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Metabolic Syndrome and Employer Sponsored Medical Benefits: An Actuarial Analysis

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ABSTRACT

Objective: Metabolic syndrome, a cluster of cardiometabolic risk factors, is associated with a twofold increased risk of developing artherosclerotic cardiovascular disease and a fivefold increased risk of developing diabetes, compared to individuals without metabolic syndrome. For a typical employer-sponsored health benefits program and population, we estimate the medical cost generated by employees and covered dependents with and without metabolic syndrome, with an emphasis on costs associated with cardiovascular events.

Methods: National Health and Nutrition Examination Survey (NHANES) 1999 to 2000 and NHANES 2001 to 2002 data sets were used to identify the prevalence of metabolic syndrome (based on National Cholesterol Education Program Adult Treatment Panel III [NCEP ATP III] criteria) in the 20- to 69-year-old age group and calculate the Framingham risk score for coronary artery disease (CAD) and stroke events. We created a 3-year event model and performed Monte Carlo simulation to produce event occurrence for each individual. Results were tabulated for people with and without metabolic syndrome and adjusted for a typical working-age demographic mix. MedStat Marketscan™ was used to develop costs of CAD and stroke events and the incremental contributing cost of metabolic syndrome. We applied these costs to working-age cohorts with and without metabolic syndrome to calculate the cost difference between cohorts.

Results: Working-age individuals with metabolic syndrome had significantly higher medical costs compared to those without metabolic syndrome: $626 per member per month (PMPM) for those with metabolic syndrome compared to $367 PMPM for those without metabolic syndrome. Of the $259 excess medical cost for individuals with metabolic syndrome, $46 is because of additional cardiovascular events and $213 is because of the expense of higher prevalence of comorbidities, particularly cardiovascular disease and diabetes.

Conclusions: These findings show that most cardiovascular cost and risk borne by employers is concentrated in the one-third of the working-age population with metabolic syndrome. Employers need resources and approaches for treating and managing metabolic syndrome that combine health, wellness, and medical management programs to enhance screening, identification, and treatment of the risk-factor components of metabolic syndrome.

Keywords: CAD and stroke events, cardiometabolic risk factors, employer medical cost, Framingham risking, metabolic syndrome, NCEP, NHANES, PMPM incremental costs.

Introduction

Metabolic syndrome has recently received increased attention as a significant health concern and cost driver for employers sponsoring medical benefit programs. About 23% of the US adult population has metabolic syndrome with much higher prevalence in the working-age population [1]. Studies show that metabolic syndrome brings an approximate twofold increase in relative risk for atherosclerotic cardiovascular disease (ASCVD), and an approximate fivefold increase in risk for developing diabetes compared to people without the syndrome [2]. Medco Health Solutions, Inc., analyzed claims from approximately two million adult patients aged 20 and older and found that individuals taking medications for at least three of the risk factors associated with metabolic syndrome had an annual drug spend more than four times that of all other patients [3].

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Definition

Metabolic syndrome is defined as a cluster of risk factors of metabolic origin—*metabolic risk factors*—that appear to directly promote the development of ASCVD and increase risk for developing type 2 diabetes mellitus [4]. The National Cholesterol Education Program, Adult Treatment Panel III (NCEP ATP III) identifies components of the metabolic syndrome that relate to cardiovascular disease, including abdominal obesity, atherogenic dyslipidemia, raised blood pres-

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sure, insulin resistance, proinflammatory state, and prothrombic state [5].

There have been several criteria sets proposed for the clinical diagnosis of metabolic syndrome over the past 10 years. The most widely accepted criteria and that proposed by the American Heart Association (AHA) and National Heart, Lung and Blood Institute (NHLBI), is that of NCEP ATP III. This criteria set (with minor modifications by AHA/NHLBI) identifies an individual as having metabolic syndrome if he or she has at least three of the five following risk factors [4].

1. Elevated waist circumference.
   - ≥102 cm (≥40 inches) in men;
   - ≥88 cm (≥35 inches) in women.
2. Elevated triglycerides.
   - ≥150 mg/dL (1.7 mmol/L); or
   - On drug treatment for elevated triglycerides.
3. Reduced HDL-C.
   - <40 mg/dL (1.03 mmol/L) in men;
   - <50 mg/dL (1.3 mmol/L) in women; or
   - On drug treatment for reduced HDL-C.
4. Elevated blood pressure.
   - ≥130 mmHg systolic blood pressure; or
   - ≥85 mmHg diastolic blood pressure; or
   - On antihypertensive drug treatment in a patient with a history of hypertension.
5. Elevated fasting glucose.
   - ≥100 mg/dL; or
   - On drug treatment for elevated glucose.

Etiology and Treatment

Although the exact cause of metabolic syndrome is not clear, there seem to be three potential causes: Abdominal obesity and disorders of adipose tissue; insulin resistance; and a constellation of independent factors. Other factors that have been cited are aging, proinflammatory state, and hormonal changes [6]. The risk for ASCVD depends on which metabolic risk factors are present as well as the presence of other risk factors. The most important metabolic syndrome risk factors are abdominal obesity and insulin resistance while other associated risk factors are physical inactivity, aging, and hormonal imbalance [6].

First-line therapy recommended for metabolic syndrome is lifestyle interventions to reduce the metabolic syndrome risk factors. The major lifestyle interventions include weight loss in overweight or obese patients, increased physical activity, and modification of an atherogenic (high-fat) diet. Drug therapy is recommended for the treatment of risk factors (dyslipidemia, elevated blood pressure, elevated glucose) [4].

We used epidemiological and medical cost data to estimate the medical cost generated by employees and covered dependents with and without metabolic syndrome, with an emphasis on costs associated with cardiovascular events.

Methods

We mapped the NCEP ATP III modified criteria for metabolic syndrome to the NHANES 1999–2000 and NHANES 2001–2002 (NHANES 1999–2002) survey data using the NHANES survey fields listed in Table 1.

Using the Framingham stroke and coronary artery disease (CAD) risking methodology [7–9], we calculated the annual risks of having a stroke or CAD event and death for NHANES 1999–2002 individuals with and without metabolic syndrome. We used the

Table 1 Mapping metabolic syndrome risk factors to NHANES survey fields

Metabolic syndrome risk factors	NHANES survey fields
Waist circumference	BMXWAIST
Triglycerides	LBXTR, or On drug treatment for elevated triglycerides: Niacin 42700 (NH code in drug file) Fenofibrate 24400 (NH code in drug file) Gemfibrozil 27000 (NH code in drug file)
HDL-C	LBDHDL, or On drug treatment for reduced HDL: Niacin 42700 (NH code in drug file) Fenofibrate 24400 (NH code in drug file) Gemfibrozil 27000 (NH code in drug file)
Blood pressure:	
systolic	BPXSAR
diastolic	BPXDAR, or On antihypertensive drug treatment in a patient with a history of hypertension: Drug file 0506 (antihypertensives) BPQ050A: Now taking prescribed medicine for hypertension
Fasting glucose	LBXGLU, or On drug treatment for elevated glucose: DIQ050 Are you now taking insulin DIQ070 Are you taking diabetes pills

NHANES, National Health and Nutrition Survey; HDL, high density lipoprotein.

NHANES survey fields from Table 2 to identify those with the Framingham risk factors.

We modeled the number of strokes, CAD events, and deaths that would occur over 3 years for individuals with and without metabolic syndrome. In accordance with the Framingham risk scoring methods we used, we assigned no CAD primary event risk to individuals under 30, no CAD secondary event risk to individuals under 35 and no stroke event risk to those under 55. We developed mortality rates for poststroke and post-CAD from rates reported in the literature [10]. We applied these rates to each year following a stroke or CAD event. Standard, life insurance mortality rates were used to account for mortality due to other causes. We applied the portions of metabolic syndrome lives by quinquennial age groups and sex to a standard employee adult population (10,000 employees and their spouses) covered through a typical large employer. The latter was from the Milliman *2005 Health Cost Guidelines*.

We modeled medical costs and events for a 3-year period. The medical costs included all paid claims (net of coinsurance) for commercially insured populations including physician, inpatient, outpatient, and pharmacy claims. The results present the average annual costs and events over the 3-year period. We used a 3-year period as this reflects a compromise between a long-term study and the short-term horizon of many employee benefit managers. To produce our cost estimates, we applied annual historical per-person medical claim costs identified in Medstat Marketscan™ claims data. These annual per-person costs were developed separately by gender by 5-year age bands for each event state and for nonevent years.

We identified individuals with claims for CAD and stroke events using a combination of International Classification of Diseases (ICD) 9th edition and current procedural terminology (CPT) code logic. We used these event costs (costs during the year of an event) and costs incurred in years 2 and 3 after an event, for individuals having a CAD or stoke event, whether or not they had metabolic syndrome. We did not apply a distinct medical cost to events that resulted in death.

For those with metabolic syndrome, we developed "no event year costs" using a regression model that captured the costs of people with diabetes, previous CAD, and hypertension. We applied the NHANES distribution of diabetes, CAD, and hypertension for people with metabolic syndrome and assigned costs to each of these conditions to arrive at an average of $544 PMPM for those with metabolic syndrome. For those without metabolic syndrome we developed "no event year costs" in a similar way to arrive at an average of $273 PMPM. We used the "no event year costs" for those not having an event for each of the 3 years of our modeling as well as for years prior to an event for those having an event in year 2 or 3.

The costs of people during the year of an event include a small number of individuals with multiple events. In our modeling, we adjusted event rates to avoid double counting individuals who may have more than one type of event in 1 year. Our model assumed that an individual could have, at most, one type of cardiovascular event (stroke, myocardial infarction [MI] without revascularization, MI with revascularization, or revascularization without MI) over the 3-year model period. We created a 3-year event model by producing Framingham risks for each working-age individual having adequate NHANES survey data. Our Monte Carlo simulation used 5000 iterations for each individual. We applied weights specified in NHANES and adjusted the age–sex distribution for our standard employer group demographics.

Table 2 Mapping Framingham risk factors to NHANES survey fields

Framingham risk factor	NHANES survey field
Diabetes any one	DIQ050 Are you now taking insulin
	DIQ070 Are you taking diabetes pills
	Drug file 1036 (blood glucose regulators)
	DIQ010 Have you ever been told by a doctor that you have diabetes or sugar diabetes
Cardiovascular disease any one	MCQ160C Doctor ever told you had CAD
	MCQ160D Doctor ever told you had angina
	MCQ160E Doctor ever told you had a heart attack
	Drug file 0503 antianginals
	Drug file 0508 coronary vasodilators
	MCQ160B Doctor told you had CHF
	BPXSAR—Systolic BP average reported to examinee >160, or
	BPXDAR—Diastolic BP average reported to examinee diastolic
	BP > 90
	Drug file 0506 (antihypertensives)
	BPQ050A Now taking prescribed medicine for hypertension
	MCQ160F—Has a doctor ever told you that you had a stroke
Cigarettes	SMQ040—Do you now smoke cigarettes?
HDL	LBDHDL
Total cholesterol	LBXTC

BP, blood pressure; CAD, coronary artery disease; CHF, congestive heart failure.

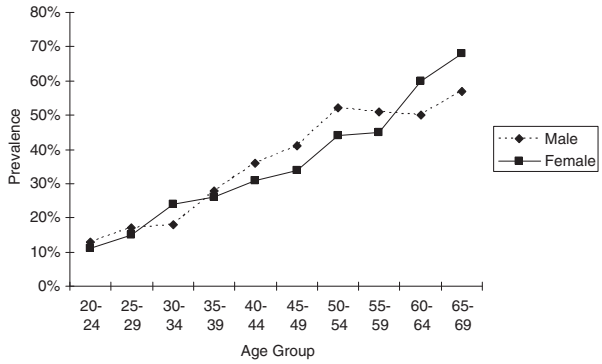

Figure 1 Prevalence of metabolic syndrome in a working-age population. Sources: NHANES 1999–2002, Milliman HCG 2005 Standard Demographics.

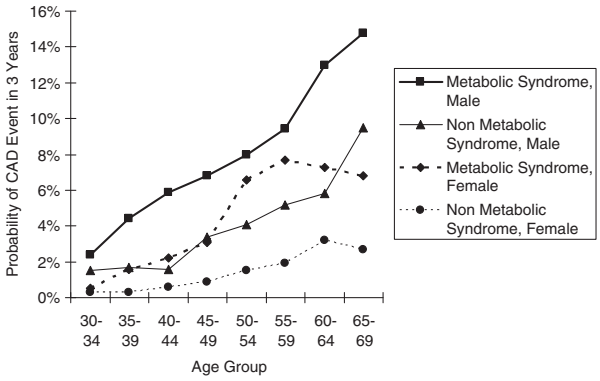

Figure 2 Three-year risk of CAD events in working-age population with and without metabolic syndrome. Source: NHANES 1999–2002, Milliman HCG 2005 Standard Demographics. Framingham risking methodology: Wilson PW, D'Agostino RB, Levy D, et al. [8]. (For primary prevention ages >30.) D'Agostino RB, Russell MW, Huse DM, et al. [9]. (For secondary prevention ages >35.)

Results

Prevalence

We identified a metabolic syndrome prevalence rate of 33% for a working-age population (20- to 69-year-olds). Figure 1 shows prevalence rates increasing with age, and prevalence rate for women surpassing men after age 60. The average age of those working-age people with metabolic syndrome in NHANES was 46 and the average age of those without metabolic syndrome was 40.

The majority of individuals identified with metabolic syndrome had the minimum three out of five risk factors (55%) while 32% had four risk factors and 13% had all five risk factors. The most common risk factors found in individuals with metabolic syndrome were abdominal obesity and dyslipidemia. This supports the AHA/NHBLI statement that the major lifestyle interventions for metabolic syndrome include weight loss, increased physical activity, and modification of an atherogenic (high-fat) diet.

The prevalence of diabetes, CAD, and hypertension are significantly higher in the metabolic syndrome cohort, particularly because the metabolic syndrome criteria includes active treatment for diabetes and hypertension as well as the presence of elevated glucose and blood pressure. Yet 70% of individuals with metabolic syndrome have not been diagnosed as having CAD or diabetes and therefore may not be receiving medical care to combat their higher risk of developing ASCVD and diabetes.

Risk for CAD and Stroke Events

Applying the Framingham risking methodology [7–9] to the NHANES population, we calculated each individual's probability of CAD (heart attack, coronary revascularization, and/or angina) and stroke events. Those with metabolic syndrome have approximately 2.5 times the risk of a CAD event and double the risk of a stroke event over a 3-year period compared to those without metabolic syndrome. Figures 2 and 3 illustrate these findings.

The decline in CAD risk in women after age 60 in Figure 2 appears to be associated with a significant decline in smoking and moderate decline in diabetes in this age group. We tested whether smoking prevalence is a driver for the difference in CAD and stroke risk between those with and without metabolic syndrome and found the difference in smoking rates to be a minor factor, with reported smoking prevalence rates of 25% for those with metabolic syndrome and 22% for those without metabolic syndrome.

Figure 4 illustrates the number of events that would occur over a 3-year period for an employer with 10,000 employees (plus 4721 spouses). People with metabolic syndrome will generate almost twice as

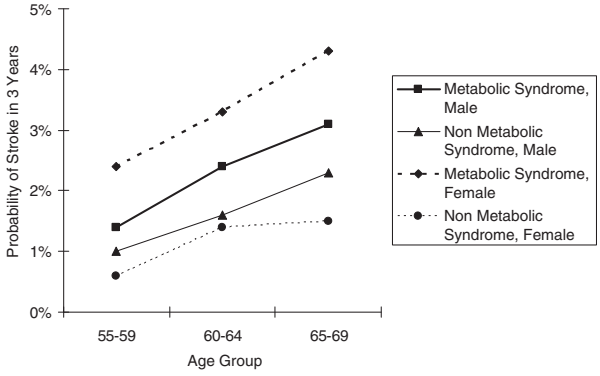

Figure 3 Three-year risk of stroke in working-age population with and without metabolic syndrome. Source: NHANES 1999–2002, Milliman HCG 2005 Standard Demographics, D'Agostino RB, Wolf PA, Belanger AJ, Kannel WB [7]. This risking is only applied to individuals ≥55 as indicated in the study.

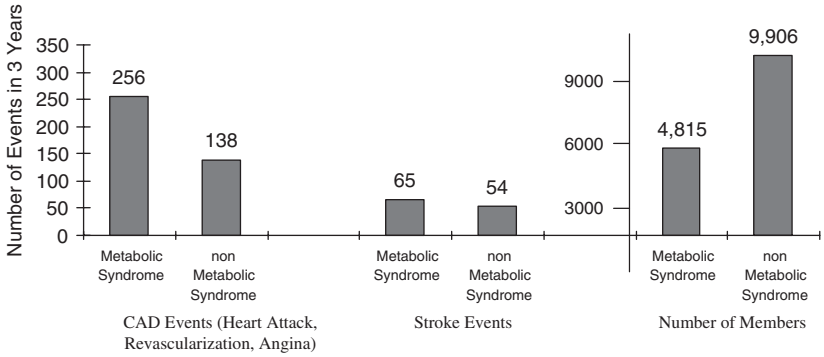

Figure 4 Three-year projection of CAD and stroke events for 10,000 employees plus spouses. Source: NHANES 1999–2002, Milliman HCG 2005 Standard Demographics, Framingham Risking Study.

many deaths from CAD events and strokes over 3 years. We have not attempted to assign life insurance or replacement costs for these deaths.

Contributing Costs

Costs during the year of a stroke or CAD event are presented in Figure 5. The event costs reflect all the medical costs incurred by a patient during the year of an event. Although, on average, costs for these people decrease in subsequent years, they are still relatively high for several years following these events and we used these subsequent year costs in our modeling. We also developed "no event costs" separately for individuals with and without metabolic syndrome to account for costs in years prior to an event and for those experiencing no events. All costs are projected to 2006 dollars.

Figure 6 summarizes the impact of several cost-increasing characteristics of people with metabolic syndrome. These people are higher cost because they have

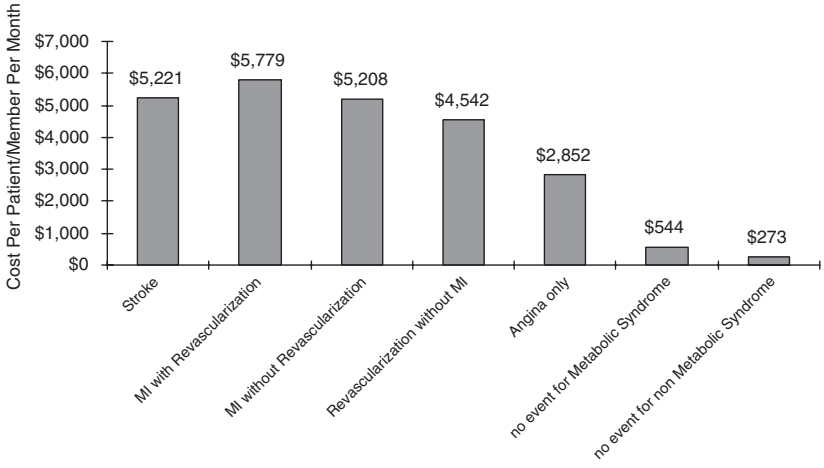

Figure 5 Cost of cardiovascular events and metabolic syndrome costs. Source: Milliman's review of MedStat MarketScan™ Commercial Data 2004 Trended to 2006 by 12% costs are for the year following an event.

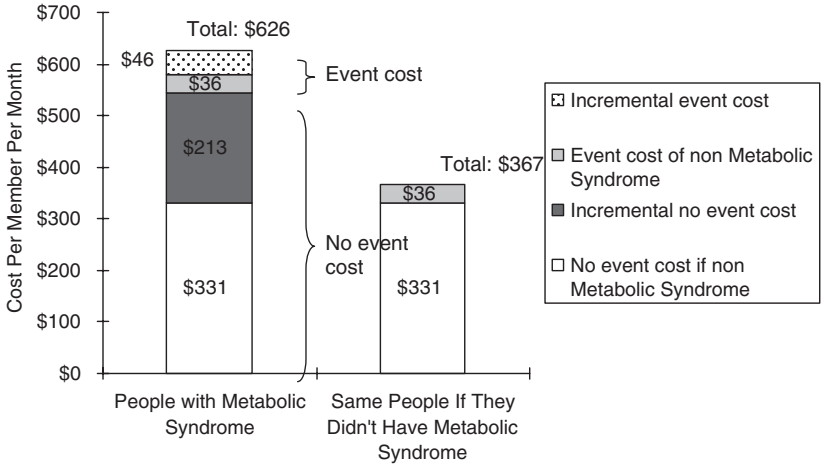

Figure 6 PMPM medical costs for age–sex adjusted individuals with and without metabolic syndrome. Source: Milliman modeling of cost data.

- More CAD and stroke events;
- Higher costs in the years after the events;
- When they do not have events, people with metabolic syndrome incur more costs related to their higher prevalence of hypertension, diabetes, and CAD.

Figure 6 distinguishes the cost impact of metabolic syndrome from the impact of age for the average person with metabolic syndrome. We show the projected PMPM costs for people with metabolic syndrome, and the costs of people with the same age–sex mix, but without metabolic syndrome. Our modeling shows that people with metabolic syndrome cost $259 PMPM more than people with the same age–sex mix but without metabolic syndrome. About $46 PMPM of the excess is because of events and $213 PMPM is because of the nonevent costs, mostly associated with CAD and diabetes.

Discussion/Potential for Progress

This report indicates that people with metabolic syndrome are expensive for employee health benefits programs. Although costs to employers associated with metabolic syndrome are not reported in the literature, costs attributable to obesity are reported to be 11.6% percent of private insurance spending in 2002. A higher prevalence of diabetes, hypertension, and hyperlipidemia in the obese population is considered a major driver of the increased costs; these are components of metabolic syndrome [11]. It is not clear if employers are aware of this risk.

Similarly, it appears as though people with metabolic syndrome are unaware of their risk. Our findings suggest that, although most cardiovascular cost and risk borne by employers is concentrated in the one-third of working-age people with metabolic syndrome, the majority of those with metabolic syndrome receive no treatment for their increased cardiovascular risk. Of those with metabolic syndrome, 71% do not have diagnosed CAD or diabetes and may not be seeking medical care. A high portion of people with risk factors for cardiovascular disease are undiagnosed, which poses a significant challenge for both the public health arena and for employers. Table 3 shows some readily available figures of the portion of people with cardiovascular risk factors who have not been diagnosed. While these figures do not come from a typical employee population, the under-diagnosis is dramatic. Most of the undiagnosed people will appear relatively healthy but some are at very high risk.

Table 3 Percent of people unaware/undiagnosed with cardiovascular risk factors. National estimates based on survey data

Condition	Percent of people with condition that are unaware/undiagnosed
Hypertension (adults)	36.6 [17]
Diabetes (adults)	29.0 [18]
Prediabetes (ages 40–74)	Over 50 [16]
Hyperlipidemia* (workforce)	41.0 [19]

*LDL cholesterol of 130 mg/dL or higher.

The need for identification and risk-factor treatment of those with metabolic syndrome is shared by both employers and employees. On-site services such as health fairs, clinics, and consumer-friendly testing devices can help identify people at risk; and because they are on-site, they bring a strong message from the employer. Wellness vendors offer a wide variety of programs and techniques to promote screening. Health risk assessment tools can and should be modified to include metabolic syndrome risk factors. A challenge with all of these tools is reaching high-risk people who do not want to participate. Some employers use financial incentives or penalties to promote participation.

Despite the advantages of on-site identification, we believe physician office visits will continue to be a main source of identification of risk factors. Physicians often improve risk factor screening efforts when payers measure and provide feedback on individual physician screening compliance. Health Plan Employer Data and Information Set (HEDIS) measures provide examples of how measurement can improve performance [12]. Initiatives to encourage providers to code for metabolic syndrome should be investigated with health plans. Although an ICD-9 code (277.7) was established for metabolic syndrome in 2002, our analysis found only 0.1% of a working-age population to have claims coded with this ICD-9. This contrasts sharply with the 33% we estimate as having metabolic syndrome.

After identification, the main treatment for metabolic syndrome components other than lifestyle changes is medication. While medical evidence proves that changes in diet and exercise will dramatically help manage metabolic syndrome risk factors, many patients will require drug therapy. Drug therapy compliance reduces events among people with dyslipidemia, hypertension, and diabetes. Pharmacy benefit managers (PBMs) and disease management companies use data analysis to identify patients who are not compliant with prescriptions and have programs to encourage compliance. Innovative benefit design programs adjust copays to promote compliance for critical need/value-based medications, taking advantage of the well-known fact that lower copays increase utilization [13]. Low-cost generic drugs are increasingly available for many of the cardio metabolic risk factors. This gives employers a tool to help manage costs while improving outcomes.

The data suggest that a focus on diabetes and prediabetes would be especially worthwhile. For diabetics, intensive blood sugar monitoring, regular retinal and foot exams, lipid testing, physical activity, and diet are associated with better outcomes. Medication com-

pliance and hemoglobin A1c levels are key metrics. Prediabetics may need medication therapy, but exercise and weight control will produce dramatically better outcomes. Most of these inputs and outputs can be measured and compared to established benchmarks.

Successful treatment of obesity through weight-loss programs has been frustrating, even though the obesity epidemic is widely recognized, as are the negative consequences of obesity. Employers may be interested in the emerging novel therapies that may have more success. In the meantime, employer coalitions have begun addressing obesity and many resources are available [14]. Some lifestyle management vendors are using personalized web-based systems to promote wellness [15] while most disease management companies concentrate their efforts on telephonic and mail contact. Visible, personal executive commitment to diet, exercise, smoking cessation, and other wellness programs will motivate some employees. The authors are optimistic that the attention being paid to obesity will produce scientifically validated weight-loss, behavioral, and medical programs.

Most employers will find it easiest to take action through third parties such as

- The health benefits insurer, health maintenance organization (HMO) or administrator;
- Disease management vendors;
- Behavioral carve-out companies, employee assistance plans, or special wellness programs.

For any actions or treatments—on-site, medication, or weight-loss programs—measuring results is key. Employers have leverage in negotiations with insurers, administrators, PBMs, and disease management companies to produce meaningful metrics and year-to-year improvements. Chronic medication compliance should mean the portion of patients who refill particular medications for the entire year—not, for example, the portion of diabetics who have filled at least one prescription for a statin during the year.

The extra costs of people with metabolic syndrome presented provide a rough estimate for a higher premium contribution for these people. Charging people higher premiums based on their risk is well-established for life insurance, but is controversial in employer-sponsored programs. Some jurisdictions may regulate how this can be done for health benefits, so an employer should consult a benefits attorney.

Given the wide variety of tools and approaches, employers should evaluate whether current in-house or outsourced programs are identifying and managing metabolic syndrome risk factors and identify enhancements that can be made to current programs as well as explore the need for new programs.

We would like to note that our conclusions need to be viewed in the context of the particular assumptions and conditions of the underlying data sources. In particular, others applying other definitions of "metabolic syndrome" would produce somewhat different results, and the Framingham risking methodologies we used are subject to revisions that may change their forecasts. Each of the data sources we used also has its own limitations. For example, NHANES data include survey information that may be inaccurate, and the coding of medical claims data reflects business practices rather than clinical trial standards. The application of our results to any particular population should consider adjustments to reflect the impact of demographic, utilization, health status, or reimbursement differences from our national representative figures.

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