% of the identified CVD patients, 93% of the diabetes patients, and 94% of the SUI patients to controls, after allowing slight variations in age (i.e., ± 3 years) and zip code while still maintaining exact correspondence in the other criteria. Zip code variations used owing to the unavailability of income data consisted of looking for controls in the same metropolitan area as the patient with per-capita income within 10% of the patient's zip code. This type of analysis is commonly found in health economics literature. Underlying it is the assumption that any zip code meeting this criterion is similar to that of the patient and thus is likely to reflect similar lifestyles and attitudes (i.e., it serves as a good proxy for socioeconomic status). The control groups used in this analysis were therefore women of similar ages and socioeconomic characteristics as the patient samples. However, since zip codes do not always encompass homogenous populations, this may not necessarily be the case.

Using this methodology with the employer claims dataset, we determined the total costs in 1997 and 1998 of both patients (under 65 years) and their controls, by condition with the incremental costs computed as the difference in costs between the two groups. Since each control group reflects the demographic characteristics of the corresponding patient sample, the total costs of the three control groups differ.

Women 65 years and older: estimation based on government statistics

Patient level Medicare claims data were not available for this study. An alternate approach, involving assumptions and published government statistics, was used to estimate the annual costs of women 65 years and older. As discussed later, these estimates were assessed for their sensitivity relative to another study that used Medicare claims data and were found to be robust.

A series of assumptions were made to extrapolate the annual costs of women 65 years and older, based on the employer claims dataset and published government statistics. We used cost ratios of patients and controls (from the administrative claims data) separately, to the average female employer beneficiary under 65 years of age (from a 10% random sample of beneficiaries), as well as the prevalence rate of the conditions among patients aged 55 to 64 years, to extrapolate the costs among women 65 years and older. We began with the per capita health care expenditures of an average woman, 65 years or older, obtained from published U.S. government statistics (Hodgson & Cohen, 1999). These per capita health care expenditures are based on the Health Care Financing Administration's (HCFA) estimates of personal health care expenditures, which are then disaggregated by age and gender using a variety of data sources such as Medicare Provider Analysis and Review, Physician/Supplier Part B files, national hospital survey, and IMS data. Similar to the cost data for the under 65 population, these figures include medical and prescription drug expenditures that are paid by both insurers (i.e., Medicare, supplemental private insurance) and out-of-pocket. To estimate the average annual incremental costs of women 65 years or older treated for one of the three conditions, we first multiplied the per capita expenditure figure by the cost ratio of patients to average female beneficiaries. To generate a corresponding cost for controls 65 years or older, we multiplied the per capita expenditure figure by the cost ratio of controls to average beneficiaries. The difference between these two figures represents the estimated average incremental per capita cost of treating a woman, 65 years and older, with the condition.

To estimate the total annual incremental cost of women 65 years or older, we first calculated the total number of women with the condition 65 years or older by multiplying the prevalence rate of the condition (assumed to be the same as that among women 55–64 years) by the number of women 65 years or older. The product was then multiplied by the average incremental per capita cost by condition estimated, to calculate the total annual incremental cost of women 65 years or older in 1997 and 1998.

Lifetime cost estimation: incidence based approach with steady-state assumptions

Ideally, one would track a cohort of patients and their costs over their entire lifetime to calculate their actual lifetime costs. This is not feasible. However, by making steady-state assumptions, we are able to use 2 years of annual cost data for a cross-section of patients to estimate lifetime costs. This incidence-based, steady-state methodology is adapted from the one used in Barnett et al. (2000) to estimate the longitudinal cost of a patient with cancer. In this method, life expectancy is not explicitly used to derive lifetime costs; rather, it is implicitly reflected in the data. The steady-state assumptions are that:

- The number of newly diagnosed patients per year is constant, and
- In any given year, the observed patient sample represents a stable cross-section of age, severity, and cost combinations.

Given these assumptions, the longitudinal stream of expected incremental (i.e., additional) costs of those newly diagnosed in 1998 (i.e., lifetime costs) are essentially incorporated in the annual 1997 and 1998 data. Specifically, if EX_{98} is the total incremental cost of those newly diagnosed with the condition in 1998 and $EX_{98}(k)$ is the incremental cost in year k for those newly diagnosed in 1998, then it follows that:

$$EX_{98} = EX_{98}(97) + EX_{98}(98) + EX_{98}(99) + EX_{98}(00) + EX_{98}(01) + EX_{98}(k) + \ldots \quad (1)$$

Moreover, if TC_{97} represents the total annual incremental cost of all diagnosed patients with the condition in 1997 and $EX_z(97)$ is the total incremental cost in 1997 for patients diagnosed with the condition in year z then,

$$TC_{97} = EX_{98}(97) + EX_{97}(97) + EX_{96}(97) + EX_{95}(97) + EX_{94}(97) + EX_z(97)\ldots \quad (2)$$

Then, based on our assumptions, we can state that:

$$EX_{97}(97) = EX_{98}(98)$$

$$EX_{96}(97) = EX_{98}(99)$$

$$EX_{95}(97) = EX_{98}(00)$$

etc.

Therefore, $EX_{98} = TC_{97}$.

In other words, the total annual incremental costs of all patients in 1997 (TC_{97}) is a proxy for the lifetime costs of patients newly diagnosed in 1998 (EX_{98}). Thus, one meaningful estimate of the incremental lifetime cost per patient is TC_{97}/N_{98}, where N_{98} is the number of newly diagnosed patients in 1998. Another, equally good, estimate of the incremental lifetime cost per patient is TC_{98}/N_{98}.

Lifetime costs (LC) can therefore be estimated as an average of these two estimates:

$$LC = (TC_{97} + TC_{98})/(2N_{98}) \quad (3)$$

where TC_{97} and TC_{98} are the total annual incremental costs of diagnosed patients in 1997 and 1998, respectively.

Using the case-control methodology detailed earlier we estimated the total annual incremental costs of diagnosed patients in 1997 and 1998, by condition. The number of newly diagnosed patients in 1998 (N_{98}) was identified for each condition as a subset of the under and over 65 years patient samples. Patients in the under 65 years sample were identified as newly diagnosed in 1998 if they had one or more medical claims for the condition in 1998 and no such claims in 1996 or 1997. Since CVD is a broad disease category, we identified CVD patients based on a subset of common CVD conditions and used stricter criteria to determine newly diagnosed CVD patients. This ensured that those who had claims for other, less common or severe CVD conditions in 1996 or 1997 were excluded. To estimate the number of newly diagnosed among the 65 years and older population, we assumed that the incidence rates of the conditions among women aged 55 to 64 years in the employer dataset are the same as those among women over 65 years and older.

Having estimated the annual incremental cost of women under and over 65 years in 1997 and 1998, and the number of newly diagnosed patients in 1998, among women under and over 65 years, by condition, we used equation (3) to estimate lifetime incremental costs for women under and over 65 years, by condition. For each condition, the lifetime cost estimates for women under and over 65 years were summed to generate the first estimates of the absolute lifetime incremental medical costs of treating women with CVD, diabetes, or SUI.

We then estimated the relative cost of the three conditions. This was calculated as the ratio of the total lifetime cost of the condition (sum of the incremental lifetime cost of the condition and the baseline lifetime cost of the controls) to the lifetime cost of the controls.

An analysis of the claims data reveals that cost of the average woman in the administrative claims database is within 15% of the average U.S. woman. To make the cost estimates more representative of the U.S. population, the data used were adjusted (i.e., inflated) to the level of average per capita health care expenditures in the United States (Hodgson & Cohen, 1999). Since the data used were from 1997 and 1998, the results were also inflated to the 2002 level using the inflation rate of the medical care component of the consumer price index, which averaged 3.8% per year from 1997 through 2001 (Bureau of Labor Statistics, 2002).

Limitations

Since a woman may have many employers or insurers over her lifetime even prior to being eligible for Medicare, the lifetime cost estimates generated by this study could be considered to represent the total cost to society as opposed to that for a single employer or insurer. These are first estimates and do not account for future medical cost inflation, changes in technology, or time discounting over a lifetime. Since the implications of future changes in technology cannot be predicted, we assumed that costs do not change over time. In all likelihood, these assumptions lead to lower-bound cost estimates. Time discounting could differentially affect the condition-specific cost estimates to the extent that the distribution of expenditures for the conditions is different over time. Furthermore, our application of the prevalence and incidence rates among women 55–64 years to those 65 years and older could lead to conservative estimates to the extent that prevalence rates rise more rapidly than incidence rates for women over 65 years. A similar underestimation may occur if the cost ratio of patients to their controls is actually higher for women 65 years and older than it is for women under 65 years. These limitations could be overcome by using claims data (not available here) for older women. Comparing the costs of female patients to those of men is beyond the scope of this analysis. This could, however, be a potentially useful area of study.

Since these estimates are based on claims of only one type of health insurance plan of a single employer, they may not be representative of a national cross-section. However, this may be alleviated to an extent since the data is from an employer with locations throughout the United States and a broad range of different job positions. Therefore, these estimates could be considered to approximate those of an employer-insured population.

Results

Annual costs

The annual incremental medical costs of treating a woman with CVD, diabetes, or SUI are high. Cardiovascular disease generates the highest annual costs, followed by diabetes, and then SUI. Figure 1 provides estimates of annual incremental costs for women (both under age 65 and 65 years and older) in 2002 dollars where incremental refers to the difference in costs between patients with the condition and their controls without the condition.

Annual medical costs are driven by medical utilization patterns, including the treatment of comorbid

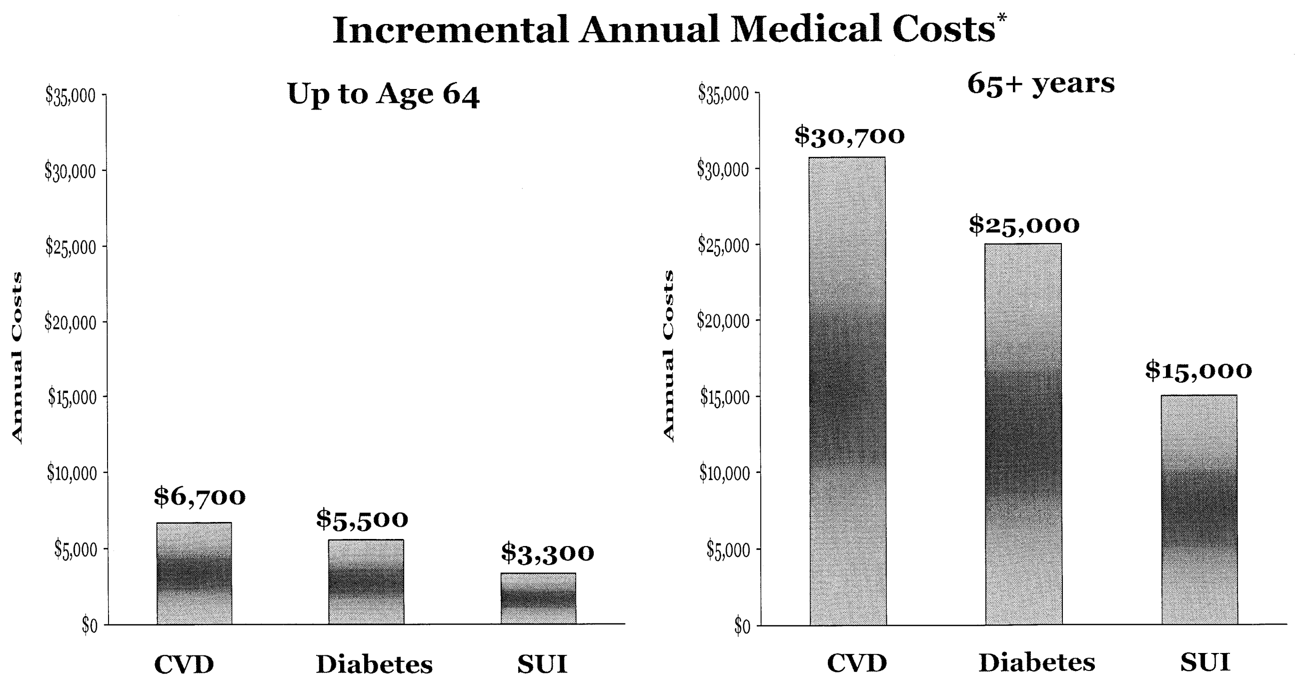

Figure 1. Annual costs by age group. *Data are averaged incremental annual medical costs per female treated for each condition where incremental refers to the difference between the total medical costs of patients and those of controls without the condition. Data adjusted to 2002 dollars.

conditions. For example, both CVD and diabetes require regular check-ups, with the more severe cases needing inpatient care. Moreover, each of the three conditions is related to other, often costly, conditions, which are risk factors for the conditions in question. For CVD, these comorbid conditions include hypertension, hypercholesterolemia, diabetes, and obesity (American Heart Association, 2002); those for diabetes include hypertension, nephropathy, neuropathy, and retinopathy (Ramsey, 2002). The treatment of each of these comorbid conditions can result in more frequent medical service utilization and thus higher costs.

Figure 2 provides an illustration of the medical utilization patterns of women under age 65, by condition. We find that women treated with any of the three conditions use more of all types of medical services than their controls. These findings are driven by the fact that women treated with these conditions are more likely than their controls to use all types of services at least once. Moreover, those who do use medical services generally use them more frequently than their controls. Inpatient care, in particular, is more common among women treated with CVD or diabetes.

Lifetime costs

Based on our calculations of the annual cost of a woman under and over 65 years with CVD, diabetes, or SUI, we projected the absolute lifetime costs of treating women with these illnesses. As presented in Figure 3, we estimated that the incremental lifetime medical cost of treating a woman with CVD is $423,000, with diabetes is $233,000, and with SUI is $58,000, compared to a woman without the condition.

Incorporating the baseline health care costs of these patients, the total lifetime medical costs (i.e., sum of incremental and baseline lifetime costs) of treating an average woman with CVD are $599,000, or 3.4 times greater than the cost of a similar woman without CVD. Similarly, a woman with diabetes has total lifetime medical costs of $393,000 on average, 2.5 times greater than the costs of her controls, while a woman with SUI has total lifetime medical costs of $133,000 on average, 1.8 times greater than the costs of her controls (see Figure 4). The baseline healthcare costs of patients and their controls varies by condition, due to the differing demographic characteristics of the corresponding patient samples.

Discussion

Our findings reveal that both the absolute and relative lifetime costs of women with CVD, diabetes, or SUI are substantial compared to similar women without the condition. However, owing to the various assumptions underlying the analysis, in particular the assumptions used to extrapolate costs for women 65 years and older, the absolute estimates are likely to be conservative. Furthermore, given that medical care is rapidly evolving, it may be that the relative cost ratios

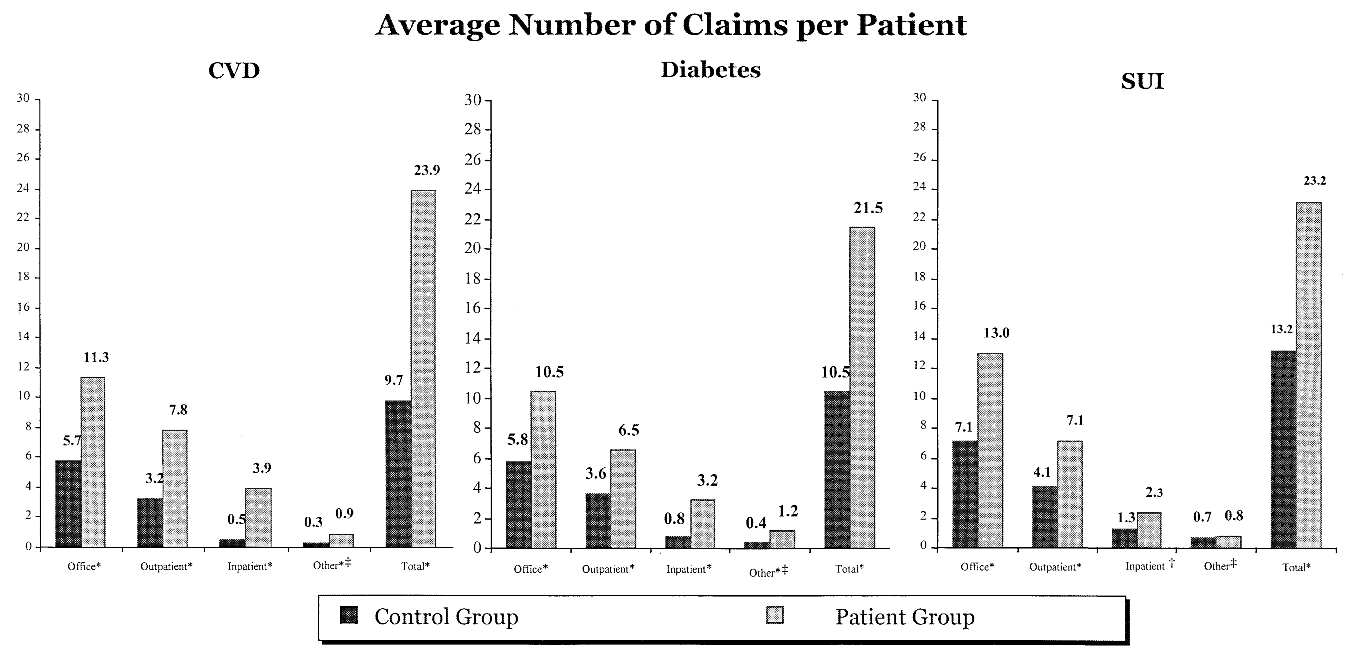

Figure 2. CVD, diabetes, SUI patients, under age 65 annual use of medical services by type of service. *All differences between the patient group and the control group: $p < .0001$. Differences were calculated using t-tests. †All differences between the patient group and the control group: $p < .05$. Differences were calculated using t-tests. ‡"Other" includes care at patient's home, nursing/extended care facility, psychiatric day-care facility, substance-abuse treatment facility, independent clinical labs, and ambulatory care.

are more stable to technological changes and hence prove more useful.

The fact that these estimates are based on claims of only one type of health insurance plan of a single employer could be considered a limitation in terms of generalizability. However, an analysis of the claims data shows that the annual cost of an average female beneficiary under 65 years in the employer claims data is similar (within 15%) to that of an average female American in the same age group. Furthermore, to the extent that this is an employer with locations throughout the United States and a broad range of different job positions, these estimates could be considered representative of an employer-insured population. Since more than 60% of American workers receive job-based health insur-

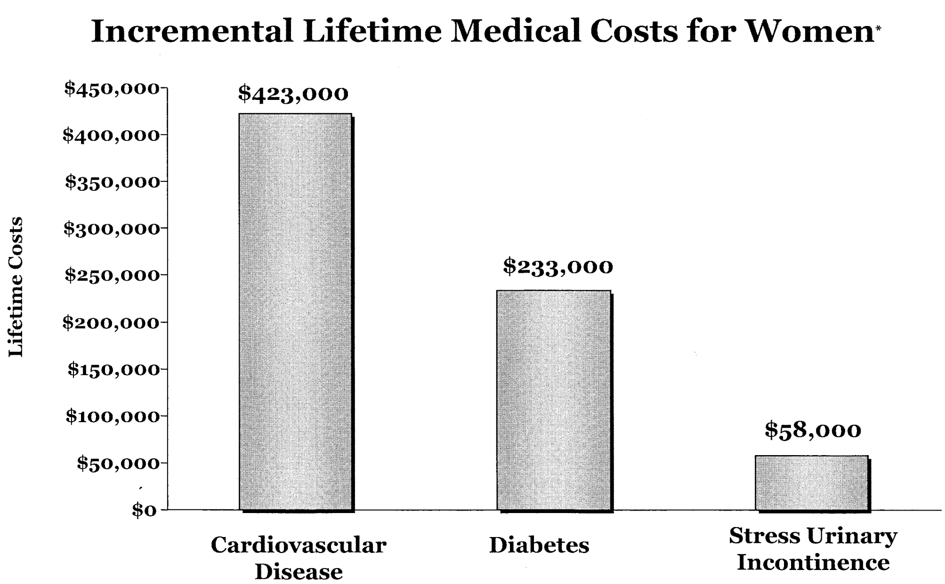

Figure 3. Absolute lifetime medical costs. *Refers to average incremental lifetime costs per female treated for each condition where incremental refers to the difference between the total medical costs of patients versus those of controls without the condition. Data adjusted to 2002 dollars.

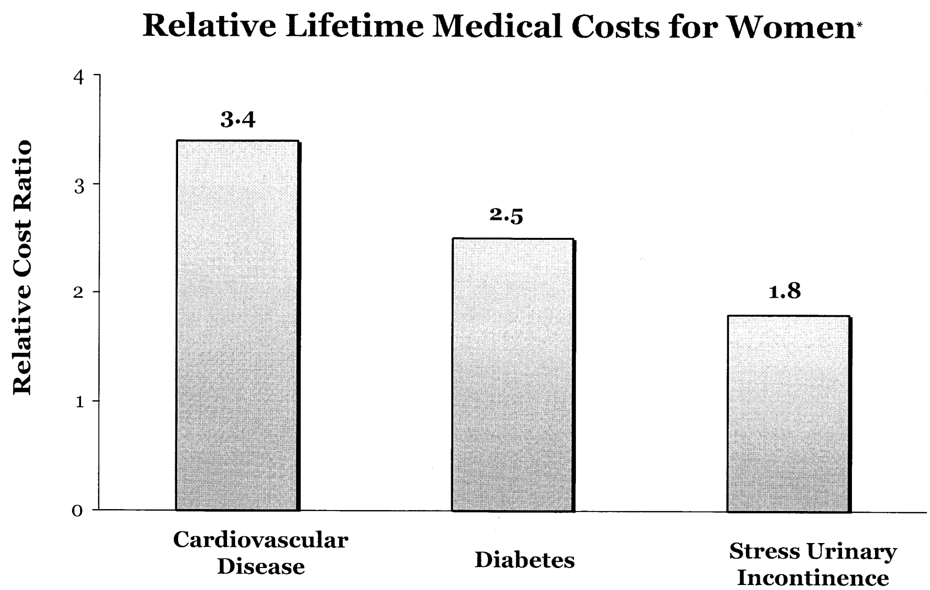

Figure 4. Relative lifetime medical costs. *Refers to the ratio of total lifetime medical costs (sum of incremental lifetime costs of the condition and baseline lifetime medical costs of the controls) to the lifetime medical costs of the controls.

ance (Health Affairs, 2003), this represents a large subgroup of the U.S. population.

We projected these lifetime costs based on annual costs of a stable cross section of patients using an incidence-based steady-state methodology. Moreover, having relied on published government statistics to generate cost estimates for women 65 years and older, our estimates are consistent with reported findings that women 65 years and older have medical costs approximately 5 times greater than women under 65 years (Hodgson & Cohen, 1999). Our estimates of the annual costs of women over 65 years are also consistent with other published research. For example, the cost figures reported by Ash et al. (2000) for diabetes and CVD are comparable to the figures reported in this research after accounting for non-Medicare-reimbursed medical expenditures and the additional treatment costs of comorbid conditions. Ash et al. report costs for women 65 years and older based solely on Medicare expenditures. In contrast, our research takes into account all medical expenditures for women 65 years and older, including payments made by supplemental private insurance, payments for prescription drugs, and out-of-pocket expenditures, in addition to Medicare's payments. Non-Medicare medical expenditures can be a significant component (almost 50%) (Centers for Medicare and Medicaid Services, 2003) of the total medical expenditures (including prescription drugs) for women 65 years and older. Furthermore, the Ash et al. paper does not take account of the additional treatment costs of comorbid conditions, as we do in this study. For example, they measure the cost of treating diabetes only, as opposed to the total incremental cost of a patient treated for diabetes and its comorbid conditions. After accounting for these differences, our figures are consistent.

The incidence-based methodology used to estimate lifetime costs in our analysis is consistent with a previous study by Mathers and Penm (1999). Their findings of the ratio of lifetime to annual costs of diabetes are consistent with ours after accounting for the differing epidemiological patterns in the data used. In fact, our analysis uses actual claims data to calculate the costs of women under 65, whereas Mathers and Penm use an extrapolation methodology based on survey data to estimate the costs of patients of all ages.

Our study provides a comprehensive view of costs by analyzing the lifetime costs of a woman with the condition rather than just the cost of treating the condition. Specifically, we account for the additional costs of treating comorbid conditions that are not borne by demographically similar women. Other studies, such as the one by Taylor et al. (1996) measure only the lifetime costs associated with treating the condition in question. Costs of comorbid conditions can form a substantial cost component of the primary condition. For patients with CVD or diabetes, these comorbidities can be especially costly and severe. Previous research suggests that for patients treated with diabetes, the costs for these comorbid conditions are greater than the cost of treating the diabetes itself (Summers, Leong, Birnbaum, Greenberg, Kemner & Ramsey, 2001). Awareness of these costs as well could allow women suffering from CVD, diabetes, or SUI to take appropriate actions regarding their health and financial security.

Some of the comorbidities for the condition, such as hypertension for CVD, are risk factors for the condition—thus they may actually precede the condition. The distinction between comorbidities caused by the condition and those that are risk factors for it is important in a study measuring only the cost of the condition, since it can bias the estimates. However, this distinction is irrelevant to our study because we are interested in the cost of treating a woman with the condition.

The findings of this study are first estimates and suggest the need for further lifetime cost research and methodological refinements. More representative estimates could be obtained by analyzing claims data from a number of different employers with a variety of insurance plans. To obtain a more holistic cost estimate, future research could assess the economic caregiver burden for patients' family members, and the indirect, work loss costs associated with the conditions, the latter being a potentially significant cost for women under 65 years.

The study provides a starting point for policy discussions on the longer term considerations regarding financing, treatment, prevention, and research as opposed to the short-term, annual focus of many policy discussions today. Evidence that conditions such as CVD are preventable continues to grow (Pearson et al., 2002). Various studies have identified persons with low levels of risk factors with low levels of CVD over their lifetime (Rosengren et al., 2001; Stamler et al., 1999). The preventable nature of these conditions, coupled with the heavy economic burden that they impose, makes it vital that increased emphasis is placed on prevention and individual financial planning. This study also highlights the need for women to be educated about their potential health risks and to seek routine preventative care. Our findings show that the costs of chronic illnesses are substantial and thus it would be beneficial to take steps to reduce the incidence of these conditions, where possible. Policymakers could benefit from awareness of these findings to consider the extent to which educational campaigns aimed at women are useful and necessary.

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References

American Diabetes Association. (1998). Economic consequences of diabetes mellitus in the United States in 1997. *Diabetes Care*, 21, 296–309.

American Heart Association. 2002 Heart and stroke statistical update. Available: http://www.americanheart.org. Accessed April 3, 2002.

Ash, A. S., Ellis, R. P., Pope, G., Ayanin, J. Z., Bates, D. W., Burstin, H., et al. (2000). Using diagnoses to describe populations and predict costs. *Health Care Financing Review*, 21, 7–28.

Bagust, A., Hopkinson, P. K., Maier, W., & Currie, C. J. (2001). An economic model of the long-term health care burden of type II diabetes. *Diabetologia*, 44, 2140–2155.

Barnett, A., Birnbaum, H., Cremieux, P. Y., Fendrick, A. M., & Slavin, M. (2000). The cost of cancer to major employer in the United States: A case-control analysis. *American Journal of Managed Care*, 6, 1243–1251.

Birnbaum, H. B., Leong, S. A., & Greenberg, P. E. (2003). The economics of women and depression: An employer's perspective. *Journal of Affective Disorders*, 74(1), 15–22.

Bloom, B. S., Bruno, D. J., Maman, D. Y., & Jayadevappa, R. (2001). Usefulness of US cost-of-illness studies in healthcare decision making. *Pharmacoeconomics*, 19, 207–213.

Bureau of Labor Statistics, U.S. Department of Labor. Available: http://stats.bls.gov/news.release/cpi.nr0.htm. Accessed April 22, 2002.

Caro, J. J., Ward, A. J., & O'Brien, J. A. (2002). Lifetime costs of complications resulting from type 2 diabetes in the U.S. *Diabetes Care*, 25, 476–481.

Centers for Medicare and Medicaid Services. Medicare: A profile. Available: http://cms.hhs.gov/statistics/35chartbk.pdf. Accessed January 17, 2003.

Giovanni, E. (1999). Stress urinary incontinence in women: Removing the barriers to exercise. *The Physician and Sports Medicine*, 27, 39–52.

Hagglund, D., Walter-Engstrom, M. L., Larsson, G., & Leppert, J. (2001). Quality of life and seeking help in women with urinary incontinence. *Acta Obstetricia et Gynecologica Scandinavica*, 80, 1051–1055.

Hartunian, N. S., Smart, C. N., & Thomson, M. S. (1980). The incidence and economic costs of cancer, motor vehicle injuries, coronary heart disease and stroke: A comparative analysis. *American Journal of Public Health*, 70, 1249–1260.

Health Affairs. Press release: Number of Americans with job-based health benefits grew through early 2001, despite higher benefit costs. January 8, 2002. Available: http://www.healthaffairs.org/press/janfeb0202.htm. Accessed April 30, 2003.

Hodgson, T., & Cohen, A. (1999). Medical expenditures for major diseases, 1995. *Health Care Financing Review*, 21, 119–164.

Hunskaar, S., & Vinsnes, A. (1991). The quality of life in women with urinary incontinence as measured by the Sickness Impact Profile. *Journal of the American Geriatrics Society*, 39, 378–382.

Mathers, C., & Penm, R. (1999). Health system costs of cardiovascular diseases and diabetes in Australia 1993–94. AIHW cat. no. HWE 11. Australian Institute of Health and Welfare (Health and Welfare Expenditure Series no. 5).

National Center for Chronic Disease Prevention and Health Promotion. Diabetes public health resource. National diabetes fact sheet. Available: http://www.cdc.gov/diabetes/pubs/facts98.htm. Accessed April 3, 2002.

Pearson, T. A., Blair, S. N., Daniels, S. R., Eckel, R. H., Fair, J. M., Fortmann, S. P., et al. (2002). AHA scientific statement. AHA guidelines for primary prevention of cardiovascular disease and stroke: 2002 update. Consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular diseases. *Circulation*, 106, 388.

Policy Analysis Inc. (December 1981). Evaluation of cost of illness ascertainment methodology, Part II. Applications of methodology to ascertain lifetime economic costs of illness in an incidence cohort. Final Report to the National Center for Health Statistics. DHHS Contract No. 233-79-2048.

Ramsey, S., Summers, K. H., Leong, S. A., Birnbaum, H. G., Kemner, J. E., & Greenberg, P. (2002). Productivity and medical costs of diabetes in a large employer population. *Diabetes Care*, 25, 23–29.

Ramanzi, L. (2001). Urinary incontinence in women and men. *The Journal of Gender-Specific Medicine*, 4, 14–20.

Rosengren, A., Dotevall, A., Eriksson, H., & Wilhelmsen, L. (2001). Optimal risk factors in the population: Prognosis, prevalence, and secular trends; Data from Goteborg population studies. *European Heart Journal*, 22, 136–144.

SAS Institute Inc. (1999). SAS/STAT user's guide, version 8. Cary, NC: SAS Institute Inc.

Society for Women's Health Research. (2002). Available: http://www.womancando.org/conditions.html. Accessed November 26, 2002.

Stamler, J., Stamler, R., Neation, J. D., Wentworth, D., Daviglus, M. L., Garside, D., et al. (1999). Low risk factor profile and long-term cardiovascular and noncardiovascular mortality and life expectancy: Findings for 5 large cohorts of young adult and middle-aged men and women. *Journal of the American Medical Association*, 282, 2012–2018.

Summers, K. H., Leong, S. A., Birnbaum, H. G., Greenberg, P. S., Kemner, J., & Ramsey, S. (2001). Cost of illness. Identification of diabetes patients using claims data: An economic analysis. *Drug Benefit Trends*, 13(B), 28–33.

Taylor, T. N., Davis, P. H., Torner, J. C., Holmes, J., Meyer, J. W., & Jacobson, M. F. (1996). Lifetime cost of stroke in the United States. *Stroke*, 27, 1459–1466.

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