Research Report

Workplace Wellness Programs

Services Offered, Participation, and Incentives

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Sponsored by the United States Department of Labor

For more information on this publication, visit www.rand.org/t/rr724

Published by the RAND Corporation, Santa Monica, Calif.

Preface

This Research Report was sponsored by the Employee Benefits Security Administration (EBSA) of the U.S. Department of Labor. The goal of this report was to leverage existing data to explore patterns of wellness program availability, employers' use of incentives, and program participation and utilization among employees. This report will be of interest to national and state policymakers, employers and wellness program vendors, employer and employee advocacy organizations, health researchers, and others with responsibilities related to designing, implementing, participating in, and monitoring workplace wellness programs.

This research was conducted under contract #DOLJ139335149 with the Department of Labor. The Task Order Officer for the project was Elaine Zimmerman of the EBSA, Department of Labor. We thank her for her guidance and review of the document; however, we note that the material contained in this report is the responsibility of the research team and does not necessarily reflect the beliefs or opinions of the Task Order Officer, EBSA, or the federal government.

This research was conducted in RAND Health Advisory Services, the consulting practice of RAND Health. A profile of RAND Health, abstracts of its publications, and ordering information can be found at www.rand.org/health. Comments or inquiries concerning this report should be sent to the lead author, Soeren Mattke, at Soeren_Mattke@rand.org or to his address at RAND: RAND Corporation, 20 Park Plaza, Suite 920, Boston, MA 02116.

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Executive Summary

Workplace health and wellness programs are becoming a common employee benefit in the United States. Most recently, the RAND *Workplace Wellness Programs Study* found about half of employers with at least 50 employees, and more than 90 percent of those with more than 50,000 employees, offered a wellness program in 2012.[1] In addition, a 2011 Aon Hewitt employer survey found that nearly 47 percent of employers without a wellness program planned to add one in the next three to five years.[2]

Wellness programs commonly screen employees—and, at times, dependents—for health risks through health risk assessment (HRA) surveys and biometric screening. These programs also provide interventions to address health risks and manifest disease, as well as promote healthy lifestyles. Wellness program popularity is mainly driven by employers' expectations that these programs will improve employee health and well-being, lower medical costs, and increase productivity.

As part of the requirements of the Patient Protection and Affordable Care Act (ACA) Section 1201, and sponsored by the Departments of Labor and of Health and Human Services, RAND recently completed a report to Congress on employer-sponsored wellness programs. That report assesses the current status of wellness programs offered by employers in the United States; evaluates the impact of programs on utilization, employee health care costs, health behaviors, and outcomes; and identifies best practices in program implementation. As the largest study on workplace wellness programs, it comprises a review of extant scientific and trade literature, a national survey of employers from the public and private sectors, statistical analyses using health care claims and wellness program data from a sample of employers, and case studies of the wellness programs offered by five heterogeneous employers. While the report fulfilled the requirements of the ACA, the data collected for this and other RAND projects provide a unique opportunity to address additional research questions.

The Office of Policy and Research (OPR) of the Employee Benefits Security Administration (EBSA) within the U.S. Department of Labor (DoL) contracted with RAND to conduct an analysis of existing data on wellness programs. This report describes the results of that analysis. The goals of the project were to leverage existing data to explore patterns of wellness program availability, use of incentives among employers, and program participation and utilization among employees.

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[1] S. Mattke, H. Liu, J. P. Caloyeras, et al., *Workplace Wellness Programs Study*, Santa Monica, Calif.: RAND Corporation, RR-254-DOL, 2013.

[2] Aon Hewitt, *2012 Health Care Survey,* Chicago, Ill., 2012.

We used two sets of data for this project. First, we used the 2012 RAND Employer Survey data set,[3] which used a nationally representative sample of U.S. employers that had detailed information on wellness program offerings, program uptake, incentive use, and employer characteristics. We used these data to answer questions on program availability, configuration, uptake, and incentive use in the first part of the report. Second, we utilized the health care claims and wellness program data for a large employer. We analyzed these data to predict program participation and changes in utilization and health as described in the second part of the report.[4]

Analysis of Employer Survey Data

The 2012 RAND Employer Survey solicited detailed information on workplace wellness programs, including the use of incentives, barriers to adopting a wellness program, reasons for discontinuing a wellness program, program evaluation, and program costs. The sampling frame was a stratified random sample of 3,000 public- and private-sector businesses employing at least 50 people, drawn from the 2011 Dun and Bradstreet Employer Data.[5] The response rate was 19 percent, resulting in a final sample of 589 employers.

We focused on two main research questions:

- Which employer characteristics predict program availability, program configuration, and incentive use?
- Are there typical program configurations—such as the combination of certain screening and health management interventions— and how are these configurations related to employee participation?

We also conducted analyses to determine whether framing incentives as rewards or penalties affected program participation rates. The analyses are based on descriptive statistics and logistic regression models that adjust for employer characteristics; all statistical analyses were weighted to make the sample nationally representative.

Which Employer Characteristics Predict Program Availability and Use of Incentives?

In our sample, 69 percent of employers offered a wellness program; of those that offered a program, 75 percent offered incentives to encourage program uptake.

Employer size was the most important predictor of whether the employer offered a program and how the program was configured. We estimated that about a third of the smallest employers (50 to 100 employees) had a wellness program, compared with about four-

[3] Mattke et al., 2013.

[4] For more details, see Mattke et al., 2013.

[5] Hoovers, a Dun & Bradstreet company, *Index*, web page, undated (subscription required).

fifths of the larger employers (more than 1,000 employees), after adjusting for employer characteristics. Similarly, about 60 percent of the smallest employers and 90 percent of other employers used incentives, mostly monetary ones, to promote program uptake.

Smaller employers without a wellness program tended to cite lack of financial resources and lack of cost-effectiveness as reasons, whereas larger employers were more likely to cite lack of employee interest. *Thus, cost concerns appear to explain the different decisions of smaller employers.* This finding has important policy implications related to resources for smaller firms to provide wellness programs, since about 36 percent of Americans work for employers with fewer than 100 employees.

How Are Wellness Programs Configured?

We used cluster analysis to determine five common combinations, or "program configurations", within wellness programs, with most employers opting for a program with a limited range of services (Table ES1). These five configuration categories reflect the services offered in a wellness program within the three main service categories: (1) screening to detect health risks, (2) lifestyle management to reduce health risks and encourage healthy lifestyles, and (3) disease management to support individuals with manifest chronic conditions.

Table ES1. Program Configuration Labels and Definitions

Program Configuration	Definition	Frequency (%)
Limited	Limited services across all three components	34
Comprehensive	Extensive services across all three components	13
Screening-focused	Broad range of screening services, limited other components	20
Intervention-focused	Broad range of lifestyle and disease management services but limited screening	21
Prevention-focused	Broad range of screening and lifestyle management services but limited disease management	12

SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.

Limited programs were particularly popular among smaller employers (50 to 100 employees): 70 percent of them offered this configuration, compared with only 41 percent of employers with 101 to 1,000 employees and only 36 percent of employers with more 1,000 employees.

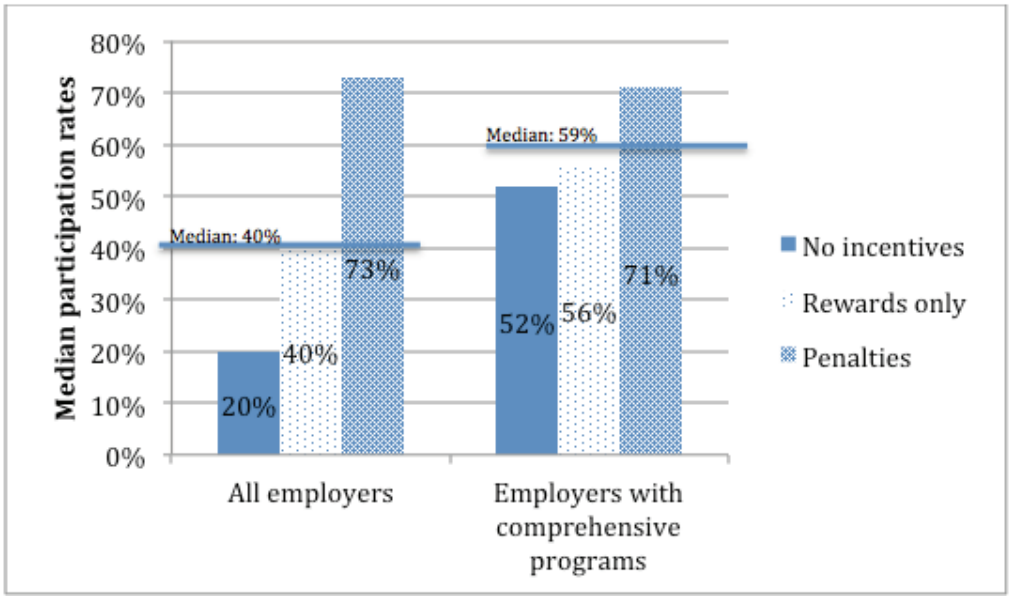
Are Incentives Increasing Program Uptake?

Employers that did not use incentives reported lower participation rates and framing incentives as penalties was associated with higher participation rates. In the absence of incentives, employers reported a median participation rate of only 20 percent (see Figure ES1). Uptake appears to increase with the use of monetary or nonmonetary incentives, with a median

participation rate of 40 percent. If penalties or surcharges for not participating were used, the median participation rate was 73 percent.

Program configuration also influenced participation. Employers with comprehensive programs reported the highest participation rate (59 percent). Participation in these programs was less sensitive to choice of incentive schemes, as Figure ES1 illustrates.

Figure ES1. Relationship of Incentives and Program Configuration to Participation Rates



Analysis of Wellness Program Data

We used data from a Fortune 100 employer to examine which employees participate in wellness programs and to estimate the effects of incentives on participation rates, as well as the effectiveness of participation on cost and utilization. The data included health care claims and wellness program data. They covered seven years of the employer's program and two baseline years for nearly 200,000 unique employees and dependents, or 730,000 full person-years.

The employer's wellness program consisted of a health risk assessment with questions on health and health-related behaviors, a lifestyle management component to address health risks, and a disease management component to support employees and dependents with manifest chronic conditions.

We focused on two overarching questions:

- Which employee characteristics predict program participation and are incentives changing these relationships?
- What changes in utilization and health are related to program participation?

To answer those questions, we used descriptive analyses and multivariate regression models. Although we used rigorous econometric techniques common in the program evaluation literature,[6] we note that the standard caveats for results from observational data analysis apply. In addition, we developed a simulation model to project the health impacts of wellness program participation over a 20-year time frame based on a nationally representative sample of working-age adults.

Which Employee Characteristics Predict Program Uptake?

Overall, only one-fifth to two-fifths of employees annually participated in wellness program components for which they were eligible, and predictors of program uptake varied by program component (e.g., lifestyle management, disease-management, predisease management). Healthier employees and those residing in higher-income ZIP codes were more likely to complete the HRA. For disease management, employees with multiple chronic conditions and older employees were more likely to participate. By contrast, health risk factors—with the exception of increasing body mass index (an indicator of weight status), did not predict lifestyle management and disease management uptake.

How Do Incentives Alter an Employee's Decision to (or Not to) Participate?

As of the fifth program year, the employer had introduced $600 surcharges for smokers who did not participate in a smoking cessation intervention, and for employees who were eligible for disease management but declined participation. The introduction of these penalties allowed us to estimate their effect on participation rates and participant characteristics.

Our estimates suggest that the surcharge was associated with a statistically significant increase in smoking cessation program uptake of 8.5 percentage points, but the participation rate remained well below 30 percent. Counterintuitively, the introduction of the surcharge in the disease management program was associated with a significant decrease in program uptake, about 18 percentage points. With the exception of higher disease burden, we found that few employee characteristics moderated the effect of the nonparticipation surcharges on program uptake.

Do Health Care Utilization Patterns Change Following Program Participation?

In the 2013 report, we found that participation in lifestyle management programs was not associated with significant changes in overall cost or utilization. *Examining this relationship at a more granular level in this report, we still find no significant cost savings or reduction in utilization*. Participants in the telephonic coaching component of the lifestyle management did

[6] Guido W. Imbens, and Jeffrey M. Wooldridge, "Recent Developments in the Econometrics of Program Evaluation," *Journal of Economic Literature,* Vol. 47, No. 1, 2009, pp. 5–86.

not exhibit lower rates of all hospital admissions, hospital admissions for wellness sensitive conditions, or emergency room visits.

Is There a Differential Effect of Selected Program Components on Medical Costs?

We hypothesized that participation in lifestyle management components, which targeted individuals with higher health risks, might be more likely to achieve reductions in health care cost. To test this hypothesis, we analyzed data for participants in the smoking cessation intervention and in the so-called predisease program for employees who were on the verge of developing a manifest chronic disease. *We found no evidence of cost savings among participants of either the smoking cessation or the predisease management program*.

Is There a Dose-Response Effect on Medical Costs in the Intensity of Program Interventions?

Greater exposure to the wellness program, through participating in more telephonic counseling sessions, also was not associated with greater health care cost savings. In fact, per-member-per-month health care costs were approximately $20 higher for high-intensity participants (those who attended five or more sessions per year) than for their lower-intensity counterparts.

What Are the Long-Term Effects of Lifestyle Management on Health and Cost?

Lower cardiovascular event rates due to wellness program participation reduced costs, but these savings did not come close to offsetting cumulative costs of participation. We used estimates from our previous report on lifestyle management program uptake and effect on health risks—such as smoking, weight, and cholesterol levels—to simulate the impact on a working-age population over a 20-year horizon. The results, under realistic assumptions, simulated a modest reduction of 257 cardiovascular deaths and 1,796 nonfatal cardiovascular events in a population of 100,000 people, at an estimated cost of about $40,000 per avoided event. While improving employee health certainly has additional benefits, these numbers suggest that employers will find it difficult to achieve financial gains from saved health care costs alone from lifestyle management.

Conclusions

The findings in this report underscore the increasing prevalence of worksite wellness programs. About four-fifths of all U.S. employers with more than 1,000 employees are estimated to offer such programs. For those larger employers, program offerings cover a range of screening activities, interventions to encourage healthy lifestyles, and support for employees with manifest chronic conditions.

Smaller employers, especially those with fewer than 100 employees, appear more reserved in their implementation of wellness programs. They are less likely to offer any program, have typically limited program offerings, and voice concerns about the business rationale.

In spite of widespread access, the actual use of wellness programs by eligible employees and/or dependents remains limited. Our analysis of data from the large employer shows that only 20 to 40 percent of eligible individuals participate in a program in any given year. Participation rates as reported in our survey suggest a median rate of 40 percent.

Thus, it is not surprising that employers are attempting to boost program uptake with rewards and penalties. And employers state that incentives have the intended effect: In our survey data, median program participation rates were reported to be 20 percent for employers who did not use incentives, compared with 40 percent for employers that used rewards and 73 percent for employers that used penalties and/or rewards.

However, the analysis of actual participation data from a large employer paints a less optimistic picture regarding the effectiveness of penalties, as a $600 penalty increased participation in a smoking cessation program by only 8 percent and failed to raise uptake of a disease management program. Combined with the observation from the survey that participation rates in comprehensive wellness programs appear to vary less with incentive use, this study suggests that employees consider factors in addition to incentives, such as program design and accessibility, when contemplating whether to join.

In this context, it is important that our results contribute to the literature that documents an inability of lifestyle management portions of workplace wellness programs to reduce health care cost. We have previously shown that lifestyle management participation is associated with reduction of health risks (such as smoking and being overweight), but not with lower cost. In this report, we analyzed whether cost savings might be realized in higher-risk employees and in those who are more engaged in the program, but we found no evidence to support this hypothesis.

In addition, we extrapolated the impact of the estimated health effects of lifestyle management programs on the risk of cardiovascular events and found that an employer with 100,000 employees would see only 1,796 fewer cardiovascular events and 257 fewer cardiovascular deaths over a period of 20 years under current estimates for program participation and effect.

While we have to acknowledge the limitations of our study, such as the nonexperimental design and the fact that we analyzed data from only one employer, our findings contribute to evidence on the currently prevailing type of lifestyle management programs that are offered by employers; i.e., telephonic coaching for employees with health risks. If similar findings were reproduced in further research, they would imply that screening large numbers of individuals for health risks combined with education and one-on-one coaching for those with risks appears not to be effective or cost-effective enough to have a meaningful impact on the health of America's workers and the cost of health coverage.

Our assessment contrasts with a widely quoted meta-analysis by Baicker et al. that estimated a reduction in health care cost of about $3 for every dollar invested in workplace wellness programs.[7] This study, however, has been criticized for including studies that were several decades old and had substantial methodological weaknesses. Our findings also appear surprising when compared to the analysis of the Johnson & Johnson program, one of the best-known and longest-running workplace programs in the United States.[8] Its most recent evaluation suggested a return on investment in a range of $1.88–$3.92 saved for every dollar spent. It should be kept in mind, though, that this evaluation compared health care cost for Johnson & Johnson to those of similar employers, correcting for workforce differences. Consequently, the effect estimates are reflective of the *overall* differences in health care coverage and health management between Johnson & Johnson and the reference companies and effect estimates may partly be attributable to unobservable firm-level differences, such as health care coverage, health management, or culture between Johnson & Johnson and the reference companies..

Because we compared program participants to statistically matched nonparticipants, our design is more reflective of the *actual incremental effect* of participating in the telephonic coaching interventions under a workplace wellness program.t. Of note, nonindustry-sponsored studies that use a similar design tend to arrive at similar conclusions. For example, a 2012 evaluation of the University of Minnesota's wellness program found no savings to be associated with lifestyle management program participation.

Apart from replicating our findings in a larger sample of employers, future research should investigate the potential of "personalized" wellness programs, which match intervention modality, intensity, and objectives more closely to an individual's beliefs, attitudes, and preferences, and of "public health" type programs, which aim to create a culture of health in the workplace rather than targeting individuals.

[7] K. Baicker, D. Cutler, and Z. Song, "Workplace Wellness Programs Can Generate Savings," *Health Affairs,* Vol. 29, No. 2, 2010, pp. 304–311.

[8] Rachel M. Henke, Ron Z. Goetzel, Janice McHugh, and Fik Isaac, "Recent Experience in Health Promotion at Johnson & Johnson: Lower Health Spending, Strong Return on Investment," *Health Affairs,* Vol. 30, No. 3, 2011, pp. 490–499.

Acknowledgments

We would like to thank our Task Order Officers, Anja Decressin, Keith Bergstresser, and Elaine Zimmerman, of the Employee Benefits Security Administration, Department of Labor.

We want to express our gratitude to the Care Continuum Alliance for providing us with the data for our analyses of program impact through its Data Aggregation Project. Particular thanks go to the project team at the Care Continuum Alliance: Jeanette May, Karen Moseley, and Sue Jennings. We also thank the other members of the Data Aggregation Project, Michael Connor, Pat Ducher, John Howard, and John Rodriguez from Alere Health; Jennifer Flynn from the Mayo Clinic; and many others who wished to remain anonymous, as well as the employers who permitted us to use their data for the project.

We want to express our appreciation to program staff, experts, and focus group participants at the case study employers for hosting us and providing invaluable color and context to our analysis; to clinicians, benefits consultants, academics, and experts in the field who took the time to provide thoughtful input and valuable data to the research team; to The Kaiser Family Foundation for generously sharing the questionnaire for the 2011 Annual Survey of Employer Health Benefits, which we used as a reference in designing our employer survey; and to Mercer for providing useful findings from the 2009 National Survey of Employer-Sponsored Health Plans. In addition to those contributors, we thank a number of other individuals and organizations that participated anonymously.

Many staff members at RAND helped us to realize this project. In particular, we thank Melissa Bradley and her team from RAND's Survey Research Group, who administered the employer survey, Patrick Orr for supporting the project team and the production of the report, and Daniela Golinelli, John Adams, Q Burkhart, and Nancy Nicosia who provided input into the statistical design. The RAND Health Quality Assurance process employs peer reviewers, including at least one reviewer who is external to the RAND Corporation. This study benefited from the rigorous technical reviews of Elizabeth Sloss at RAND and Jill Horwitz, Professor of Law at the University of California at Los Angeles.

Abbreviations

ACA	Patient Protection and Affordable Care Act
BMI	body mass index
CAD	coronary artery disease
CHF	congestive heart failure
DBP	diastolic blood pressure
DD	difference-in-differences
DDD	triple differences, or difference-in-difference-in-differences
DoL	U.S. Department of Labor
EBSA	Employee Benefits Security Administration
ER	emergency room
GLM	generalized linear model
HRA	health risk assessment
ITT	intent to treat
Kaiser/HRET	Kaiser/Health Research & Educational Trust
NAICS	North American Industry Classification System
NHANES	National Health and Nutrition Examination Survey
OPR	Office of Policy and Research
PMPM	per member per month
PSM	propensity score matching
Rx	prescription
SBP	systolic blood pressure
SD	standard deviation
SE	standard error

1. Introduction

Workplace health and wellness programs are becoming a common employee benefit in the United States.[9] Most recently, the RAND Workplace Wellness Programs Study found about half of employers with at least 50 employees—and more than 90 percent of those with more than 50,000 employees—offered a wellness program in 2012.[10] In addition, a 2011 Aon Hewitt employer survey found that nearly 47 percent of employers without a wellness program planned to add one in the next three to five years.[11] Wellness programs screen employees—and, at times, dependents—to identify health risks, provide interventions to address health risks and manifest disease, and promote healthy lifestyles. Their complexity varies across employers, with large employers much more likely to offer complex wellness programs that combine a variety of interventions and components.

Wellness program popularity is mainly driven by employers' expectations that these programs improve employee health and wellbeing, lower medical costs, and increase productivity. For instance, a 2011 employer survey conducted by Automatic Data Processing Inc., a payroll and benefits services company, found the four most common reasons for offering a program were to "improve employee health" (78 percent), "control health care costs" (71 percent), "increase productivity" (42 percent), and "reduce absenteeism" (43 percent).

A number of provisions in the ACA, such as those that allow for greater flexibility in the use of incentives for health standards, may encourage uptake of wellness programs by employers. In fact, under the ACA, the limit on maximum incentives that are tied to specific health standards through a group health plan will increase from 20 percent to 30 percent of the cost of coverage in 2014. For programs addressing tobacco use, the maximum incentive will be set at 50 percent of the cost of coverage.[12]

As part of the requirements of the ACA Section 1201 and sponsored by the Department of Labor and the Department of Health and Human Services, RAND recently completed a report to Congress. The report assesses the current status of wellness programs offered by employers in the United States, evaluates the impact of programs on employee health care costs, utilization,

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[9] ADP Research Institute, *Why You Should Care About Wellness Programs*, Roseland, N.J.: ADP Research Institute, 2012; Deloitte Center for Health Solutions, *2012 Deloitte Survey of U.S. employers: Opinions About the U.S. Health Care System and Plans for Employee Health Benefits*, New York: Deloitte, July 2012.

[10] S. Mattke, H. Liu, J. P. Caloyeras, C. Y. Huang, et al., *Workplace Wellness Programs Study*,. Santa Monica, Calif.: RAND Corporation, RR-254-DOL, 2013.

[11] Aon Hewitt, *2012 Health Care Survey,* Chicago, Ill., 2012.

[12] "Incentives for Nondiscriminatory Wellness Programs in Group Health Plans," Washington, D.C.: Federal Register 78(106), 2013.

health behaviors, and outcomes, and identifies best practices in program implementation. As the largest study on workplace wellness programs, it comprises a review of extant scientific and trade literature, a national survey of employers from the public and private sectors, statistical analyses using health care claims and wellness program data from a sample of employers, and case studies of the wellness programs offered by five heterogeneous employers. The survey component of this work, the RAND Employer Survey, contains detailed information on wellness program offerings, incentives and relevant employer characteristics. While the report fulfilled the requirements of the ACA, the data collected for this and other RAND projects provide a unique opportunity to address additional research questions.

The Office of Policy and Research (OPR) of the Employee Benefits Security Administration (EBSA) in the U.S. Department of Labor (DoL) contracted with RAND to conduct an analysis of existing data on wellness programs. This report describes the results of that analysis. The goals of the project are to use existing data to explore patterns of wellness program offering, use of incentives among employers, and program participation and utilization among employees.

We have used these data to further expand the knowledge base around workplace wellness programs. Chapter Two addresses the following two research questions based on an analysis of data from the RAND Employer Survey conducted in 2012:

- Which employer characteristics predict wellness program offering, program configuration, and incentive use?
- Are there typical wellness program configurations—such as the combination of certain screening and health management interventions— and how are these configurations related to employee participation?

Chapter Three addresses two other research questions based on data from a Fortune 100 employer:

- Which employee characteristics predict wellness program participation? Do incentives change these relationships?
- What changes in utilization and health are related to wellness program participation?

Each of those two chapters is self-contained, with a description of the objectives, data sources, methods, and results, as well as a discussion of the findings. Chapter Four integrates key findings and discusses limitations from both chapters as conclusions. Detailed technical appendixes describe the statistical models, regression output, and other supplemental material.

2. Employer Survey Analysis

Introduction

This chapter expands on the RAND *Workplace Wellness Programs Study*,[13] which provided descriptive information about workplace wellness programs in the United States. The detailed description of the RAND Employer Survey, such as sample selection, instrument development, analytic weights and the key variables (i.e., incentive types, relevant covariates) are defined in the 2013 report and form the foundation of the analysis presented in this chapter.

The primary objective of this additional analysis of the survey is to deepen the knowledge base surrounding an employer's decision to offer a workplace wellness program, how these programs are structured, and the types of employee incentives used to increase participation. Data from the RAND Employer Survey, combined with employer characteristics from the Dun and Bradstreet Employer Data,[14] enable us to examine these questions in greater detail.

The study focused on two main research questions:

- Which employer characteristics predict wellness program offerings and use of incentives?
- Are there typical wellness program configurations and incentive structures? Are these configurations associated with employee participation in wellness programs?

Methods

Data Sources

Our analysis uses two data sets: The RAND Employer Survey and Dun and Bradstreet Employer Data.[15] The RAND Employer Survey is a self-administered, nationally representative survey of 589 organizations, each of which employs more than 50 people. The survey was conducted in 2012 and is the most comprehensive survey to date of employer wellness programs. It solicited detailed information on these programs, including the use of incentives, barriers to adopting a wellness program, reasons for discontinuing a wellness program, program evaluation, and program costs. Specific variables from the survey are listed in Table 1.

The survey used a stratified random sample to ensure a balanced representation of different types of employers, including private companies and government agencies. The sample was

[13] Mattke et al., 2013.

[14] Hoovers, a Dun & Bradstreet company, *Index*, web page, undated (subscription required).

[15] Mattke et al., 2013; Hoovers, undated.

stratified on the basis of number of employees and industry because these characteristics were expected to be associated with the type and scope of wellness program offerings based on the literature and expert input. The overall response rate was approximately 19 percent (from an initial sample of 3,000 employers), resulting in a final sample of 589 employers.[16]

More details on the sampling process can be found in Appendix A of the *Workplace Wellness Programs Study*.[17] The appendix also includes details about the analytic weights used in the analysis of the RAND Employer Survey data. These analytic weights correct for uneven response rates from different employer segments (e.g., size, location) based on observable characteristics, and enable extrapolation to the national level.

The Dun and Bradstreet Employer Dataset is a large-scale data set containing a complete listing of private and public companies or organizations in the United States.[18] The data set contained records on 72.4 million businesses and government agencies at the end of 2011, when the RAND Employer Survey was developed. Selected variables from this data set were merged with the RAND Employer Survey to create a more comprehensive data set on employer wellness programs and other employer characteristics. An overview of the variables drawn from these two data sets is shown in Table 1.

[16] This is a typical response rate for a business survey using a nontelephone mode. For more details see Kaiser Family Foundation/Health Research and Educational Trust (Kaiser/HRET), *Employer Health Benefits: 2010 Annual Survey*, Menlo Park, Calif.; Chicago, Ill., 2010.

[17] Mattke et al., 2013.

[18] Hoovers, undated.

Table 1. Relevant Variables in the Dataset Used in the Employer Analysis

Variable	Definition
Offers a wellness program*	Whether an employer offers a wellness program
Offers incentives*	Whether an employer that offers a wellness program offers incentives for participation
Type of incentive offered*	Whether an employer offers a monetary or nonmonetary incentive, or both
Wellness program components*	Whether an employer offers specific program components within four broad program categories (see Table 3 for a list of subcomponents)
Lifestyle management	
Screening	
Disease management	
Participation rate*	Percentage of employees who participate in wellness program (reported by employer)
Barriers to offering*	Barriers to offering wellness program (e.g. financial, lack of interest) (ranked by importance by employer)
Plans to offer in the future*	Whether the employer plans to offer a wellness program over the next five years
Employer characteristics	
Gender composition*	Percentage of employees who are female
Age composition*	Percentage of employers who are 50 years old or older
Salary bands**	Average salary band for full-time employees (divided into five categories)
Number of employees**	Number of full-time employees (divided into six categories)
Firm characteristics	
Industry type**†	Whether an employer is in heavy industry, trade, services, or public administration
Revenue**	Total annual revenue
Region**	Region of the country in which employer is located (Four Census regions)
Years in business**	Number of years in business

SOURCES: * Mattke et al., 2013; ** Hoovers, undated.
NOTE: † Industry type is defined using the 2007 North American Industry Classification System, as follows: heavy industry (e.g., agriculture, mining, construction, manufacturing), trade (e.g., retail trade, warehousing), service (e.g., information, finance and insurance, educational services), and public administration (e.g., federal, state governments)

Analytic Approach

Research questions and analytic methods are summarized in Table 2. We started with two big-picture questions, which we subdivided into research questions that were then addressed by statistical techniques. The technical details of these techniques are described in Appendix A.

Table 2. Analytic Approach for Employer Survey Analysis

	Research Questions	Analysis
Which employer characteristics predict wellness program offering and use of incentives?	1.1: Which employer characteristics are associated with offering a wellness program?	Logistic regression of employer offering a wellness program on employer characteristics
	1.2: Which employer characteristics are associated with use of incentives?	Logistic regression of employer offering participation incentives on employer characteristics
	1.3: Which employer characteristics are associated with barriers to offering a wellness program or reasons for discontinuing a program?	Descriptive statistics of ranking a reason for not offering a wellness program as "important" and employer characteristics
	1.4: Which employer characteristics are associated with employers planning to offer a wellness program?	Logistic regression of employer planning to continue to offer a wellness program on employer characteristics
Are there typical wellness program configurations and incentive structures? How are these related to employee participation in the programs?	2.1: Are there standard combinations of wellness program features? Do employers combine certain features with others?	Cluster analysis to determine typical wellness program features
	2.2: Are certain wellness program features associated with employee participation?	Descriptive statistics of participation rates within wellness program type
	2.3: Are rewards, penalties, or a combination associated with employee participation?	Descriptive statistics of participation rates by incentive structure

Research Question 1: Which employer characteristics predict wellness program offering and use of incentives?

To answer Research Questions 1.1 and 1.2, we first describe the distribution of wellness program and incentive offerings and their associations with employer characteristics (i.e., size as measured by number of employees, region, industry, years in business, average salary, share of female employees, share of employees over the age of 50). We initially had included a variable for employer revenue, but we elected to exclude it because of its high correlation with employer size and the fact that it was missing for most government employers.

For each employer characteristic, we conducted an appropriate statistical test (e.g. chi-square, t-tests) for an association between the characteristic and offering a wellness program or using incentives. All descriptive analyses were conducted using sampling weights, the details of which are contained in the appendix of the *Workplace Wellness Programs Study*.[19]

We estimated the effect of employer characteristics on the likelihood of offering a wellness program (Research Question 1.1) using a logistic regression model. We estimated the impact of each characteristic on the likelihood of offering a wellness program while adjusting for other characteristics (shown in Table 1). For employers who offered a wellness program, we also

[19] Mattke et al., 2013.

estimated what employer characteristics were associated with an employer offering any incentives and incentives greater than $100 (Research Question 1.2) using two separate logistic regression models. We included both nonmonetary (e.g., token rewards) and monetary incentives. Monetary incentives included both rewards (e.g., cash payments) and penalties (e.g., higher employee contribution to health coverage).

Among employers with no wellness program, we analyzed the reasons that employers had identified as "very important" or "extremely important" for their decision not to offer a wellness program. Specifically, we investigated whether the "most important" reasons for not offering a wellness program differed by employer characteristics (e.g., size) (Research Question 1.3). The results are presented as descriptive statistics for which we conducted tests to detect significant differences. We analyzed which employer characteristics predict whether an employer intends to offer a wellness program in the next five years (Research Question 1.4) by performing a logistic regression similar to the model used for Research Questions 1.1 and 1.2. However, the number of employers who did not offer a wellness program was too small to support this type of model, therefore we present only descriptive results.

Research Question 2: Are there typical wellness program configurations and incentive structures and how are these configurations related to employee participation in the programs?

Wellness programs offer services that fall under three main service categories: screening to detect health risks, lifestyle management to reduce health risks and encourage healthy lifestyles, and disease management to support individuals with manifest chronic conditions. The services within each of the three service categories are listed in Table 3.

Table 3. Services Offered Within Wellness Program Components

Program Component	Services
Screening	Health risk assessment (HRA) Blood glucose Blood pressure Body weight/body mass Index (BMI) Body fat percentage Bone density Cancer screening Cholesterol/lipids General physical exam Psychological stress Tobacco use Vision Hearing Other
Lifestyle or Risk Factor Management	Alcohol and/or drug abuse counseling Blood sugar management Cholesterol/lipid management Fitness program Healthy eating program Health education classes Smoking cessation program Stress management program Weight/obesity management Others
Disease Management	Asthma Cancer COPD/emphysema Coronary artery disease (CAD) Depression Diabetes Heart failure Low back pain No disease specified Other

SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.

Based on the detailed information from the RAND Employer Survey data on wellness program services offered, we used cluster analysis to determine five common combinations of services, or "program configurations," within wellness programs. Cluster analysis groups employers together based on the shared characteristics of their service offerings and is preferred to factor analysis when grouping cases.[20] As an example of a program configuration, employers offering screening for cholesterol may be more likely to offer disease management programs targeting cholesterol reduction. This is distinct from program content, which describes the messages that are communicated through the program. Additional detail about this analysis is provided in Appendix A.

[20] B. Everitt, S. Landau, M. Leese, and D. Stahl, *Cluster Analysis, 5th ed.,* Chichester, UK: John Wiley and Sons, 2011.

After identifying clusters and assigning each employer to a cluster, we used multinomial logistic regression to examine the associations between employer characteristics and cluster membership. The results are expressed as the adjusted likelihood of offering a given cluster by employer characteristics.

A similar analysis was conducted to measure the association between the wellness program configurations and participation rates (Research Question 2.2). We generated descriptive statistics for participation rates within each cluster and also for the subgroup of employers within the cluster that offered incentives. Then, we estimated the effect of belonging to a given cluster on participation rates using a linear regression model, and on offering incentives using a logistic regression model, adjusting for employer characteristics. We utilized regression analyses to predict participation rates as a function of program configurations.

We also conducted an analysis to determine if the manner by which incentives are framed has an effect on wellness program participation rates (Research Question 2.3). To do this, we categorized incentives as:

- Rewards only (e.g., cash payment)
- Penalties only (e.g., higher contribution to health plan)
- Combination of rewards and penalties

We found only 11 employers with wellness programs that solely used penalties. Due to the small sample size for this group, we combined the "penalties only" and "combination of rewards and penalties" categories for further analysis. Using descriptive statistics, we estimated the differences between participation rates across incentive structures and whether the relationship between participation rate and incentive structure varied by program configuration.

For all multivariate analyses, we present the results as adjusted likelihoods, where employers with a given characteristic have a calculated percentage likelihood of a certain outcome (e.g., offering a wellness program), after adjusting for other employer characteristics. Results that describe the effect relative to a reference group for characteristics that group employers into categories are also presented in Appendix A. For example, the marginal effect of an employer being located in the South describes the change in likelihood of offering a wellness program compared to being located in the Northeast (i.e., the reference group). Marginal effects are interpreted as the percent change in the likelihood of a certain outcome (i.e., offering a wellness program), for a given change in the employer characteristic. Appendix A provides additional details regarding the interpretation of marginal effects.

Results

Question 1.1: Which employer characteristics are associated with offering a wellness program?

Sixty-nine percent of employers offer a wellness program, and of those that offer a program, 75 percent offer incentives for participation. More than half of RAND Employer Survey respondents

(58 percent) were in the two smallest employer size categories (50–100 and 101–1,000 employees) and most (81 percent) had average salaries falling within the two lowest bands ($25,000 and under and $25,001–$50,000). On average, responding employers had been in business for 47 years, and 44 percent of their employees were female. Characteristics are listed in Table 4.

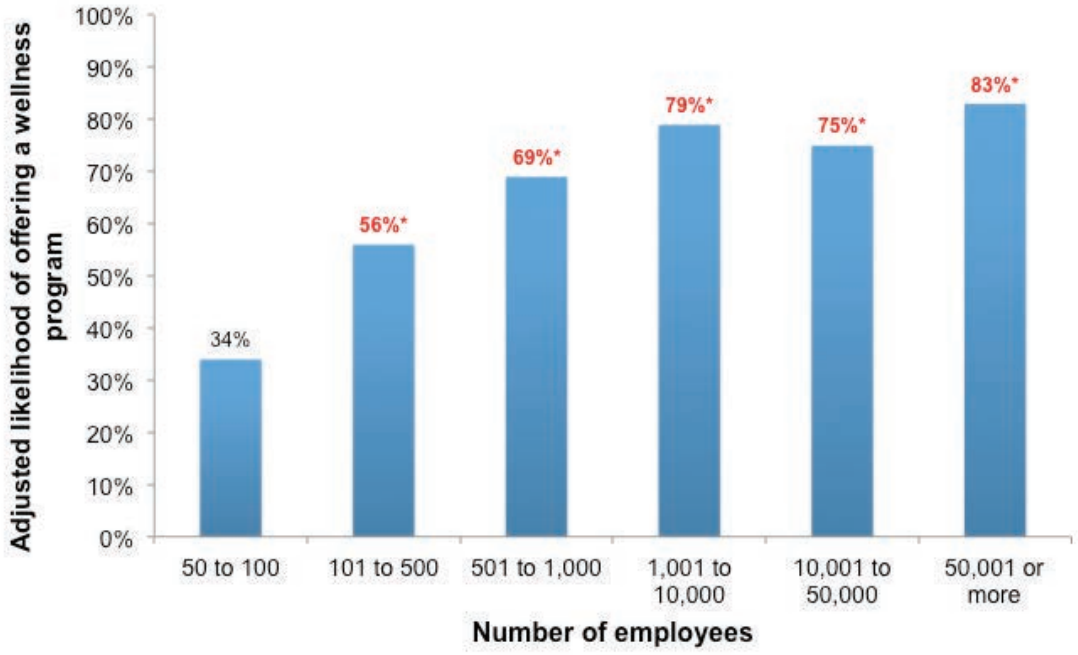
Table 4. Characteristics of Employers Responding to Survey

Variable	Survey Respondents (N=589)
Offers a Wellness Program	69%
Of those: Offers Incentives for Program Uptake	75%
Type of Industry*	
Heavy industry	23%
Trade	16%
Services	57%
Government	4%
Employer Size	
50–100	27%
101–500	25%
501–1,000	6%
1,001–10,000	22%
10,001–50,000	16%
50,001 or more	5%
Region	
Northeast	18%
Midwest	28%
South	33%
West	21%
Company Revenue (Millions)	$2,816
Mean(standard deviation [SD]) in millions	($9,650)
Years in Business	47.1
Mean (SD)	(37.4)
Female Employees	44.4%
Percent (SD)	(27.5)
Employees Over 50	32.6%
Percent (SD)	(18.8)
Average Salary	
$25,000 and under	14%
$25,001–$50,000	67%
$50,001–$75,000	13%
$75,001–$100,000	4%
More than $100,000	2%

SOURCE: RAND Employer Survey, Mattke et al., 2013; Hoovers, undated.
NOTE: *Industry was defined using the 2007 North American Industry Classification System, as follows: heavy industry (e.g., agriculture, mining, construction, and manufacturing), trade (e.g., retail trade and warehousing), service (e.g., information, finance and insurance, and educational services), and public administration (e.g., federal and state governments).

The results of the multivariate analysis indicate that certain employer characteristics are significantly associated with offering a wellness program.[21] Figures 1 and 2 show the adjusted likelihood (as a percentage) of offering a wellness program for three types of employer characteristics: employer size, years in business, and gender composition.

Figure 1. Larger Employers More Likely to Offer a Wellness Program



SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Sample sizes can be found in Table 3.
* The adjusted likelihood of offering a wellness program in the respective category is significantly different from that of the smallest employer size (50–100). Analysis adjusts for region, industry type, years in business, gender composition, age composition, and average salary bands. Adjusted likelihood is calculated using the mean for other covariates.

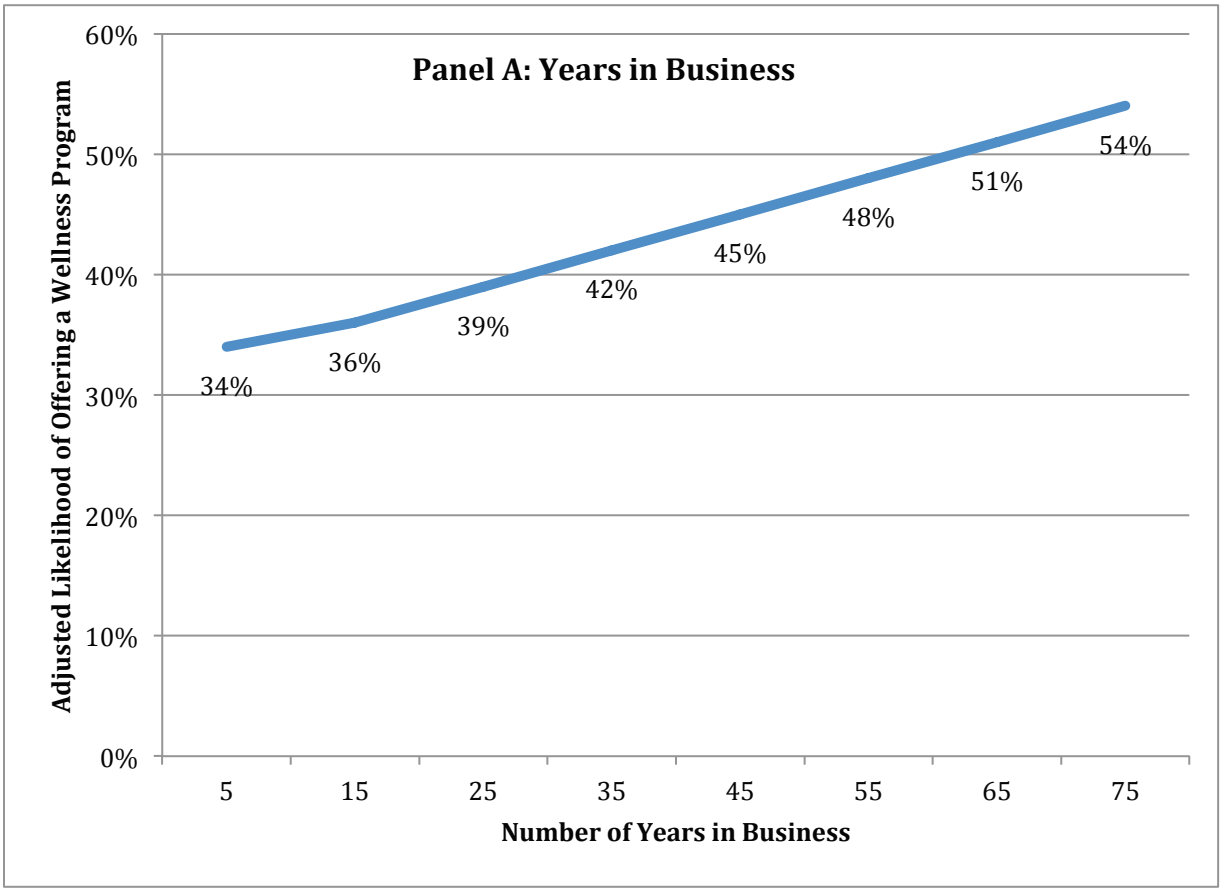
The results suggest that larger employers are significantly more likely to offer a wellness program, even after adjusting for other characteristics. About a third (34 percent) of the smallest employers (50 to 100 employees) are predicted to have a wellness program, compared with about four-fifths (83 percent) of the largest employers (more than 50,000 employees), after adjusting for other characteristics (i.e. region, industry, years in business, gender composition, age composition, average salary bands). Adjusted likelihood is calculated using the mean for other covariates). Our findings also show that the adjusted likelihood of offering a program levels off

[21] A complete table with the marginal effects results for all employer characteristics appears in Appendix A.

for employers with more than 1,000 employees; statistically, the likelihoods are indistinguishable among the three largest size categories.[22]

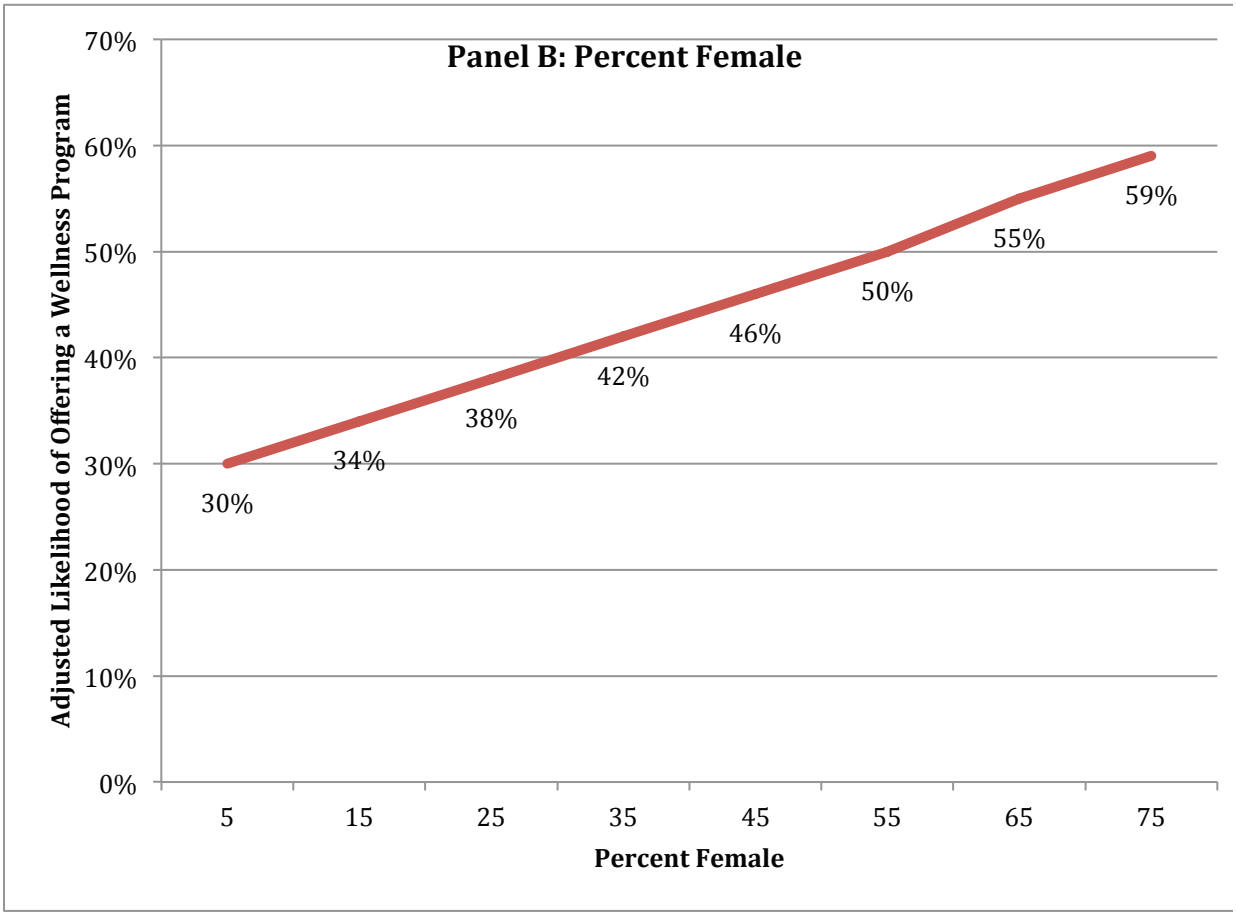
The number of years an employer has been in business (Panel A of Figure 2) is also a significant predictor of offering a wellness program; the more years in business, the more likely an employer is to offer a program. For every ten additional years in business, we estimated a 2-percent increase in the likelihood of offering a program. We tested whether there is an association between the number of years in business and the size of the employer by introducing a term into the model that accounted for this association. However, the term was not associated with a significant change in the likelihood of offering a program.

Figure 2. Years in Business and Gender Composition Associated with Offering a Program



[22] A test of the differences in the likelihood of offering a program for the three largest employers (i.e., more than 1,001 employees) found that there is no difference in likelihood between them (chi-square: 0.40; p-value: 0.817). Two tests comparing the three largest employers with the employers with 101 to 500 employees, however, did show a significant difference (chi-square: 4.82; p-value: 0.028).

Figure 2—Cont.



SOURCE: Analysis of RAND Employer Survey 2012. Mattke et al., 2013.
NOTE: Analysis adjusts for region, industry type, size, age composition, and average salary bands. Adjusted likelihoods calculated using the mean for other covariates.

The results also indicate that the higher the percentage of female employees, the more likely an employer is to offer a wellness program (Panel B of Figure 2). The adjusted likelihood of offering a wellness program increases by about 4 percent for every 10 percent increase in female employees. We also tested whether the percentage of females varies by type of industry by introducing a term in the model that accounted for this association. The term was not associated with a significant change in likelihood.

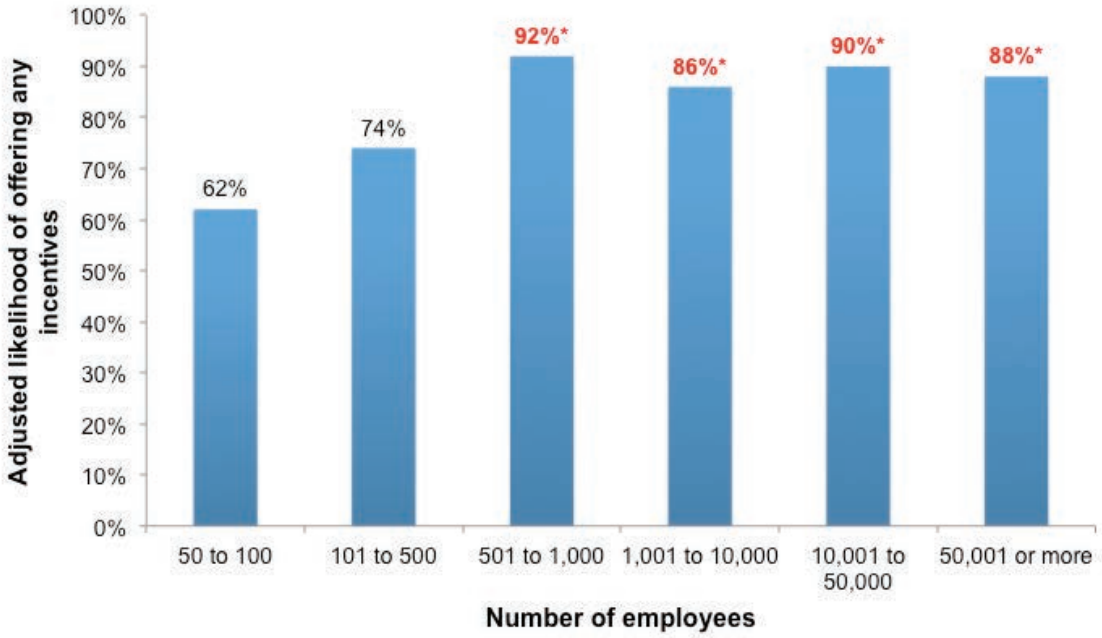
Question 1.2: If an employer offers a wellness program, which characteristics are associated with using incentives?

In the RAND Employer Survey, employers were asked whether they offered specific types of incentives for participating in the wellness program. Among those offering incentives, 302 employers (99 percent) offered monetary incentives and three (1 percent) offered only nonmonetary incentives. Of those offering monetary incentives, 99 employers (33 percent) also offered nonmonetary incentives. The median amount of rewards an employee could earn per year

was $189, and the maximum over multiple years was $3,500. The median amount of penalties was $312, and the maximum over multiple years was $2,600.

Using an approach similar to the one described above, we estimated the likelihood of offering any incentives for employers that offer a wellness program. Adjusted likelihoods (as percentages) were calculated using the results from the model, which adjusted for other employer characteristics and are displayed in Figures 3 and 4. We discuss results for the three employer characteristics that were significantly associated with the likelihood of offering incentives; size, region, and gender composition. For employer size, those in the categories of 501–1,000; 1,001–10,000; 10,001–50,000; and more than 50,000 employees were significantly more likely to offer any incentives than employers with 50 to 100 employees, but not significantly different from each other.

Figure 3. Small Employers Less Likely to Offer Incentives

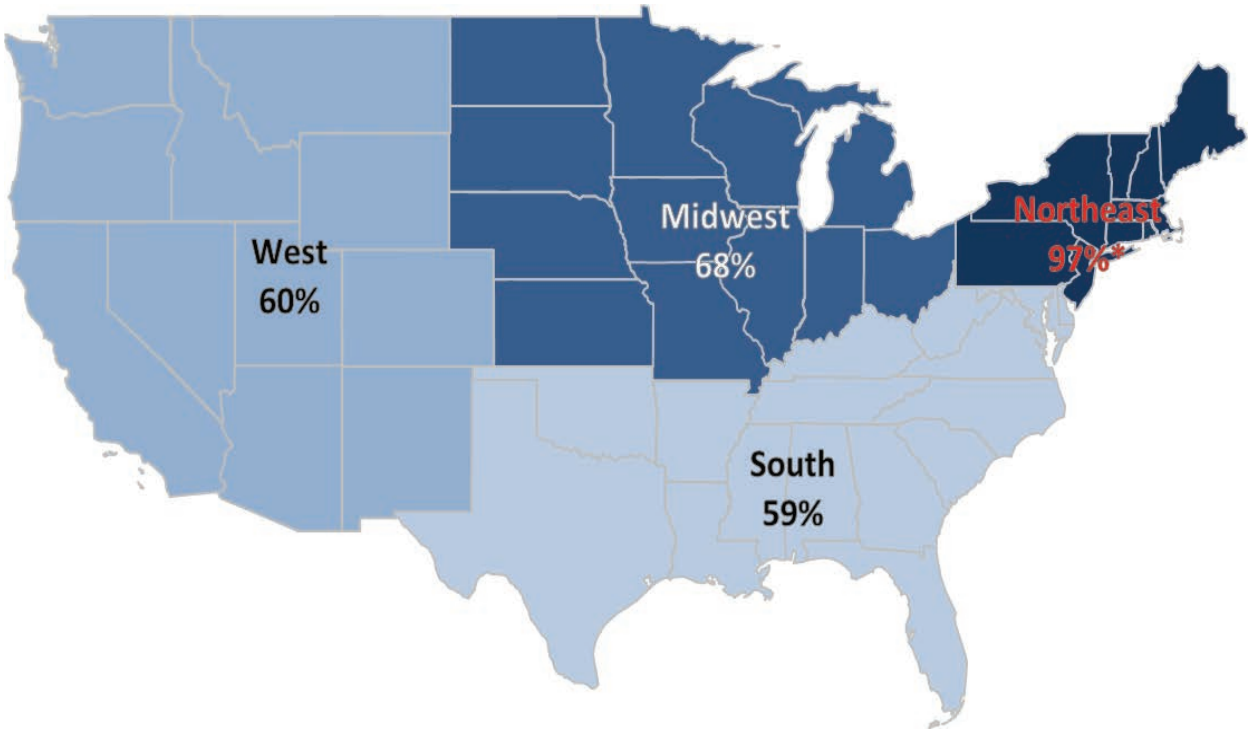


SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Sample sizes can be found in Table 3.
* A significant difference in the likelihood of offering incentives from that of the smallest employer size (50–100). Analysis adjusts for region, industry type, years in business, gender composition, age composition, and average salary bands. Predicted probabilities calculated using the mean for other covariates.

Employers located in the Northeastern region of the United States are much more likely to offer any incentives than employers located in the other three regions (Figure 4).

A test of the differences in the adjusted likelihood of offering incentives indicated that the difference between employers in the Northeast (97 percent adjusted likelihood) and employers in the other regions (59 to 68 percent) is significant, and the difference between the Southern, Midwestern, and Western regions is not significant.

Figure 4. Use of Incentives Much More Common in the Northeast



SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Sample sizes can be found in Table 3.
* A significant difference in the likelihood of offering relative to the three other regions. Analysis adjusts for industry type, size, years in business, gender composition, age composition, and average salary bands. Adjusted likelihoods calculated using the mean for other covariates.

Gender composition (i.e., percentage of females) is also significantly associated with likelihood of offering incentives. On average, every 10-percent increase in the proportion of females is associated with a 7-percent increase in the adjusted likelihood of offering incentives. As with previous analyses, we explored the association between size and years in the business and between gender composition and industry. Neither of the characteristics is significantly associated with offering incentives.

Findings related to the amount of the incentive (i.e., greater than $100) were similar to those from the analysis of any incentives. These results are provided in Appendix A.

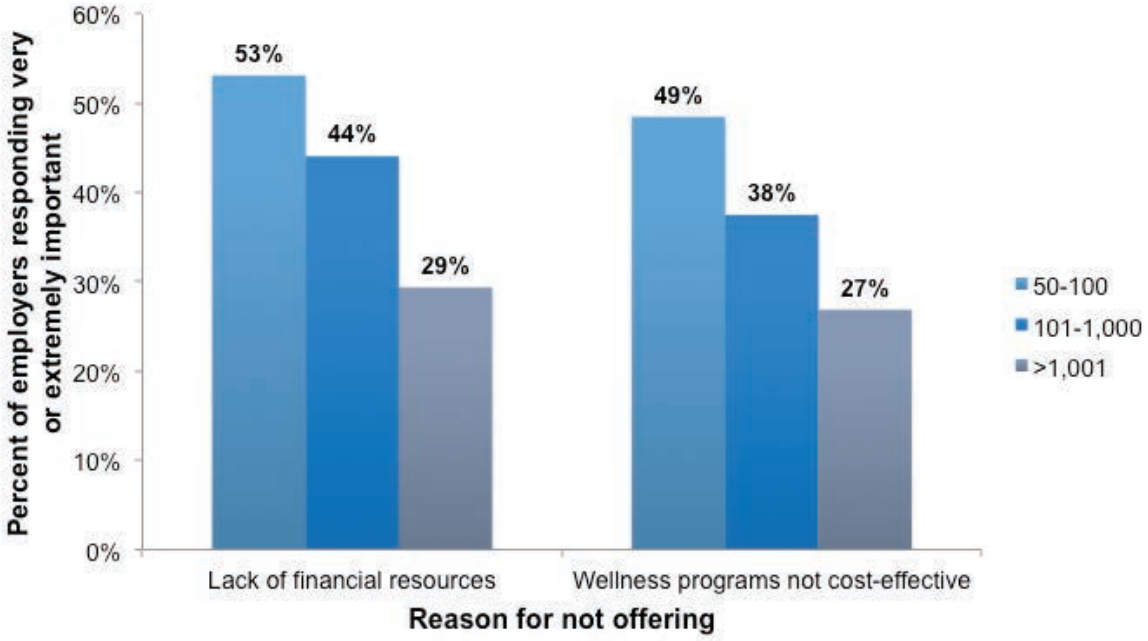
Question 1.3: If an employer does not offer a wellness program or has discontinued its program, which characteristics are associated with barriers to offering a program?

To address this question, we explored the RAND Employer Survey data regarding reasons for not offering a wellness program.[23] Since employer size was significantly associated with offering a wellness program, we examined the barriers to offering a program reported by

[23] Mattke et al., 2013.

employers of different sizes. Figure 5 shows the percentage of employers that indicated "lack of financial resources" or "not cost-effective" as a reason for not offering a wellness program. About half of the smallest employers (fewer than 50 employees) but only about a quarter of the largest employers (more than 1,000 employees) identified those reasons as their top two in terms of importance. Larger employers ranked "lack of employee interest" as the most important reason overall, with "lack of financial resources" falling second (results not shown). However, it is important to note that tests for differences across employer sizes were not significant, which is likely due to the fact that the number of employers in this analysis (i.e., those that did not offer a wellness program) was relatively small (182 employers).

Figure 5. Cost of Programs Appears to Be a Deterrent for Small Employers



SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Sample sizes can be found in Table 3. Reported are percent of employers rating reasons for not offering wellness programs by employer size.

Question 1.4: Which employer characteristics are associated with employers planning to offer a wellness program?

We also explored whether employers that do not currently offer a wellness program intend to offer one in the future. Among employers who do not offer a program, 22 percent of employers with between 50 and 100 employees indicated they plan to offer a wellness program in the future, versus more than 50 percent of employers in the largest employer groups.

Question 2.1: Are there patterns in wellness program offerings—do employers combine certain offerings with others?

Our cluster analysis suggests that there are five distinct and mutually exclusive patterns of how employers configure their wellness programs by combining different services for screening, lifestyle management, and disease management. For each of these five patterns, which we term program configurations, we developed labels that characterize the range of services offered by the respective program. The labels for each configuration and a brief definition of each are listed in Table 5 below. We then provide a more detailed description along with illustrative example of employers that typify each program configuration.

Table 5. Program Configuration Labels and Definitions

Program Configuration	Definition
Limited	Limited services across all components
Comprehensive	Extensive services across all components
Screening-focused	Extensive screening, limited other components
Intervention-focused	Extensive lifestyle and disease management, limited screening
Prevention-focused	Extensive screening and lifestyle management, limited disease management

SOURCE: Analysis of RAND Employer Survey 2012, Mattke et al., 2013.

Limited Program—Limited Services Across All Components

Limited wellness programs are characterized by limited services related to screening, lifestyle, and disease management. Approximately a third of limited programs incorporate the three most common screening activities used to identify metabolic syndrome—i.e., blood glucose, BMI, body fat percentage—and 40 percent offer lifestyle management interventions, such as diet and exercise programs. Limited programs rarely have disease management services, except for diabetes.

Employer A is a service company located in the Northeast with 75 employees. It has a wellness program that is run by internal staff. It conducts worksite screening for body weight, BMI, and blood pressure, and it refers at-risk employees to a weight management program. It also provides a smoking cessation program, but no disease management services for employees with chronic conditions.

Comprehensive Program—Extensive Services Across All Components

Comprehensive programs offer a full spectrum of services related to screening, as well as lifestyle and disease management, in contrast to the limited program offerings. Nearly all employers offering the comprehensive program configuration screen for metabolic syndrome, and about 20 percent include additional screening tests (e.g., cholesterol levels, bone density). In addition, almost all employers with the comprehensive program configuration offer various lifestyle and disease management interventions.

Employer B is a trade company located in the Midwest with 40,000 employees. It contracts with a vendor for a comprehensive wellness program. Each year, employees and dependents are asked to complete an online HRA and are given the opportunity to participate in a health fair with screening for blood glucose, lipid levels, weight/BMI, and blood pressure, as well as general physical exams. Employees with identified risk factors are referred to lifestyle management services for nutrition, fitness, weight control, stress reduction, and smoking cessation programs. The employer also has a disease management program for all major chronic conditions (asthma/COPD, heart disease, diabetes, and depression) and a back pain program.

Screening-Focused Program—Extensive Screening, Limited Other Components

Screening-focused programs provide a range of screening tests that is broader than the comprehensive program's range of test's offered. However, they provide a limited range of lifestyle management services, similar to the limited programs. The services offered under their disease management components are more extensive than those of the limited wellness programs, but are more limited than those of the comprehensive programs.

Employer C is a service company located in the South with 150 employees. Its screening-focused wellness program is run by internal staff. It conducts worksite blood pressure and glucose screens, BMI and body weight checks, and screening for hearing and vision problems. The program does not offer lifestyle management services, but provides a disease management program for those with heart failure, diabetes, or asthma.

Intervention-Focused Program—Extensive Lifestyle And Disease Management, Limited Screening

Intervention-focused programs emphasize lifestyle and disease management components but offer almost no screening services. These programs do not offer screenings for the common risk factors for metabolic syndrome (i.e., blood glucose, blood pressure, BMI, body fat percentage), which are typically offered by other program configurations. The emphasis of this program configuration is lifestyle and disease management components, offering a range of services in these subcomponents that is comparable to comprehensive programs. The focus is on the management, rather than detection, of health risks and chronic disease.

Employer D is a heavy industry company located in the South with 9,300 employees. Its intervention-focused wellness program is run by internal staff. It provides no screening services but allows open access to a fitness program, which includes healthy eating education and weight management services. It also provides disease management services for employees with chronic conditions like asthma, diabetes, CAD, lower back pain, and asthma.

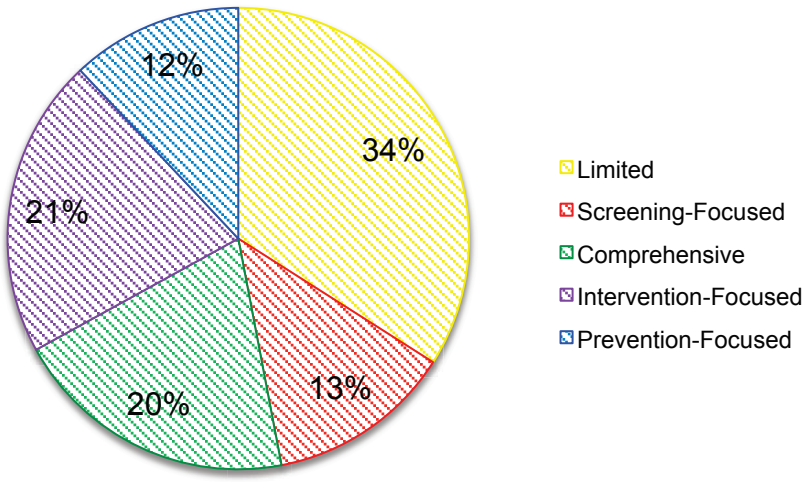
Prevention-Focused Program—Extensive Screening and Lifestyle Management, Limited Disease Management

Prevention-focused programs provide a greater range of screening services than limited programs but not as many as comprehensive programs. Prevention-focused programs resemble the comprehensive programs with respect to the breadth of lifestyle management components and are at least twice as likely to offer these components as limited programs. Regarding disease management services, prevention-focused programs commonly provide only diabetes management, similar to the limited programs. These programs provide services that focus on preventing the development of chronic disease rather than managing manifest chronic conditions.

Employer E is a trade company located in the West with 14,000 employees. Its prevention-focused wellness program is run jointly by internal staff and an outside vendor. It conducts worksite blood pressure and glucose screens as well as BMI weigh-ins and cholesterol tests. Employees at high risk can be referred to an extensive fitness program with education and weight management components. The program offers no services to help employees manage chronic disease.

Frequencies of employers offering each type of wellness program configuration are displayed in Figure 6. These frequencies have not been adjusted for other employer characteristics (e.g., size, industry). About one-third of all employers (34 percent) have limited configurations, while 20 percent offer comprehensive programs.

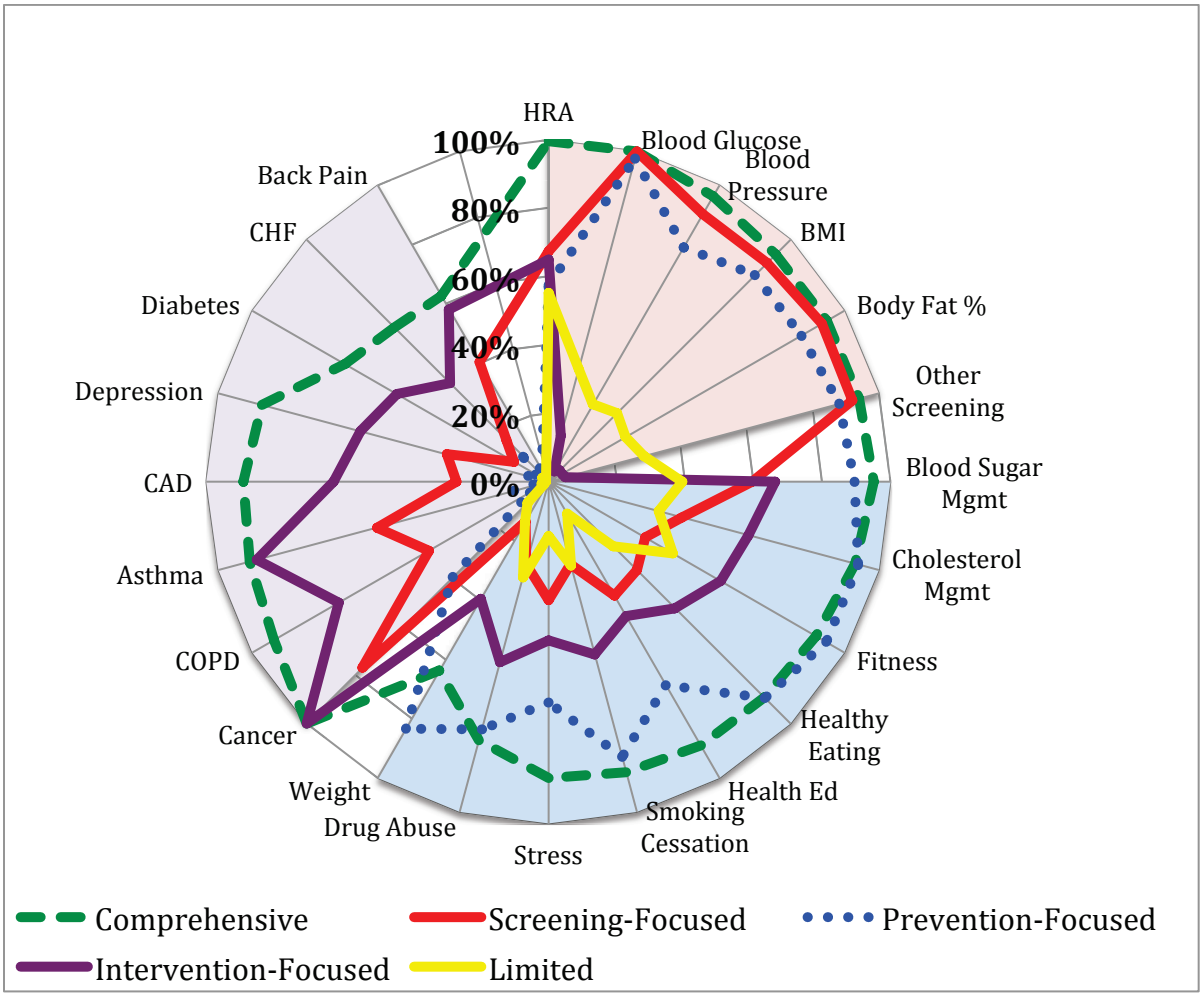
Figure 6. About One-Third of Employers Offer the Limited Program Configuration



SOURCE: Analysis of RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Reported are percent of employers offering each type of wellness program configuration according to cluster analysis.

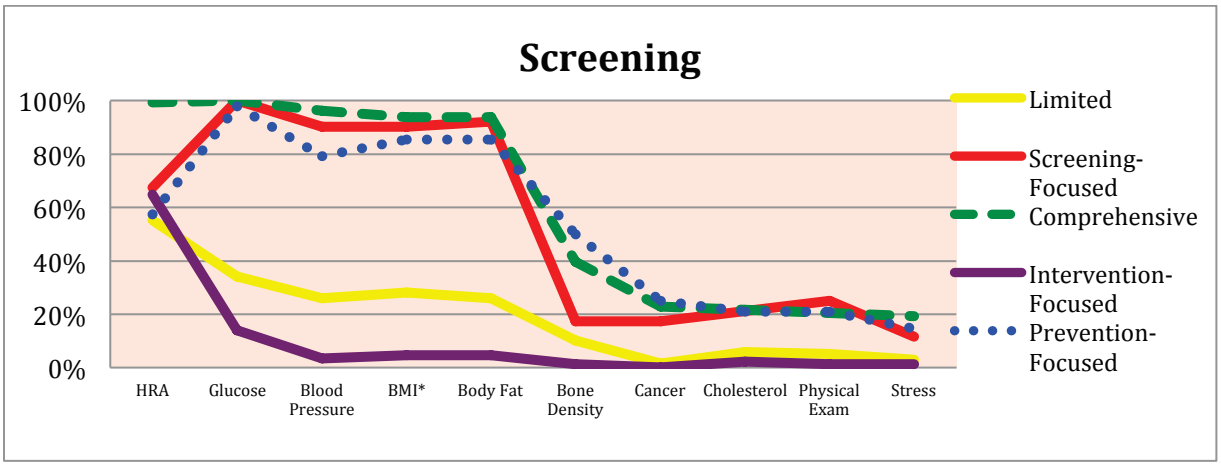
Figure 7 provides a visualization of the differences in services offered by each program configuration. Each radial line represents a service within one of the three subcomponents. The farther away from the center of the circle a colored line for program configuration is, the higher the percentage of employers within that configuration that offer that service. The figure illustrates differences in services offered, with comprehensive programs reaching toward the edge of the circle (closer to 100 percent offering) and limited programs rarely breaking 60 percent. These lines are broken down by subcomponent in Figure 8, which also lists the services.

Figure 7. Subcomponent Offerings by Program Configuration

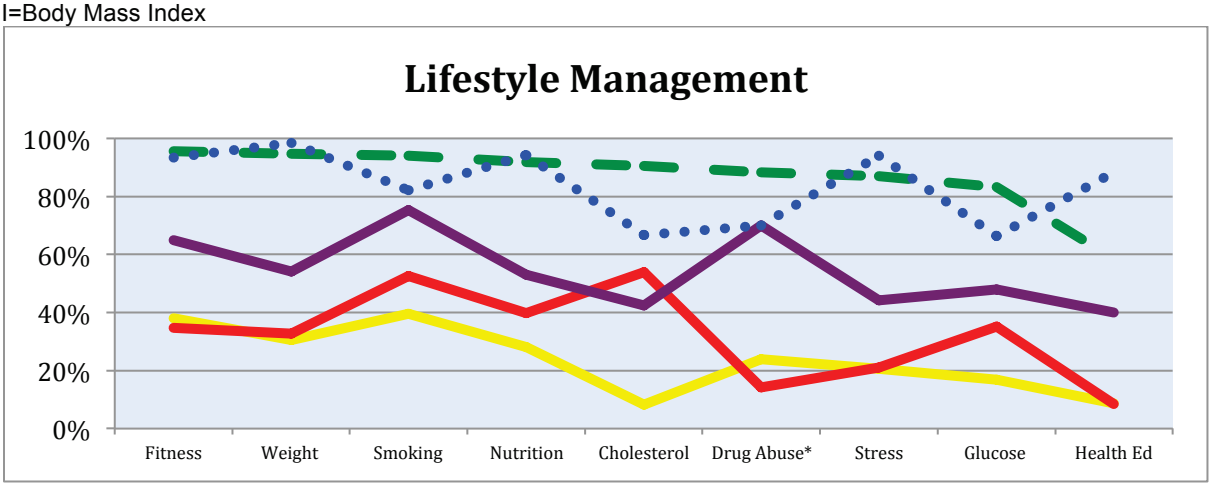


NOTE: Each radial line represents a service within one of the three subcomponents. The farther away from the center of the circle a line for a program configuration is, the higher the percentage of employers within that configuration that offer that service. The colored lines are broken down by subcomponent in the figures below.

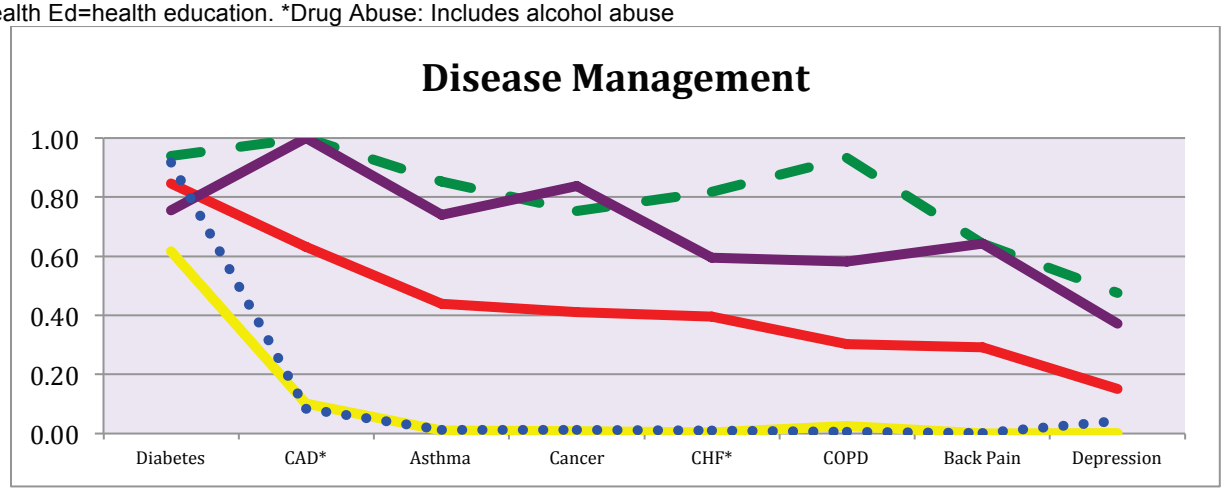
Figure 8. Proportion of Employers Offering Services under Three Components



*BMI=Body Mass Index



*Health Ed=health education. *Drug Abuse: Includes alcohol abuse



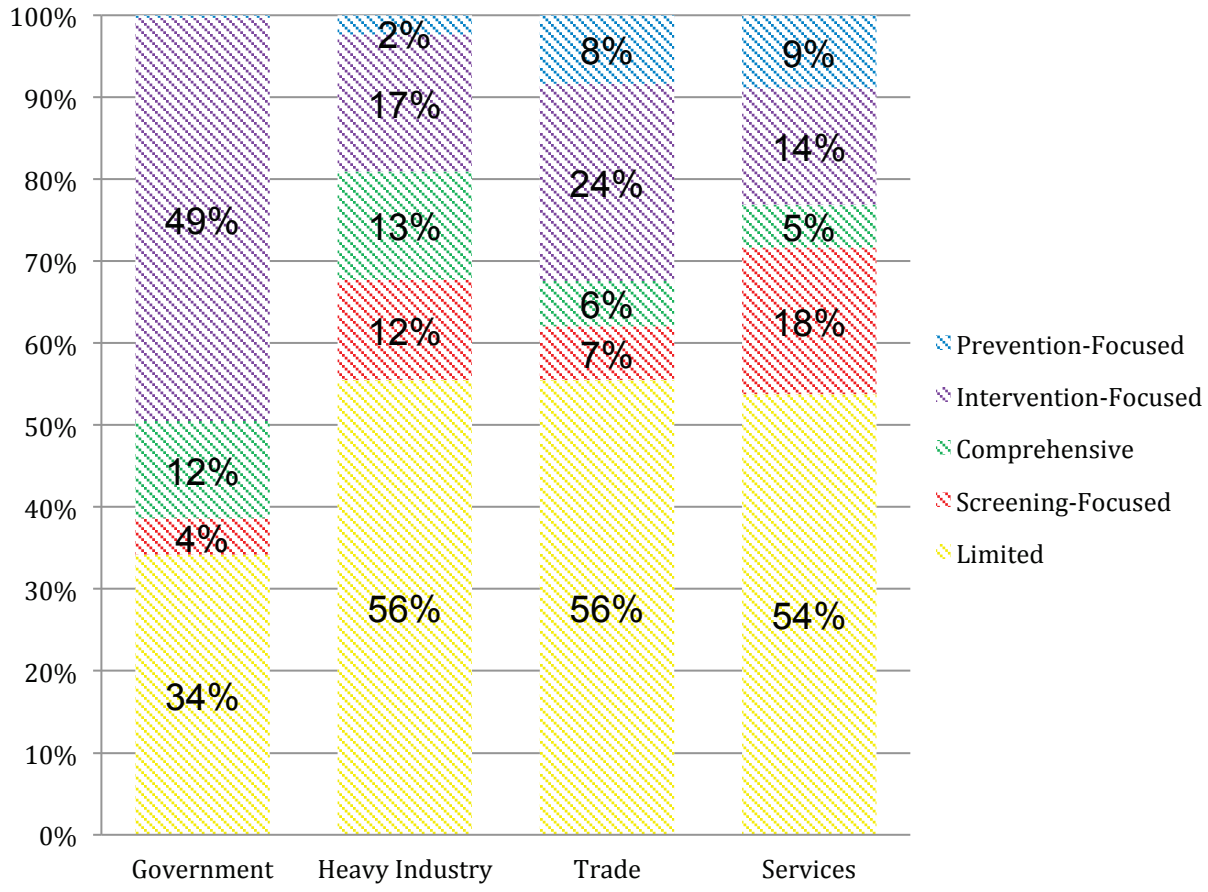
*CAD=coronary artery disease; CHF=congestive heart failure

SOURCE: Analysis of RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Reported are percentage of employers offering each type of program subcomponent by program configuration.

In the next pages, we describe the association between employer characteristics (e.g., size, industry) and our five program configurations. In this analysis, we collapsed the "number of employees" variable to three levels (i.e., 50 to 100, 101 to 1000, and >1000) to account for the small sample size for larger employers. We found that three employer characteristics—type of industry, region, and number of employees—were significantly associated with offering one of the five wellness program configurations.

Figure 9 presents the likelihood of offering a specific program configuration by type of industry. Heavy industry and services employers were less likely to offer an intervention-focused program (17 percent and 14 percent, respectively) than government employers (49 percent). Trade employers were more likely (8 percent) to offer a prevention-focused program than government employers (0 percent). These differences in offering by industry approached significance ($p<0.10$). Though service employers were also more likely to offer a prevention-focused program (9 percent) than government employers, this difference did not approach statistical significance. Government employers were least likely to offer limited programs (34 percent vs. 56, 56, and 54 percent in heavy industry, trade, and services employers, respectively).

Figure 9. Adjusted Likelihood of Program Configuration by Industry

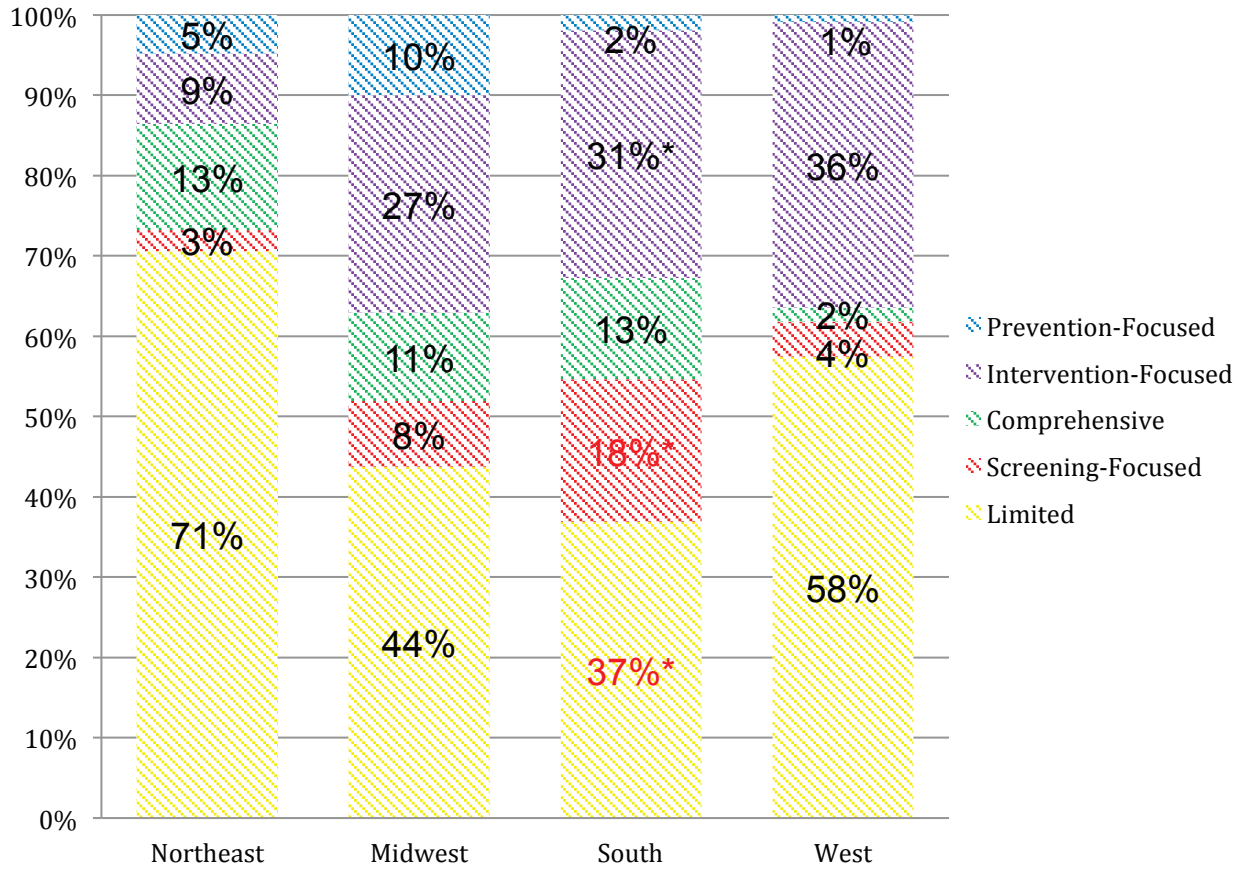


SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.

NOTE: Sample sizes can be found in Table 3. Adjusted likelihood of government employers offering prevention-focused programs was equal to zero. Adjusted likelihood adjusts for region, size, years in business, percentage female, percentage older than 50, and average salary band at the mean value of each covariate.

As shown in Figure 10, employers in the Northeast were significantly more likely to offer a limited program than those in the Midwest or South, which were more likely to offer intervention- or screening-focused programs. Employers in the South differed from the Northeast, with 18 percent offering a screening-focused program versus the Northeast's 3 percent, and 31 percent offering an intervention-focused program versus 9 percent in the Northeast.

Figure 10. Adjusted Likelihood of Program Configuration by Region

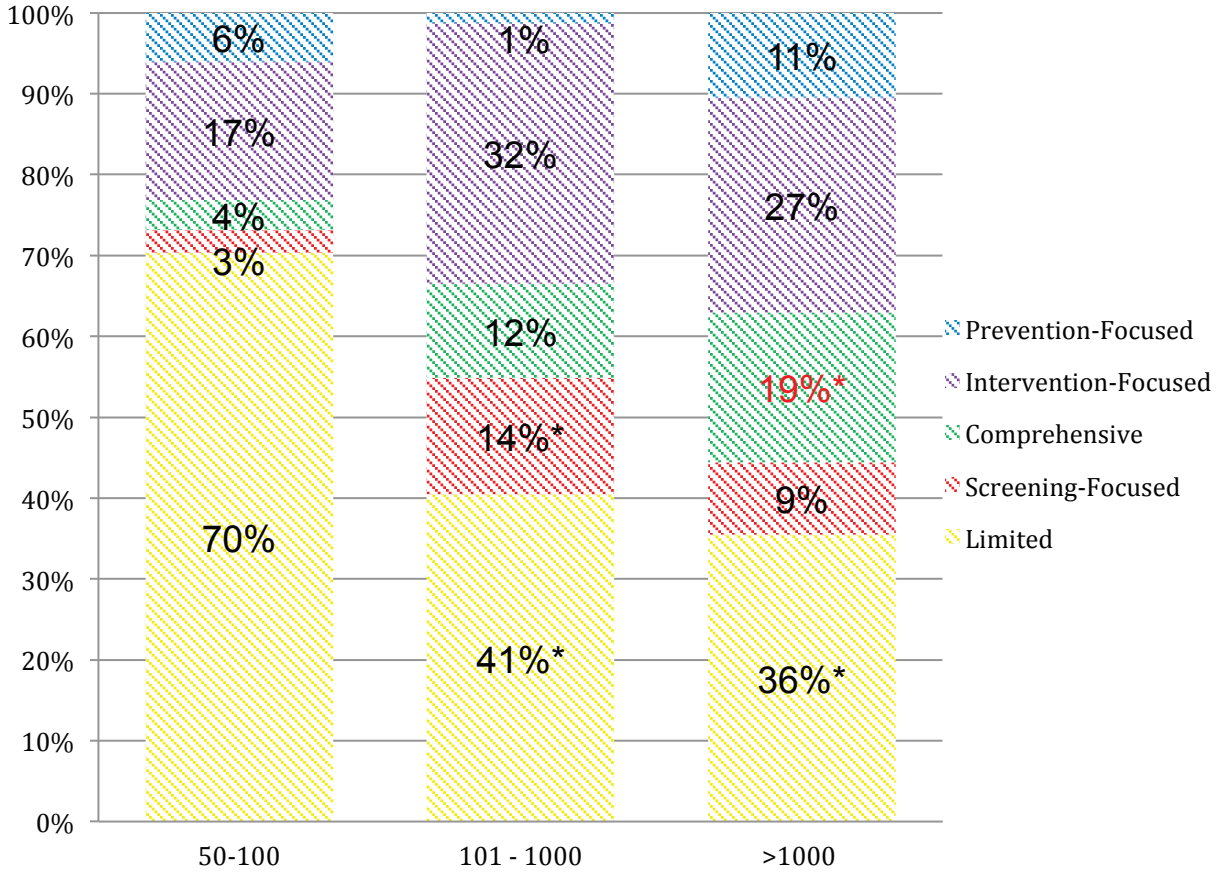


SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Sample sizes can be found in Table 3.
* The adjusted likelihood is significantly different from the Northeast. Adjusted likelihood adjusts for industry type, size, years in business, gender composition, age composition, and average salary band at the mean value of each covariate.

As shown in Figure 11, small employers were much more likely to offer a limited program (70 percent) than medium-size (41 percent) and large employers (36 percent). Medium-size employers were more likely to offer a screening-focused program (14 percent) than small

employers (3 percent) and large employers were more likely to offer a comprehensive program (19 percent) than small employers (4 percent).

Figure 11. Adjusted Likelihood of Type of Program by Employer Size



SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Sample sizes can be found in Table 3.
* The adjusted likelihood is significantly different from the smallest employer size (50–100). Adjusted likelihood adjusts for industry type, region, years in business, gender composition, age composition, and average salary band at the mean value of each covariate.

Question 2.2: Are certain wellness program configurations associated with higher employee participation?

Descriptive statistics for participation by program configuration are reported in Table 6. Among all employers offering wellness programs, incentive-based and otherwise, we found that employers offering a comprehensive wellness program were more likely to report higher participation rates (median of 59 percent) while those with intervention-focused programs were more likely to have low participation (median of 28 percent). Employers with prevention-focused programs also reported higher participation rates, with a median participation rate of 45 percent. The differences in participation rates among program configurations were shown to be significant. We predicted participation rates as a function of program configurations while

controlling for other employer characteristics and found the results provided no additional insight over those seen in the descriptive statistics.

However, when we limited the sample to those employers that offered incentives, the differences in participation level between program configurations were no longer significant ($p<0.08$). This lack of significance may be due in part to the fact that, among those offering incentives, the percentage of employers reporting low participation levels (0 to 25 percent) was reduced across all program configurations. Comprehensive programs still had higher median participation rate.

Table 6. Employee Participation by Program Configuration

	Limited (%)	Screening-Focused (%)	Comprehensive (%)	Intervention-Focused (%)	Prevention-Focused (%)	P-value (F-test)
Median participation rate	40	44	59	28	45	
Participation level						
0–25%	39	38	19	49	30	<.01
26–50%	27	19	21	25	28	
51–75%	20	17	36	12	20	
76–100%	15	26	24	13	23	
Median participation rate if any incentives	50	48	59	30	50	
Participation level if any incentives						
0–25%	32	32	15	43	25	0.08
26–50%	24	22	23	22	28	
51–75%	24	20	37	15	22	
76–100%	21	27	25	20	25	

SOURCE: Analysis of RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Participation rates were reported by employers and grouped into quartiles. F-test tested for any significant differences in distribution across participation quartiles between program configurations

Question 2.3: Are rewards, penalties, or a combination of the two associated with higher participation rates?

Descriptive statistics on the relationship between incentive structure and participation rate are reported in Table 7. As only 4 percent of employers reported using penalties exclusively, we combined these employers with the employers that used both rewards and penalties to increase wellness program participation.

Table 7. Unadjusted Employee Participation Rates by Incentive Structure

	All program configurations		Comprehensive programs	
	# of Employers	Median Participation Rate	# of Employers	Median Participation Rate
No Incentives	105	20%	9	52%
Reward	225	40%	48	56%
Penalty or Reward + Penalty	63	73%	22	71%

SOURCE: RAND Employer Survey 2012, Mattke et al., 2013.
NOTE: Rates are not adjusted for employer characteristics.

Our results suggest that incentives are associated with higher participation rates. The median participation rate reported by employers that did not use incentives was 20 percent. The median participation rate for employers with reward incentives was reported as 40 percent, while the participation rate among wellness programs using penalty or "penalty and reward" incentives was 73 percent.

Since the array of services (rather than the incentive structure) may be driving participation rates, we analyzed median participation rates among employers with comprehensive programs, as already defined. We found that participation rates were similar between employers without incentives and those with rewards, but rates remained higher among employers incorporating penalties into their incentive structure (results not shown).

Discussion

Employer size is an important predictor of whether an employer offers a wellness program and how the program is configured. We estimate that about a third (34 percent) of the smallest employers (50 to 100 employees) but about four-fifths (83 percent) of the largest employers (over 50,000 employees) have a wellness program, after adjusting for employer characteristics. Similarly, about 60 percent of the smallest employers and 90 percent of other employers employ incentives to promote program uptake. Those patterns do not change linearly with employer size; employers with >1,000 employees are similar to one another in terms of likelihood of offering a program and program configuration.

The Kaiser/HRET Employer Health Benefits Survey also found that smaller employers are less likely to offer wellness programs and, if they offer wellness programs, are less likely to offer incentives for participation, although the definitions of small employer sizes vary by survey and the offering rates for both wellness programs and incentives are somewhat lower for the Kaiser/HRET survey.[24] The different results are likely due to the inclusion of smaller employers in the Kaiser/HRET survey (which includes employers with as few as three employees), and their lower likelihood of offering wellness programs.

[24] Kaiser/HRET, *Employer Health Benefits: 2013 Annual Survey*, Washington, D.C., 2013.

About 70 percent of small employers offering a wellness program choose a "limited" wellness program configuration with a limited range of services, whereas a lower percentage (40 percent) of larger employers opted for this configuration.

The RAND Employer Survey responses offer insights into why smaller employers make different decisions about workplace wellness. **About half of small employers without a program cited "lack of financial resources" and "not cost-effective" as the two primary reasons for not offering a wellness program**. Of those employers, 22 percent indicated they plan to introduce a wellness program in the future, compared to more than 50 percent of employers in the larger employer groups.

Thus, cost concerns appear to explain the different decisions of smaller employers. This finding has important policy implications since about 36 percent of Americans work at employers with less than 100 employees.[25] Several levers exist to improve access to wellness programs in this segment of the workforce. The Centers for Disease Control and Prevention support low-cost programs for employers to use with free tools and resources to promote workplace health and wellness.[26] The Commonwealth of Massachusetts offers tax incentives for small employers that choose to provide worksite wellness programs.[27] On a federal level, the ACA set aside $200 million in grants for small employers to offer wellness programs to their employees.[28]

We identified five distinct configurations for workplace wellness programs, with the most common program being one offering limited services (34 percent). A small proportion (20 percent) of all employers opted for the comprehensive program configuration, which offers a broad range of screening, lifestyle, and disease management services. The remaining third of all employers have programs that emphasize either screening, preventive services, or interventions.

There are regional differences in wellness program configurations. **Employers located in the Northeastern region are more likely to offer limited programs and use incentives to promote program participation**. Our data suggest that almost all Northeastern employers (97 percent) use incentives.

Both wellness program configuration and the use of incentives are independently associated with program participation rates. Participation rates, as reported by employers, are higher overall in comprehensive programs than other configurations, but that difference is smaller among programs that use incentives. Because the participation rates are based on

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[25] Bureau of Labor Statistics, *New Quarterly Data from BLS on Business Employment Dynamics by Size of Firm*, Washington, D.C., 2013.

[26] Centers for Disease Control and Prevention, *National Healthy Worksite Program*, Atlanta, Ga., February 10, 2014.

[27] Massachusetts Executive Office of Health and Human Services, *Massachusetts Wellness Tax Credit*, Boston, Mass., 2014.

[28] Public Law No. 111-148: H.R. 3590. § 10408, 2010.

employers' self-reporting and should be validated with actual participation data, they must be interpreted with caution. However, they provide some important insights into the reasons for higher and lower participation rates in these programs.

Employers with comprehensive programs report the highest participation rates (59 percent) of any other program configuration. Intervention-focused programs appear to attract 28 percent of eligible employees. Limited programs, the most common configuration, have an average participation rate of 40 percent.

The use of incentives appears to be related to program participation rates, with the presence of both penalties and rewards being associated with higher participation rates than rewards alone. Among employers that do not use incentives, median participation rate was low (20 percent). Employers with reward-only incentive schemes have higher participation rates (40 percent), but significantly lower than employers using penalties alone or penalties and rewards (73 percent). **Reported participation rates for comprehensive programs seemed to be less sensitive to choice of incentive schemes, suggesting that program design might be similarly effective in attracting employees.** However, further research needs to be conducted to fully disentangle these effects.

We point out that our survey results may be subject to response bias or measurement error bias due to the self-reported measures. We do, however, however use sampling weights used to adjust for nonresponse in all analyses. [29]

[29] For more details, see Mattke et al., 2013.

3. Wellness Program Data Analysis

Introduction

Achieving the goals of any wellness program requires employee participation. The RAND Workplace Wellness Programs Study found average participation rates ranged from 20 to 40 percent, underscoring the challenge of program uptake.[30] Adding to the problem of low employee uptake is the fact that the decision to participate is not random. For example, the motivation to improve or maintain health drives both the decision to participate in a wellness program and other behaviors associated with improved health status. While some studies have conducted limited analyses of who participates in wellness programs, we still know little about the relationship between various employee characteristics and wellness program participation.[31]

In an effort to boost employee participation, employers are increasingly offering monetary incentives. The ACA, which increased the flexibility of using incentives under wellness programs, is expected to further increase the likelihood that employers will implement or increase incentives. Although studies have examined the effect of incentives on the decision to participate in a variety of intervention types, these studies are typically conducted in experimental settings, and often with small samples. Such studies offer high internal validity, but the results are often not generalizable to other populations and real-world settings. Further, previous studies have not examined whether employee characteristics influence the effect of incentives on participation in wellness programs.[32] Understanding what drives employee participation is distinct from the issue of whether a particular program is efficacious;[33] our study endeavors to understand the decision to participate assuming an employer desires greater participation. Designing programs that involve evidence-based interventions, although important for estimating the overall effectiveness of a program, is separate from motivating individuals to participate.

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[30] Mattke et al., 2013.

[31] Maurice A. J. Niessen, Eva L Laan, Suzan J. W. Robroek, Marie-Louise Essink-Bot, et al., "Determinants of Participation in a Web-Based Health Risk Assessment and Consequences for Health Promotion Programs," Journal of Medical Internet Research, Vol. 15, No. 8, 2013.

[32] Michael S. Taitel, Vincent Haufle, Debi Heck, Ronald Loeppke, et al., "Incentives and Other Factors Associated with Employee Participation in Health Risk Assessments," *Journal of Occupational and Environmental Medicin*e, Vol. 50, No. 8, 2008, pp. 863–872; Erin L. D. Seaverson, Jessica Grossmeier, Toni M. Miller, and David R. Anderson, "The Role of Incentive Design, Incentive Value, Communications Strategy, and Worksite Culture on Health Risk Assessment Participation," American Journal of Health Promotion, Vol. 23, No. 5, 2009, pp. 343–352.

[33] Jill R. Horwitz, Brenna D. Kelly, and John E. DiNardo, "Wellness Incentives in the Workplace: Cost Savings Through Cost Shifting to Unhealthy Workers," *Health Affairs,* Vol. 32, No. 3, 2013, pp. 468–476.

Our prior research found no effect of participation in telephonic coaching under lifestyle management programs on health care costs.[34] One possible reason is that participation may in fact increase certain types of health care utilization. For example, if participation has the intended effect of motivating individuals to improve their overall health and well-being, individuals might increase their use of primary care physicians for visits related to preventive care evaluation and management. Another possible explanation for the lack of effect is that these prior studies assessed program impact on overall utilization, rather than utilization specific to conditions targeted by wellness programs (e.g., physician visits to treat diabetes).

Previous studies may also have found little effect of wellness programs on health status or health care utilization because the studies evaluated overall programs or program components (e.g., lifestyle management), rather than specific interventions, such as smoking cessation.[35] Similarly, an intervention may have a measurable effect only on employees with high levels of engagement; therefore, combining active participants with casual participants may mask the effect.

A clear understanding of these issues should help identify factors that may assist in designing better studies of the impact of wellness programs and ultimately in improving the design and implementation of effective employer wellness programs. Nevertheless, assessment of program impacts may require recognition of what programs should realistically be expected to accomplish, in terms of health care cost reductions or longer-term health outcomes. In fact, a recent study attempted to address the former question by estimating how much health care costs would be reduced if all modifiable risk factors, such as obesity, were reduced to the lowest theoretical levels.[36] However, no study to date has taken a long-term look, at least from the perspective of a workplace wellness program, at the health benefits of risk factor reductions. For example, what should the impact of improved blood pressure and cholesterol levels be over 20 years on health outcomes such as risk for cardiovascular events?

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[34] Mattke et al., 2013; John Caloyeras, Hangsheng Liu, Ellen Exum, Megan Broderick, et al., "Managing Manifest Diseases, But Not Health Risks, Saved PepsiCo Money Over Seven Years," *Health Affairs,* Vol. 33, No. 1, 2014, pp. 124-131.

[35] Baicker, K., D. Cutler, Z. Song, "Workplace Wellness Programs Can Generate Savings," *Health Affairs,* Vol. 29, No. 2, 2010, pp. 304–311

L. S. Chapman, "Meta-Evaluation of Worksite Health Promotion Economic Return Studies: 2005 Update," *American Journal of Health Promotion,* Vol. 19, No. 6, 2005, pp. 1–11; H. Liu, K. M. Harris, S. Weinberger, S. Serxner, et al., "Effect of an Employer-Sponsored Health and Wellness Program on Medical Cost and Utilization," *Popular Health Management,* Vol. 16, No. 1, 2013, pp. 1–6; J. A. Nyman, J. M. Abraham, M. M. Jeffery, and N. A. Barleen, "The Effectiveness of a Health Promotion Program After 3 Years: Evidence from the University of Minnesota," *Medical Care*, Vol. 50, No. 9, 2012, pp. 772–778.

[36] Howard Bolnick, Francois Millard, and Jonathan P. Dugas, "Medical Care Savings from Workplace Wellness Programs: What Is a Realistic Savings Potential?" *Journal of Occupational and Environmental Medicine,* Vol. 55, No. 1, 2013, pp. 4-9.

In this chapter, we use administrative and employee self-reported data from a Fortune 100 employer to examine who participates in wellness programs and estimate the effects of incentives on participation rates and use. We then assess the impact of participation on utilization patterns and determine the evidence for differential effects on outcomes for certain interventions or levels of participation. We conclude our analyses with our projection of the health impacts of wellness program participation over a 20-year time frame based on a nationally representative sample of working age adults. Our main research questions guiding this analysis are listed below and outlined in Table 8.

- **Research Question 3.1:** What employee characteristics predict employee uptake of programs?
- **Research Question 3.2:** How do incentives alter an employee's decision whether to participate?
- **Research Question 3.3:** Do health care utilization patterns change following program participation?
- **Research Question 3.4**: Is there a differential effect of various programs on medical costs?[37]
- **Research Question 3.5:** Is there a dose-response effect on medical costs in the intensity of program interventions?
- **Research Question 3.6:** Is there evidence that program participation may create long-term gains in health?

[37] In this analysis, we treat medical claims paid as costs from the employer's perspective.

Table 8. Analytics Approach for Wellness Program Data Analysis

Research Questions	Hypotheses	Analysis
Question 3.1: What employee characteristics predict employee uptake of programs?	Employees with greater health risks, greater health care costs, higher levels of education, and income will be more likely to participate	Logistic regression participation on employee characteristics
Question 3.2: How do incentives alter an employee's decision whether to participate?	Program nonparticipation surcharges are associated with a greater probability of program participation. The surcharge effect is larger for higher levels of education and for participants with greater health care costs in preceding years.	Regression adjusted (logistic) difference-in-differences (DD)
Question 3.3: Do health care utilization patterns change following program participation?	Wellness program participation is associated with increase physician visits in the first year, but with fewer visits thereafter. Program participation is associated with reduced health care utilization for wellness-sensitive conditions.	Propensity score matching (PSM) followed by negative binomial fixed effects regression (for visits) and logistic regression (for hospitalizations)
Question 3.4: Is there a differential effect of various programs on medical costs?	Participation in the wellness program targeting employees with greater health risks has larger effects on medical costs than participation in the preventive wellness programs.[a]	PSM followed by generalized linear model (GLM) estimation with a log link function
Question 3.5: Is there a dose-response effect on medical costs in the intensity of program interventions?	Intervention intensity is positively associated with the effect of wellness program participation on medical costs.	PSM followed by GLM estimation with a log link function
Question 3.6: Is there evidence that program participation may create long-term gains in health?		Simulation model

[a] In this analysis, we treat medical claims paid as costs from the employer's perspective.

Methods

Our analytic approach builds on the methodologies used for the RAND Workplace Wellness Programs Study and similar projects.[38] These methodologies include using propensity score methods to create matched samples of participants and comparison groups to control for potential self-selection bias in program participation based on observable characteristics. We also relied on previously used algorithms to identify program participation, define outcomes, and estimate multivariate models.[39] Of note, our approach determines the incremental effect of participating in the telephonic coaching interventions under a workplace wellness program.

[38] Mattke et al., 2013.

[39] Mattke et al., 2013.

Program Description

The first set of analyses in this chapter is based on the wellness program implemented in 2004 by a Fortune 100 employer. Since then, the program has evolved to offer a menu of wellness components that, overall, promote healthy living and disease prevention as well as support management of chronic conditions. We briefly describe these components and the process by which an employee is identified and invited to participate.

First, all employees are invited to complete an HRA—a 20-minute questionnaire that can be completed online or on paper. [40] Based on employees' answers to the HRA questions, they are invited to participate in the lifestyle management program, which uses telephonic coaching and support materials to help employees engage in more healthful living. For example, employees who indicate low levels of physical activity on their HRA are invited to participate in a physical activity intervention. Other interventions within the lifestyle management program include smoking cessation, weight management, nutrition, and stress management.[41] During the lifestyle management telephonic coaching sessions, wellness coaches provide education, advice, and motivational support tailored to the needs of a participant. Participants also have access to an Internet portal with health-related information, and they receive educational materials by mail. Given the central role of the telephonic coaching sessions, we measure intensity of participation by the number of completed sessions.

The lifestyle management program also contains a set of "predisease" interventions that target individuals identified as having elevated risk for developing diabetes, obesity, hyperlipidemia, or hypertension. The "predisease" program is also based on telephonic coaching sessions combined with educational material, but provides longer and more frequent sessions as well as tailored content.

In addition, the wellness program vendor analyzes employee health care claims data to identify employees with any of the following ten chronic conditions: asthma, CAD, atrial fibrillation, CHF, stroke, hyperlipidemia, hypertension, diabetes, low back pain, and chronic obstructive pulmonary disease (see Figure 12). Employees with any of these conditions that meet vendor-defined criteria for cost and utilization are invited to participate in the disease management program that aims to improve medication adherence and self-care knowledge and skills specific to a chronic condition through several nurse phone consultations over a period of six to nine months.

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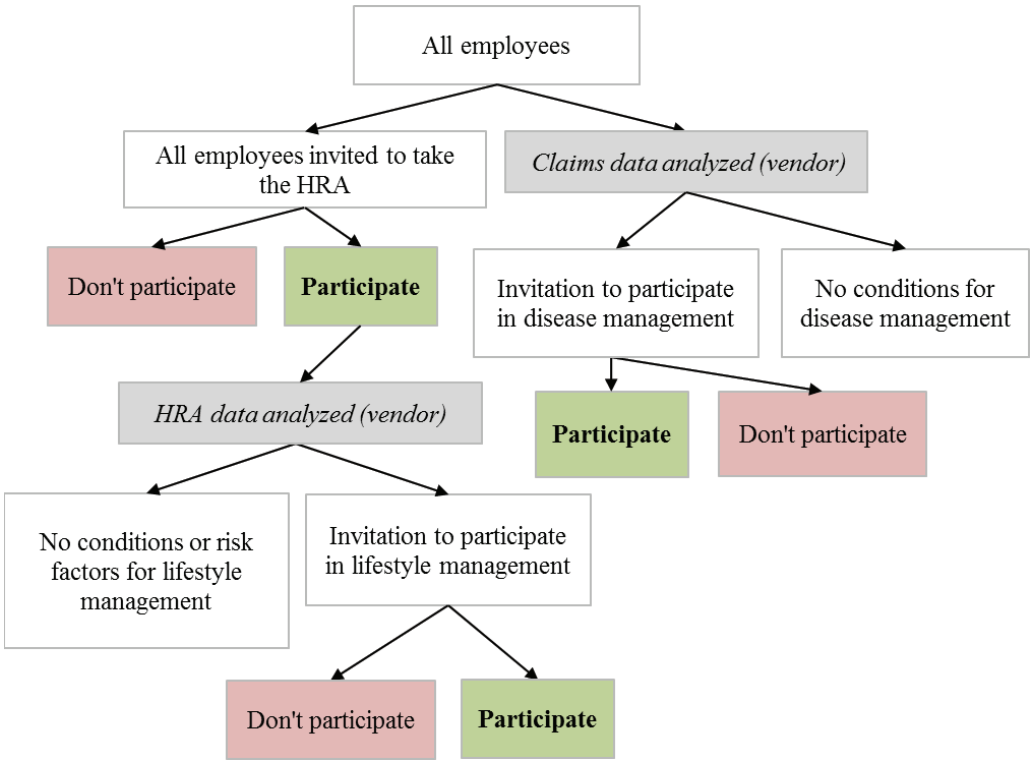
[40] Fewer than 10 percent of employees who are enrolled in a health maintenance organization or receive their health coverage through their union are ineligible to participate.

[41] The full list of lifestyle management program interventions includes: back care, CAD, depression, exercise, low back pain, nutrition, stress, smoking cessation, weight management, physical health, predisease diabetes, predisease hyperlipidemia, predisease hypertension and predisease obesity.

Figure 12. Wellness Program Design and Employee Participation Decisions



NOTE: Claims data are available for all employees who obtain coverage through the employer; HRA data are available only for those who complete the HRA.

Data Sources

We used a large data set composed of wellness program data and health care claims for the Fortune 100 employer for the years 2003 to 2011. This data set is large, with nearly 200,000 unique members (730,000 full member years) and allows us to extend analyses conducted in our previous RAND Workplace Wellness Programs Study by looking more in depth at the participation decision, incentive effects, and the extent to which program effects vary by program type, intervention intensity or exposure.[42] The strengths of these data include:

- Availability of baseline data before program launch. As shown in Table 9, we have one and two years of baseline data prior to the implementation of the disease management and lifestyle management programs, respectively, giving us eight years of intervention data for the disease management program and seven years of intervention data for the lifestyle management program.
- Availability of program data for management of both health risk factors (lifestyle management) and diagnosed chronic conditions (disease management).

[42] Mattke et al., 2013.

- Long average employee tenure. The average employee tenure is about six years, allowing us to track many individuals over long time periods.
- Broad geographic coverage. Employees reside in 49 states.
- Variation in incentive use. As shown in Table 9, sizable incentives were introduced in 2010, which gives us the opportunity to assess their effect on program participation.
- Rich content. The data set has detailed information on employees, including race/ethnicity, education (high school or less, some college, college graduate); employee work classification (hourly versus salaried); job classification (e.g., laborer, sales, executive); and employee ZIP code, which allows us to approximate socioeconomic status by using ZIP-code level median household income.[43]

Table 9. Fortune 100 Employer Data Availability and Wellness Program Evolution

Year	Change
2003	Start of health care claims data
2004	Introduction of disease management program
2005	Introduction of lifestyle management program
↓	
2010	Introduction of smoking cessation and disease management nonparticipation surcharges End of available HRA data
2011	End of available health care claims, lifestyle management, and disease management data

SOURCE: RAND analysis of Fortune 100 employer data.

Employee Characteristics and Program Participation

Research Question 3.1: What employee characteristics predict employee uptake of programs?

- *Hypothesis 3.1.1: Program-eligible employees with a higher level of health risk (e.g., high blood pressure or high cholesterol) are more likely to participate in a lifestyle management program.*
- *Hypothesis 3.1.2: Program-eligible employees with greater health care costs in the prior year are more likely to participate in a lifestyle or disease management program.*
- *Hypothesis 3.1.3: Program-eligible employees with a higher level of education are more likely to participate in a lifestyle or disease management program.*
- *Hypothesis 3.1.4: Program-eligible employees living in higher income areas are more likely to participate in a lifestyle or disease management program.*

[43] Race/ethnicity, education, and job classification are available only for employees who completed the HRA.

Our analysis of employee participation focused on each of the three decision nodes that characterize aspects of participation in wellness programs. As described earlier and in Figure 12, employees have three main decision points:

1. Whether to participate in the HRA
2. Whether to participate in the lifestyle management program
3. Whether to participate in the disease management program.

For each of these three forms of participation, we select all eligible and invited employees for the program component in question, and compare individuals who participated to those who did not.

We examined associations between participation and individual baseline characteristics using both program participants and nonparticipants who were eligible to participate. Specifically, we compared age, gender, region of residence, employee tenure, Charlson comorbidities,[44,] health care utilization (e.g., emergency room [ER] visits, hospital admissions), and health care costs between the two groups. Of note, we included a number of variables in our analysis that were not available in the data used for the previous *Wellness Programs Study*, including whether the employee is salaried or hourly and neighborhood median income.

For individuals who completed the HRA, we compared additional measures across the two groups. HRA completion is required to determine eligibility for the lifestyle management program but not for the disease management program (as illustrated in Figure 12). Thus, we compare only a subset of disease management participants and nonparticipants based on variables captured in the HRA. These HRA variables include a variety of self-reported health status metrics such as BMI (kg/m^2), total cholesterol (mg/dL), and systolic and diastolic blood pressure (mm Hg). The variables also include self-reported education, ethnicity, and job classification.

We examine both unadjusted and adjusted differences between participants and nonparticipants. The adjusted differences are based on results from logistic regressions to identify which factors are associated with participation for each decision node while controlling for several individual level characteristics (see Appendix B for details).

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[44] Charlson comorbidities are a set of conditions used to predict patient mortality. The presence of the comorbidities is determined annually, similar to the health care utilization calculations. The comorbidities are commonly used as risk adjustors. There are 19 conditions: myocardial infarction, hemiplegia or paraplegia, congestive heart failure, renal disease, peripheral vascular disease, cerebrovascular disease, dementia, leukemia, chronic pulmonary disease, lymphoma, connective tissue disease, peptic ulcer disease, any tumor, metastatic solid tumor, mild liver disease, moderate or severe liver disease, acquired immunodeficiency syndrome/human immunodeficiency virus, diabetes without chronic complication, and diabetes with chronic complication. For our purposes, we will consider the two liver diseases as one condition, the two diabetic conditions as one condition, and the tumor conditions as one condition. M. E. Charlson, P. Pompei, K. L. Ales, and C. R. MacKenzie, "A New Method of Classifying Prognostic Comorbidity in Longitudinal Studies: Development and Validation," *Journal of Chronic Diseases,* Vol. 40, No. 5, 1987, pp. 373–383. Of note, the definitions and algorithms used to create those comorbidity variables may differ from those used by the disease management program vendor to identify employees who are program eligible.

Financial Incentives and Program Participation

Research Question 3.2: How do incentives alter an employee's decision whether to participate?

- *Hypothesis 3.2.1: Program nonparticipation surcharges are associated with a greater probability of program participation.*
- *Hypothesis 3.2.2: The effect of nonparticipation surcharges on program participation is larger among eligible employees with a higher level of education.*
- *Hypothesis 3.2.3: The effect of nonparticipation surcharges on program participation is larger among eligible employees with greater health care costs in the prior year.*

To investigate the impact of incentives on participation, we incorporated the fact that the employer introduced nonparticipation surcharges in 2010 into the design of the analyses.[45] Specifically, a $600 smoking cessation nonparticipation surcharge was applied to all individuals who reported smoking during enrollment for medical benefits but who did not complete the smoking cessation program (only "active participation" and not successful cessation was required to avoid the surcharge). Individuals identified as eligible for the disease management program were also penalized with a $600 nonparticipation surcharge if they did not actively participate in at least one of the programs for which they were eligible. Thus, the maximum surcharge an individual may have faced in a given year was $1,200. The surcharge dollars are deducted from paychecks on a monthly basis in the form of a "health insurance premium surcharge."

We assessed the impact of the surcharges on participation using regression adjusted DD model to control or adjust for various individual-level factors. We also assessed the extent to which incentives differentially affected certain subgroups of individuals—e.g., young versus old, living in lower- versus higher-income neighborhoods, risk factor severity (such as normal weight versus overweight or obese)—these are essentially triple differences (DDD) estimates (see Appendix B for more details).

Health Care Utilization Patterns after Program Participation

Research Question 3.3: Do health care utilization patterns change following program participation?

- *Hypothesis 3.3.1: Program participation is associated with more physician visits in the first year, but with fewer physician visits thereafter.*

[45] The employer also offers smaller incentives for other activities under the wellness program, such as HRA completion. The maximum overall cash value is $300. As those incentives were introduced with the inception of the program, we are unable to study their effect.

- *Hypothesis 3.3.2: Program participation is associated with reduced health care utilization for wellness-sensitive conditions.*

To answer these research questions, we separately examined lifestyle management, disease management, and predisease management participation, respectively. For each program, we used propensity scoring methods to create an analytic sample that contained program participants and their matched comparison groups using propensity score methods (see Appendix B for details).

We constructed four measures of health care utilization—outpatient office visits for primary care evaluation and management, inpatient hospital admissions, ER visits, and any wellness-sensitive event, which is an inpatient admission or ER visit related to a condition that one would expect wellness program participation to affect. For example, participation in a smoking cessation program might reduce the risk of hospital admissions for patients with chronic obstructive pulmonary disease if participation is associated with successful smoking cessation or at least reductions in smoking. Although the wellness-sensitive event measure has not been comprehensively tested and validated, using this measure may allow us to detect significant impacts of wellness program participation that might not be detectable with less specific all-cause office visits and hospital admission utilization measures.[46] We utilized a continuous measure for office visits, but created three separate indicator variables for the hospital admissions, ER visits, and wellness-sensitive events in a given year, which are set equal to one if the individual had any utilization in that category.

To test Hypotheses 3.3.1 and 3.3.2, we performed longitudinal regression analyses using matched pairs of participants and nonparticipants to estimate the impact of program participation on health care utilization measures (see Appendix B for details). Briefly, for Hypothesis 3.3.1, we estimated a fixed-effects negative binomial regression of outpatient office visits for primary care evaluation and management (a continuous measure) as a function of the years an individual was enrolled in the program. Including individual-level fixed effects in the model allows us to remove any time-invariant, person-specific, unobserved heterogeneity that might affect our results. It does not, however, address any selection on unobservable characteristics that change over time. For Hypothesis 3.3.2, we were unable to use a fixed-effects specification due to the low incidence of hospitalizations and ER visits. We regressed our dichotomous measures of hospitalization—whether the individual had any hospitalizations, any ER visits, or any wellness-sensitive events—on program participation using a logistic model with standard errors (SEs) clustered at the person level to address the multilevel nature of these data. In all regressions, we also adjusted for age, sex, whether the individual was an employee, region of residence, several Charlson comorbidity indicators from baseline, and year fixed effects.

[46] For more details on how we define wellness-sensitive events, see Gowrisankaran et al., as we use their definitions. Gautam Gowrisankaran, Karen Norberg, Steven Kymes, Michael E. Chernew, et al., "A Hospital System's Wellness Program Linked to Health Plan Enrollment Cut Hospitalizations But Not Overall Costs," *Health Affairs,* Vol. 32, No. 3, 2013, pp. 477–485.

Differential Effects of Program Components

Research Question 3.4: Is there a differential effect of various programs on medical costs?[47]

- *Hypothesis 3.4.1: Participation in the lifestyle management predisease interventions has larger effects on medical costs than participation in the non-predisease lifestyle management interventions.*
- *Hypothesis 3.4.2: Participation in the smoking cessation intervention has larger effects on medical costs than other lifestyle management interventions*.

We tested the extent to which medical costs varied across wellness program components by pooling the predisease management matched sample and lifestyle management matched sample for Hypothesis 3.4.1 and using the matched lifestyle management sample for Hypothesis 3.4.2. As already described, we used propensity score methods to create each of the matched program samples (see Appendix B for details). Briefly, we estimated a GLM with a log link function to address the fact that medical costs are skewed with SEs clustered at the person level to address the multilevel nature of these data. We compared the adjusted effect size of each program on costs to test Hypotheses 3.4.1 and 3.4.2 (See Appendix B for more details).

Dose Response Effect of Program Participation

Research Question 3.5: Is there a dose-response effect on medical costs in the intensity of program interventions?

- *Hypothesis 3.5.1: Intervention intensity is positively associated with the effect of lifestyle management program participation on medical costs.*
- *Hypothesis 3.5.2: Intervention intensity is positively associated with the effect of predisease management program participation on medical costs.*

To shed light on whether participation exerts a dose-response effect on health care costs, we first created slightly different matched samples, using propensity score methods. Instead of matching participants with nonparticipants based on an estimated likelihood of participation, we matched on their estimated probability of participating at one of three levels: none, low intensity, and high intensity. For example, a participant with a high level of participation was matched to a nonparticipant whose predicted probability of high-intensity participation was similar to the participant's. To estimate the effect of intervention intensity on costs, we used the matched samples for each program to estimate a GLM with a log link function allowing for a categorical participation measure to capture intervention intensity (i.e., no participation, low intensity, and high intensity). We defined this categorical measure based on the actual distribution of number of sessions used per year among participants.

[47] In this analysis, we treat medical claims paid as costs from the employer's perspective.

Long-Term Gains in Health from Program Participation

Research Question 3.6: Is there evidence that program participation may create long-term gains in health?

Our previous work has shown that lifestyle management programs positively affect multiple health risk factors and health status variables but fail to reduce health care costs over a period of up to seven years.

To predict longer-term effects of program participation on costs, we conducted simulations using a nationally representative cohort of working-age individuals in the United States from the 2009–2010 National Health and Nutrition Examination Survey (NHANES). We used our previous estimates for the impact of program participation on BMI, blood pressure, cholesterol, and smoking as default values for predicting the impact of these changes in terms of risk for various cardiovascular events over several decades. Cardiovascular risks are predicted using the risk equations from the Framingham Study.[48] The model compares three scenarios: no wellness program participation, participation resulting in the effects estimated in our prior studies, and a theoretical "what if" scenario in which we reduce all risk factors to their minimum possible values (for example, individuals with total cholesterol above that recommended by treatment guidelines have their cholesterol lowered to the top end of the "desirable" range). Table 10 is an overview of key model input parameters and outcome measures.

Table 10. Key Simulation Model Input Parameters and Outcome Measures

Input Parameters	Outcome Measures
Time horizon (1–20 years)	Cardiovascular and stroke events
Population specifications:	All-cause mortality
Age categories (e.g., 50–64 years)	Person-years of participation
Gender	Cardiovascular and stroke event costs
Presence of clinical conditions (e.g., diabetes)	Participation costs
Wellness program impact:	
BMI (change in kg/m^2)	
Cholesterol (change in mg/dL)	
Blood pressure (change in mmHg)	
Smoking status (proportion of smokers that quit)	
Wellness program participation:	
Proportion of individuals that participate	

[48] Ralph B. D'Agostino, Mason W. Russell, Daniel M. Huse, R. Curtis Ellison, et al., "Primary and Subsequent Coronary Risk Appraisal: New Results from the Framingham Study," American Heart Journal, Vol. 139, No. 2, 2000, pp. 272–281; R. B. D'Agostino, P. A. Wolf, A. J. Belanger, W. B. Kannel, "Stroke Risk Profile: Adjustment for Antihypertensive Medication: The Framingham Study," *Stroke,* Vol. 25, No. 1, 1994, pp. 40–43; P. A. Wolf, R. B. D'Agostino, A. J. Belanger, and W. B. Kannel, "Probability of Stroke: A Risk Profile from the Framingham Study," *Stroke,* Vol. 22, No. 3, 1991, pp. 312–318.

Results

In this section, we first present profiles of participating and nonparticipating employees. We then present the findings of our analysis of the effects of these employee characteristics and the effects of financial incentives and penalties on program participation, followed by our findings on the effects of program participation and intensity of participation on utilization of health services and projected health costs.

Question 3.1: What Employee Characteristics Predict Employee Uptake of Programs?

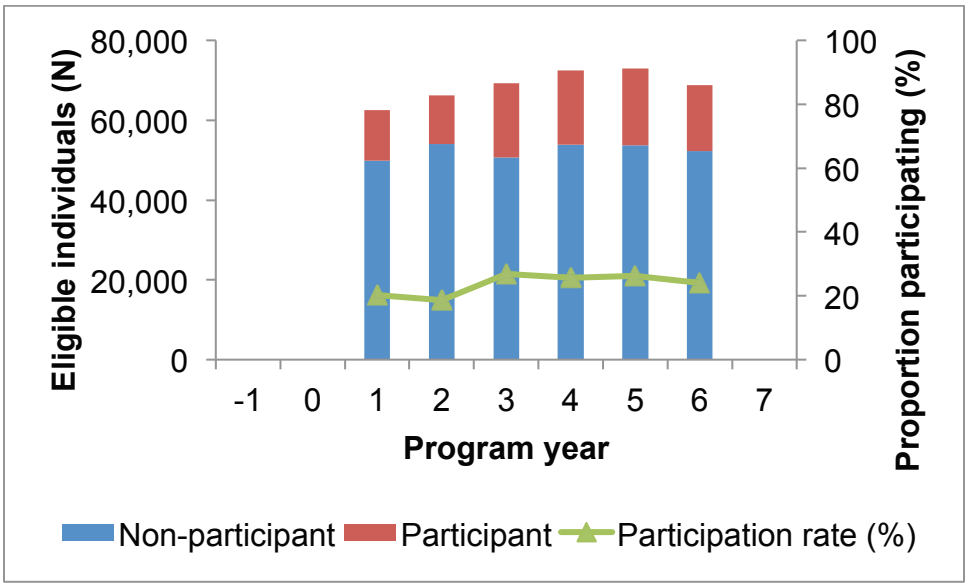
For each of the three wellness program components offered by the Fortune 100 employer, we compared the characteristics of participating and nonparticipating employees. These contrasts between participants and nonparticipants were generated using subsamples of employees eligible for the program component in question. We begin by presenting overall participation rates for the three program components, as well as unadjusted participation rates by individual characteristics. We conclude with the results of our multivariate regression analyses in the form of predicted probabilities,[49] which we generated to understand the relationship between employee characteristics and program participation.

Overall Program Participation

Participation trends over time for the HRA, telephonic lifestyle management, and telephonic disease management components of the Fortune 100 employer's wellness program are shown in Figures 13, 14, and 15, respectively. Program year zero corresponds to calendar year 2004. In any year, approximately 24 percent of full-time company employees invited to complete the HRA chose to do so. For lifestyle management, the participation rate among invited (eligible) individuals (i.e., those who had a modifiable health risk based on HRA responses) was more than 38 percent, while for disease management, the participation rate for individuals with a diagnosed chronic condition was less than 20 percent. Participation in the HRA component of the program was stable over time, with the lowest rate occurring in year two of the program (19 percent). Participation trends for the telephonic lifestyle management and disease management programs varied over time (Figures 14 and 15).

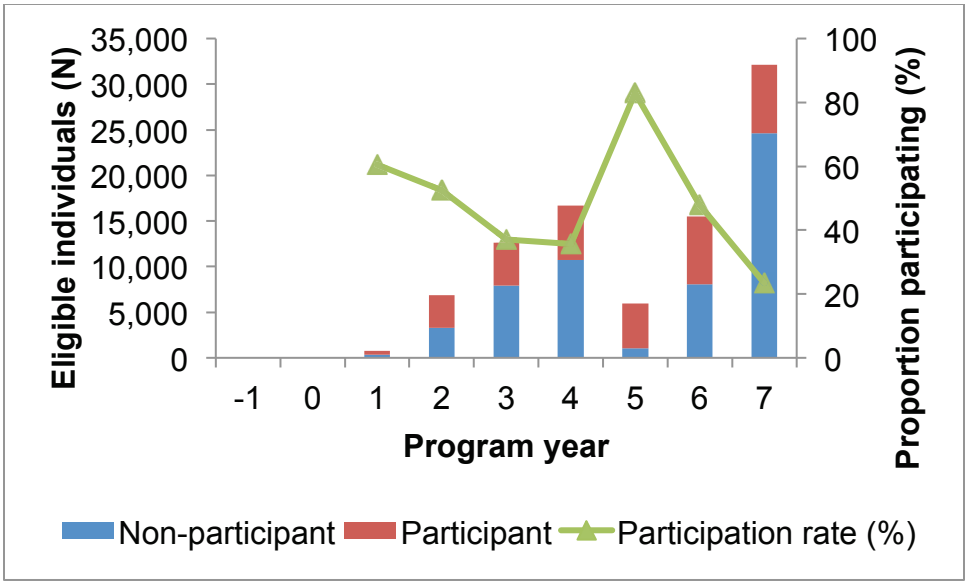
[49] Predicted probabilities estimated for an employee characteristic can be conceptualized as adjusted means for each value of the characteristic variable. For example, using the results from the multivariate regressions, we can generate a predicted probability of participation for men and women to compare whether the likelihood of participation varies by gender. See Appendix B for more details.

Figure 13. HRA Eligibility and Participation, by Program Year



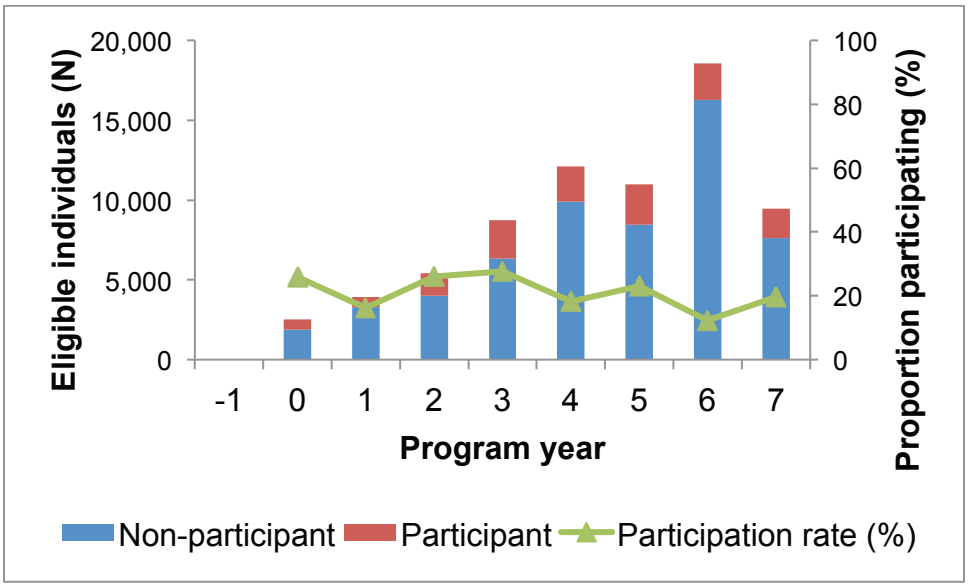
SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Baseline program year (0) corresponds to calendar year 2004. See Appendix B for sample sizes. The sample sizes at the person-year level are: 412,177 eligible, 314,312 nonparticipants, 97,865 participants, and an overall 23.7-percent participation rate.

Figure 14. Lifestyle Management Eligibility and Participation, by Program Year



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Baseline program year (0) corresponds to calendar year 2004. See Appendix B for sample sizes.

Figure 15. Disease Management Eligibility and Participation, by Program Year

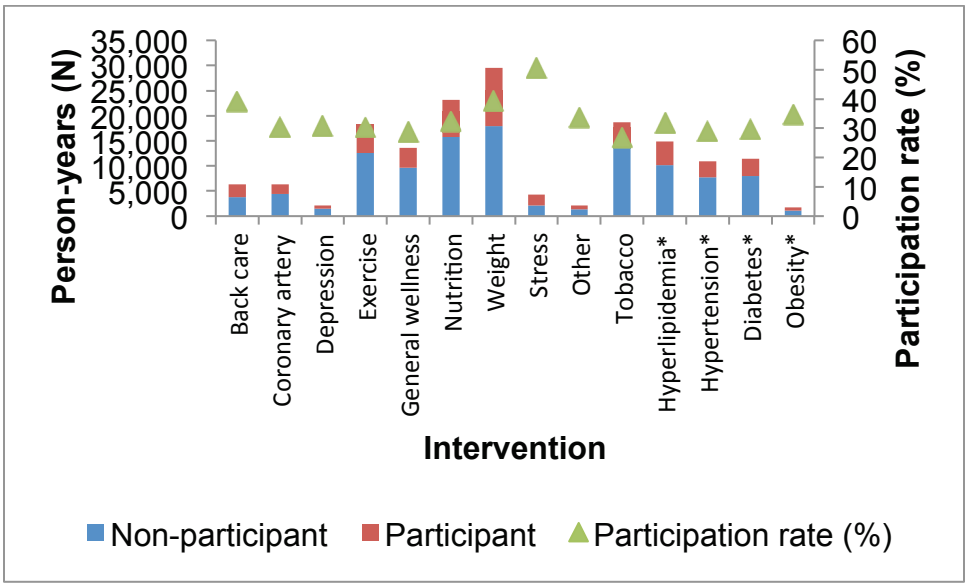


SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Baseline program year (0) corresponds to calendar year 2004. See Appendix B for sample sizes.

We present the eligibility and participation trends by specific interventions in Figure 16. The interventions with the largest number of person-years of eligibility are focused on treating factors that contribute to excess weight, such as physical activity, nutrition, and weight management. Differences in the number of person-years of eligibility reflect not only the prevalence of conditions identified through the HRAs, but also the algorithm used by the program vendor to identify eligible individuals and the number of years in which the intervention was offered.

Across the lifestyle management interventions with at least 10,000 person-years of eligibility, participation rates varied from a minimum of 27 percent for the smoking cessation intervention to 39 percent for the weight management intervention. Across all interventions, only the stress management program had a participation rate in excess of 50 percent. Overall, all lifestyle management interventions, regardless of the health risks targeted, have uptake rates between 25 percent and 40 percent.

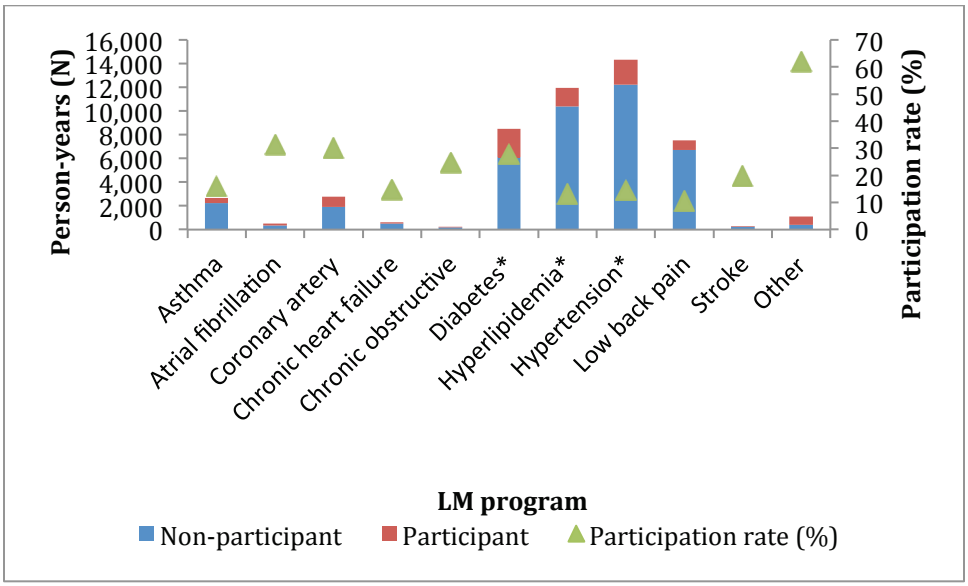
Figure 16. Lifestyle Management Eligibility and Participation, by Intervention



SOURCE: RAND analysis of Fortune 100 employer data.
* Predisease intervention. See Appendix B for sample sizes.

Participation rates in the specific disease management interventions offered are shown in Figure 17. As expected from the overall disease management participation rate of less than 20 percent, the majority of disease management interventions show low rates of participation. The low back pain intervention has the lowest participation rate, at more than 10 percent. Among the four interventions with the largest number of person-years of eligibility, only the diabetes intervention has a participation rate above 20 percent.

Figure 17. Disease Management Eligibility and Participation, by Diagnosis



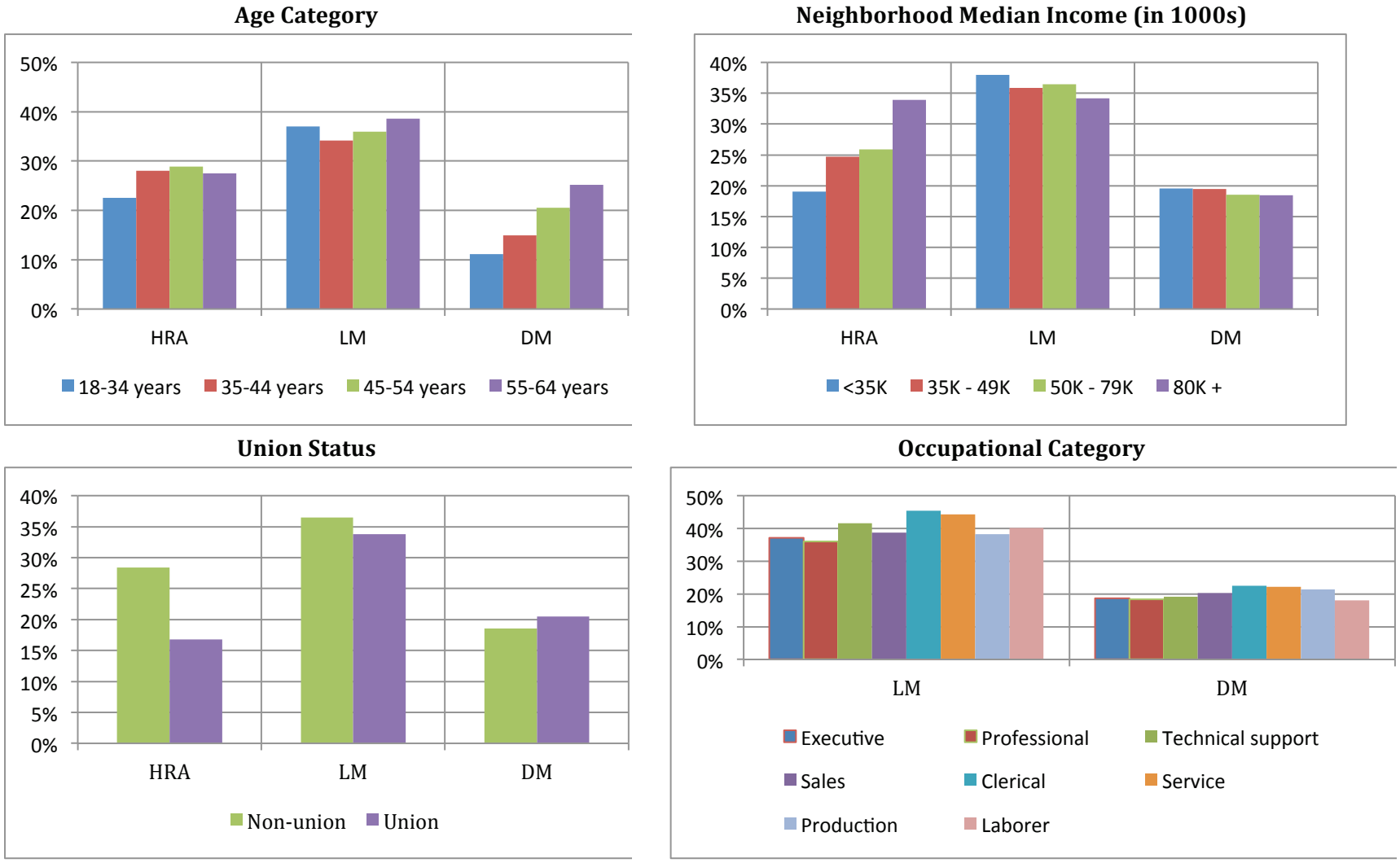
SOURCE: RAND analysis of Fortune 100 employer data.

* Predisease program. See Appendix B for sample sizes.

Predictors of Employee Participation

Figure 18 is a panel of bar charts, which depict wellness program participation by employee characteristics. These unadjusted analyses show the extent to which employee characteristics are associated with higher (or lower) rates of program participation. As a reminder, all analyses are of employees eligible for the intervention in question, such as lifestyle management. Not surprisingly, age tends to be positively correlated with participation in the disease management program. Participants living in higher-income neighborhoods (a proxy for income) tend to be more likely to participate in the HRA. Nonunionized employees are more likely to participate in the HRA as well. These charts also suggest variation in participation rates across occupational categories.

Figure 18. Program Participation Rates, by Employee Characteristics and Program Component



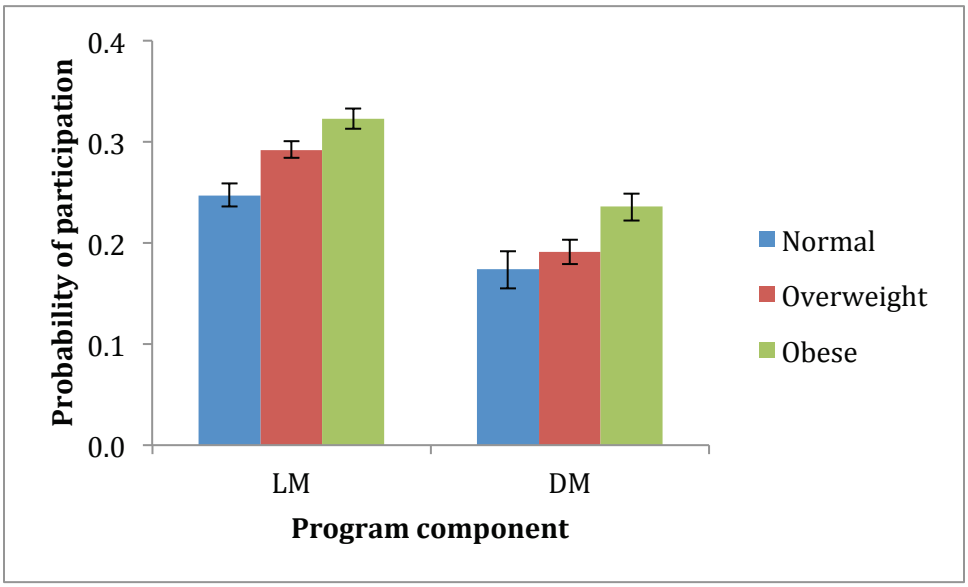
SOURCE: RAND analysis of Fortune 100 employer data. See Appendix B for sample sizes.

To better approximate the true relationship between employee characteristics and program uptake, we generated predicted probabilities of participation for all employee characteristics available in the health plan enrollment files or collected as part of the HRA. We present graphical results of these analyses for each of our study hypotheses, as well as for a number of additional employee characteristics.

Figures 19, 20, and 21 show the predicted probabilities of participation across different risk factor categories for BMI, blood pressure, and total cholesterol. Our hypothesis was that individuals with a higher level of health risks are more likely to participate in a lifestyle management or disease management intervention, holding all other characteristics in the model constant.

Our results, shown in Figure 19, reveal that obese individuals are more likely to accept the invitation into a lifestyle management or disease management program than comparable overweight and normal weight individuals. The absolute differences in participation rates are between three and seven percentage points; the relative difference, between 10 percent and 24 percent, respectively.

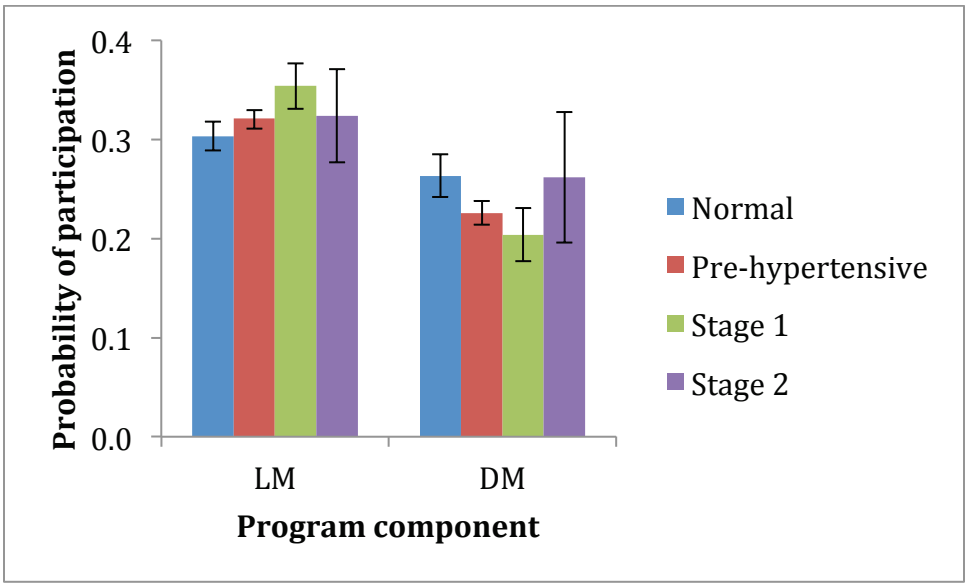
Figure 19. Multivariate Results: Employee Weight and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: An individual is classified as normal weight if BMI<25 (all expressed in kg/m^2), overweight if BMI≥25, but <30, and obese if BMI≥30. Results are based on multivariate regression and includes other covariates as described in Appendix B. Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

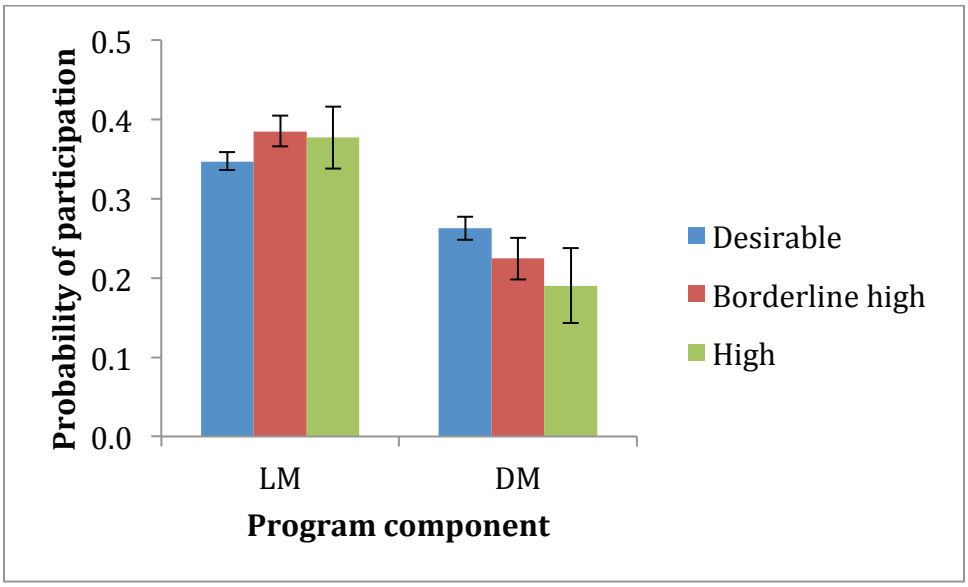
Turning to the other two health risks examined—blood pressure and total cholesterol—our analyses identified differences between adjusted participation rates and health risks, but most differences were not statistically significant and did not support our hypothesis.

Figure 20. Multivariate Results: Employee Blood Pressure and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: An individual is classified as normal if systolic blood pressure (SBP) is <120 (all expressed in mmHg) and diastolic blood pressure (DBP) is <80; prehypertensive if SBP is ≥120 but <140mmHg or DBP is ≥90 but <100; stage-1 hypertensive if SBP is ≥140 but <160 or DBP is ≥90 but <100 and stage-2 hypertensive if SBP is ≥160 or DBP ≥100. Results are based on multivariate regression and include other covariates as described in Appendix B. Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

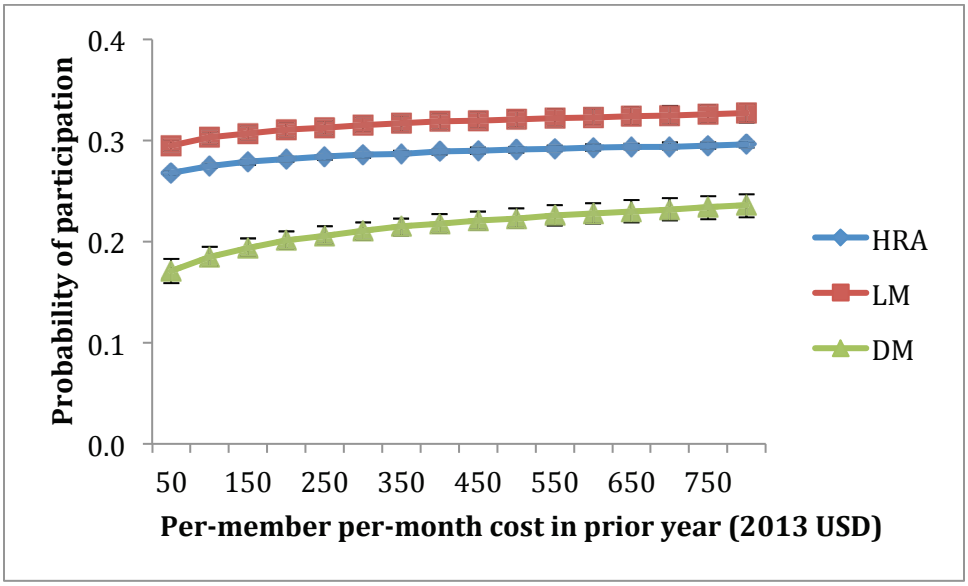
Figure 21. Multivariate Results: Employee Cholesterol and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: An individual is classified as desirable if total cholesterol is <200 (all expressed in mg/dL), borderline high if total cholesterol is ≥200 but <240 and as high if cholesterol is ≥240. Results are based on multivariate regression and include other covariates as described in Appendix B. Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

We also hypothesized that greater health care costs in the prior year make an employee more likely to participate in a lifestyle management or disease management intervention. We show the predicted probabilities of participation for different levels of health care cost in Figure 22. While lifestyle management participation increases slightly with employee health care costs, the changes in participation rates are relatively small. For example, we predict employees with per-member-per-month (PMPM) health care costs of $50 will have a 30-percent chance of participating, while those with costs of $750 will have a 33-percent chance, a difference of 3.2 percentage points (difference significant at $p<0.01$).

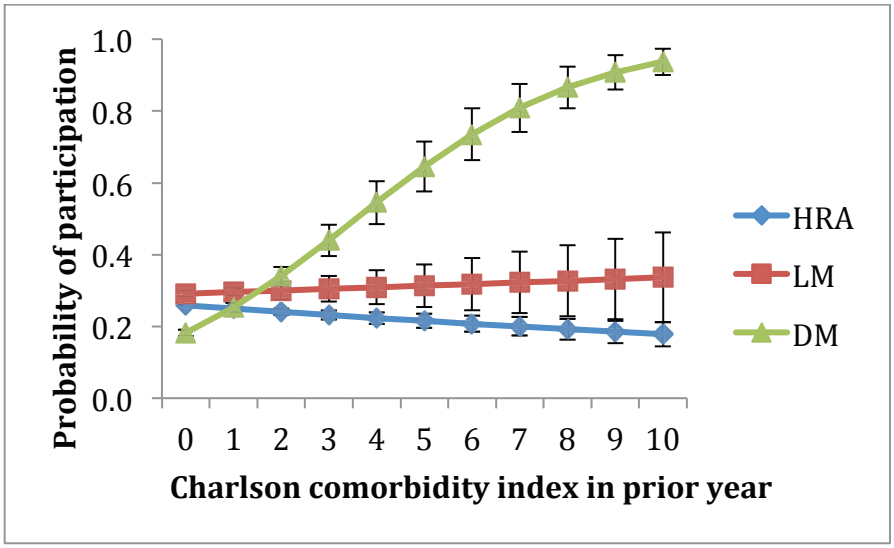
Figure 22. Multivariate Results: Baseline Employee Health Care Costs and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Results based on multivariate regression and includes other covariates as described in Appendix B. Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

As health care costs in part reflect the presence and/or severity of illness, we generated predicted probabilities for each Charlson comorbidity index value (Figure 23). We found that the probability of participating in the HRA significantly decreases with disease burden, although the change in likelihood is small. Conversely, the probability of participating in the lifestyle management program significantly increases with disease burden, but the effect is also modest. By contrast, the impact of increasing disease severity on disease management participation is substantial: At a Charlson comorbidity index of four, the predicted participation is more than 50 percent, which increases to more than 80 percent for Charlson comorbidity index values of seven or greater.

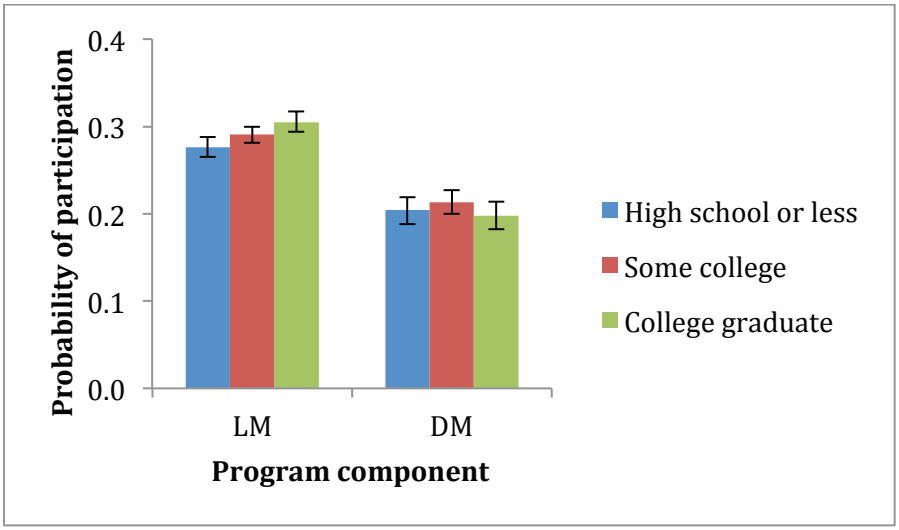
Figure 23. Multivariate Results: Baseline Employee Comorbidities and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Results based on multivariate regression and includes other covariates as described in Appendix B. Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

We hypothesized that individuals with a higher level of education are more likely to participate in a lifestyle management or disease management intervention. The predicted probabilities, by level of education, for the lifestyle management and disease management components are shown in Figure 24. In short, our results do not support our hypothesis, as we found that predicted probabilities of participation do not vary across levels of education.

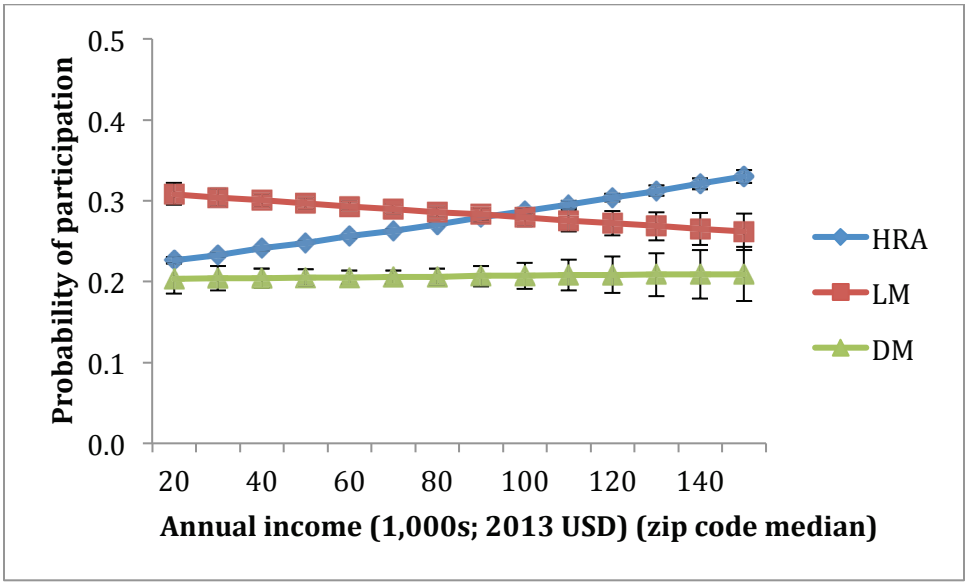
Figure 24. Multivariate Results: Employee Education Level and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Results based on multivariate regression and includes other covariates as described in Appendix B. Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

Figure 25 shows the predicted probabilities of participation by neighborhood median income. Our hypothesis was that individuals living in higher income areas are more likely to participate in a lifestyle management or disease management intervention. We found that the likelihood of lifestyle management participation falls with living in an increasingly wealthy area and that the likelihood of disease management participation remains relatively constant. However, we found that the likelihood of HRA participation increases with neighborhood income. The predicted probability for HRA participation increases by 10 percentage points between neighborhood incomes of $20,000 per year and $150,000 per year (difference significant at $p<0.01$). Further, the change in the likelihood of HRA participation across income categories is somewhat remarkable when compared to the declining and flat predicted probabilities for lifestyle management and disease management participation, respectively.

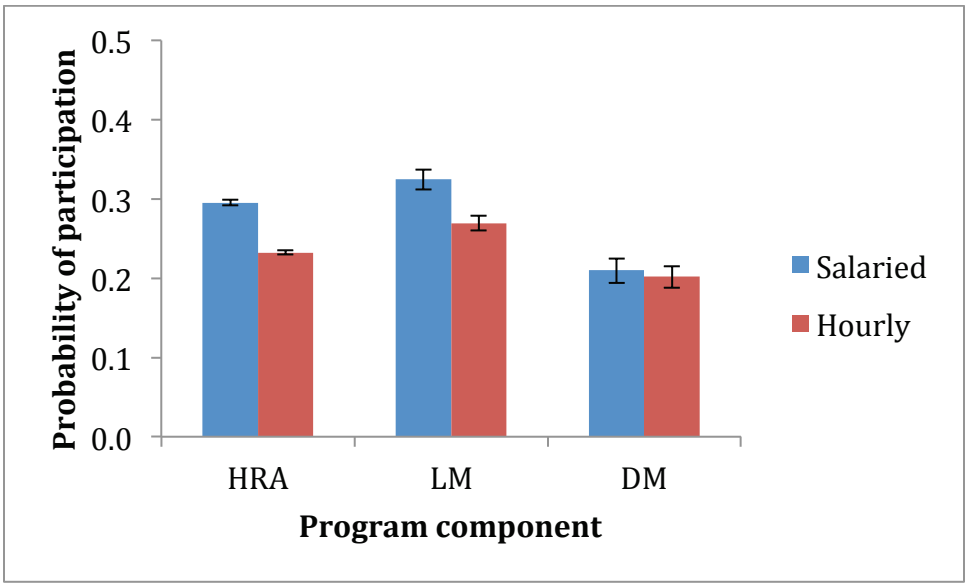
Figure 25. Multivariate Results: Neighborhood Median Income and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Neighborhood median income is approximated by ZIP-code level median household income. Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

To complement our analysis of predicted probabilities across neighborhood income levels, we generated probabilities by pay type (salaried or hourly pay), as shown in Figure 26. As salaried employees generally earn more than those paid on an hourly basis, we expected probabilities—given the results shown above for neighborhood income levels—of HRA participation to be higher for salaried employees than for hourly employees—and, conversely, for lifestyle management participation probabilities to be lower. However, we found that predicted probabilities of participation are higher among individuals paid on a salaried versus hourly basis for both HRA and lifestyle management components.

Figure 26. Multivariate Results: Employee Pay Type and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.
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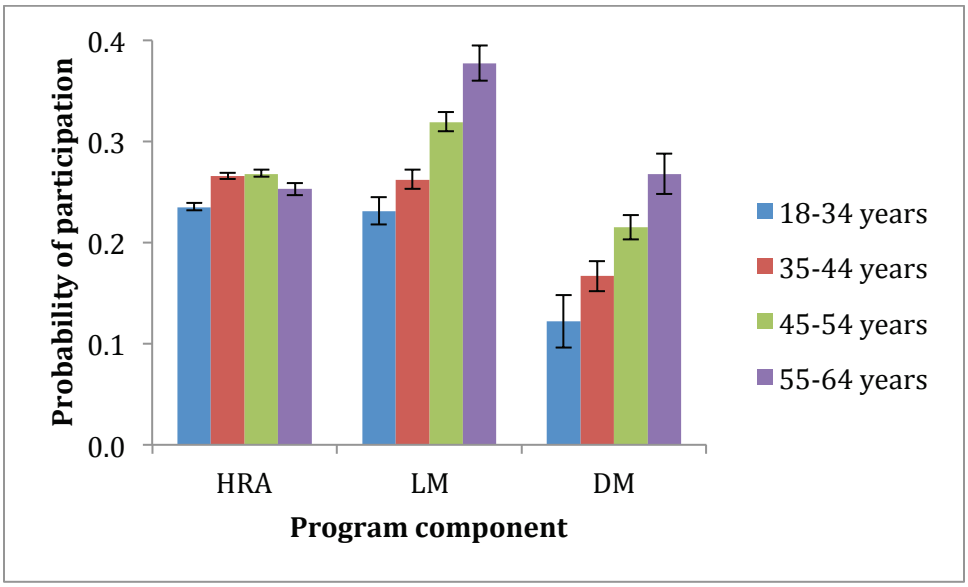
Our final predicted probabilities of participation were generated for each of our age categories. Figure 27 shows that predicted probabilities of HRA participation are quite similar across all age categories. In contrast, for both lifestyle management and disease management, our predicted probabilities of participation rise with increasing age. The differences are significant among all age categories for lifestyle management and for disease management. The predicted probability increases by 15 percentage points between the 18–34 and 55–64 years of age groups for both lifestyle management participation and disease management participation ($p<0.01$ for both differences).

Figure 27. Multivariate Results: Employee Age and Predicted Program Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

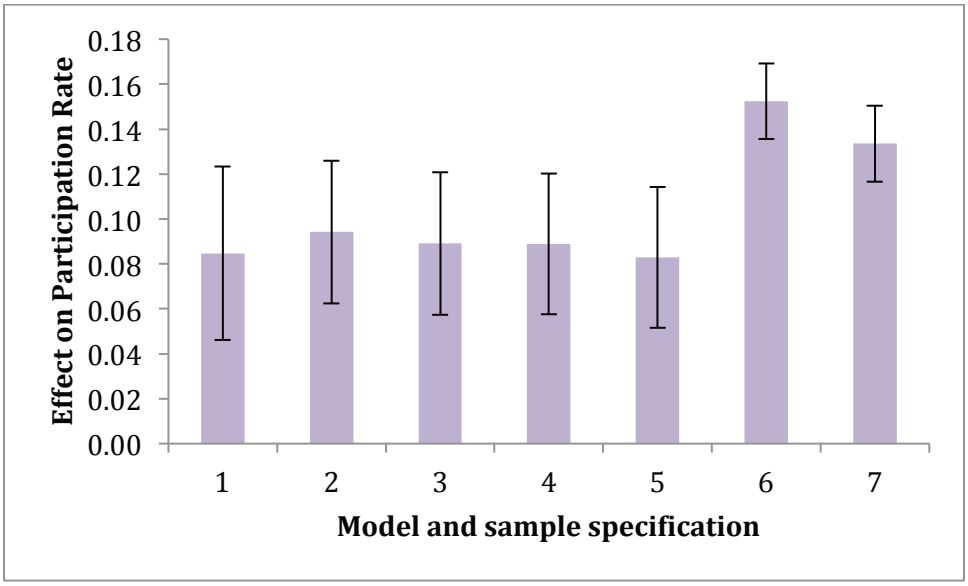
Question 3.2: How Do Incentives Alter an Employee's Decision to (or Not to) Participate?

We analyzed the impact of nonparticipation surcharges on the likelihood of participating for both the smoking cessation intervention (part of the lifestyle management component) and the disease management component. We conducted our analyses for the smoking cessation and disease management component separately as we customized our analytic approach to differences in how the surcharges were introduced and the availability of individuals who could be used as statistical controls.

Impact of Surcharge for Nonparticipation in Smoking Cessation Program

We found that, in the presence of incentives, smokers increased their participation, on average, by 8.5 percentage points ($p<0.01$). Our findings were similar across multiple methods of model specification (eligibility variables only versus eligibility and HRA variables), as well as the sample used for the analysis (full sample from eligibility file versus subsample of individuals that completed an HRA) (Figure 28). Our overall finding that nonparticipation surcharges increased the probability of participation supports our first hypothesis that incentives are associated with increases in program uptake.

Figure 28. Incentive Effects for Smoking Cessation on Participation in Lifestyle Management Programs: Difference in Differences Estimate by Model and Sample Specification

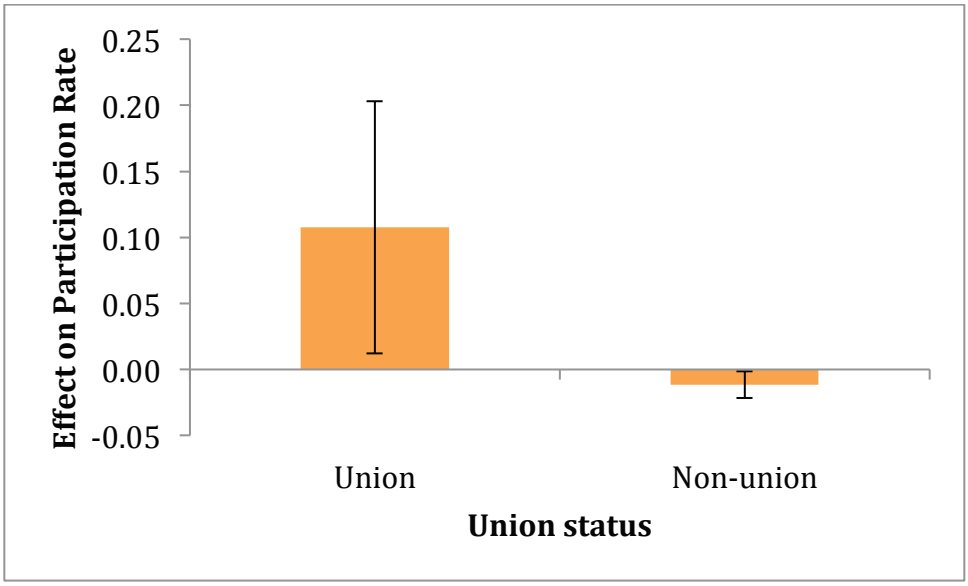


SOURCE: RAND analysis of Fortune 100 employer data.
NOTES:
Model 1 = HRA sample + HRA variables + interaction terms.
Model 2 = HRA sample + HRA variables.
Model 3 = HRA sample + HRA variables + program year 5 dropped.
Model 4 = HRA sample + no HRA variables.
Model 5 = HRA sample + no HRA variables + program year 5 dropped.
Model 6 = Full sample.
Model 7 = Full sample + program year 5 dropped.
Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

But is the effect of incentives moderated by any employee characteristics? We investigated the following employee characteristics as potential moderators: educational attainment, prior-year health care costs, union status, Charlson comorbidity index, occupational classification, and BMI status. Our analyses found that neither educational attainment nor previous-year health care costs significantly affected response to nonparticipation surcharges. The employee characteristics that appear to moderate the effect of incentives are union status (whether an individual's position was unionized), Charlson comorbidity index, occupational classification, and BMI status.

Figure 29 shows that the surcharge differentially affected unionized smokers. On average, being a unionized smoker increased the probability of participation in the smoking cessation program by 11 percentage points. This effect is statistically different from zero ($p<0.05$) and is statistically different ($p<0.05$) as compared to the estimated effect for nonunionized smokers. We estimate that nonunionized smokers, when faced with nonparticipation surcharges, decrease their likelihood of participation by 1.1 percentage points ($p<0.05$).

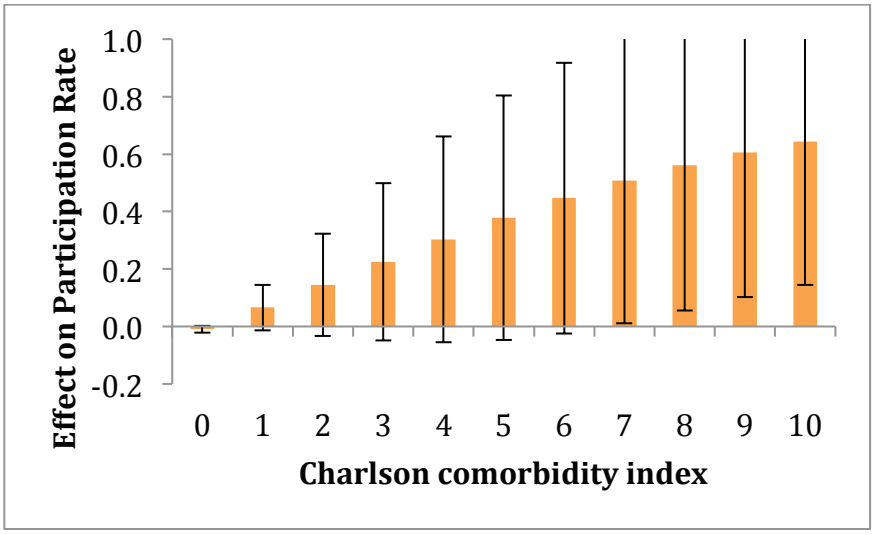
Figure 29. Incentive Effects for Smoking Cessation on Participation in Lifestyle Management Programs: Impact of Union Status



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes. These are the DDD estimates (see Appendix B for more details).

Our models also predicted high Charlson comorbidity index scores to have a positive moderating effect on the impact of the incentives on participation of smokers in a smoking cessation program (Figure 30). Specifically, the surcharge effect is significantly smaller for lower comorbidity categories (i.e., Charlson comorbidity index values of 1 or 0) as compared to the surcharge effects for comorbidity categories defined as the presence of multiple chronic conditions.

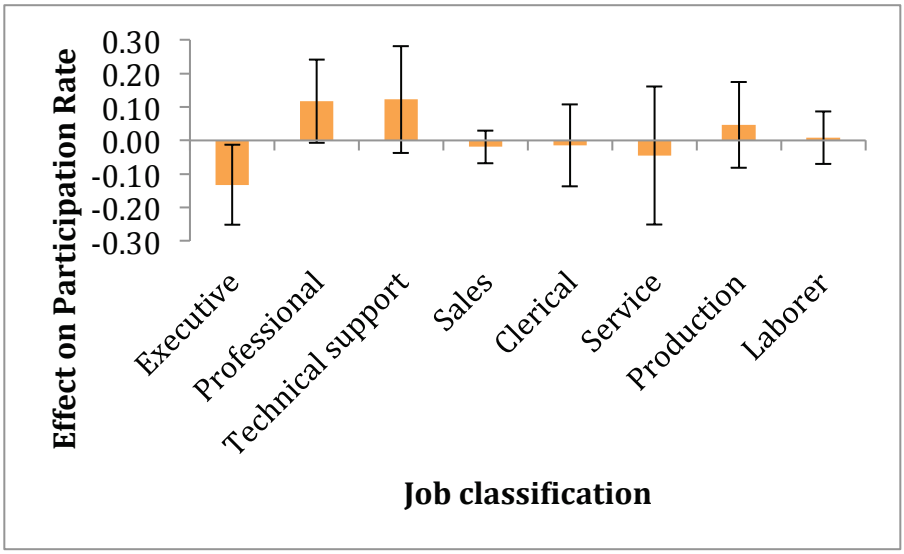
Figure 30. Incentive Effects for Smoking Cessation on Participation in Lifestyle Management Programs: Impact of Charlson Comorbidity Index



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes. These are the DDD estimates (see Appendix B for more details).

The only job classification category that was found to moderate the effect of incentives on participation in a smoking cessation program was that of "executives" (Figure 31). This finding aligns with the hypothesis that higher-income earners may not be sensitive to nonparticipation penalties of $600.

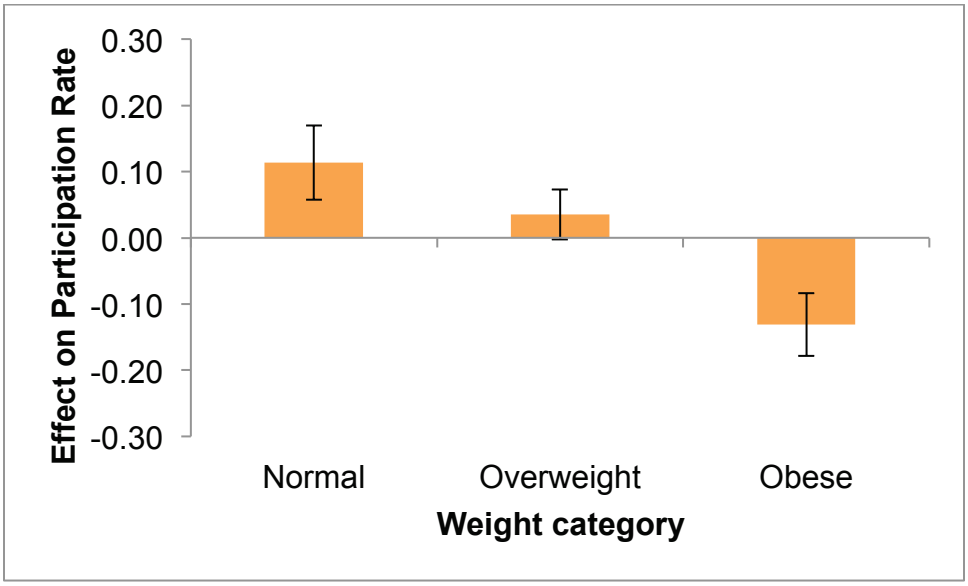
Figure 31. Incentive Effects for Smoking Cessation on Participation in Lifestyle Management Programs: Impact of Occupational Classification



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes. These are the DDD estimates (see Appendix B for more details).

Lastly, we found normal weight status to positively moderate the effect of incentives on participation in a smoking cessation program (Figure 32). Conversely, obese weight status is associated with a negative moderating effect. These results indicate that weight status has an impact on the effect of incentives on participation, with those in the highest risk category expected to have an uptake rate that is 24 percentage points lower than those in the lowest risk category (difference significant at $p<0.01$).

Figure 32. Incentive Effects for Smoking Cessation on Participation in Lifestyle Management Programs: Impact of Weight

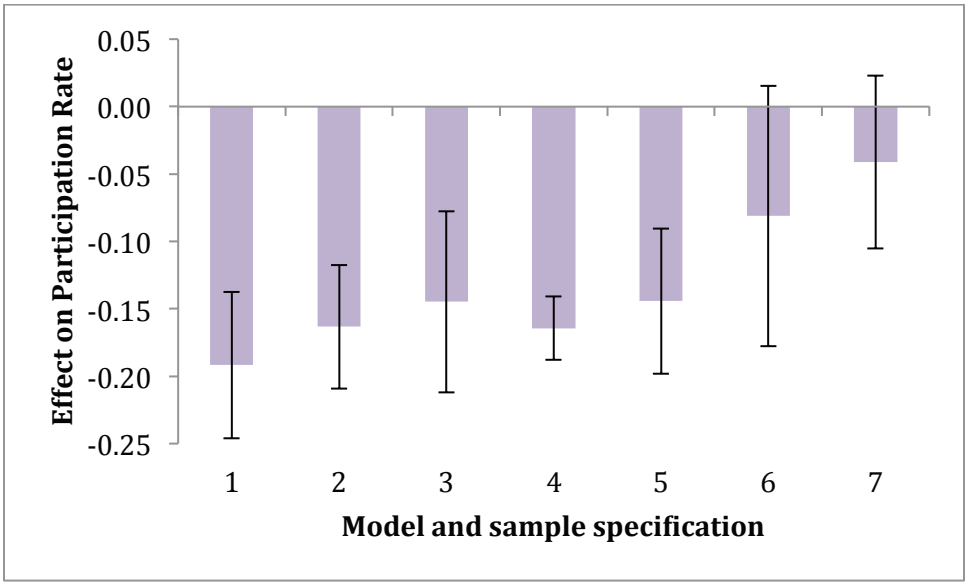


SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes. These are the DDD estimates (see Appendix B for more details).

Impact of Disease Management Nonparticipation Surcharge

Figure 33 shows all of our estimates for the change in participation in the disease management component associated with the introduction of disease management nonparticipation surcharges. Across all model and sample specifications, the introduction of the disease management nonparticipation surcharge was associated with declines in participation, although this decline is not statistically different from zero for model and sample specifications #6 and #7. Our preferred estimate is from model and sample specification #1, which uses the sample of individuals eligible for disease management who also have complete HRA variables for BMI, ethnicity, education, and job classification. We thus conclude that the introduction of disease management nonparticipation surcharges was associated with a decrease in participation. See the discussion section for an analysis of this unexpected finding.

Figure 33. Incentive Effects on Participation in Disease Management Programs: Difference in Differences Estimate by Model and Sample Specification

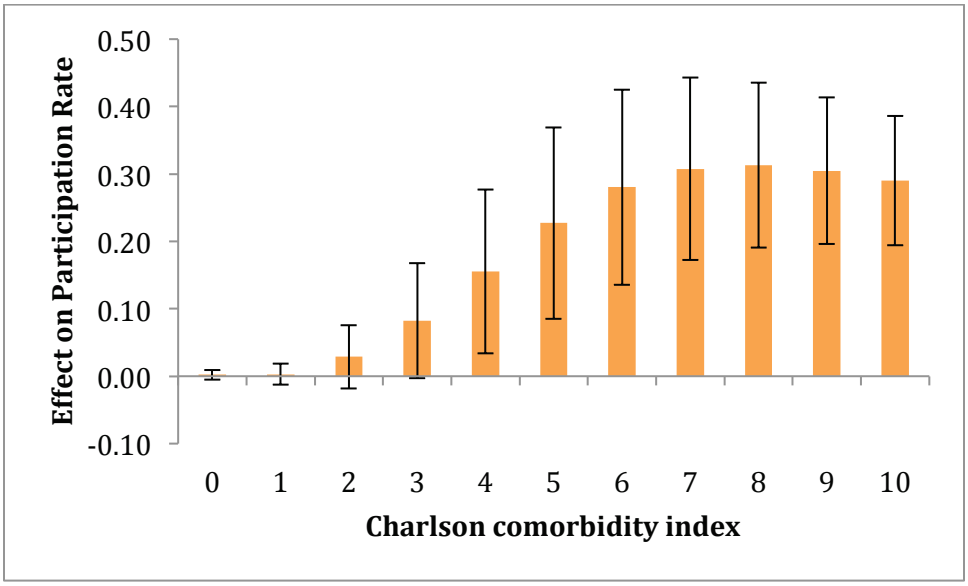


SOURCE: RAND analysis of Fortune 100 employer data.
NOTES:
Model 1 = HRA sample + HRA variables + interaction terms.
Model 2 = HRA sample + HRA variables.
Model 3 = HRA sample + HRA variables + program year 6 dropped.
Model 4 = HRA sample + no HRA variables.
Model 5 = HRA sample + no HRA variables + program year 6 dropped.
Model 6 = Full sample.
Model 7 = Full sample + program year 6 dropped.
Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes.

Although we unexpectedly found the introduction of disease management nonparticipation surcharges to be associated with a decrease in participation, we nevertheless explored whether any employee characteristics moderate the relationship between the presence of the surcharge and the participation rate.

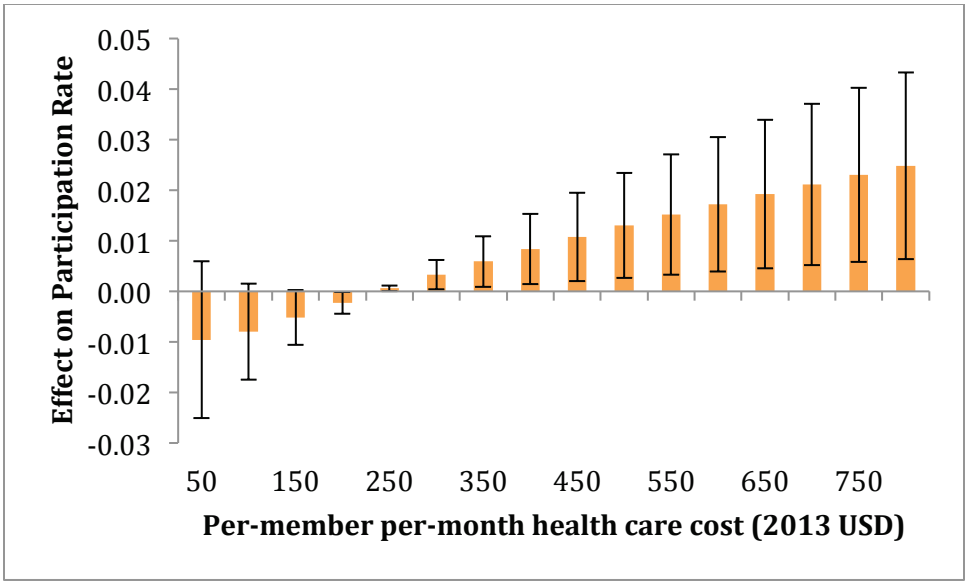
Figure 34 shows that the predicted change in the participation rate before and after surcharges increases with disease burden, as measured by the Charlson comorbidity index. Similarly, we see in Figure 35 that the predicted difference in the participation rate before and after surcharges rises with PMPM health care costs.

Figure 34. Incentive Effects on Participation in Disease Management Programs: Impact of Charlson Comorbidity Index



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes. These are the DDD estimates (see Appendix B for more details).

Figure 35. Incentive Effects on Participation in Disease Management Programs: Impact of Prior Year PMPM Health Care Costs

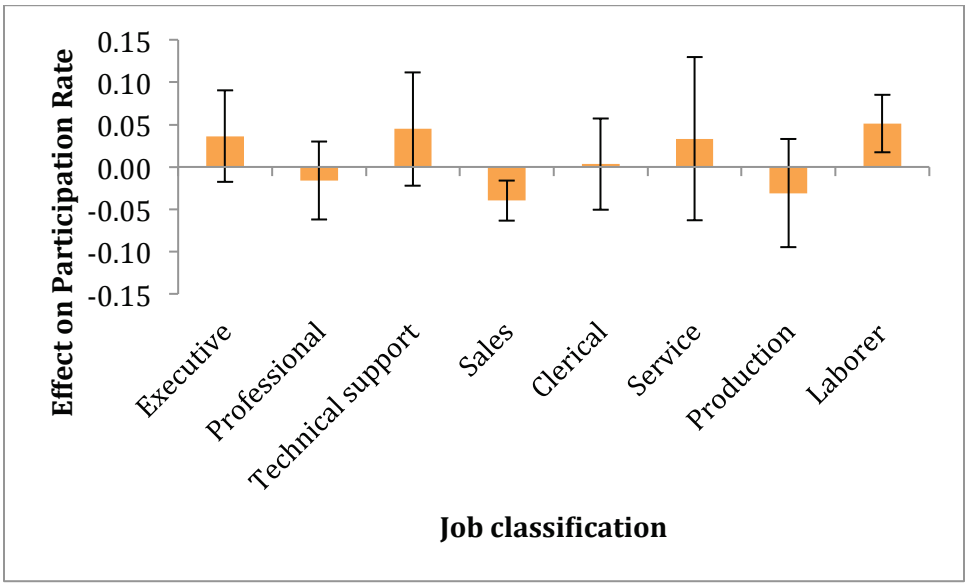


SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes. These are the DDD estimates (see Appendix B for more details).

The only other employee characteristic—across all of the characteristics we tested—found to moderate the association between the nonparticipation surcharge and the disease management

participation rate is the occupational classification of "laborer" (Figure 36). However, the effect is modest: The change in the participation rate is estimated to increase by five percentage points, meaning the impact of the surcharge on participation moves from the base-case estimate of –19 percentage points to a change of –14 percentage points.

Figure 36. Incentive Effects on Participation in Disease Management Programs: Impact of Occupational Classification



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Error bars represent 95 percent confidence intervals. See Appendix B for sample sizes. These are the DDD estimates (see Appendix B for more details).

We thus conclude that the introduction of nonparticipation surcharges had an unexpected effect on the participation rate for the disease management component of –19 percentage points, meaning the surcharges were associated with a *decrease* in participation. Similar to our analysis of the nonparticipation surcharge under smoking cessation programs, we found few employee characteristics that moderate the effect of the surcharges on the participation rate.

Question 3.3: Do Health Care Utilization Patterns Change Following Program Participation?

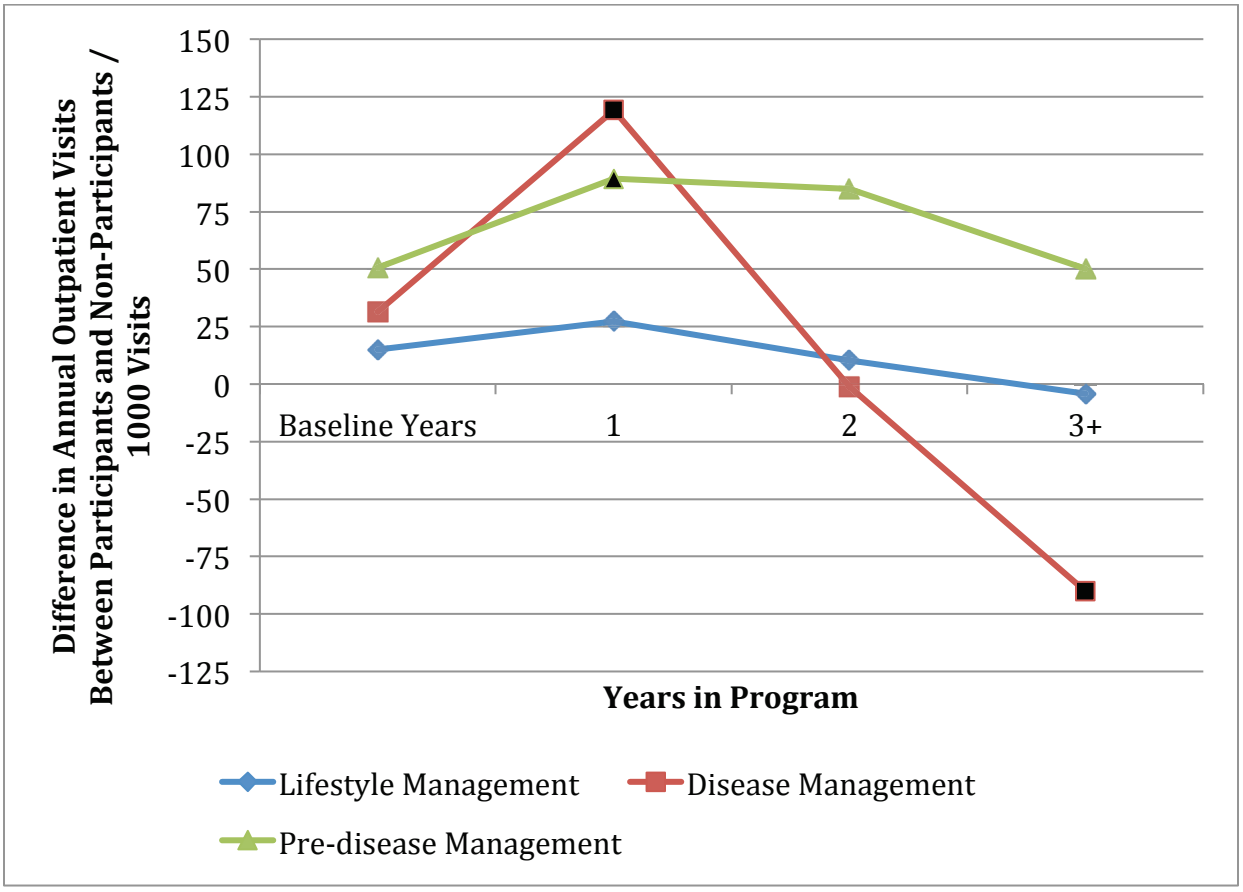
How does utilization of outpatient services change for program participants? Overall, they changed very little for lifestyle management and predisease management participants. However, disease management participants increased utilization in their first year of the program, and by the third year and beyond, they actually were seeing their doctor for primary care evaluation and management significantly less often than at baseline.

In Figure 37, we present results showing the adjusted changes in the rate of annual outpatient office visits for primary care evaluation and management (per 1,000) between program participants and nonparticipant comparison groups for each program, by the number of years

participants have been enrolled in their respective programs. There is no evidence that participation in the lifestyle management program was associated with more physician visits for primary care evaluation and management in the first year followed by fewer visits in subsequent years (blue line) as suggested by Hypothesis 3.3.1. There are no significant differences in the number of visits for lifestyle management participants versus comparison groups regardless of the number of years of participation.

Disease management participants, however, increased the rate of annual outpatient office visits for primary care evaluation and management (per 1,000) by about 120 relative to comparison groups in their first year in the program (Figure 38). This increase was followed by decreases in visits in subsequent years with disease management participants having about 90 fewer annual outpatient visits (per 1,000) relative to comparison groups in program years 3 and beyond (red line). Predisease management participants exhibited a similar but less pronounced pattern, with a smaller uptick in visits in program year 1 relative to comparison groups and no difference between the comparison groups in subsequent years. Annual visits for primary care evaluation and management are not significantly different among participants and comparison groups in the baseline years (years prior to participation). Data points in solid black are significantly different from zero at the 5-percent level (see full regression results in Appendix B).

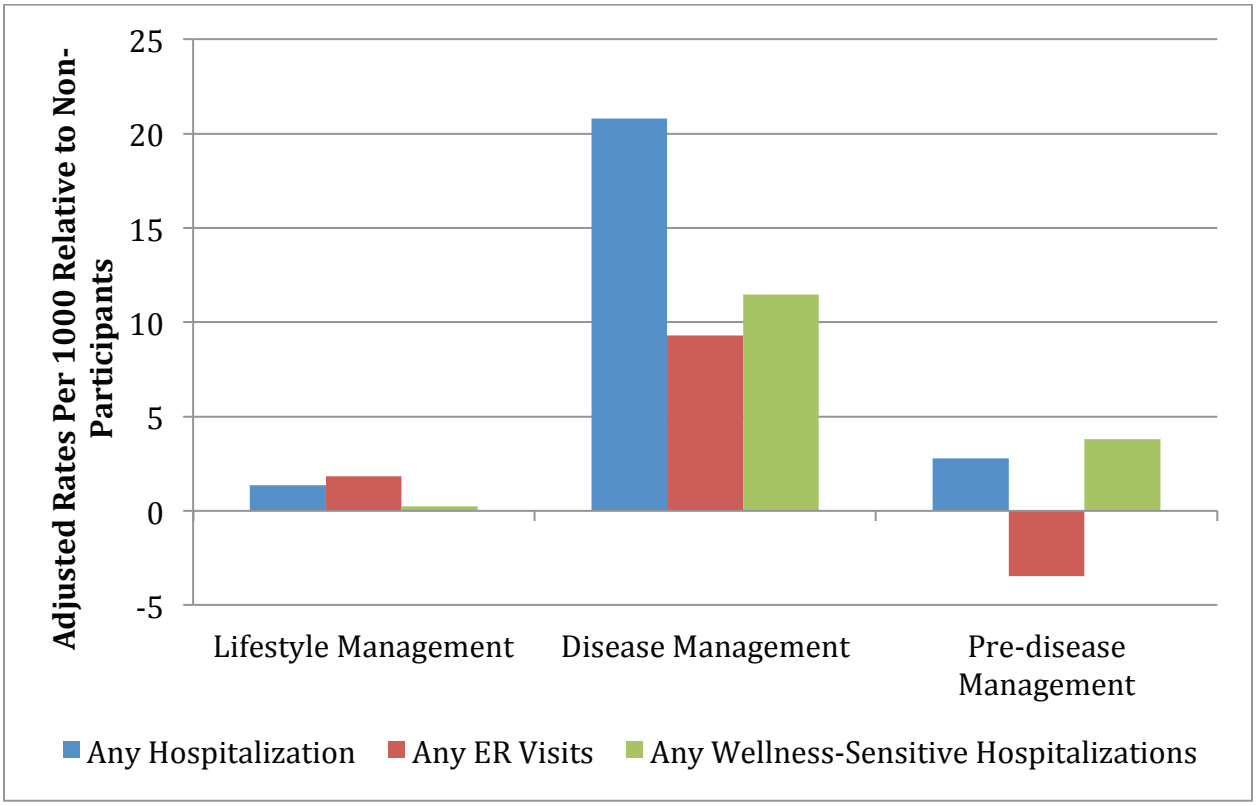
Figure 37. Adjusted Changes in Annual Outpatient Visits for Participants Relative to Nonparticipants, by Years in Program and Program Type



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Data points represent the adjusted difference between program participants and comparisons' annual outpatient visits for years prior to program participation (baseline years); year 1 in program; year 2 in program; and years 3 and beyond in program. Solid black data points are significantly different from zero at the 5-percent level or better. See Table B14 in Appendix B for sample sizes and full regression results.

We found no support for the hypothesis that program participation is associated with fewer hospitalizations, wellness-sensitive or otherwise (Hypothesis 2.3.2). No significant differences were observed in adjusted rates of any of our hospitalization rates in lifestyle management or predisease management participants and their respective comparison groups (Figure 38). For disease management participants, we actually found that rates of wellness-sensitive hospitalizations, as well as rates of any hospitalization or ER use, *increased* relative to comparison groups.

Figure 38. Adjusted Rates of Inpatient/ER Utilization for Participants Relative to Nonparticipants, by Program Type

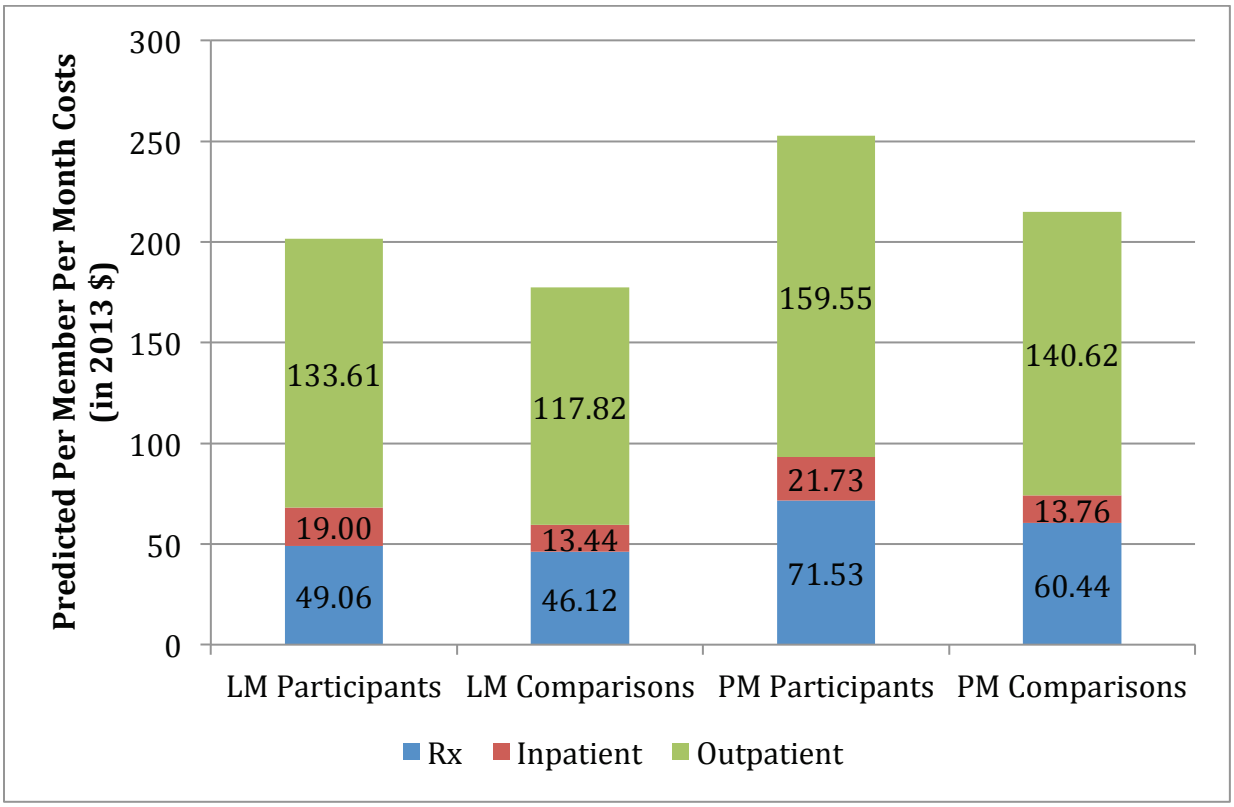


SOURCE: RAND analysis of Fortune 100 employer data.
NOTES: Bars represent the adjusted difference between program participants and comparison groups' rates of any hospitalization, ER visit, and wellness-sensitive hospitalization in program years, adjusting for baseline rates. Only rates for disease management participants are significantly different from zero at the 5-percent level or higher. See Tables B15–B17 in Appendix B for sample sizes and full regression results

Question 3.4: Is There a Differential Effect of Various Programs on Medical Costs?

Given that we found little evidence of differences in utilization among lifestyle management and predisease management participants, it was unlikely that we would find significant differences in medical costs from participation. In fact, we found that costs were actually greater among both lifestyle management and predisease management participants, relative to their respective comparison group. In Figure 39, we present the adjusted or predicted PMPM prescription (Rx), inpatient, and outpatient costs for participants and the comparison group. Costs have been adjusted for individuals' baseline costs, age, gender, region of residence, Charlson comorbidities, and year fixed effects. For both programs, total PMPM costs were greater for participants than for the comparison group. Lifestyle management participants' adjusted costs were about $203, compared with $177 PMPM for the comparison group. Similarly, predisease management participants' predicted costs were about $253 versus $215 PMPM for the comparison group.

Figure 39. Adjusted PMPM Costs, by Type of Cost and Program



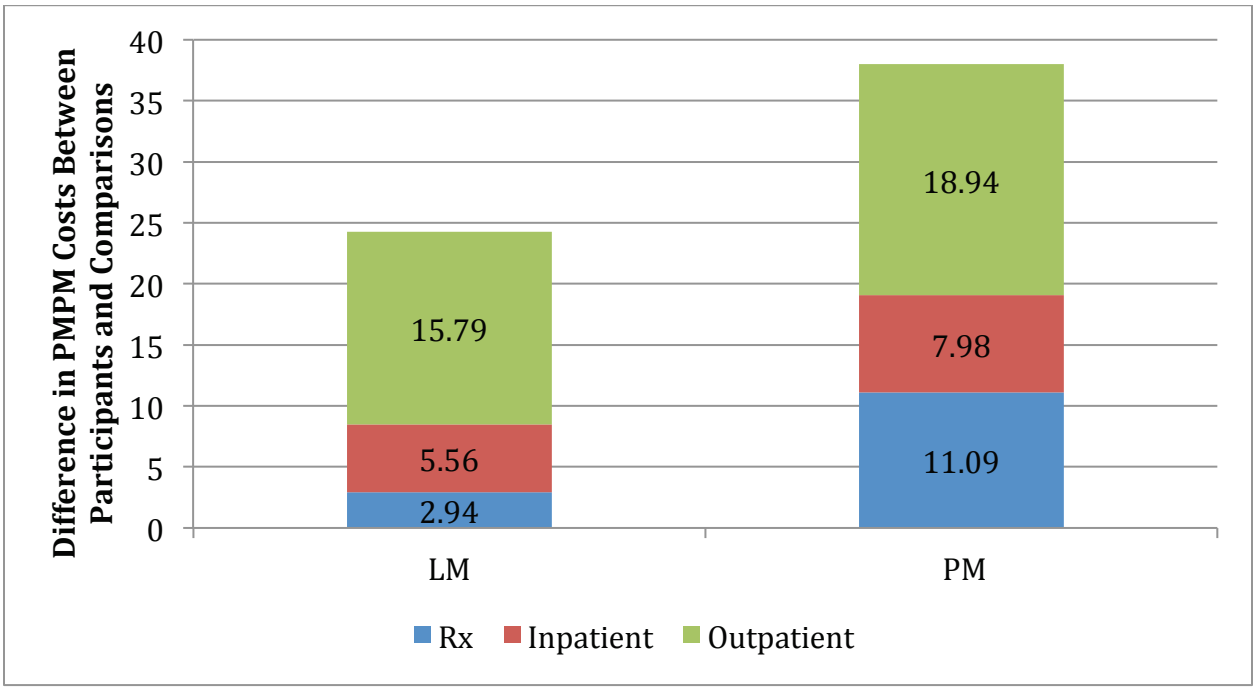
SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Bars represent the adjusted total medical costs adjusting for baseline costs and individual level covariates for lifestyle management participants and their matched comparisons and predisease management participants and their matched comparison group (see Appendix B for more details). Each colored segment of a stacked bar corresponds to one of the following components to total PMPM costs: Rx, inpatient, and outpatient. See Table B18 in Appendix B for sample sizes and full regression results

To determine whether one program had a larger effect on costs than another (Hypothesis 3.4.1), we compared these differences across programs. Overall, we found no significant difference in the effect of the predisease management program on total PMPM costs (increase by $38) compared with the effect of the lifestyle management program on total costs (increase by $25).[50] Moreover, none of the differences by type of cost (Rx, inpatient, or outpatient) is significant at conventional levels of significance. These results are presented in Figure 40, which shows the differences between the adjusted costs for the participants and comparison groups by type of cost and program. For example, the increase in total PMPM medical costs for the lifestyle management program participants was $23 ($200 minus $177) relative to the comparison group. This breaks down to almost $16 more for outpatient costs, almost $6 more for inpatient costs, and almost $3 more for Rx costs PMPM for lifestyle management participants relative to the comparison group. The breakdown for the predisease management program is $19 more in

[50] The difference, $16.86 (standard error = $11.13) is significant only at the 13 percent level (i.e., p = 0.13).

outpatient costs, $8 more in inpatient costs, and $11 more in Rx costs. As noted, none of these values is statistically different at conventional levels of significance suggesting the data do not support the hypothesis that the predisease management program has a larger effect on costs than the lifestyle management program.

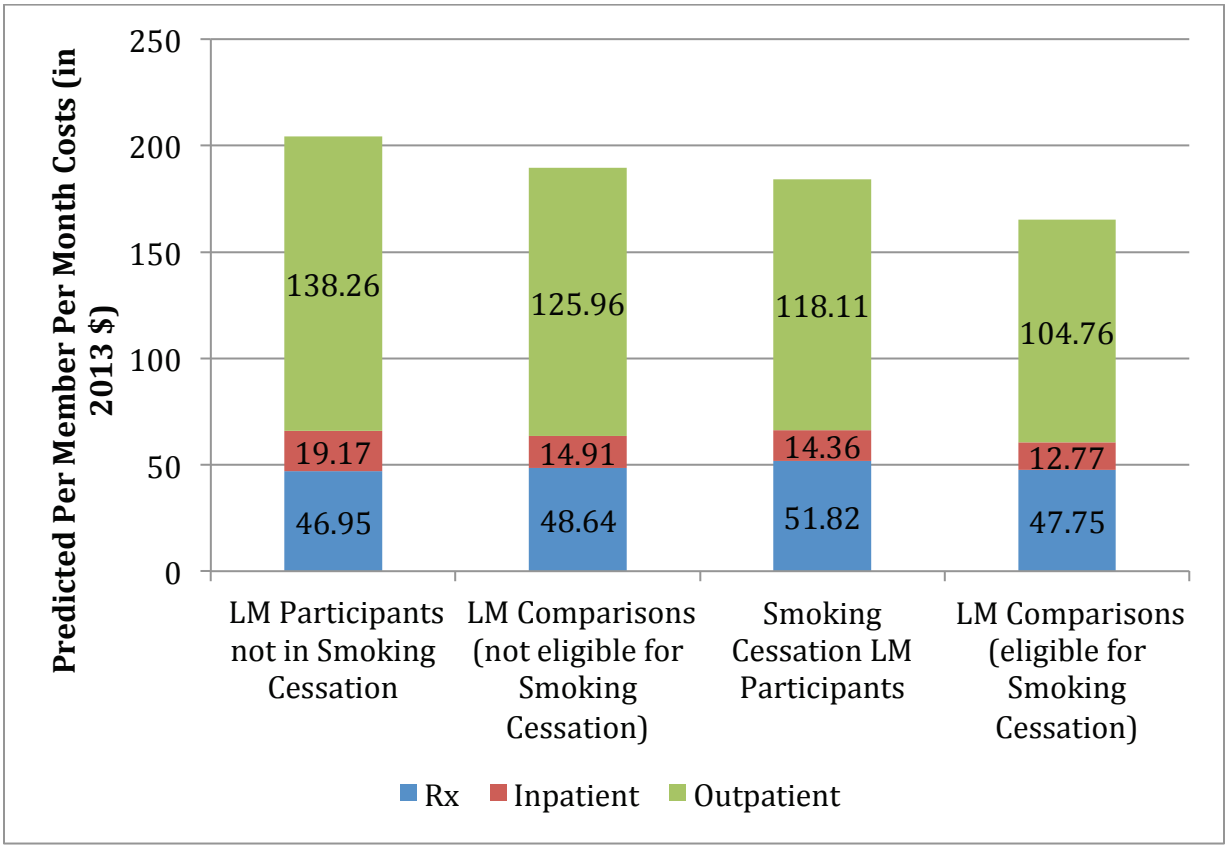
Figure 40. Adjusted Differences Between Participant and Comparison Groups PMPM Costs, by Type of Cost and Program



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Bars represent the adjusted difference between program participants and comparison group's total medical costs adjusting for baseline costs and individual level covariates (see Appendix B for more details). Each colored segment of a stacked bar corresponds to one of the following components to total PMPM costs: Rx, inpatient, and outpatient. See Table B18 in Appendix B for sample sizes and full regression results.

Next, we examined effects on medical costs for lifestyle management participants, by whether they participated in the smoking cessation program. Again, program participation was associated with greater medical spending as adjusted costs were greater for lifestyle management participants relative to the comparison group, regardless of participation in the smoking cessation program (Figure 41).

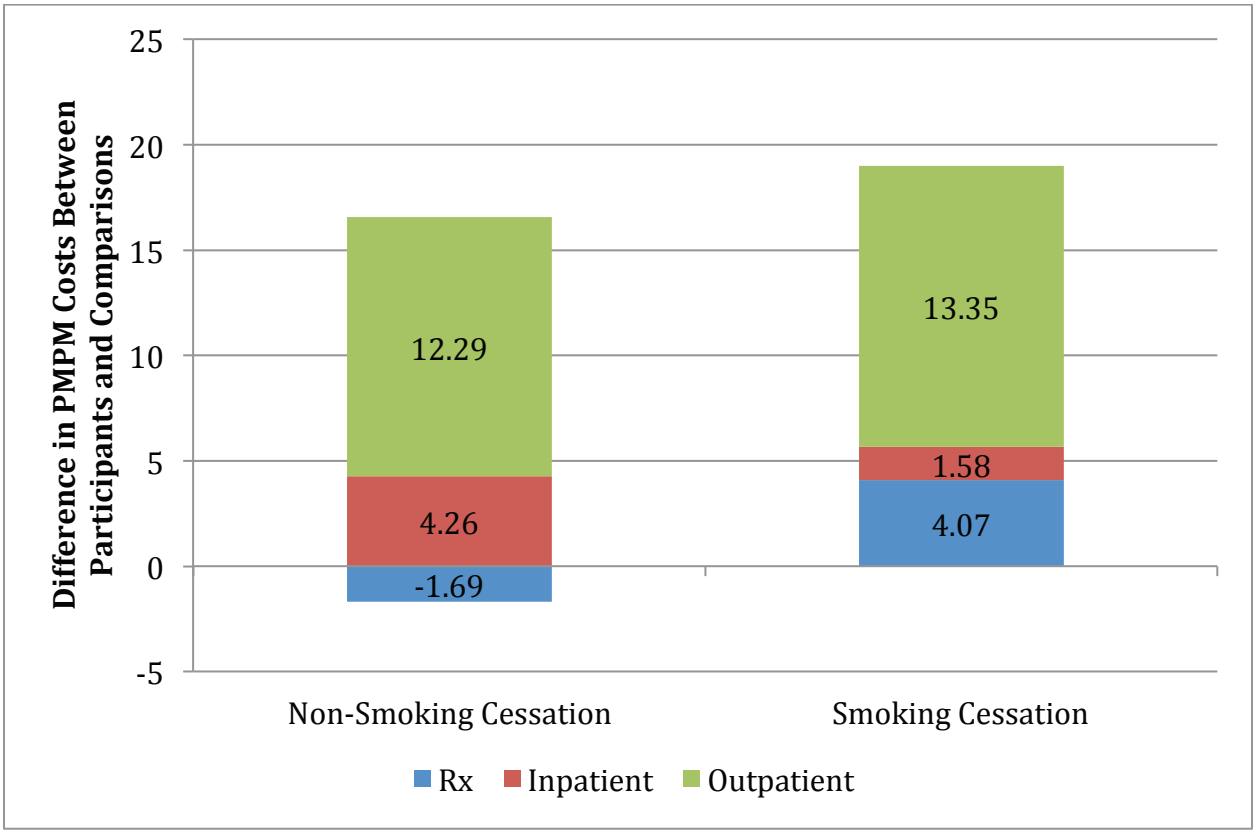
Figure 41. Adjusted PMPM Costs for Lifestyle Management Program, by Type of Cost and Participation in the Smoking Cessation Program



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Bars represent the adjusted total medical costs adjusting for baseline costs and individual level covariates for lifestyle management participants not enrolled in the smoking cessation program and their matched comparison group, and for lifestyle management participants enrolled in the smoking cessation program and their matched comparison group (see Appendix B for more details). Each colored segment of a stacked bar corresponds to one of the following components to total PMPM costs: Rx, inpatient, and outpatient. See Table B19 in Appendix B for sample sizes and full regression results

To test whether the smoking cessation program had a greater effect on medical costs (Hypothesis 3.4.2), we compared the estimated effect on costs for the smoking cessation participants relative to the estimated effect on costs for the lifestyle management participants not enrolled in the smoking cessation program. Consistent with Hypothesis 3.4.1, we observed no significant differences in the increases in medical costs for one set of program participants relative to another (Figure 42). In this case, the adjusted effect for nonsmoking cessation participants was a $17 PMPM increase, which is not statistically different from the increase of $21 PMPM for smoking cessation participants. Comparing effects on different components of the total medical costs (i.e. Rx, inpatient, and outpatient) yielded similar findings: no significant difference between effects on lifestyle management participants who did not enroll in the smoking cessation program and those who did enroll. Thus, we did not find support for the hypothesis that the smoking cessation program had a greater effect on medical costs (Hypothesis 3.4.2).

Figure 42. Adjusted Differences between Lifestyle Management Participant and Comparison Groups PMPM Costs, by Type of Cost and Smoking Cessation Participation



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Bars represent the adjusted difference between program participants and comparison group's total medical costs adjusting for baseline costs and individual level covariates (see Appendix B for more details). Each colored segment of a stacked bar corresponds to one of the following components to total PMPM costs: Rx, inpatient, and outpatient. See Table B19 of Appendix B for sample sizes and full regression results

Question 3.5: Is There a Dose-Response Effect on Medical Costs in the Intensity of Program Interventions?

To understand whether greater program exposure or intervention intensity yields stronger programmatic effects, we first had to determine levels of intervention intensity. Among participants, the median number of annual sessions was four for both lifestyle management and predisease management programs. In Table 11, we present the distributions of annual sessions among participants for both programs. Based on these distributions, we defined low exposure, or "low intensity," to be participation in four (the median) or fewer sessions per year and high exposure, or "high intensity," to be participation in five or more sessions per year.

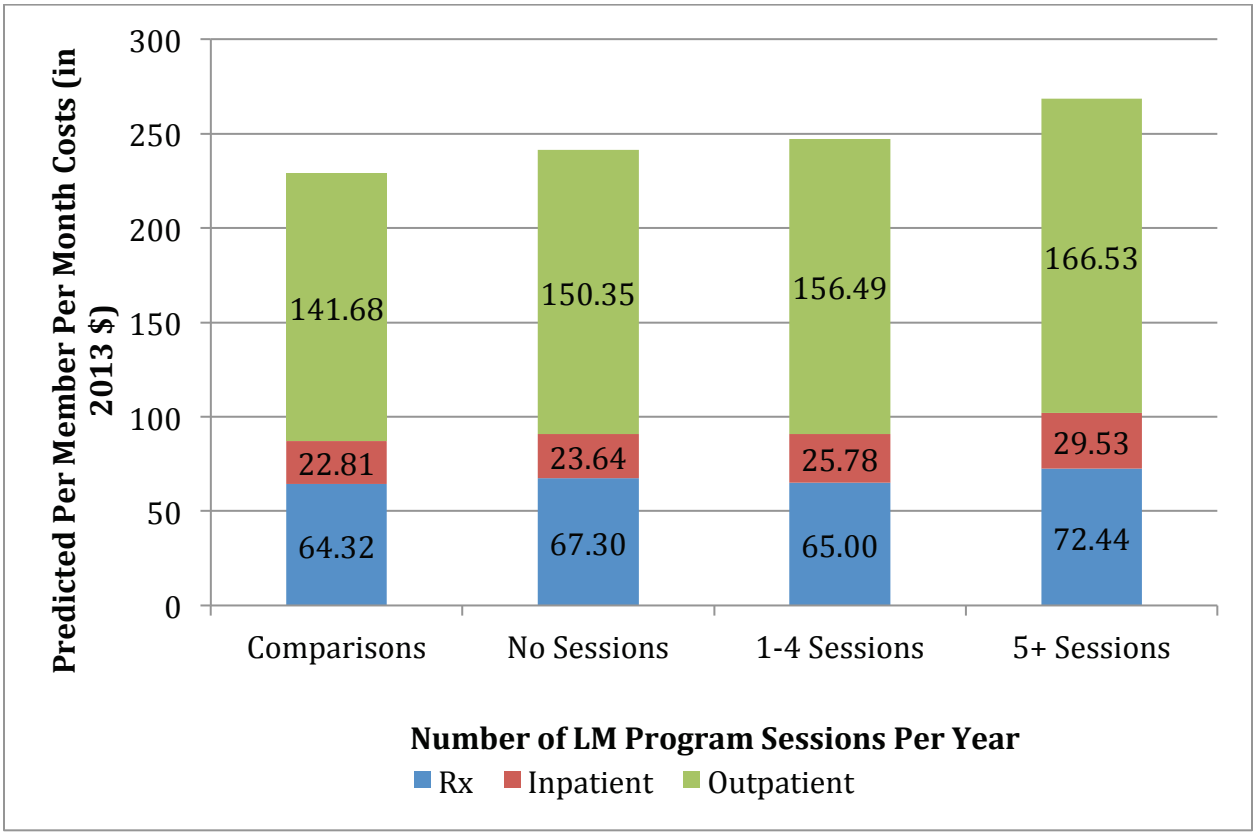
Table 11. Number of Sessions in Lifestyle Management or Disease Management Programs per Year among Participants

	Lifestyle Management Sessions	Predisease Management Sessions
10th percentile	1	1
25th percentile	2	2
50th percentile (median)	4	4
75th percentile	7	6
90th percentile	12	9
Mean	5.75	4.73
SD	(6.29)	(3.43)

SOURCE: RAND analysis of Fortune 100 employer data.

A higher number of sessions was associated with greater medical costs for lifestyle management participants. The adjusted total medical costs for lifestyle management participants increased from $241 PMPM in years in which they did not participate in the program, to $249 and $270 in years in which they participated in one to four and five or more sessions, respectively (Figure 43). Differences in total costs are statistically significant ($p<0.05$) across all four categories—comparisons, participants in years in which they did not participate, participants in years in which they participated in one to four sessions, and participants in years in which they participated in five or more sessions. These differences are significant across types of costs as well (Rx, inpatient, and outpatient).

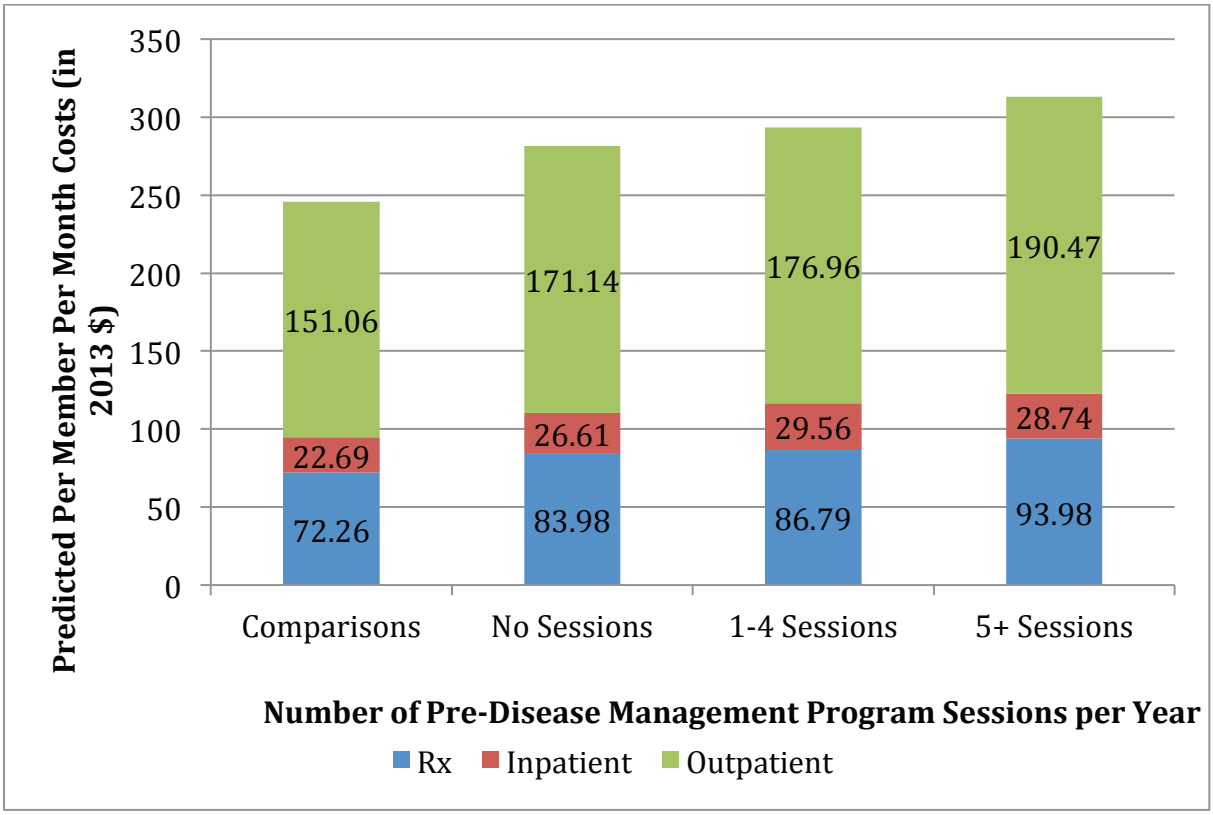
Figure 43. Adjusted PMPM Costs for Lifestyle Management Participants and Comparison Group, by Intervention Intensity



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Bars represent the total medical costs adjusting for baseline costs and individual level covariates (see Appendix B for more details). Each colored segment of a stacked bar corresponds to one of the following components to total PMPM costs: Rx, inpatient, and outpatient. The leftmost bar represents costs for lifestyle management comparison group, whereas the three right bars represent costs for lifestyle management participants, based on the number of program sessions they participated in per year. See Table B20 in Appendix B for sample sizes and full regression results

Similar to the lifestyle management program, participation in more sessions in the predisease management program was associated with increased medical costs (Figure 44). Specifically, predisease management participants who participated in one to four sessions per year had total adjusted costs of $291 PMPM versus $313 PMPM for participants who attended five or more sessions per month ($p<0.05$). Differences in total costs are significantly different ($p<0.05$) across all four categories, except between participant costs for those with no attendance in a given year and those participating in one to four sessions ($282 versus $291, $p = 0.15$). This pattern held across all types of medical costs except inpatient costs, which are not significantly different across intervention intensities.

Figure 44. Adjusted PMPM Costs for Predisease Management Participants and Comparison Group, by Intervention Intensity



SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Bars represent the total medical costs adjusting for baseline costs and individual level covariates (see Appendix B for more details). Each colored segment of a stacked bar corresponds to one of the following components to total PMPM costs: Rx, inpatient, and outpatient. The leftmost bar represents costs for the predisease management comparison group, whereas the three right bars represent costs for predisease management participants, based on the number of program sessions they participated in per year. See Table B21 in Appendix B for sample sizes and full regression results

Question 3.6: Is There Evidence that Program Participation May Create Long-Term Gains in Health?

Our simulation model starts from the natural history of a representative sample of the U.S. population ("no wellness program" column in Table 12) and estimates the maximum possible impact of a wellness program, which assumes all risk factors are reduced to their theoretical minimums (last column of Table 12). The model predicts that complete elimination of cardiovascular risk factors would avoid 682 cardiovascular deaths and 4,736 nonfatal cardiovascular events in 100,000 individuals over 20 years (Scenario 3 in Table 12).

As workplace wellness programs will not eliminate all risk factors, we estimated the impact of two other scenarios. First, we used the estimates of program effect on risk factors from our previous study, which point to an absolute reduction of 10 to 25 percent, and assumed that every employee with a health risk would join the program ("Program impact + full participation"

column). Second, we applied the actual program participation rates from the current study, which are 20 to 40 percent ("Program impact + observed participation" column). The results suggest that full participation in wellness programs would avoid 293 cardiovascular deaths and 2,571 nonfatal cardiovascular events in 100,000 individuals over 20 years (Scenario 2 in Table 12). Under realistic assumptions for participation, 257 cardiovascular deaths and 1,796 nonfatal cardiovascular events are avoided in 100,000 individuals over 20 years (Scenario 1 in Table 12).

If we apply estimates for program cost of $150 per-participant per-year and compare to savings from reduced cardiovascular events, we estimate that employers have to spend about $40,000 on wellness programs to avoid one cardiovascular event.

Table 12. Simulation Model Results, by Treatment Scenario

Outcomes	No Wellness Program	Scenario 1 Program Impact + Observed Participation	Scenario 2 Program Impact + Full Participation	Scenario 3 All Risk Factors to Theoretical Minimums
Starting population (N)	100,000	100,000	100,000	100,000
Final population (N)	83,784	84,262	84,094	84,459
Deaths				
Life table deaths	15,003	14,782	14,987	15,010
Cardiovascular event deaths	1,213	956	920	531
Total deaths	16,216	15,738	15,906	15,541
Cardiovascular events	11,025	8,972	8,161	5,606
Experienced cardiovascular event (%)	10.39%	8.61%	7.85%	5.45%
Costs				
Cardiovascular event costs	$253,216,139	$206,726,452	$190,295,766	
Wellness program participation costs	$0	$60,112,233	$195,656,494	
Total costs	$253,216,139	$266,838,685	$385,952,260	

SOURCE: RAND wellness program simulation model.
NOTE: Approximate program impact corresponds to a risk factor reduction of 15 percent; observed participation corresponds to a rate of 30 percent.

Discussion

Only one-fifth to two-fifths of employees annually participated in wellness program components for which they were eligible. These results reflect participation trends found in the survey portion of the RAND Wellness Programs Study. We also find that overall participation rates largely reflected those seen in specific interventions. In other words, program uptake was similar for most interventions (e.g., smoking cessation, diabetes, nutrition) offered in a particular employer's wellness program, especially for interventions with the largest populations of eligible employees.

We found that predictors of program uptake varied by program component. **Individuals with more severe diseases appeared to be more likely to participate in disease management programs—in some cases the difference in program uptake exceeded 50 percentage points.** This finding makes sense, intuitively: Individuals with more medical conditions and problems may find programs aimed at helping them manage these conditions to be increasingly attractive, convenient, and beneficial to their health. By contrast, we found **health risk factors, with the exception of higher BMI, did not predict lifestyle management and disease management uptake.** While we hypothesized such a relationship would exist, our results indicate that—at least in the case of the disease management program—an individual's decision to participate was influenced more by having actual diseases than by having risk factors.

HRA completion was more likely among those with fewer health risks (with a maximum difference of eight percentage points in participation rates), **as well as among those with higher income** (where we found participation to be up to ten percentage points higher). These findings support the notion that individuals with manifest diseases do not need to take an HRA to know about their health status: They know they have a disease as evidenced by their medical claims experience. Future research might test the idea that the appeal of HRAs to individuals living in wealthier neighborhoods may simply reflect the fact that they are more likely to have desk jobs, so completing an online 20-minute assessment is easier and more convenient.

We found that **lifestyle management and disease management program participation increased with age, but HRA completion did not.** This finding broadly supports the hypothesis that as individuals age, they become more concerned with and engaged in maintaining or improving their health, relative to their younger counterparts. HRA completion rates were lower as age increased, but this is consistent with the idea that older individuals are likely to already be aware of their chronic conditions and risk factors.

We found **nonparticipation surcharges for smoking cessation were associated with an increase in program uptake of 8.5 percentage points**. However, we would like to underscore that even after the introduction of the surcharges, the participation rate in the smoking cessation program remained well below 30 percent. We have confidence in our estimated effect of the smoking surcharge, as our findings were robust to a variety of model and sample specifications. In addition, we were able to use a DD approach that gave us a control group to account for unobserved time trends that may have also influenced program uptake.

Surcharges for nonparticipation in the disease management program were associated with decreases in program uptake. This finding is contrary to our hypothesized effect, which was that participation would increase with the introduction of nonparticipation surcharges. These results were robust to variation in model specification. However, we would like to underscore that our bivariate analyses identified overall time trends toward lower participation among employees eligible for the disease management program. These trends suggest that unobserved factors we could not account for may have outweighed the effect of the nonparticipation surcharges. If we had access to a suitable control group for use in our analyses—as was the case

for the smoking nonparticipation surcharges—it is possible we could have identified an uptick in disease management participation following the introduction of the surcharges.

With the exception of increasing disease burden, we found that few employee characteristics moderated the effect of the nonparticipation surcharges on program uptake. We consider it unlikely that the relative lack of effect of the surcharges ($600 for both smoking and disease management) could be attributed to the affected employees regarding it as a small cost. In our analysis of predictors of employee participation, we found increased disease burden to be associated with higher rates of program uptake. When these findings are combined with our results discussed here, one explanation is that the surcharges were more effective among people in whom probabilities of program uptake were already high. In other words, the incentives provided the final bit of motivation needed to drive someone to participate in the smoking cessation or disease management program.

In our previous analyses, we reported no overall effect of the lifestyle management program on participants' health care costs and utilization. **Examining this relationship at a more granular level, we still find no significant cost savings or reduction in utilization**. Employees who participated in the telephonic coaching component of lifestyle management did not exhibit lower rates of hospitalization or health care costs. We also did not observe a utilization pattern for lifestyle management participants that suggested an increase in outpatient visits in the first year of participation followed by a decrease in subsequent years. We observed this pattern for the disease management participants who are at higher risk.

We found no evidence of cost savings among participants in either the lifestyle management or the predisease management program. In fact, both programs resulted in greater health care costs of $25 to $38 PMPM among participants (these amounts are not statistically different). We had expected that cost savings would be greater among the predisease management participants, who are at an elevated risk for chronic conditions, but the data did not support this hypothesis.

In a similar vein, we expected that cost savings would be greater among lifestyle management participants enrolled in the smoking cessation program than among nonsmoker participants. Costs increased for both groups, however, by about $20 PMPM after participation. Thus, **the smoking cessation program did not yield greater health care savings relative to other lifestyle management participants**.

Greater exposure to the wellness program, through participating in more sessions per year, also was not associated with greater health care cost savings. In fact, PMPM health care costs were approximately $20 higher for high-intensity participants (those who attended five or more sessions per year) than for their low-intensity counterparts. Our additional investigation of the effects of the lifestyle management and predisease programs consistently revealed that the programs were not associated with meaningful declines in costs or utilization.

Lower cardiovascular event rates due to wellness program participation reduced costs, but these savings did not come close to offsetting cumulative costs of participation. These

results, which were generated from a 20-year simulation of a working-age population, underscore that while wellness programs are effective in improving health, they produce very modest gains in health per dollar spent compared with many other well-accepted treatments and interventions aimed at improving health.[51]

We note the following caveats from these analyses: First, data from the HRAs are self-reported; second, our results are not necessarily generalizable beyond the single employer whose data we analyzed.

Although we used rigorous econometric techniques to address issues of endogeneity, sample selection, and unobserved heterogeneity,[52] we note that the standard caveats to results from observational data analysis apply. Propensity score matching allows us to match individuals based on baseline (preprogram exposure) utilization and costs to address concerns of potential endogeneity (reverse causality). It also addresses issues of selection on observables, to the extent that we are able to capture the covariates that correlate with the decision to participate.[53] Selection on unobservables, however, remains an issue. In some specifications, we are able to include individual-level fixed effects that remove unobserved heterogeneity that is time invariant. We used a regression-adjusted difference in differences framework, which allowed us to disentangle program effects from secular trends or changes in outcomes of interest over time that are common to both participants and matched comparisons. In spite of the large starting sample, even a five-year follow-up period may not have been long enough to detect cost changes, because of the long latency period for health-related behaviors to affect health care cost.[54] Contamination bias is often a concern when comparison individuals may have been exposed to "treatment;" this was less of a concern in our analysis as "treatment" largely involved one-on-one coaching sessions and online educational programs. We note the standard limitations of intent to treat (ITT) assumptions, which are appropriate in this setting, apply and may understate the true program effects if noncompliance is a significant issue. Finally, our simulation model makes a host of assumptions necessary to estimate a tractable model; results may therefore not be generalizable or applicable in all circumstances.

[51] With modified simulation results, the cost-effectiveness is about the same as other interventions ($10,000 to $40,000 per event avoided).

[52] Imbens and Wooldridge, 2009.

[53] We note that our use of PSM assumes unconfoundedness (selection on observables) and that we have overlap (common support of distributions), which means we have strong ignorability (see Imbens and Wooldridge, 2009).

[54] However, our calculations from our previous work (Mattke et al., 2013) confirm that the study was adequately powered to detect a meaningful change in health care costs.

4. Conclusion

The findings in this report underscore the increasing prevalence of worksite wellness programs. About four-fifths of all U.S. employers with more than 1,000 employees are estimated to offer the programs. For those larger employers, program offerings cover a range of screening activities, interventions to encourage healthy lifestyles, and support for employees with manifest chronic conditions.

Smaller employers, especially those with fewer than 100 employees, appear more reserved in their implementation of wellness programs. They are less likely to offer any program, have typically limited program offerings, and voice concerns about the business rationale.

In spite of widespread access, the actual use of wellness programs by eligible employees and/or dependents remains limited. Our analysis of data from the large employer shows that only 20 to 40 percent of eligible individuals participate in a program in any given year. Participation rates as reported in our survey suggest a median rate of 40 percent.

It is therefore not surprising that employers are attempting to boost program uptake with rewards and penalties. Employers state that incentives have the intended effect: In our survey data, median program participation rates were reported to be 20 percent for employers who did not use incentives compared with 40 percent for employers that used rewards and 73 percent for employers that used penalties and/or rewards.

However, the analysis of actual participation data from a large employer paints a less optimistic picture regarding the effectiveness of penalties, as a $600 penalty increased participation in a smoking cessation program by only eight percentage points and failed to raise uptake of a disease management program. The small percentage-point increase in the smoking cessation program still resulted in a participation rate of less than 30 percent in the smoking cessation program. Our lack of evidence of a surcharge effect for the disease management program may be due to not having an adequate comparison group, however. Combined with the observation from the survey that participation rates in comprehensive wellness programs appear to vary less with incentive use, this study suggests that employees consider factors other than incentives, such as program design and accessibility, when contemplating whether to join.

In this context, our results cast further doubt on the ability of telephone coaching to promote healthy lifestyles under workplace wellness programs to reduce health care cost. We have previously shown that lifestyle management participation is associated with reduction of health risks, such as smoking and overweight, but not with lower cost.[55] In this report, we analyze

[55] For example, see Figures 4.10–4.12 and 4.24 in Mattke et.al., 2013.

whether cost savings might be realized in higher-risk employees and in those who are more engaged in the program, but we see no evidence to support this hypothesis.

In addition, we extrapolated the impact of the estimated health effects of lifestyle management programs on the risk of cardiovascular events and find that an employer with 100,000 employees would see 1,796 fewer cardiovascular events and 257 fewer cardiovascular deaths over a period of 20 years under current estimates for program participation and effect on employee health.

While we acknowledge the limitations of our study as discussed in each chapter, such as the nonexperimental design and the fact that we analyze data from only one employer, our findings contribute to evidence on the currently prevailing type of lifestyle management program, which is reliant on telephonic coaching to promote healthy lifestyles. If similar findings were reproduced in future research, they would imply that screening large numbers of individuals for health risks combined with education and one-on-one coaching for those with risks alone may not be effective (or cost-effective) enough to have a meaningful impact on the health of America's workers and the cost of health coverage.

Our assessment contrasts with a widely quoted meta-analysis by Baicker et al. that estimated a reduction in health care costs of about $3 for every dollar invested in workplace wellness programs.[56] This study, however, has been criticized for including studies that were several decades old and had substantial methodological weaknesses.[57] Our findings also differ from the results of the analysis of the Johnson & Johnson program, one of the best-known and longest-running workplace wellness programs in the United States. Its most recent evaluation suggested a return on investment in a range of $1.88–$3.92 saved for every dollar spent.[58] It should be kept in mind, however, that this evaluation compared health care costs for Johnson & Johnson to those of similar employers, correcting for workforce differences. Consequently, the effect estimates are reflective of the *overall* differences in health care coverage and health management between Johnson & Johnson and the comparison companies and the effect estimates may be influenced by unobservable firm-level differences, such as health care coverage, health management, or culture between Johnson & Johnson and the reference companies.

As we compare program participants to statistically matched nonparticipants, our design is more reflective of the *actual program* effect; i.e., the effect of participating in the coaching interventions. Of note, nonindustry-sponsored studies that use a similar design tend to arrive at

[56] Baicker et al., 2010.

[57] Caloyeras et al., 2014.

[58] Henke, Rachel M., Ron Z. Goetzel, Janice McHugh, and Fik Isaac, "Recent Experience in Health Promotion at Johnson & Johnson: Lower Health Spending, Strong Return on Investment," *Health Affairs,* Vol. 30, No. 3, 2011, pp. 490–499.

similar conclusions. For example, a 2012 evaluation of the University of Minnesota's wellness program found no savings to be associated with lifestyle management program participation.[59]

In addition to conducting studies designed to replicate our findings in a larger sample of employers, future research should investigate the potential of "personalized" wellness programs, which match intervention modality, intensity, and objectives more closely to an individual's beliefs, attitudes, and preferences, and of "public health" type programs, which aim to create a culture of health in the workplace rather than targeting individuals.

[59] Nyman et al., 2010.

Appendix A. Employer Survey Analysis

Question 1.1: Which employer characteristics are associated with offering a wellness program?

Question 1.2: If an employer offers a wellness program, which characteristics are associated with using incentives?

The multivariate analyses for Questions 1.1 and 1.2, on offering a program, offering any incentives and offering incentives of more than $100, employed logistic regression models to predict the outcome of the binary dependent variable. The models took the following general form:

$$Logit(P_i) = \beta_0 + X_i\beta_i + e_i \qquad [1]$$

where P_i is (1) the probability of offering a program, (2) the probability of offering incentives given a program is offered, or (3) the probability of offering specific incentives, by type. X_i is a vector of employer characteristics and associated workforce characteristics, βs are parameters to be estimated and e_i is the residual error term.

Results are presented in Appendix Table A1 as marginal effects. These effects can be interpreted as the likelihood of offering a program relative to some reference category (for categorical variables). For example, employers in heavy industry are 10.9 percent more likely than government employers to offer a wellness program (Column 1, Row 1).

Table A1. Results for Likelihood of Offering A Wellness Program, Offering Any Incentives, Offering Incentives Over $100

Employer Characteristics	Likelihood of Offering a Wellness Program (SE)	Likelihood of Offering Any Incentives (SE)	Likelihood of Offering Incentives (> $100) (SE)
INDUSTRY (ref = Government)			
Heavy industry	0.109 (0.143)	0.138 (0.138)	0.027 (0.160)
Trade	0.200 (0.133)	0.219* (0.096)	0.001 (0.125)
Services	-0.020 (0.157)	-0.057 (0.159)	-0.078 (0.141)
REGION (ref = Northeast)			
Midwest	-0.114 (0.139)	-0.548*** (0.145)	0.001 (0.127)
South	-0.009 (0.128)	-0.608*** (0.127)	-0.004 (0.139)
West	0.023 (0.151)	-0.618*** (0.138)	-0.245* (0.101)
EMPLOYER SIZE (ref = 50–100)			
101– 500 employees	0.220** (0.106)	0.103 (0.126)	-0.069 (0.114)
501–1000 employees	0.336** (0.124)	0.238* (0.079)	0.037 (0.167)
1001–10000 employees	0.411*** (0.090)	0.189* (0.083)	0.031 (0.125)
10001 - 50000 employees	0.372*** (0.092)	0.203** (0.066)	0.217 (0.161)
50,001 or more employees	0.429*** (0.094)	0.19* (0.075)	0.338** (0.167)
Years in business	0.003** (0.001)	0.001 (0.002)	-0.001 (0.001)
Gender composition	0.004* (0.002)	0.006** (0.003)	0.002 (0.003)
Percent over 50	0.002 (0.003)	-0.003 (0.003)	-0.001 (0.003)
AVERAGE SALARY BANDS (ref = <$25,000)			
$25,001–$50,000	0.253 (0.160)	-0.221 (0.202)	-0.311 (0.217)
$50,001–$75,000	0.387** (0.146)	-0.222 (0.343)	-0.211 (0.123)
$75,001–$100,000	0.335 (0.184)	-0.061 (0.388)	-0.258* (0.069)
Greater than $100,000	0.27 (0.297)	†	†
N	425	282	282

NOTE:
*** p<0.01, ** p<0.05, * p<0.1
† Dropped due to perfect prediction.

Question 2.1: Are there patterns in program offerings—do employers combine certain offerings with others?

Cluster Analysis

Cluster analysis is an exploratory technique that finds groups of similar individuals in large or complex data sets. Reducing a data set that contains a large number of individual firms to a smaller number of sets of similar individual firms enables the similarities between firms to be considered.

A cluster analysis has two stages: First, a distance matrix is calculated, and second, the distance matrix is clustered. Distance matrices can be calculated via several methods, the most common of which is the Squared Euclidean Distance:

$$\left|\left|a-b\right|\right|^2 = \sum_i (a_i - b_i)^2 \qquad [2]$$

where a and b are values from two separate "entities" between which one is calculating the distance on measure i. For example, if firm A offers a number of subprograms that firm B does not,

the distance between them would be large. Once the distance between firms is calculated, the clustering process begins. Clustering is a step-by-step process in which the individuals (or firms, in our case) are joined together in clusters. The first step is to find the two firms that are closest together in terms of distance. These are joined and form a cluster. The second step is to find the next two firms that are closest together, or the firm that is nearest to an already formed cluster. If two firms are closer, these are joined into a new cluster; if a firm is near an already formed cluster, it will join that cluster. The distance between the two units joined is recorded, and the process continues until all individuals and clusters have been joined into a single large cluster.

The chart that results from the clustering process is called a *dendrogram* and shows the distance between one cluster and another. The analyst uses this chart to determine the number of clusters for which there is a relatively large distance, as larger distances suggest the clusters are noticeably different from one another. This occurred for our analysis when there were five clusters remaining, which suggested that the data contain five clusters of similar firms. We considered three or five clusters when examining the chart, and concluded that the five-cluster approach best represented the data.

Once the clusters were created using the above process, we characterized clusters by comparing the offering rates for program subcomponents using the following classification:

Table A2. Program Subcomponent Offering Characterization

Offering Rate	Classification	Rank
10-20%	Low	5
21-40%	Low-Medium	4
41-50%	Medium-High	3
51-70%	High	2
>70%	Very High	1

We went cluster by cluster and ranked the offering rates for each of the program types (screening, lifestyle risk, disease management, and HRA). Using this method, we were able to observe patterns in the clusters by program type, and named the clusters based on the generosity of offering rates.

Multinomial Logistic Regression Model

The multinomial logistic regression model took the following general form:

$$Logit(P_i=K) = \beta_{0,k} + X_{M,i}\beta_{M,k} + e_{k,i} \qquad [3]$$

where P_i is the probability of having outcome K, in this case, one of the five program clusters. X_{Mi} is a vector of M employer characteristics and associated workforce characteristics, βs are parameters to be estimated and $e_{k,i}$ is the residual error term.

Table A3. Likelihood of Offering Different Program Subtypes, by Employer Characteristic

	Program Subtype				
Employer Characteristics n=285	**Limited (SE)**	**Screening-Focused (SE)**	**Comprehensive (SE)**	**Intervention-Focused (SE)**	**Prevention-Focused (SE)**
INDUSTRY (Ref = Government)					
Heavy industry	0.213(0.18)	0.079(0.07)	0.013(0.08)	-0.325*(0.18)	0.020(0.03)
Trade	0.213(0.20)	0.022(0.06)	-0.064(0.07)	-0.251(0.19)	0.080*(0.05)
Services	0.196(0.20)	0.135(0.09)	-0.067(0.08)	-0.350*(0.19)	0.086(0.06)
REGION (Ref= Northeast)					
Midwest	-0.268*(0.16)	0.056(0.06)	-0.022(0.09)	0.183(0.11)	0.052(0.07)
South	-0.338**(0.15)	0.152**(0.07)	-0.006(0.09)	0.221*(0.10)	-0.028(0.05)
West	-0.132(0.19)	0.018(0.04)	-0.115(0.08)	0.268*(0.15)	-0.039(0.05)
EMPLOYER SIZE (Ref = 50-100)					
101 –1,000 employees	-0.297** (0.13)	0.115** (0.04)	0.079* (0.05)	0.151 (0.12)	-0.047 (0.03)
>1,000 employees	-0.347*** (0.13)	0.061 (0.04)	0.147** (0.07)	0.094 (0.12)	0.044 (0.08)
Years in business	0.001 (0.00)	-0.001 (0.00)	-0.001 (0.00)	0.000 (0.00)	-0.000 (0.00)
Gender composition	0.001 (0.00)	0.000 (0.00)	0.001 (0.00)	-0.001 (0.00)	-0.001 (0.00)
Age composition	-0.000 (0.00)	-0.001 (0.00)	-0.001 (0.00)	0.001 (0.00)	0.001 (0.00)
Salary >$50,000	-0.168 (0.14)	-0.007 (0.04)	0.091 (0.07)	0.102 (0.14)	-0.018 (0.02)

NOTE: *** p<0.01, ** p<0.05, * p<0.1

Appendix B. Program Data Analysis Methods

In this appendix, we provide additional details related to our program data analyses.

Analytic Sample

To obtain our analytic sample, we applied a number of inclusion and exclusion criteria. How these criteria affected our sample for analysis is shown in Table B1. For certain research questions, additional exclusion criteria were applied to create appropriate analytic subsamples; the impact of these criteria on the sample size are also shown below.

Table B1. Creation of the Analytic Sample from the Fortune 100 Employer Data

Inclusion Criteria	Employee Years (N)	Unique Employees (N)
1. Ages 18–64	683,206	166,842
2. Not enrolled in HMO	677,609	164,204
3. Not pregnant during data year	651,277	160,336
4. One or more full-year enrollment	610,517	119,576
5. Two or more full-year enrollment	565,883	97,259
Additional criteria for analytic subsamples		
Employees only	383,395	64,966
Completed the HRA	103,268	52,875
Eligible for lifestyle management	90,570	49,515
Eligible for disease management	71,681	34,497
Eligible for smoking surcharge	21,722	12,040
BMI data available	323,702	50,701
Ethnicity data available	233,156	36,595
Education data available	224,096	35,307

SOURCE: RAND analysis of Fortune 100 employer data.

Employee Characteristics and Program Participation

Following our bivariate analyses, we conducted multivariate analyses, using models with the following general form:

$$P_{it} = \beta_0 + X_{i(t-1)}\beta_1 + T\beta_2 \qquad [4]$$

where P_{it} is the participation indicator for employee i in year t, $X_{i(t-1)}$ is a vector of employee characteristics for employee i from the prior year $(t-1)$, T is a vector of year indicators, and βs are the parameters we estimated using a logistic regression. Our dependent variable is an indicator for participation status for the given type of participation (HRA, lifestyle management, or disease management).

Unadjusted comparisons, by program component, of eligible participants and nonparticipants are shown in Tables B2, B3, and B4. To obtain our analytic sample, we excluded spouses, as many of the variables being used to predict participation in our multivariate analyses describe the employee (e.g., salaried vs. hourly) and not their spouse. We present multivariate results estimating the likelihood of HRA participation, lifestyle management participation, and disease management participation in Tables B5–B7, respectively.

Table B2. Characteristics of HRA Eligible Participants and Nonparticipants.

Characteristic	Nonparticipants		Participants		p-value
Sex (n, %)					
Female	30,408	14.9%	19,039	25.6%	<.01
Male	173,995	85.1%	55,220	74.4%	
Age (years) (n, %)					
18–34	63,217	30.9%	18,430	24.8%	<.01
35–44	67,319	32.9%	26,220	35.3%	
45–54	57,872	28.3%	23,533	31.7%	
55–64	15,995	7.8%	6,076	8.2%	
Age (years) (mean, SD)	40.29	9.81	41.53	9.22	<.01
Region (n, %)					
East	35,680	17.5%	10,924	14.7%	<.01
Midwest	39,924	19.5%	20,316	27.4%	
South	98,490	48.2%	35,330	47.6%	
West	30,309	14.8%	7,689	10.4%	
Pay type (n, %)					
Hourly	130,351	63.8%	37,293	50.2%	<.01
Salaried	74,052	36.2%	36,966	49.8%	
Union status (n, %)					
Nonunion	169,093	82.7%	67,148	90.4%	<.01
Union	35,310	17.3%	7,111	9.6%	
ZIP code median income, 2008 (10Ks, 2013 USD) (n, %)					
<$35,000	10,469	5.1%	2,470	3.3%	<.01
$35,000–$49,000	67,479	33.0%	22,145	29.8%	
$50,000–$64,000	59,921	29.3%	20,345	27.4%	
$65,000–$79,000	33,264	16.3%	12,235	16.5%	
$80,000–$99,000	20,629	10.1%	9,675	13.0%	
>=$100,000	12,641	6.2%	7,389	10.0%	
ZIP code median income, 2008 (10,000s, 2013 US$) (mean, SD)	6.05	2.24	6.49	2.53	<.01
PMPM cost (2013 USD) (mean, SD)	150.39	291.98	193.84	323.75	<.01
Utilization per 1,000 member years (mean, SD)					
ER visits	122.79	379.45	111.15	358.44	<.01
Inpatient admissions	12.60	121.18	13.00	120.96	0.45
Office visits for primary care evaluation and management	2,054.03	2,668.97	2,572.68	2,897.76	<.01
Charlson comorbidity index (mean, SD)	0.11	0.41	0.12	0.43	<.01

SOURCE: RAND analysis of Fortune 100 employer data.

Table B3. Characteristics of Lifestyle Management Eligible Participants and Nonparticipants

Characteristic	Nonparticipants		Participants		p-value
Sex (n, %)					
Female	9,966	21.6%	5,610	21.7%	0.77
Male	36,181	78.4%	20,255	78.3%	
Age (years) (n, %)					
18–34	9,066	19.6%	5,339	20.6%	<.01
35–44	15,429	33.4%	8,017	31.0%	
45–54	16,514	35.8%	9,278	35.9%	
55–64	5,138	11.1%	3,231	12.5%	
Age (years) (mean, SD)	43.17	9.11	43.26	9.56	0.22
Region (n, %)					
East	6,839	14.8%	4,622	17.9%	<.01
Midwest	11,809	25.6%	5,481	21.2%	
South	22,875	49.6%	12,556	48.5%	
West	4,624	10.0%	3,206	12.4%	
Pay type (n, %)					
Hourly	29,699	64.4%	13,851	53.6%	<.01
Salaried	16,448	35.6%	12,014	46.4%	
Union status (n, %)					
Nonunion	36,135	78.3%	20,764	80.3%	<.01
Union	10,012	21.7%	5,101	19.7%	
ZIP code median income, 2008 (10Ks, 2013 USD) (n, %)					
<35K	1,753	3.8%	1,074	4.2%	<.01
$35K,000–$49,000	15,177	32.9%	8,487	32.8%	
$50K,000–$64,000	13,214	28.6%	7,565	29.2%	
$65K,000–$79,000	7,348	15.9%	4,239	16.4%	
$80K,000–$99,000	5,211	11.3%	2,795	10.8%	
>=$100,000	3,444	7.5%	1,705	6.6%	
ZIP code median income, 2008 (10Ks, 2013 USD) (mean, SD)	6.20	2.32	6.12	2.24	<.01
PMPM cost (2013 US$) (mean, SD)	193.39	329.08	230.55	360.38	<.01
Utilization per 1,000 member years (mean, SD)					
ER visits	112.90	363.81	124.34	380.88	<.01
Inpatient admissions	12.72	119.37	15.31	130.42	<.01
Office visits for primary care evaluation and management	2,522.20	2,891.93	2,953.30	3,143.51	<.01
Charlson comorbidity index (mean, SD)	0.13	0.44	0.16	0.50	<.01
HRA status (n, %)					
Nonparticipant	13,955	49.9%	12,967	63.6%	<.01
Participant	14,025	50.1%	7,409	36.4%	
Ethnicity (n, %)					
African-American	3,172	9.8%	1,307	10.0%	<.01
Asian or Pacific Islander	770	2.4%	348	2.7%	
Caucasian/Non-Hispanic	25,504	78.5%	10,348	78.9%	
Hispanic	2,252	6.9%	817	6.2%	
Native American/Alaskan Native	553	1.7%	189	1.4%	
Multiracial	119	0.4%	31	0.2%	
Other	125	0.4%	74	0.6%	

Characteristic	Nonparticipants		Participants		p-value
Education (n, %)					
High school or less	8,161	29.7%	5,436	30.5%	<.01
Some college	10,230	37.2%	7,017	39.4%	
College graduate	9,074	33.0%	5,349	30.0%	
Job classification (n, %)					
Executive	2,297	8.4%	1,357	7.7%	<.01
Professional	3,527	12.9%	1,982	11.2%	
Technical support	879	3.2%	625	3.5%	
Sales	10,657	39.0%	6,719	37.9%	
Clerical	2,151	7.9%	1,788	10.1%	
Service	540	2.0%	429	2.4%	
Production	1,335	4.9%	827	4.7%	
Laborer	5,931	21.7%	3,979	22.5%	
BMI category (n, %)					
Normal weight	8,282	22.5%	3,769	18.0%	<.01
Overweight	16,088	43.7%	8,462	40.4%	
Obese	12,406	33.7%	8,701	41.6%	
BMI (mean, SD)	28.68	5.18	29.60	5.39	<.01
Blood pressure category (n, %)					
Normal	4,896	25.1%	2,759	22.7%	<.01
Prehypertensive	11,937	61.3%	7,503	61.8%	
Stage 1 hypertension	2,167	11.1%	1,535	12.6%	
Stage 2 hypertension	475	2.4%	341	2.8%	
Total cholesterol category (n, %)					
Desirable	7,649	68.8%	4,969	66.4%	<.01
Borderline high	2,740	24.6%	1,972	26.4%	
High	732	6.6%	538	7.2%	
Days of work missed due to illness (past 12 months) (mean, SD)	1.39	4.35	1.34	4.06	0.73
Hours missed from work b/c of health problems (past 4 weeks) (mean, SD)	1.68	7.55	1.63	7.24	0.86
Hours actually worked (past 4 weeks) (mean, SD)	173.35	52.80	176.14	54.00	0.17

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: The following variables were obtained from completed HRAs and thus were only available for a subset of employees: ethnicity, education, job classification, BMI, blood pressure (systolic and diastolic), total cholesterol, days of work missed due to illness, hours missed from work because of health problems and hours actually worked.

Table B4. Characteristics of Disease Management Eligible Participants and Nonparticipants

Characteristic	Nonparticipants		Participants		p-value
Sex (n, %)					
Female	7,685	20.6%	1,768	20.3%	0.58
Male	29,683	79.4%	6,942	79.7%	
Age (years) (n, %)					
18–34	4,663	12.5%	586	6.7%	<.01
35–44	10,309	27.6%	1,814	20.8%	
45–54	15,638	41.8%	4,035	46.3%	
55–64	6,758	18.1%	2,275	26.1%	
Age (years) (mean, SD)	45.89	9.00	48.63	8.30	<.01
Region (n, %)					
East	6,685	17.9%	1,472	16.9%	<.01
Midwest	7,191	19.2%	1,859	21.3%	
South	19,170	51.3%	4,457	51.2%	
West	4,322	11.6%	922	10.6%	
Pay type (n, %)					
Hourly	21,064	56.4%	5,129	58.9%	<.01
Salaried	16,304	43.6%	3,581	41.1%	
Union status (n, %)					
Nonunion	30,904	82.7%	7,042	80.8%	<.01
Union	6,464	17.3%	1,668	19.2%	
ZIP code median income, 2008 (10,000s, 2013 US$) (n, %)					
$35,000	1,617	4.3%	393	4.5%	0.18
$35,000–$49,000	12,354	33.1%	2,995	34.4%	
$50,000–$64,000	10,675	28.6%	2,437	28.0%	
$65,000–$79,000	5,861	15.7%	1,333	15.3%	
$80,000–$99,000	4,115	11.0%	949	10.9%	
>=$100,000	2,746	7.3%	603	6.9%	
ZIP code median income, 2008 (10,000s, 2013 US$) (mean, SD)	6.17	2.37	6.10	2.28	<.01
PMPM cost (2013 US$) (mean, SD)	353.82	429.37	577.11	572.16	<.01
Utilization per 1,000 member years (mean, SD)					
ER visits	179.54	456.95	234.67	521.26	<.01
Inpatient admissions	29.60	186.90	93.92	343.10	<.01
Office visits for primary care evaluation and management	4,131.50	3,515.54	5,421.01	3,946.87	<.01
Charlson comorbidity index (mean, SD)	0.30	0.64	0.57	0.81	<.01
HRA status (n, %)					
Nonparticipant	23,801	75.8%	4,725	66.7%	<.01
Participant	7,593	24.2%	2,363	33.3%	
Ethnicity (n, %)					
African-American	2,000	12.8%	555	12.0%	0.04
Asian or Pacific Islander	279	1.8%	76	1.6%	
Caucasian/Non-Hispanic	11,883	76.1%	3,632	78.3%	
Hispanic	1,055	6.8%	270	5.8%	
Native American/Alaskan Native	302	1.9%	88	1.9%	
Multiracial	29	0.2%	5	0.1%	
Other	72	0.5%	14	0.3%	

Characteristic	Nonparticipants		Participants		p-value
Education (n, %)					
High school or less	6,297	34.5%	1,567	35.1%	0.09
Some college	7,095	38.9%	1,786	40.0%	
College graduate	4,845	26.6%	1,116	25.0%	
Job classification (n, %)					
Executive	1,614	8.9%	371	8.4%	<.01
Professional	1,852	10.2%	415	9.3%	
Technical support	736	4.1%	174	3.9%	
Sales	6,002	33.1%	1,533	34.5%	
Clerical	1,703	9.4%	496	11.2%	
Service	507	2.8%	144	3.2%	
Production	1,059	5.8%	288	6.5%	
Laborer	4,636	25.6%	1,019	23.0%	
BMI category (n, %)					
Normal weight	4,189	17.2%	913	14.6%	<.01
Overweight	10,268	42.2%	2,359	37.8%	
Obese	9,894	40.6%	2,972	47.6%	
BMI (mean, SD)	29.63	5.40	30.60	5.81	<.01
Blood pressure category (n, %)					
Normal	3,182	20.9%	1,075	23.9%	<.01
Prehypertensive	9,593	63.0%	2,829	62.8%	
Stage 1 hypertension	2,018	13.3%	494	11.0%	
Stage 2 hypertension	423	2.8%	105	2.3%	
Total cholesterol category (n, %)					
Desirable	6,358	69.1%	2,364	78.3%	<.01
Borderline high	2,197	23.9%	527	17.5%	
High	640	7.0%	129	4.3%	
Days of work missed due to illness (past 12 months) (mean, SD)	1.63	4.93	2.62	7.51	<.01
Hours missed from work because of health problems (past 4 weeks) (mean, SD)	1.71	7.40	2.55	10.01	<.01
Hours actually worked (past 4 weeks) (mean, SD)	173.80	55.11	167.28	60.52	<.01

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: The following variables were obtained from completed HRAs and thus were only available for a subset of employees: ethnicity, education, job classification, BMI, blood pressure (systolic and diastolic), total cholesterol, days of work missed due to illness, hours missed from work because of health problems and hours actually worked.

Table B5. Regression Coefficients from HRA Participation Regression

	Sample: Full
Male (0/1)	-0.417***
	(0.0120)
2006 (0/1)	-0.312***
	(0.0181)
2007 (0/1)	0.307***
	(0.0168)
2008 (0/1)	0.158***
	(0.0167)
2009 (0/1)	0.254***
	(0.0164)
2010 (0/1)	0.0223
	(0.0167)
Age 35–44 (0/1)	0.162***
	(0.0125)
Age 45–54 (0/1)	0.175***
	(0.0129)
Age 55–64 (0/1)	0.0942***
	(0.0192)
Region = Central (0/1)	0.634***
	(0.0156)
Region = South (0/1)	0.173***
	(0.0143)
Region = West (0/1)	-0.0307*
	(0.0186)
Salaried (0/1)	0.326***
	(0.0109)
Union member (0/1)	-0.571***
	(0.0161)
Household income (ZIP code median)	0.0401***
	(0.00210)
Charlson comorbidity index (prior year)	-0.0473***
	(0.0120)
Log(Total PMPM Costs) (prior year)	0.0495***
	(0.00166)
Constant	-1.558***
	(0.0261)
Observations	241,614

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Regression coefficients are in log odds units as estimated by the logistic regression. Female is the omitted gender, 2005 is the omitted year, age 18–34 is the omitted age category, East is the omitted region category, hourly pay is the omitted salaried (pay type) category, nonunion member is the omitted union member category, household income is entered into the regression in $10,000s, 2013 US$; PMPM health care costs adjusted to 2013 US$. SEs are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B6. Regression Coefficients from Lifestyle Management Participation Regressions

	Sample: Full	Sample: HRA with full sample (eligibility) variables only	Sample: HRA with HRA variables added
Male (0/1)	0.133***	0.0639*	0.0273
	(0.0227)	(0.0329)	(0.0377)
2007 (0/1)	-0.411***	-0.397***	-0.379***
	(0.0390)	(0.0725)	(0.0738)
2008 (0/1)	-0.407***	0.255***	0.276***
	(0.0369)	(0.0667)	(0.0681)
2009 (0/1)	1.755***	2.208***	2.232***
	(0.0508)	(0.0854)	(0.0867)
2010 (0/1)	0.165***	0.743***	0.750***
	(0.0374)	(0.0673)	(0.0686)
2011 (0/1)	-1.006***	-0.00760	0.0217
	(0.0369)	(0.0660)	(0.0673)
Age 35–44 (0/1)	-0.109***	0.173***	0.166***
	(0.0256)	(0.0448)	(0.0452)
Age 45–54 (0/1)	-0.0286	0.436***	0.445***
	(0.0253)	(0.0435)	(0.0443)
Age 55–64 (0/1)	0.0816**	0.691***	0.701***
	(0.0331)	(0.0534)	(0.0544)
Region = Central (0/1)	-0.335***	-0.0691	-0.0846*
	(0.0287)	(0.0447)	(0.0451)
Region = South (0/1)	-0.182***	-0.182***	-0.206***
	(0.0256)	(0.0412)	(0.0418)
Region = West (0/1)	0.0595*	-0.141**	-0.186***
	(0.0343)	(0.0606)	(0.0613)
Salaried (0/1)	0.511***	0.241***	0.265***
	(0.0204)	(0.0334)	(0.0449)
Union member (0/1)	0.346***	0.113**	0.120**
	(0.0244)	(0.0484)	(0.0494)
Household Income (ZIP code median)	-0.0622***	-0.0259***	-0.0176***
	(0.00422)	(0.00630)	(0.00665)
Charlson comorbidity index (prior year)	0.0572***	0.0324	0.0211
	(0.0197)	(0.0288)	(0.0291)
Log(Total PMPM Costs) (prior year)	0.0501***	0.0557***	0.0531***
	(0.00328)	(0.00539)	(0.00543)
Ethnicity = Asian or Pacific Islander (0/1)			0.299***
			(0.0983)
Ethnicity = Caucasian/Non-Hispanic (0/1)			-0.0998**
			(0.0492)

	Sample: Full	Sample: HRA with full sample (eligibility) variables only	Sample: HRA with HRA variables added
Ethnicity = Hispanic (0/1)			-0.158**
			(0.0724)
Ethnicity = Native American/Alaskan Native (0/1)			-0.246
			(0.154)
Ethnicity = Multiracial (0/1)			-0.539**
			(0.239)
Ethnicity = Other (0/1)			0.270
			(0.170)
Job = Professional (0/1)			0.118*
			(0.0610)
Job = Technical support (0/1)			0.304***
			(0.0905)
Job = Sales (0/1)			0.360***
			(0.0623)
Job = Clerical (0/1)			0.311***
			(0.0726)
Job = Service (0/1)			0.343***
			(0.121)
Job = Production (0/1)			0.0993
			(0.0942)
Job = Laborer (0/1)			0.268***
			(0.0741)
Education = Some college (0/1)			0.0692*
			(0.0356)
Education = College graduate (0/1)			0.141***
			(0.0425)
BMI = Overweight (0/1)			0.228***
			(0.0377)
BMI = Obese (0/1)			0.371***
			(0.0393)
Constant	-0.264***	-1.529***	-2.040***
	(0.0545)	(0.0936)	(0.134)
Observations	63,758	28,087	28,087

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Regression coefficients are in log odds units as estimated by the logistic regression. Female is the omitted gender; 2006 is the omitted year; age 18– 34 is the omitted age category; East is the omitted region category; hourly pay is the omitted salaried (pay type) category; nonunion member is the omitted union member category; household income is entered into the regression in $10,000s 2013 US$; PMPM health care costs adjusted to 2013 US$; African-American is the omitted ethnicity category; “executive” is the omitted job classification category; “high school or less” is the omitted education category; “normal” BMI (<25) is the omitted BMI category. SEs are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table B7. Regression Coefficients from Disease Management Participation Regressions

	Sample: Full	Sample: HRA with full sample (eligibility) variables only	Sample: HRA with HRA variables added
Male (0/1)	0.113***	0.254***	0.202***
	(0.0344)	(0.0572)	(0.0674)
2005 (0/1)	-0.549***	-0.688***	-0.691***
	(0.0807)	(0.136)	(0.137)
2006 (0/1)	-0.0325	-0.138	-0.130
	(0.0721)	(0.120)	(0.121)
2007 (0/1)	0.153**	0.214*	0.211*
	(0.0664)	(0.121)	(0.121)
2008 (0/1)	-0.357***	-0.353***	-0.355***
	(0.0666)	(0.119)	(0.119)
2009 (0/1)	-0.206***	0.759***	0.761***
	(0.0667)	(0.119)	(0.119)
2010 (0/1)	-0.959***	-1.078***	-1.073***
	(0.0658)	(0.111)	(0.111)
2011 (0/1)	-0.453***	-0.848***	-0.850***
	(0.0682)	(0.115)	(0.116)
Age 35–44 (0/1)	0.267***	0.395***	0.366***
	(0.0580)	(0.133)	(0.134)
Age 45– 54 (0/1)	0.543***	0.699***	0.677***
	(0.0548)	(0.127)	(0.128)
Age 55– 64 (0/1)	0.763***	0.981***	0.967***
	(0.0582)	(0.133)	(0.134)
Region = Central (0/1)	0.109**	0.242***	0.223***
	(0.0440)	(0.0847)	(0.0854)
Region = South (0/1)	0.0603	0.196**	0.200**
	(0.0386)	(0.0776)	(0.0785)
Region = West (0/1)	0.0253	0.302***	0.262**
	(0.0521)	(0.109)	(0.110)
Salaried (0/1)	0.0111	0.0793	0.0505
	(0.0307)	(0.0585)	(0.0754)
Union member (0/1)	0.0653*	0.0612	0.115
	(0.0380)	(0.0858)	(0.0879)
Household income (ZIP code median)	-0.0135**	-0.0107	0.00290
	(0.00611)	(0.0109)	(0.0116)
Charlson comorbidity index (prior year)	0.346***	0.414***	0.421***
	(0.0181)	(0.0334)	(0.0335)
Log(Total PMPM costs) (prior year)	0.144***	0.150***	0.146***
	(0.00945)	(0.0203)	(0.0204)
Ethnicity = Asian or Pacific Islander (0/1)			0.298
			(0.209)

	Sample: Full	Sample: HRA with full sample (eligibility) variables only	Sample: HRA with HRA variables added
Ethnicity = Caucasian/Non-Hispanic (0/1)			0.0832
			(0.0806)
Ethnicity = Hispanic (0/1)			-0.109
			(0.126)
Ethnicity = Native American/Alaskan Native (0/1)			-0.245
			(0.268)
Ethnicity = Multiracial (0/1)			-0.483
			(0.648)
Ethnicity = Other (0/1)			-0.170
			(0.321)
Job = Professional (0/1)			-0.0637
			(0.111)
Job = Technical support (0/1)			-0.123
			(0.156)
Job = Sales (0/1)			0.191*
			(0.106)
Job = Clerical (0/1)			0.168
			(0.123)
Job = Service (0/1)			0.0516
			(0.195)
Job = Production (0/1)			-0.0146
			(0.157)
Job = Laborer (0/1)			-0.0543
			(0.126)
Education = Some college (0/1)			0.0587
			(0.0605)
Education = College graduate (0/1)			-0.0357
			(0.0756)
BMI = Overweight (0/1)			0.115
			(0.0753)
BMI = Obese (0/1)			0.383***
			(0.0743)
Constant	-2.593***	-2.796***	-3.142***
	(0.107)	(0.214)	(0.267)
Observations	40,355	10,792	10,792

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Regression coefficients are in log odds units as estimated by the logistic regression. Female is the omitted gender; 2004 is the omitted year; age 18– 34 is the omitted age category; East is the omitted region category; hourly pay is the omitted salaried (pay type) category; nonunion member is the omitted union member category; household income is entered into the regression in $10,000s 2013 US$; PMPM health care costs adjusted to 2013 US$; African-American is the omitted ethnicity category; “executive” is the omitted job classification category; “high school or less” is the omitted education category; “normal” BMI (<25) is the omitted BMI category. SEs are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Financial Incentives and Program Participation

The multivariate analyses for this research question used an analytic approach similar to that of the previous research question (predictors of employee participation), but with a slightly modified form. Since there is no variation in the incentives data (in terms of the dollar amount offered as well as when the incentives were introduced), our analyses were restricted to models where the incentives variable was specified as an indicator for whether incentives were offered. We also removed our vector of year indicator variables from the model, mainly due to collinearity with our incentive indicator caused by the fact that the incentives were introduced at a single point in time for all eligible employees. We ran separate models to determine the impact of the smoking cessation (part of lifestyle management) and disease management incentives on participation in the lifestyle management and disease management programs, respectively, including only eligible and invited individuals for the given program in our analytic sample. Our model took the following form:

$$Logit(P_{it}) = \beta_0 + X_{i(t-1)}\beta_1 + I_t\beta_2 + E_{it}\beta_3 + I_t*E_{it}\beta_4 + X_{i(t-1)}*I_t*E_{itit}\beta_5 \qquad [5]$$

where P_{it} is the participation indicator for employee i in *year t,* $X_{i(t-1)}$ is a vector of employee characteristics for employee i from the prior year (t-1), I_t is a vector of incentive indicators that represent whether the incentive was offered in year *t,* E_{it} represents whether an employee i was eligible for the incentive in year *t,* $I_{it}*E_{it}$ is our DD estimator that represents an interaction between eligibility for incentives and whether incentives were offered, $X_{i(t-1)}*I_t*E_{it}$ represents the interaction among employee characteristics, eligibility for the incentive, and whether the incentive was offered, and βs are parameter vectors to be estimated. Our model for the impact of the disease management participation incentive had to be simplified to exclude the interaction term between whether the incentive was offered and eligibility for the incentive because we had no groups for use as controls (that is, the incentive eligibility variable was not in the model). As such, our triple interaction term in our smoking analysis was reduced to an interaction between whether incentives were offered and employee characteristics.

For our analysis of the smoking incentive, our DD estimator represents the impact of the presence of incentives among smokers eligible for the incentives on their overall participation in the lifestyle management component of the program (see Table B8). For our disease management incentive analysis, our incentive indicator represents the change in the participation rate associated with the introduction of incentives (see Table B9).

The triple interaction term shown above for our smoking incentives analysis indicates whether the employee characteristic in question (e.g., being female) significantly moderates the effect of incentives on program participation among smokers; this is our DDD estimate. For example, if a female indicator variable interacting with the DD estimator yields a positive coefficient that is statistically different from zero, we can conclude that being a female smoker increases the effect of incentives on participation. The parallel interpretation in our disease management incentive analysis is that being female increases the effect of the introduction of the incentive on disease management participation.

Table B8. Regression Coefficients from Smoking Surcharge DD Regressions

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Eligible for smoking cessation (0/1)	-0.266	-0.197***	-0.189***	-0.232***	-0.226***	-0.736***	-0.712***
	(0.369)	(0.0425)	(0.0483)	(0.0420)	(0.0478)	(0.0274)	(0.0308)
Eligible for smoking nonparticipation surcharge (0/1)	-0.792***	-0.0823***	0.210***	-0.0900***	0.198***	-0.646***	-0.348***
	(0.249)	(0.0299)	(0.0320)	(0.0297)	(0.0317)	(0.0200)	(0.0211)
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)	0.602	0.443***	0.442***	0.422***	0.420***	0.653***	0.633***
	(0.761)	(0.0743)	(0.0777)	(0.0740)	(0.0774)	(0.0406)	(0.0429)
Male (0/1)	0.00224	0.0311	0.0188	0.0636**	0.0535	0.158***	0.129***
	(0.0615)	(0.0363)	(0.0383)	(0.0317)	(0.0334)	(0.0219)	(0.0229)
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Male (0/1)	0.0421						
	(0.0824)						
Interaction: Eligible for smoking cessation (0/1)*Male (0/1)	-0.0651						
	(0.114)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Male (0/1)	0.209						
	(0.170)						
Age 35– 44 (0/1)	0.214***	0.171***	0.150***	0.179***	0.163***	-0.113***	-0.0956***
	(0.0684)	(0.0437)	(0.0460)	(0.0433)	(0.0456)	(0.0247)	(0.0260)
Age 45– 54 (0/1)	0.461***	0.475***	0.434***	0.468***	0.434***	0.00374	0.00146
	(0.0684)	(0.0428)	(0.0451)	(0.0421)	(0.0443)	(0.0243)	(0.0257)
Age 55– 64 (0/1)	0.748***	0.767***	0.686***	0.755***	0.682***	0.0994***	0.0873***
	(0.0896)	(0.0524)	(0.0553)	(0.0514)	(0.0543)	(0.0318)	(0.0334)
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Age 35– 44 (0/1)	-0.0924						
	(0.0969)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Age 45–54 (0/1)	0.00730						
	(0.0955)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Age 55–64 (0/1)	0.0303						
	(0.118)						
Interaction: Eligible for smoking cessation (0/1)*Age 35– 44 (0/1)	0.00961						
	(0.137)						
Interaction: Eligible for smoking cessation (0/1)*Age 45– 54 (0/1)	0.0205						
	(0.135)						
Interaction: Eligible for smoking cessation (0/1)*Age 55– 64 (0/1)	-0.0417						
	(0.182)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Age 35–44 (0/1)	-0.159						
	(0.225)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Age 45– 54 (0/1)	0.118						
	(0.213)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Age 55– 64 (0/1)	-0.0244						
	(0.263)						
Region = Central (0/1)	-0.113	-0.174***	-0.157***	-0.159***	-0.140***	-0.381***	-0.349***
	(0.0722)	(0.0433)	(0.0454)	(0.0429)	(0.0451)	(0.0277)	(0.0290)
Region = South (0/1)	-0.177***	-0.253***	-0.260***	-0.236***	-0.237***	-0.248***	-0.252***
	(0.0686)	(0.0402)	(0.0422)	(0.0396)	(0.0415)	(0.0246)	(0.0257)
Region = West (0/1)	-0.167*	-0.253***	-0.270***	-0.215***	-0.228***	0.0135	-0.0201
	(0.0977)	(0.0588)	(0.0622)	(0.0581)	(0.0614)	(0.0328)	(0.0346)
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Region = Central (0/1)	-0.137						
	(0.0963)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Region = South (0/1)	-0.170*						
	(0.0894)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Region = West (0/1)	-0.221*						
	(0.131)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking cessation (0/1)*Region = Central (0/1)	0.00878						
	(0.146)						
Interaction: Eligible for smoking cessation (0/1)*Region = South (0/1)	-0.00421						
	(0.140)						
Interaction: Eligible for smoking cessation (0/1)*Region = West (0/1)	0.172						
	(0.192)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Region = Central (0/1)	-0.128						
	(0.231)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Region = South (0/1)	-0.199						
	(0.221)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Region = West (0/1)	-0.452						
	(0.308)						
Salaried (0/1)	0.0515	0.192***	0.256***	0.186***	0.226***	0.497***	0.490***
	(0.0673)	(0.0418)	(0.0441)	(0.0317)	(0.0335)	(0.0195)	(0.0205)
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Salaried (0/1)	0.274***						
	(0.0941)						
Interaction: Eligible for smoking cessation (0/1)*Salaried (0/1)	0.0199						
	(0.129)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Salaried (0/1)	0.530**						
	(0.213)						
Union member (0/1)	0.0669	0.102**	0.0857*	0.0908*	0.0777	0.0803***	0.0312
	(0.0857)	(0.0474)	(0.0502)	(0.0465)	(0.0492)	(0.0224)	(0.0233)
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Union member (0/1)	-0.00832						
	(0.111)						
Interaction: Eligible for smoking cessation (0/1)*Union member (0/1)	-0.0800						
	(0.154)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Union member (0/1)	0.423**						
	(0.191)						
Household income (ZIP code median)	-0.00957	-0.0211***	-0.0189***	-0.0294***	-0.0293***	-0.0777***	-0.0741***
	(0.0102)	(0.00642)	(0.00675)	(0.00607)	(0.00639)	(0.00408)	(0.00429)
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Household Income (ZIP code median)	-0.0191						
	(0.0140)						
Interaction: Eligible for smoking cessation (0/1)*Household income (ZIP code median)	-0.00607						
	(0.0220)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Household income (ZIP code median)	-0.0397						
	(0.0394)						
Charlson comorbidity index (prior year)	0.0214	0.0316	0.0292	0.0454	0.0439	0.0645***	0.0717***
	(0.0495)	(0.0280)	(0.0293)	(0.0277)	(0.0290)	(0.0190)	(0.0196)
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Charlson comorbidity index (prior year)	0.0187						
	(0.0624)						
Interaction: Eligible for smoking cessation (0/1)*Charlson comorbidity index (prior year)	-0.102						
	(0.105)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Charlson comorbidity index (prior year)	0.257						
	(0.182)						
Log(Total PMPM costs) (prior year)	0.0448***	0.0571***	0.0538***	0.0599***	0.0570***	0.0415***	0.0409***
	(0.00878)	(0.00525)	(0.00555)	(0.00522)	(0.00551)	(0.00318)	(0.00335)
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Log(Total PMPM costs) (prior year)	0.0304**						
	(0.0121)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking cessation (0/1)*Log(Total PMPM costs) (prior year)	0.00184						
	(0.0157)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Log(Total PMPM costs) (prior year)	-0.0130						
	(0.0229)						
Ethnicity = Asian or Pacific Islander (0/1)	0.275*	0.352***	0.333***				
	(0.157)	(0.0951)	(0.0993)				
Ethnicity = Caucasian/Non-Hispanic (0/1)	0.0686	-0.0415	-0.0676				
	(0.0814)	(0.0478)	(0.0498)				
Ethnicity = Hispanic (0/1)	0.102	-0.135*	-0.182**				
	(0.115)	(0.0700)	(0.0735)				
Ethnicity = Native American/Alaskan Native (0/1)	-0.305	-0.345**	-0.224				
	(0.218)	(0.150)	(0.155)				
Ethnicity = Multiracial (0/1)	0.0547	-0.392*	-0.541**				
	(0.459)	(0.229)	(0.249)				
Ethnicity = Other (0/1)	0.715**	0.324**	0.291*				
	(0.326)	(0.165)	(0.170)				
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Asian or Pacific Islander (0/1)	0.0678						
	(0.208)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Caucasian / Non-Hispanic (0/1)	-0.181*						
	(0.105)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Hispanic (0/1)	-0.410***						
	(0.152)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Native American / Alaskan Native (0/1)	0.372						
	(0.359)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Multiracial (0/1)	-0.699						
	(0.552)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Other (0/1)	-0.553						
	(0.391)						
Interaction: Eligible for smoking cessation (0/1)*Ethnicity = Asian or Pacific Islander (0/1)	0.763**						
	(0.347)						
Interaction: Eligible for smoking cessation (0/1)*Ethnicity = Caucasian/Non-Hispanic (0/1)	-0.0136						
	(0.183)						
Interaction: Eligible for smoking cessation (0/1)*Ethnicity = Hispanic (0/1)	-0.0434						
	(0.275)						
Interaction: Eligible for smoking cessation (0/1)*Ethnicity = Native American/Alaskan Native (0/1)	-0.201						
	(0.418)						
Interaction: Eligible for smoking cessation (0/1)*Ethnicity = Multiracial (0/1)	-0.694						
	(0.925)						
Interaction: Eligible for smoking cessation (0/1)*Ethnicity = Other (0/1)	-2.062*						
	(1.115)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Asian or Pacific Islander (0/1)	-0.0660						
	(0.570)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Caucasian/Non-Hispanic (0/1)	-0.438*						
	(0.251)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Hispanic (0/1)	-0.559						
	(0.415)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Native American/Alaskan Native (0/1)	-0.245						
	(0.912)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Multiracial (0/1)	0.167						
	(0.987)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Ethnicity = Other (0/1)	0.000616						
	(0.722)						
Job = Professional (0/1)	0.126	0.111*	0.103*				
	(0.0890)	(0.0587)	(0.0620)				
Job = Technical support (0/1)	0.192	0.264***	0.283***				
	(0.143)	(0.0870)	(0.0917)				
Job = Sales (0/1)	0.156*	0.322***	0.345***				
	(0.0919)	(0.0596)	(0.0628)				
Job = Clerical (0/1)	0.214*	0.303***	0.312***				
	(0.113)	(0.0698)	(0.0736)				
Job = Service (0/1)	0.139	0.344***	0.376***				
	(0.216)	(0.116)	(0.123)				
Job = Production (0/1)	-0.00279	0.0439	0.0896				
	(0.155)	(0.0905)	(0.0954)				
Job = Laborer (0/1)	0.0899	0.240***	0.267***				
	(0.116)	(0.0708)	(0.0747)				
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Job = Professional (0/1)	0.00170						
	(0.127)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Job = Technical support (0/1)	0.234						
	(0.195)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Job = Sales (0/1)	0.405***						
	(0.131)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Job = Clerical (0/1)	0.204						
	(0.155)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Job = Service (0/1)	0.504*						
	(0.275)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Job = Production (0/1)	0.248						
	(0.207)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Job = Laborer (0/1)	0.299*						
	(0.159)						
Interaction: Eligible for smoking cessation (0/1)*Job = Professional (0/1)	-0.256						
	(0.199)						
Interaction: Eligible for smoking cessation (0/1)*Job = Technical support (0/1)	-0.532*						
	(0.281)						
Interaction: Eligible for smoking cessation (0/1)*Job = Sales (0/1)	-0.147						
	(0.188)						
Interaction: Eligible for smoking cessation (0/1)*Job = Clerical (0/1)	-0.111						
	(0.217)						
Interaction: Eligible for smoking cessation (0/1)*Job = Service (0/1)	-0.255						
	(0.373)						
Interaction: Eligible for smoking cessation (0/1)*Job = Production (0/1)	-0.397						
	(0.284)						
Interaction: Eligible for smoking cessation (0/1)*Job = Laborer (0/1)	-0.0165						
	(0.222)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Job = Professional (0/1)	1.064**						
	(0.473)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Job = Technical support (0/1)	1.048**						
	(0.527)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Job = Sales (0/1)	0.911**						
	(0.456)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Job = Clerical (0/1)	0.761						
	(0.479)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Job = Service (0/1)	0.800						
	(0.605)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Job = Production (0/1)	0.884*						
	(0.524)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Job = Laborer (0/1)	1.057**						
	(0.482)						
Education = Some college (0/1)	-0.00358	0.0604*	0.0697*				
	(0.0603)	(0.0343)	(0.0363)				
Education = College graduate (0/1)	0.0530	0.144***	0.130***				
	(0.0692)	(0.0409)	(0.0432)				
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Education = Some college (0/1)	0.0797						
	(0.0794)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*Education = College graduate (0/1)	0.0818						
	(0.0926)						
Interaction: Eligible for smoking cessation (0/1)*Education = Some college (0/1)	0.176*						
	(0.106)						
Interaction: Eligible for smoking cessation (0/1)*Education = College graduate (0/1)	0.385***						
	(0.129)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Education = Some college (0/1)	0.0465						
	(0.150)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*Education = College graduate (0/1)	0.0928						
	(0.204)						
BMI = Overweight (0/1)	-0.0280	0.215***	0.246***				
	(0.0618)	(0.0364)	(0.0387)				
BMI = Obese (0/1)	-0.0199	0.409***	0.445***				
	(0.0644)	(0.0378)	(0.0401)				

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*BMI = Overweight (0/1)	0.508***						
	(0.0842)						
Interaction: Eligible for smoking nonparticipation surcharge (0/1)*BMI = Obese (0/1)	0.907***						
	(0.0872)						
Interaction: Eligible for smoking cessation (0/1)*BMI = Overweight (0/1)	0.0667						
	(0.111)						
Interaction: Eligible for smoking cessation (0/1)*BMI = Obese (0/1)	0.155						
	(0.116)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*BMI = Overweight (0/1)	0.124						
	(0.154)						
Interaction: Eligible for smoking cessation (0/1)*Eligible for smoking nonparticipation surcharge (0/1)*BMI = Obese (0/1)	-0.159						
	(0.179)						
Constant	-1.302***	-1.629***	-1.919***	-1.100***	-1.356***	0.0565	-0.225***
	(0.185)	(0.113)	(0.120)	(0.0723)	(0.0765)	(0.0451)	(0.0476)
Observations	28,087	28,087	26,552	28,087	26,552	63,758	59,470

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE:
Model 1 = HRA sample + HRA variables + interaction terms.
Model 2 = HRA sample + HRA variables.
Model 3 = HRA sample + HRA variables + program year 5 dropped.
Model 4 = HRA sample + no HRA variables.
Model 5 = HRA sample + no HRA variables + program year 5 dropped.
Model 6 = Full sample.
Model 7 = Full sample + program year 5 dropped.
SEs are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table B9. Regression Coefficients from Disease Management Surcharge Difference Regressions

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Eligible for disease management nonparticipation surcharge (0/1)	-3.871***	-1.003***	-0.844***	-1.003***	-0.836***	-0.609***	-0.272***
	(0.592)	(0.0511)	(0.0689)	(0.0507)	(0.0684)	(0.0289)	(0.0403)
Male (0/1)	0.0421	0.185***	0.133*	0.230***	0.181***	0.111***	0.0803**
	(0.0844)	(0.0665)	(0.0750)	(0.0562)	(0.0630)	(0.0342)	(0.0375)
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Male (0/1)	0.300**						
	(0.139)						
Age 35–44 (0/1)	0.127	0.321**	0.221	0.349***	0.245*	0.266***	0.233***
	(0.149)	(0.132)	(0.141)	(0.132)	(0.140)	(0.0577)	(0.0620)
Age 45–54 (0/1)	0.421***	0.654***	0.529***	0.672***	0.541***	0.545***	0.474***
	(0.143)	(0.126)	(0.135)	(0.126)	(0.134)	(0.0545)	(0.0586)
Age 55–64 (0/1)	0.715***	1.003***	0.837***	1.012***	0.839***	0.767***	0.653***
	(0.154)	(0.132)	(0.143)	(0.131)	(0.142)	(0.0579)	(0.0627)
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Age 35–44 (0/1)	0.841**						
	(0.353)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Age 45–54 (0/1)	0.989***						
	(0.341)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Age 55–64 (0/1)	1.109***						
	(0.348)						
Region = Central (0/1)	0.252**	0.205**	0.271***	0.222***	0.292***	0.123***	0.141***
	(0.102)	(0.0842)	(0.0935)	(0.0835)	(0.0927)	(0.0436)	(0.0476)
Region = South (0/1)	0.184*	0.200***	0.215**	0.198***	0.218**	0.0706*	0.0687
	(0.0949)	(0.0774)	(0.0862)	(0.0765)	(0.0851)	(0.0383)	(0.0419)
Region = West (0/1)	0.293**	0.291***	0.350***	0.333***	0.410***	0.0334	0.0586
	(0.133)	(0.108)	(0.120)	(0.107)	(0.119)	(0.0519)	(0.0565)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Region = Central (0/1)	-0.150						
	(0.182)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Region = South (0/1)	0.0536						
	(0.166)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Region = West (0/1)	-0.00893						
	(0.233)						
Salaried (0/1)	-0.0868	0.0239	-0.0229	0.0657	0.0449	-0.00380	-0.0192
	(0.0845)	(0.0712)	(0.0779)	(0.0563)	(0.0624)	(0.0302)	(0.0330)
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Salaried (0/1)	0.191						
	(0.161)						
Union member (0/1)	0.0334	0.137	0.145	0.0920	0.102	0.0804**	0.0798**
	(0.110)	(0.0862)	(0.0962)	(0.0842)	(0.0942)	(0.0376)	(0.0407)
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Union member (0/1)	0.238						
	(0.179)						
Household income (ZIP code median)	0.00210	-0.00224	0.00965	-0.0154	6.83e-05	-0.0129**	-0.00173
	(0.0139)	(0.0114)	(0.0126)	(0.0107)	(0.0117)	(0.00607)	(0.00656)
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Household income (ZIP code median)	-0.0191						
	(0.0249)						
Charlson comorbidity index (prior year)	0.288***	0.437***	0.373***	0.433***	0.366***	0.353***	0.282***
	(0.0444)	(0.0333)	(0.0376)	(0.0332)	(0.0374)	(0.0180)	(0.0198)
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Charlson comorbidity index (prior year)	0.301***						
	(0.0685)						
Log(Total PMPM costs) (prior year)	0.121***	0.172***	0.126***	0.176***	0.130***	0.150***	0.116***
	(0.0226)	(0.0207)	(0.0213)	(0.0205)	(0.0211)	(0.00945)	(0.00997)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Log(Total PMPM costs) (prior year)	0.273***						
	(0.0518)						
Ethnicity = Asian or Pacific Islander (0/1)	0.545**	0.296	0.371				
	(0.256)	(0.207)	(0.230)				
Ethnicity = Caucasian/Non-Hispanic (0/1)	0.0631	0.0801	0.0563				
	(0.0987)	(0.0795)	(0.0884)				
Ethnicity = Hispanic (0/1)	0.0146	-0.0612	-0.0641				
	(0.154)	(0.124)	(0.138)				
Ethnicity = Native American/Alaskan Native (0/1)	-0.239	-0.337	-0.232				
	(0.288)	(0.266)	(0.271)				
Ethnicity = Multiracial (0/1)	-0.630	-0.351	-0.447				
	(1.091)	(0.637)	(0.783)				
Ethnicity = Other (0/1)	0.104	-0.0866	-0.0336				
	(0.436)	(0.315)	(0.362)				
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Ethnicity = Asian or Pacific Islander (0/1)	-0.666						
	(0.480)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Ethnicity = Caucasian / Non-Hispanic (0/1)	-0.00834						
	(0.166)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Ethnicity = Hispanic (0/1)	-0.189						
	(0.263)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Ethnicity = Native American / Alaskan Native (0/1)	-0.640						
	(0.816)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Ethnicity = Multiracial (0/1)	0.400						
	(1.348)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Ethnicity = Other (0/1)	-0.401						
	(0.646)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Job = Professional (0/1)	0.0889	-0.0687	0.0216				
	(0.136)	(0.110)	(0.123)				
Job = Technical support (0/1)	-0.144	-0.150	-0.104				
	(0.194)	(0.153)	(0.172)				
Job = Sales (0/1)	0.293**	0.158	0.217*				
	(0.128)	(0.104)	(0.116)				
Job = Clerical (0/1)	0.202	0.161	0.208				
	(0.152)	(0.121)	(0.136)				
Job = Service (0/1)	0.0114	0.0216	0.0971				
	(0.242)	(0.192)	(0.216)				
Job = Production (0/1)	0.129	-0.0700	0.0243				
	(0.190)	(0.154)	(0.172)				
Job = Laborer (0/1)	-0.110	-0.0780	-0.0676				
	(0.152)	(0.123)	(0.138)				
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Job = Professional (0/1)	-0.447*						
	(0.232)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Job = Technical support (0/1)	-0.0507						
	(0.318)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Job = Sales (0/1)	-0.424*						
	(0.225)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Job = Clerical (0/1)	-0.117						
	(0.250)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Job = Service (0/1)	-0.0188						
	(0.396)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Job = Production (0/1)	-0.567*						
	(0.329)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Job = Laborer (0/1)	0.0442						
	(0.263)						

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Education = Some college (0/1)	0.0988	0.0601	0.105				
	(0.0744)	(0.0597)	(0.0670)				
Education = College graduate (0/1)	0.0833	-0.0320	0.0327				
	(0.0919)	(0.0746)	(0.0831)				
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Education = Some college (0/1)	-0.0905						
	(0.125)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*Education = College graduate (0/1)	-0.327**						
	(0.159)						
BMI = Overweight (0/1)	0.0323	0.117	0.0911				
	(0.0905)	(0.0744)	(0.0825)				
BMI = Obese (0/1)	0.194**	0.396***	0.325***				
	(0.0899)	(0.0734)	(0.0816)				
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*BMI = Overweight (0/1)	0.210						
	(0.164)						
Interaction: Eligible for disease management nonparticipation surcharge (0/1)*BMI = Obese (0/1)	0.562***						
	(0.160)						
Constant	-2.503***	-3.207***	-2.878***	-2.878***	-2.559***	-2.791***	-2.554***
	(0.292)	(0.249)	(0.269)	(0.192)	(0.204)	(0.0894)	(0.0955)
Observations	10,792	10,792	7,570	10,792	7,570	40,355	29,776

SOURCE: RAND analysis of Fortune 100 employer data.
NOTES: SEs are in parentheses.
Model 1 = HRA sample + HRA variables + interaction terms.
Model 2 = HRA sample + HRA variables.
Model 3 = HRA sample + HRA variables + program year 6 dropped.
Model 4 = HRA sample + no HRA variables.
Model 5 = HRA sample + no HRA variables + program year 6 dropped.
Model 6 = Full sample.
Model 7 = Full sample + program year 6 dropped.

Health Care Utilization Patterns After Program Participation

Research Question 3.3: Do health care utilization patterns change following program participation?

- *Hypothesis 3.3.1: Program participation is associated with more physician visits in the first year, fewer physician visits thereafter.*
- *Hypothesis 3.3.2: Program participation is associated with reduced health care utilization for wellness-sensitive conditions.*

First, we created three analytic samples separately for each program using propensity score methods: lifestyle management, disease management, and predisease management. To estimate the propensity scores, we restricted the sample to individuals who were eligible to participate in the program, were observed at least one year prior to participation and at least one year afterward, and are ages 18 to 64. We excluded individuals who participated in other programs, although this was not common. We then estimated the probability of ever participating (at the person level) in the program as a function of age, sex, region, baseline health care costs, baseline number of outpatient visits, baseline number of inpatient admissions, baseline Charlson comorbidity indicators, and the first year the individual is observed in the data (as a logit). We then used the predicted probabilities, or propensity scores, from the model to match participants to the "nearest" nonparticipant neighbor (i.e., the individual with the closest propensity score serves as the comparison). We conducted one-to-one matching (i.e., one comparison for each participant) with replacement, meaning that we allowed nonparticipants to serve as comparisons more than once. In Table B10, we present the regression coefficients from the propensity score regression for each program. In Tables B11–B13, we present the descriptive statistics for participants and matched comparisons for each program after matching.

Table B10. Regression Coefficients from Propensity Score Estimation for Each Program

	Ever Participated in:		
	Lifestyle Management	**Disease Management**	**Predisease Management**
Male (0/1)	0.859**	1.127**	0.973
	(5.439)	(3.255)	(0.458)
Region = South (0/1)	0.567**	1.091	1.100
	(11.346)	(1.287)	(0.906)
Region = Midwest (0/1)	1.037	1.037	1.207*
	(0.851)	(0.611)	(2.122)
Region = West (0/1)	0.853**	0.983	0.976
	(2.701)	(0.211)	(0.187)
Baseline Charlson comorbidity indicators			
Myocardial infarction	0.468	1.238	1.172
	(0.976)	(0.602)	(0.156)
CHF	2.121	1.456	0.709
	(1.573)	(1.525)	(0.484)
Peripheral vascular disease	0.600	1.158	0.770
	(1.408)	(0.549)	(0.410)
Cerebrovascular disease	0.862	0.900	0.544
	(0.507)	(0.529)	(0.988)
Rheumatic disease	1.076	0.924	1.253
	(0.300)	(0.424)	(0.541)
Peptic ulcer disease	0.623	1.091	0.667
	(1.299)	(0.306)	(0.513)
Metastatic solid tumor	0.645*	0.786	0.551
	(2.318)	(1.413)	(1.524)
Hemiplegia or paraplegia	0.211	0.721	
	(1.299)	(0.359)	
Renal disease	0.823	1.146	0.520
	(0.349)	(0.357)	(0.639)
AIDS/HIV	0.767	0.464	1.091
	(0.525)	(1.485)	(0.114)
Diabetes	0.821	1.970**	0.829
	(1.526)	(7.343)	(0.836)
moderate or severe liver disease	0.835	0.712	0.599
	(0.798)	(1.511)	(1.152)
Has one comorbidity (0/1)	1.178*	1.409**	1.299
	(2.204)	(4.633)	(1.670)
Has two comorbidities (0/1)	1.364	1.893**	2.531*
	(1.267)	(3.968)	(2.358)
Has three comorbidities (0/1)	2.940	2.091*	
	(1.473)	(2.097)	

	Ever Participated in:		
	Lifestyle Management	**Disease Management**	**Predisease Management**
Baseline Visits/Admissions			
One ER visit per year (0/1)	0.957	1.072	1.023
	(0.991)	(1.324)	(0.234)
Two ER visits per year (0/1)	0.822*	1.120	0.784
	(1.963)	(1.094)	(1.093)
Three visits per year (0/1)	0.802	1.126	0.640
	(1.217)	(0.591)	(0.914)
Four visits per year (0/1)	0.989	1.748	0.932
	(0.030)	(1.499)	(0.065)
Five visits per year (0/1)	1.521	1.643	0.416
	(1.222)	(1.574)	(0.837)
One inpatient admission per year (0/1)	0.907	1.150	1.398
	(0.985)	(1.567)	(1.843)
Two inpatient admissions per year (0/1)	0.669	1.640*	1.015
	(1.047)	(2.154)	(0.020)
Three inpatient admissions per year (0/1)	1.622	0.298	
	(0.405)	(1.043)	
Four inpatient admissions per year (0/1)		0.630	
		(0.385)	
Five inpatient admissions per year (0/1)		4.973	
		(1.143)	
Log(Baseline PMPM total costs)	1.046**	1.057**	1.030**
	(9.214)	(5.999)	(2.603)
Salaried (0/1)	1.024	0.953	0.900
	(0.810)	(1.192)	(1.637)
Union (0/1)	1.519**	0.938	0.909
	(10.190)	(1.256)	(1.074)
n	30,467	22,499	13,095

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the odds ratios from estimating a logistic regression to determine the propensity score for each program. In addition to the covariates listed, we also adjust for age (include a vector of age dummies) and the year the individual was first observed in the data. SEs are in parentheses.
* p<0.05; ** p<0.01

Table B11. Comparison of Lifestyle Management Participants and Their Matched Comparisons

	Nonparticipant Comparisons		Participants		Statistically
	Mean	SD	Mean	SD	Different?
Age	37.113	(8.84)	37.140	(8.76)	no
Male	0.596	(.49)	0.610	(.49)	no
Myocardial infarction	0.000	(.02)	0.000	(.01)	no
CHF	0.001	(.03)	0.001	(.03)	no
Peripheral vascular disease	0.000	(.02)	0.001	(.03)	no
Cerebrovascular disease	0.002	(.05)	0.002	(.05)	no
Rheumatic disease	0.004	(.06)	0.004	(.06)	no
Chronic pulmonary disease	0.002	(.04)	0.001	(.03)	no
Metastatic solid tumor	0.005	(.07)	0.005	(.07)	no
Hemiplegia or paraplegia	0.000	(.02)	0.000	(.01)	no
Renal disease	0.000	(.01)	0.000	(.02)	no
AIDS/HIV	0.000	(.02)	0.001	(.03)	no
Diabetes	0.013	(.12)	0.014	(.12)	no
Moderate to severe liver disease	0.005	(.07)	0.005	(.07)	no
Baseline ER visits per year	0.169	(.51)	0.166	(.5)	no
Baseline inpatient admissions per year	0.025	(.17)	0.023	(.16)	no
Log (Baseline total PMPM costs)	3.154	(2.81)	3.078	(2.92)	no
Salaried	0.356	(.48)	0.351	(.48)	no
Union	0.129	(.34)	0.162	(.37)	yes
N	6,082		11,474		

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: "Yes" in the "Statistically Different?" column indicates means are different at the 5-percent level or better across the two groups.

Table B12. Comparison of Disease Management Participants and their Matched Comparisons

	Nonparticipant Comparisons		Participants		Statistically
	Mean	SD	Mean	SD	Different?
Age	44.402	(8.48)	44.956	(8.43)	yes
Male	0.574	(.49)	0.567	(.5)	no
Myocardial infarction	0.003	(.05)	0.004	(.06)	no
CHF	0.005	(.07)	0.008	(.09)	no
Peripheral vascular disease	0.004	(.07)	0.007	(.08)	no
Cerebrovascular disease	0.012	(.11)	0.011	(.11)	no
Rheumatic disease	0.009	(.09)	0.012	(.11)	no
Chronic pulmonary disease	0.004	(.06)	0.004	(.07)	no
Metastatic solid tumor	0.016	(.13)	0.016	(.12)	no
Hemiplegia or paraplegia	0.000	(.00)	0.000	(.02)	no
Renal disease	0.004	(.06)	0.004	(.06)	no
AIDS/HIV	0.002	(.05)	0.001	(.03)	no
Diabetes	0.108	(.31)	0.146	(.35)	yes
Moderate to severe liver disease	0.008	(.09)	0.008	(.09)	no
Baseline ER visits per year	0.267	(.65)	0.278	(.67)	no
Baseline inpatient admissions per year	0.060	(.27)	0.076	(.32)	yes
Log (Baseline total PMPM costs)	4.493	(2.37)	4.675	(2.45)	yes
Salaried	0.327	(.47)	0.336	(.47)	no
Union	0.180	(.38)	0.179	(.38)	no
n	3,356		4,303		

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: "Yes" in the "Statistically Different?" column indicates means are different at the 5-percent level or better across the two groups

Table B13. Comparison of Pre-Disease Management Participants and their Matched Comparisons

	Nonparticipant Comparisons		Participants		Statistically Different?
	Mean	SD	Mean	SD	
Age	40.299	(8.53)	40.408	(8.49)	no
Male	0.628	(.48)	0.632	(.48)	no
Myocardial infarction	0.001	(.03)	0.001	(.03)	no
CHF	0.000	(.00)	0.001	(.04)	no
Peripheral vascular disease	0.004	(.06)	0.002	(.05)	no
Cerebrovascular disease	0.002	(.04)	0.003	(.05)	no
Rheumatic disease	0.005	(.07)	0.006	(.07)	no
Chronic pulmonary disease	0.002	(.04)	0.001	(.04)	no
Metastatic solid tumor	0.008	(.09)	0.006	(.08)	no
Hemiplegia or paraplegia	0.000	(.00)	0.000	(.00)	no
Renal disease	0.000	(.00)	0.001	(.03)	no
AIDS/HIV	0.002	(.05)	0.001	(.04)	no
Diabetes	0.028	(.17)	0.036	(.19)	no
Moderate to severe liver disease	0.003	(.06)	0.004	(.06)	no
Baseline ER visits per year	0.146	(.44)	0.163	(.46)	no
Baseline inpatient admissions per year	0.033	(.18)	0.032	(.18)	no
Log (Baseline total PMPM costs)	3.481	(2.77)	3.529	(2.8)	no
Salaried	0.326	(.47)	0.338	(.47)	no
Union	0.133	(.34)	0.138	(.35)	no
N	1,264		1,431		

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: "Yes" in the "Statistically Different?" column indicates means are different at the 5-percent level or better across the two groups.

To test Hypotheses 3.3.1, we used the matched samples for each program, included all years of available data for each individual and estimated:

$$Visits_{it} = \alpha + \beta everpart_i + \Delta YrsPgm_{it} + \Gamma X_{it} + TYR_t + \varepsilon_{it} \qquad [6]$$

where *Visits* is our outcome measure and is equal to the number of outpatient visits for individual *i* at time *t*. *X* is a vector of individual level controls and *YR* is a vector of time fixed effects. We used an ITT analysis and define *everpart* as equal to one if an individual ever participated in the program; this is defined separately for each wellness program and Equation 6 is estimated separately for each wellness program. *YrsPgm* is a vector of four dummies to capture what year of participation the participant is in: zero years in the program (all pre-participation years), first year in the program, second year in the program, and third or later years in the program. β represents the change in the outcome variable that is associated with ever being a participant. $\delta_1, \delta_2,$ and δ_3 (zero years in the program is the omitted category) represent the additional change in the outcome variable for the first, second, and third (or later) year of participation. We estimated Equation 1 as a fixed-effects negative binomial regression to address the fact that we

have multiple observations per person. The negative binomial model is appropriate with a count dependent variable with overdispersion.

In Figure 41, we presented the difference between each year in the program and nonparticipation for each program: *($\delta_0 - \beta, \delta_1 - \beta, \delta_2 - \beta$ and $\delta_3 - \beta$)*. In Table B14, we present the marginal coefficients from estimating Equation 1 for each program that were used in generating Figure 41.

Table B14. Regression Coefficients from Negative Binomial Fixed Effects Estimation of Equation 1, by Program Type: Effects on Annual Outpatient Visits

	Lifestyle Management	Disease Management	Predisease Management
Ever participate (0/1)	1.051	1.117**	1.021
	(1.669)	(3.014)	(0.301)
First year participating	1.018	1.096**	1.039
	(1.842)	(8.209)	(1.535)
Second year participating	1.004	0.973	1.032
	(0.290)	(1.939)	(0.778)
Third year or beyond participating	0.992	0.895**	0.995
	(0.621)	(7.609)	(0.076)
Age 18–34 (0/1)	0.910**	0.880**	0.900
	(3.536)	(3.867)	(1.735)
Age 35–44 (0/1)	0.926**	0.937**	0.917
	(3.487)	(3.073)	(1.938)
Age 45–54 (0/1)	0.954**	0.969*	0.980
	(2.610)	(2.201)	(0.593)
Employee (0/1)	0.905*	1.058	0.858
	(2.572)	(1.223)	(1.586)
Male (0/1)	0.633**	0.796**	0.742**
	(12.852)	(4.958)	(3.250)
Region = South (0/1)	1.059*	0.966	0.907
	(1.976)	(0.871)	(1.250)
Region = Midwest (0/1)	1.057*	1.016	0.998
	(2.554)	(0.557)	(0.030)
Region = West (0/1)	0.902**	0.957	0.801*
	(3.376)	(0.972)	(2.555)
Baseline Charlson comorbidity indicators			
Myocardial infarction	1.064	0.940	0.761
	(0.411)	(1.037)	(1.131)
CHF	1.109	1.120*	0.967
	(1.011)	(2.468)	(0.196)
Peripheral vascular disease	0.956	1.009	0.841
	(0.553)	(0.221)	(1.124)
Cerebrovascular disease	0.939	1.051	0.713*
	(0.848)	(1.410)	(2.272)
Chronic pulmonary disease	0.869*	0.984	0.756*
	(2.098)	(0.532)	(2.082)
Rheumatic disease	0.969	1.113*	0.878

	Lifestyle Management	Disease Management	Predisease Management
	(0.422)	(2.572)	(0.848)
Peptic ulcer disease	0.938	1.029	0.862
	(0.752)	(0.519)	(0.957)
Metastatic solid tumor	0.981	1.132**	0.869
	(0.254)	(3.186)	(0.928)
Hemiplegia or paraplegia	0.928	1.300*	0.544
	(0.358)	(2.005)	(0.957)
Renal disease	0.923	1.110	0.787
	(0.561)	(1.600)	(0.947)
AIDS/HIV	1.067	0.992	0.779
	(0.386)	(0.054)	(0.978)
Diabetes	0.943	1.119**	0.794
	(0.841)	(3.425)	(1.673)
Moderate or severe liver disease	0.872	0.993	0.777
	(1.893)	(0.177)	(1.762)
Has one comorbidity (0/1)	1.764**	1.433**	1.976**
	(8.448)	(11.586)	(5.081)
Has two comorbidities (0/1)	2.448**	1.711**	3.154**
	(7.238)	(10.014)	(4.696)
Has three comorbidities (0/1)	3.327**	1.956**	3.353**
	(5.961)	(8.110)	(2.841)
Has four comorbidities (0/1)	3.806**	1.747**	6.389**
	(4.029)	(4.021)	(3.233)
Has five comorbidities (0/1)	2.475	2.064	
	(1.620)	(1.845)	
Has six comorbidities (0/1)		0.891	
		(0.209)	
Year = 2004	1.023	1.037**	1.026
	(1.322)	(2.640)	(0.775)
Year = 2005	1.058**	1.087**	1.054
	(3.413)	(6.138)	(1.613)
Year = 2006	1.043*	1.098**	1.039
	(2.565)	(6.797)	(1.184)
Year = 2007	1.065**	1.146**	1.107**
	(3.835)	(9.640)	(3.211)
Year = 2008	1.122**	1.182**	1.145**
	(6.993)	(11.273)	(4.291)
Year = 2009	1.185**	1.247**	1.243**
	(10.124)	(14.038)	(6.895)
Year = 2010	1.212**	1.261**	1.255**
	(11.062)	(13.828)	(6.976)
Year = 2011	1.182**	1.211**	1.212**
	(9.107)	(10.450)	(5.381)
N	105,447	49,229	16,948

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the incidence rate ratios from estimating the fixed effects negative binomial model. Age 55–64 is the omitted age category, East is the omitted region category, and 2003 is the omitted year. Robust SE in parentheses.
* p<0.05; ** p<0.01

To test Hypotheses 2.3.2, we used the matched samples for each program, included all years of available data for each individual and estimated:

$$Hosp_{it} = \alpha + \beta_1 everpart_i + \beta_2 Participating_{it} + \Gamma X_{it} + TYR_t + \varepsilon_{it} \qquad [7]$$

where *Hosp* is one our measures of hospitalization: (1) Any hospitalization equals one if individual *i* had any hospitalizations in year *t* and zero, otherwise; (2) any ER visits equals to one if individual *i* had any ER visits in year *t* and zero, otherwise; and (3) any wellness-sensitive hospitalization equals to one if individual *i* had any inpatient admissions or ER visits in year *t* and zero, otherwise. *X* is a vector of individual level controls and *YR* is a vector of time fixed effects. *Everpart* is our treatment indicator variable; this equals one for program participants in all years and zero for comparisons in all years. *Participating* is equal to one in the first year an individual participates in the program and every year thereafter (ITT), but equals to zero in the participant's pre-participation or baseline years. *Participating* equals zero in all years for comparisons. We estimated Equation 2 separately for each program as a logit model with SEs clustered at the person level. To create Figure 42, we used the predicted probabilities from estimating Equation 2 and plotted the difference between the predicted probability of hospitalization for participants (in the years they are in the program) with the predicted probability of hospitalization for comparisons. We present the odds ratios from these models in Tables B15–B17.

Table B15. Odds Ratios from Estimation of Equation 2 for Lifestyle Management Participation-Effects on the Likelihood of Hospitalization

	Any Hospitalization	Any ER Visits	Any Wellness-Sensitive Hospitalization
Ever participate (0/1)	0.997	1.004	0.973
	(0.054)	(0.138)	(0.344)
Participating in current year (0/1)	1.166*	1.015	1.131
	(2.057)	(0.492)	(1.371)
Age 18–34 (0/1)	0.632**	1.980**	1.323
	(3.848)	(11.484)	(1.916)
Age 35–44 (0/1)	0.748**	1.525**	1.046
	(2.595)	(7.187)	(0.312)
Age 45–54 (0/1)	0.726**	1.191**	0.847
	(2.872)	(2.981)	(1.155)
Employee (0/1)	0.438**	0.871**	0.617**
	(11.930)	(3.831)	(5.083)
Male (0/1)	0.709**	0.791**	0.922
	(4.927)	(7.233)	(0.902)
Region = South (0/1)	0.976	0.917*	1.044
	(0.255)	(2.192)	(0.383)
Region = Midwest (0/1)	1.192*	1.000	1.279**
	(2.238)	(0.009)	(2.652)
Region = West (0/1)	1.082	0.809**	1.014
	(0.739)	(4.532)	(0.112)
Baseline Charlson comorbidity indicators			
Myocardial infarction	20.685**	1.916	27.402**
	(4.563)	(1.263)	(4.728)
CHF	2.928	0.825	3.932
	(1.587)	(0.484)	(1.825)
Peripheral vascular disease	3.021*	1.273	1.885
	(2.127)	(0.723)	(0.987)
Cerebrovascular disease	7.160**	3.187**	13.635**
	(4.021)	(3.857)	(4.439)
Chronic pulmonary disease	1.921	1.540	6.497**
	(1.374)	(1.517)	(3.283)
Rheumatic disease	1.226	0.974	0.646
	(0.391)	(0.088)	(0.600)
Peptic ulcer disease	11.593**	3.426**	1.683
	(4.709)	(3.709)	(0.693)
Metastatic solid tumor	1.993	0.950	1.206
	(1.404)	(0.167)	(0.291)
Hemiplegia or paraplegia	6.728	2.672	
	(1.902)	(1.520)	
Renal disease	13.000**	3.074**	1.839
	(4.187)	(2.691)	(0.551)
AIDS/HIV	1.370	1.017	
	(0.358)	(0.040)	
Diabetes	1.750	0.842	1.867

	Any Hospitalization	Any ER Visits	Any Wellness-Sensitive Hospitalization
	(1.110)	(0.581)	(1.039)
Moderate or severe liver disease	2.828*	1.200	1.104
	(2.104)	(0.602)	(0.162)
Has one comorbidity (0/1)	1.574	1.887*	2.062
	(0.951)	(2.227)	(1.259)
Has two comorbidities (0/1)	1.491	2.658	1.738
	(0.450)	(1.827)	(0.513)
Has three comorbidities (0/1)	1.434	1.856	0.872
	(0.240)	(0.692)	(0.063)
Has four comorbidities (0/1)	1.359	3.891	2.792
	(0.166)	(1.141)	(0.438)
Year = 2004	0.752*	0.821**	0.768
	(2.375)	(3.569)	(1.465)
Year = 2005	0.603**	0.855**	1.067
	(4.133)	(2.906)	(0.381)
Year = 2006	0.612**	0.827**	0.900
	(4.109)	(3.539)	(0.619)
Year = 2007	0.481**	0.787**	0.732
	(5.934)	(4.442)	(1.773)
Year = 2008	0.471**	0.792**	0.864
	(6.054)	(4.316)	(0.844)
Year = 2009	0.391**	0.832**	0.817
	(7.406)	(3.418)	(1.161)
Year = 2010	0.434**	0.753**	0.841
	(6.540)	(5.057)	(0.975)
Year = 2011	0.305**	0.763**	0.911
	(8.465)	(4.648)	(0.509)
n	109,455	109,455	109,368

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the odds ratios from estimating a logit model. Age 55–64 is the omitted age category, East is the omitted region category, and 2003 is the omitted year. SEs clustered at the person level are in parentheses.
* p<0.05; ** p<0.01

Table B16. Odds Ratios from Estimation of Equation 2 for Disease Management Participation-Effects on the Likelihood of Hospitalization

	Any Hospitalization	Any ER Visits	Any Wellness-Sensitive Hospitalization
Ever participate (0/1)	1.358**	1.170**	1.490**
	(5.067)	(4.058)	(5.469)
Participating in current year (0/1)	1.435**	1.002	1.222*
	(5.352)	(0.043)	(2.555)
Age 18 –34 (0/1)	0.943	2.046**	1.130
	(0.569)	(11.480)	(0.996)
Age 35–44 (0/1)	1.093	1.555**	1.121
	(1.277)	(9.267)	(1.360)
Age 45–54 (0/1)	1.013	1.215**	1.036
	(0.203)	(4.602)	(0.480)
Employee (0/1)	0.486**	0.821**	0.773**
	(11.398)	(4.496)	(3.447)
Male (0/1)	0.900	0.765**	0.930
	(1.650)	(6.149)	(0.963)
Region = South (0/1)	1.048	1.157**	1.098
	(0.571)	(2.675)	(0.962)
Region = Midwest (0/1)	1.205**	1.223**	1.263**
	(2.617)	(4.220)	(2.743)
Region = West (0/1)	1.154	1.003	1.022
	(1.372)	(0.046)	(0.176)
Baseline Charlson Comorbidity Indicators:			
Myocardial infarction	4.256**	1.851**	2.953**
	(5.612)	(2.714)	(3.870)
CHF	2.901**	1.210	1.848*
	(4.562)	(1.033)	(2.440)
Peripheral vascular disease	1.719*	1.162	1.032
	(2.380)	(0.900)	(0.132)
Cerebrovascular disease	3.226**	2.096**	3.692**
	(5.952)	(5.214)	(6.506)
Chronic pulmonary disease	1.483*	1.602**	2.225**
	(2.121)	(3.669)	(4.302)
Rheumatic disease	0.810	0.898	0.456**
	(0.968)	(0.646)	(2.695)
Peptic ulcer disease	4.406**	2.625**	0.496
	(5.344)	(4.558)	(1.587)
Metastatic solid tumor	1.114	0.839	0.502*
	(0.508)	(1.096)	(2.511)
Hemiplegia or paraplegia	3.439*	2.312	0.379
	(1.969)	(1.907)	(0.920)
Renal disease	2.270**	0.877	0.883
	(2.814)	(0.576)	(0.388)
AIDS/HIV	0.636	1.059	0.738
	(0.948)	(0.141)	(0.581)
Diabetes	0.819	0.932	0.790

	Any Hospitalization	Any ER Visits	Any Wellness-Sensitive Hospitalization
	(0.999)	(0.527)	(1.172)
Moderate or severe liver disease	1.626*	1.558**	0.552*
	(2.099)	(2.667)	(2.103)
Has one comorbidity (0/1)	1.890**	1.446**	2.730**
	(3.375)	(2.842)	(5.210)
Has two comorbidities (0/1)	2.763**	1.947**	4.980**
	(2.997)	(2.980)	(4.698)
Has three comorbidities (0/1)	3.977**	2.490**	6.596**
	(2.768)	(2.611)	(3.709)
Has four comorbidities (0/1)	3.928	2.607	8.209*
	(1.748)	(1.609)	(2.557)
Has five comorbidities (0/1)	3.895		19.380*
	(1.212)		(2.354)
Year = 2004	0.888	0.737**	0.985
	(1.445)	(6.020)	(0.141)
Year = 2005	0.609**	0.708**	0.792*
	(5.633)	(6.772)	(2.126)
Year = 2006	0.616**	0.730**	0.837
	(5.409)	(6.132)	(1.639)
Year = 2007	0.625**	0.774**	0.853
	(5.277)	(4.944)	(1.440)
Year = 2008	0.602**	0.776**	0.805
	(5.418)	(4.634)	(1.872)
Year = 2009	0.549**	0.740**	0.787*
	(6.138)	(5.306)	(2.029)
Year = 2010	0.500**	0.747**	0.870
	(6.704)	(4.930)	(1.140)
Year = 2011	0.299**	0.697**	0.664**
	(9.871)	(5.672)	(3.124)
N	49,427	49,425	49,427

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the odds ratios from estimating a logit model. Age 55–64 is the omitted age category, East is the omitted region category, and 2003 is the omitted year. SEs clustered at the person level are in parentheses.
* p<0.05; ** p<0.01

Table B17. Odds Ratios from Estimation of Equation 2 for Predisease Management Participation-Effects on the Likelihood of Hospitalization

	Any Hospitalization	Any ER Visits	Any Wellness-Sensitive Hospitalization
Ever participate (0/1)	1.139	0.899	1.074
	(0.573)	(1.031)	(0.279)
Participating in current year (0/1)	0.991	1.121	1.075
	(0.078)	(1.747)	(0.444)
Age 18–34 (0/1)	0.639	1.600**	1.283
	(1.884)	(4.242)	(0.871)
Age 35–44 (0/1)	0.707	1.229*	1.200
	(1.695)	(1.998)	(0.719)
Age 45–54 (0/1)	0.848	0.898	0.891
	(0.852)	(1.077)	(0.454)
Employee (0/1)	0.572**	1.046	0.916
	(3.856)	(0.511)	(0.409)
Male (0/1)	0.675**	0.661**	0.737
	(2.731)	(5.068)	(1.523)
Region = South (0/1)	1.556*	1.063	1.127
	(2.190)	(0.629)	(0.498)
Region = Midwest (0/1)	1.244	1.077	1.086
	(1.192)	(0.910)	(0.406)
Region = West (0/1)	1.236	0.896	0.808
	(0.850)	(0.887)	(0.705)
Baseline Charlson comorbidity indicators:			
Myocardial infarction	8.580*	4.123	82.230**
	(2.121)	(1.414)	(4.003)
CHF	2.112	1.630	5.376
	(0.772)	(0.666)	(1.331)
Peripheral vascular disease	1.455	1.282	1.629
	(0.404)	(0.375)	(0.423)
Cerebrovascular disease	2.124	2.859	24.649**
	(0.929)	(1.665)	(3.636)
Chronic pulmonary disease	0.526	1.448	10.811**
	(0.789)	(0.630)	(2.892)
Rheumatic disease	0.121*	0.705	0.434
	(2.055)	(0.556)	(0.645)
Peptic ulcer disease	1.691	1.797	2.557
	(0.614)	(0.887)	(0.867)
Metastatic solid tumor	0.709	0.730	0.538
	(0.448)	(0.508)	(0.494)
Renal disease		1.618	
		(0.441)	
AIDS/HIV	0.825	0.947	3.692
	(0.204)	(0.080)	(0.994)
Diabetes	0.280	0.693	3.007

	Any Hospitalization	Any ER Visits	Any Wellness-Sensitive Hospitalization
	(1.422)	(0.596)	(1.216)
Moderate or severe liver disease	0.648	1.226	
	(0.478)	(0.316)	
Has one comorbidity (0/1)	5.102*	1.688	0.941
	(2.041)	(0.889)	(0.072)
Has two comorbidities (0/1)	11.759	2.432	0.716
	(1.792)	(0.819)	(0.230)
Has three comorbidities (0/1)	60.132	2.260	2.137
	(1.499)	(0.390)	(0.329)
Has four comorbidities (0/1)	0.000	2.131	
	(0.159)	(0.294)	
Year = 2004	0.783	0.887	0.962
	(1.193)	(1.012)	(0.108)
Year = 2005	0.466**	0.845	1.146
	(3.258)	(1.392)	(0.375)
Year = 2006	0.437**	0.858	1.178
	(3.490)	(1.321)	(0.472)
Year = 2007	0.451**	0.850	0.676
	(3.506)	(1.397)	(0.991)
Year = 2008	0.416**	0.824	1.185
	(3.868)	(1.690)	(0.509)
Year = 2009	0.439**	0.823	1.105
	(3.853)	(1.710)	(0.288)
Year = 2010	0.415**	0.817	1.334
	(3.955)	(1.718)	(0.825)
Year = 2011	0.226**	0.855	1.215
	(5.184)	(1.221)	(0.534)
N	17,201	17,209	17,108

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the odds ratios from estimating a logit model. Age 55–64 is the omitted age category, East is the omitted region category, and 2003 is the omitted year. SEs clustered at the person level are in parentheses.
* p<0.05; ** p<0.01

Differential Effects of Program Components

Research Question 3.4: Is there a differential effect of various program components (exercise, weight control, nutrition, etc.) on medical costs?

- *Hypothesis 3.4.1: Participation in the predisease management program has larger effects on medical costs than participation in the lifestyle management program.*
- *Hypothesis 3.4.2: Participation in the smoking cessation program has larger effects on medical costs than other lifestyle management program components.*

For Hypothesis 3.4.1, we pooled the two matched program samples (lifestyle management and predisease management) to estimate:

$$costs_{it} = \alpha + \beta Program_{it} + \Gamma X_{it} + TYR_t + \varepsilon_{it} \quad [8]$$

where *costs* is a vector of PMPM medical costs for individual *i* at time *t* – total, Rx, inpatient, and outpatient; *Program* is a vector of mutually exclusive categorical variable representing participation in lifestyle and disease management programs; *X* is a vector or individual level controls, and *YR* is a vector of year fixed effects. The five indicators in the *Program* vector are:

1. participant in the lifestyle management program (lifestyle management),
2. eligible for only the lifestyle management program, but not participating,
3. participant in the predisease management program (predisease management),
4. eligible for only the predisease management program, but not participating
5. eligible for both the lifestyle management and the predisease management program, but not participating in either.

Thus, we can compare the vector of *βs* to assess the extent to which average costs vary across these groups.

We estimated Equation 8 as a GLM model with a log link function to address the fact that medical costs are skewed (not normally distributed) with SEs clustered at the person level to again address the multilevel nature of the data. We present regression coefficients and robust SEs in Table B18.

Table B18. Regression Coefficients from GLM Estimation of Equation 3 for Differential Program Effects on Costs (Lifestyle Management Participation Is the Omitted Program Category)

	PMPM Costs			
	Total	**Rx**	**Outpatient**	**Inpatient**
Eligible for lifestyle management, but not participating (0/1)	-0.133**	-0.062*	-0.126**	-0.346**
	(6.470)	(2.056)	(6.027)	(3.011)
Predisease management participant (0/1)	0.225**	0.377**	0.177**	0.134
	(4.950)	(4.207)	(3.700)	(0.489)
Eligible for predisease management, but not participating (0/1)	0.043	0.209**	0.051	-0.323*
	(1.389)	(4.316)	(1.608)	(2.255)
Eligible for both lifestyle management & predisease management, but not participating (0/1)	0.058*	0.181**	0.028	0.048
	(2.019)	(3.583)	(1.020)	(0.336)
Baseline total PMPM costs	0.000**			
	(8.238)			
Baseline Rx PMPM costs		0.001**		
		(9.801)		
Baseline outpatient PMPM costs			0.000**	
			(5.670)	

	PMPM Costs			
	Total	**Rx**	**Outpatient**	**Inpatient**
Baseline inpatient PMPM costs				0.000**
				(4.567)
Age 18–34 (0/1)	-0.521**	-0.836**	-0.368**	-0.587**
	(13.250)	(16.113)	(9.455)	(3.216)
Age 35–44 (0/1)	-0.332**	-0.478**	-0.218**	-0.558**
	(9.400)	(10.216)	(6.281)	(3.396)
Age 45–54 (0/1)	-0.188**	-0.273**	-0.120**	-0.472**
	(5.541)	(6.045)	(3.536)	(2.924)
Employee (0/1)	-0.337**	-0.221**	-0.263**	-1.330**
	(13.189)	(5.795)	(10.862)	(9.354)
Male (0/1)	-0.392**	-0.341**	-0.461**	-0.132
	(16.880)	(9.352)	(20.813)	(0.933)
Region = South (0/1)	-0.014	-0.002	-0.033	0.109
	(0.450)	(0.046)	(1.163)	(0.825)
Region = Midwest (0/1)	0.015	0.136**	-0.064**	0.198
	(0.577)	(2.916)	(2.667)	(1.860)
Region = West (0/1)	-0.052	-0.109	-0.086**	0.217
	(1.457)	(1.652)	(2.610)	(1.407)
Baseline Charlson comorbidity indicators:				
Myocardial infarction	0.884**	-0.333	0.323	3.740**
	(3.321)	(1.410)	(0.997)	(6.920)
CHF	0.153	-0.801**	0.369	1.298*
	(0.776)	(2.866)	(1.672)	(1.992)
Peripheral vascular disease	0.169	-0.910**	0.273	1.625**
	(1.155)	(3.881)	(1.635)	(3.319)
Cerebrovascular disease	0.262	-1.019**	0.394*	2.100**
	(1.748)	(4.288)	(2.412)	(4.504)
Chronic pulmonary disease	-0.376**	-0.925**	-0.290*	0.767
	(2.722)	(3.903)	(1.963)	(1.939)
Rheumatic disease	-0.093	-0.184	-0.208	-0.030
	(0.611)	(0.704)	(1.242)	(0.060)
Peptic ulcer disease	0.140	-0.881**	0.124	2.236**
	(0.865)	(3.370)	(0.725)	(5.131)
Metastatic solid tumor	-0.294	-1.097**	-0.023	1.031*
	(1.794)	(4.489)	(0.145)	(2.103)
Hemiplegia or paraplegia	-0.023	-1.432**	-0.060	1.518
	(0.070)	(3.709)	(0.191)	(1.443)
Renal disease	-0.508	-1.112**	-0.250	2.070**
	(1.132)	(4.353)	(0.561)	(3.784)
AIDS/HIV	0.951**	0.432	-0.068	0.284
	(5.588)	(0.715)	(0.292)	(0.281)
Diabetes	-0.441**	-0.703**	-0.519**	0.627
	(2.923)	(2.705)	(3.292)	(1.368)
Moderate or severe liver disease	-0.012	-1.059**	0.072	1.190**
	(0.078)	(3.618)	(0.458)	(2.767)
Has one comorbidity (0/1)	1.099**	1.665**	0.975**	0.219

	PMPM Costs			
	Total	Rx	Outpatient	Inpatient
	(8.030)	(6.920)	(6.661)	(0.543)
Has two comorbidities (0/1)	1.686**	2.270**	1.590**	-0.260
	(7.143)	(6.502)	(6.027)	(0.371)
Has three comorbidities (0/1)	1.901**	3.522**	1.854**	-1.532
	(4.642)	(5.702)	(4.039)	(1.178)
Has four comorbidities (0/1)	2.902**	4.833**	2.605**	-0.802
	(3.952)	(4.399)	(3.850)	(0.507)
Has five comorbidities (0/1)	2.734**	5.518**	1.519*	-1.712
	(4.023)	(4.832)	(2.057)	(0.832)
Year = 2005	0.121**	0.369**	-0.017	0.455
	(3.021)	(7.347)	(0.441)	(1.327)
Year = 2006	0.139**	0.382**	0.006	0.504
	(3.578)	(8.198)	(0.167)	(1.551)
Year = 2007	0.134**	0.390**	0.045	0.233
	(3.446)	(8.485)	(1.177)	(0.699)
Year = 2008	0.162**	0.401**	0.089*	0.164
	(4.187)	(8.272)	(2.306)	(0.498)
Year = 2009	0.224**	0.438**	0.177**	0.146
	(5.675)	(9.523)	(4.562)	(0.439)
Year = 2010	0.222**	0.418**	0.177**	0.204
	(5.629)	(8.409)	(4.590)	(0.619)
Year = 2011	0.180**	0.401**	0.166**	-0.283
	(4.500)	(7.240)	(4.223)	(0.822)
Constant	5.712**	3.985**	5.336**	3.694**
	(96.249)	(46.910)	(93.023)	(9.839)
n	106,415	106,415	106,415	106,415

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the regression coefficients from estimating Equation 3 with a GLM. Age 55–64 is the omitted age category, East is the omitted region category, and 2004 is the omitted year. SEs clustered at the person level are in parentheses.
* p<0.05; ** p<0.01

For Hypothesis 3.4.2, we used the sample of matched lifestyle management (lifestyle management) participants and their comparisons to estimate Equation 8, but we redefined program to be an indicator variables related to participation in the smoking cessation program including

1. participant in the lifestyle management program *without* smoking cessation
2. eligible only for the lifestyle management program *without* smoking cessation, but not participating
3. participant in the lifestyle management program *with* smoking cessation
4. eligible only for the lifestyle management program *with* smoking cessation, but not participating
5. eligible for the lifestyle management program both with and without smoking cessation, but not participating in either program.

Note that the smoking cessation program is for those in the lifestyle management program. Results are in Table B19.

Table B19. Regression Coefficients from GLM Estimation of Equation 3 for Smoking Cessation Versus Nonsmoking Cessation Lifestyle Management Effects on Costs (Nonsmoking Cessation Lifestyle Management Participation Is the Omitted Program Category)

	PMPM Costs			
	Total	**Rx**	**Outpatient**	**Inpatient**
Eligible for nonsmoking lifestyle management, but not participating (0/1)	-0.087**	0.031	-0.094**	-0.251*
	(4.019)	(0.989)	(4.175)	(2.141)
Smoking cessation lifestyle management participant (0/1)	-0.117*	0.092	-0.164**	-0.266
	(2.468)	(1.050)	(3.600)	(1.038)
Eligible for smoking cessation lifestyle management, but not participating (0/1)	-0.229**	0.021	-0.276**	-0.401**
	(6.235)	(0.347)	(7.799)	(2.622)
Eligible for both lifestyle management programs, but not participating (0/1)	-0.196**	-0.035	-0.212**	-0.241
	(5.144)	(0.554)	(6.226)	(1.132)
Baseline total PMPM costs	0.000**			
	(8.115)			
Baseline Rx PMPM costs		0.001**		
		(9.043)		
Baseline outpatient PMPM costs			0.000**	
			(5.204)	
Baseline inpatient PMPM costs				0.000**
				(4.721)
Age 18–34 (0/1)	-0.585**	-0.874**	-0.435**	-0.723**
	(13.718)	(15.174)	(10.338)	(3.445)
Age 35–44 (0/1)	-0.378**	-0.502**	-0.267**	-0.660**
	(9.819)	(9.512)	(7.046)	(3.513)
Age 45–54 (0/1)	-0.240**	-0.318**	-0.168**	-0.586**
	(6.451)	(6.149)	(4.584)	(3.182)
Employee (0/1)	-0.309**	-0.165**	-0.234**	-1.397**
	(11.399)	(3.916)	(9.289)	(8.478)
Male (0/1)	-0.430**	-0.410**	-0.489**	-0.104
	(17.172)	(10.201)	(21.216)	(0.646)
Region = South (0/1)	-0.028	-0.010	-0.036	-0.008
	(0.834)	(0.178)	(1.138)	(0.054)
Region = Midwest (0/1)	0.017	0.132**	-0.060*	0.181
	(0.619)	(2.660)	(2.339)	(1.578)
Region = West (0/1)	-0.059	-0.099	-0.083*	0.123
	(1.523)	(1.444)	(2.304)	(0.726)

	PMPM Costs			
	Total	**Rx**	**Outpatient**	**Inpatient**
Baseline Charlson comorbidity indicators:				
Myocardial infarction	0.913**	-0.032	0.329	3.801**
	(4.001)	(0.110)	(0.975)	(6.977)
CHF	0.235	-0.764*	0.379	1.842**
	(1.092)	(2.248)	(1.644)	(2.903)
Peripheral vascular disease	0.308	-0.699*	0.349	1.874**
	(1.895)	(2.504)	(1.938)	(3.592)
Cerebrovascular disease	0.369*	-0.694*	0.411*	2.341**
	(2.226)	(2.541)	(2.376)	(4.633)
Chronic pulmonary disease	-0.287	-0.746**	-0.261	0.969*
	(1.939)	(2.610)	(1.689)	(2.263)
Rheumatic disease	0.020	0.088	-0.153	0.086
	(0.121)	(0.289)	(0.833)	(0.157)
Peptic ulcer disease	0.341*	-0.620	0.242	2.561**
	(1.969)	(1.901)	(1.326)	(5.138)
Metastatic solid tumor	-0.227	-0.898**	-0.048	1.194*
	(1.263)	(3.071)	(0.287)	(2.222)
Hemiplegia or paraplegia	0.107	-1.478**	0.055	1.743
	(0.310)	(3.189)	(0.170)	(1.602)
Renal disease	-0.666	-1.074**	-0.642	2.396**
	(1.253)	(3.651)	(1.041)	(4.014)
AIDS/HIV	1.158**	1.513**	-0.051	-1.377
	(6.010)	(4.037)	(0.170)	(1.263)
Diabetes	-0.271	-0.473	-0.413*	0.967*
	(1.673)	(1.461)	(2.451)	(2.004)
Moderate or severe liver disease	0.071	-0.939*	0.114	1.334**
	(0.434)	(2.242)	(0.677)	(2.798)
Has one comorbidity (0/1)	1.016**	1.489**	0.951**	0.018
	(6.848)	(5.079)	(6.152)	(0.041)
Has two comorbidities (0/1)	1.527**	2.090**	1.488**	-0.492
	(5.902)	(5.088)	(5.355)	(0.637)
Has three comorbidities (0/1)	1.557**	2.998**	1.706**	-2.166
	(3.385)	(3.743)	(3.391)	(1.565)
Has four comorbidities (0/1)	2.976**	4.695**	2.912**	-1.380
	(3.889)	(3.769)	(4.262)	(0.758)
Has five comorbidities (0/1)	2.393**	4.936**	1.517*	-2.973
	(3.271)	(3.553)	(1.978)	(1.362)
Year = 2005	0.131**	0.359**	0.010	0.478
	(2.885)	(5.821)	(0.230)	(1.152)
Year = 2006	0.140**	0.360**	0.024	0.510
	(3.183)	(5.945)	(0.590)	(1.282)
Year = 2007	0.124**	0.358**	0.052	0.216
	(2.787)	(5.843)	(1.252)	(0.529)
Year = 2008	0.159**	0.368**	0.107*	0.163
	(3.577)	(5.859)	(2.563)	(0.402)

	PMPM Costs			
	Total	Rx	Outpatient	Inpatient
Year = 2009	0.213**	0.406**	0.194**	0.059
	(4.768)	(6.730)	(4.668)	(0.146)
Year = 2010	0.207**	0.377**	0.185**	0.159
	(4.611)	(5.742)	(4.462)	(0.390)
Year = 2011	0.189**	0.378**	0.188**	-0.206
	(4.164)	(5.118)	(4.443)	(0.491)
Constant	5.786**	4.004**	5.397**	3.866**
	(89.374)	(43.622)	(88.324)	(8.550)
N	91,134	91,134	91,134	91,134

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the regression coefficients from estimating Equation 3 with a GLM. Age 55–64 is the omitted age category, East is the omitted region category, and 2004 is the omitted year. SEs clustered at the person level are in parentheses.
* p<0.05; ** p<0.01

Dose-Response Effect of Program Participation

Research Question 3.5: Is there a dose-response effect on medical costs in the intensity of program interventions?

- *Hypothesis 3.5.1: Intervention intensity is positively associated with the effect of lifestyle management program participation on medical costs.*
- *Hypothesis 3.5.2: Intervention intensity is positively associated with the effect of predisease management program participation on medical costs.*

We use a modified version of the aforementioned propensity score estimation used for Research Questions 3.3 to 3.4. Instead of using an indicator variable for participation, we used a categorical measure for participation intensity. For program participants, we examined the distribution of the average number of sessions participants had in the years they were enrolled in the program. In Table 8, we showed these distributions of annual sessions for the lifestyle management and disease management programs, respectively. Then we created a measure of participation intensity equal to zero for the nonparticipant comparisons (no participation), one for participants who attended at least the population median number of sessions per year (low intensity), on average, and two for participants who attended more than the median number of sessions per year (high intensity), on average. For both the lifestyle management and predisease management programs, the median number of sessions per year of participant was 4. We then estimated an ordered logit regression with the same covariates as described above to obtain predicted probabilities of low-intensity participation and high-intensity participation. We then matched low-intensity participants to the "nearest" comparisons based on the propensity score for low-intensity participation. We did the same for high-intensity participants as well. Again, we conducted one-to-one matching (i.e., one comparison for each participant) with replacements, meaning that we allowed nonparticipants to serve as comparisons more than once.

To estimate the effect of intervention or participation intensity on medical costs, we estimated:

$$costs_{it} = \alpha + \beta_1 everpart_i + \beta_2 Intensity_{it} + \Gamma X_{it} + TYR_t + \varepsilon_{it} \qquad [9]$$

where all variables are as described above, but we have added intensity which equals zero at time *t* if individual *i* did not participate in any sessions, one if individual *i* participated in one to four sessions in year *t*, and two if individual *i* participated in five or more sessions in year *t*. This is slightly different from the intensity measure we used for the propensity score measure, as we did the matching at the person level and the data used for estimating Equation 9 are person-year level. Thus, intensity equals zero both for comparisons and for participants in their preparticipation (baseline) years. Again, we estimated this as a GLM with a log link function and SEs are clustered at the person level for each program. We estimated Equation 9 for both Hypotheses 3.5.1 and 3.5.2; results are in Appendix Tables B20 and B21, respectively.

Table B20. Regression Coefficients from GLM Estimation for Lifestyle Management Program Dose Response Effects on Medical Costs (Zero Lifestyle Management Sessions Is the Omitted Dose Category)

	PMPM Costs			
	Total	**Rx**	**Outpatient**	**Inpatient**
One to four sessions per year (0/1)	0.033*	-0.035	0.040*	0.087
	(1.967)	(1.016)	(2.221)	(0.984)
Five or more sessions per year (0/1)	0.114**	0.074**	0.102**	0.223*
	(6.346)	(2.928)	(5.495)	(2.191)
Ever participate (0/1)	0.098**	0.083**	0.124**	0.108
	(6.763)	(3.564)	(8.591)	(1.862)
Baseline total PMPM costs	0.000**			
	(10.117)			
Baseline Rx PMPM costs		0.001**		
		(14.651)		
Baseline outpatient PMPM costs			0.000**	
			(8.497)	
Baseline inpatient PMPM costs				0.000**
				(3.179)
Age 18–34 (0/1)	-0.695**	-1.051**	-0.511**	-0.763**
	(27.586)	(31.219)	(19.708)	(6.870)
Age 35–44 (0/1)	-0.416**	-0.602**	-0.282**	-0.517**
	(18.174)	(19.471)	(12.337)	(5.791)
Age 45–54 (0/1)	-0.189**	-0.263**	-0.138**	-0.253**
	(9.200)	(8.742)	(5.931)	(2.948)
Employee (0/1)	-0.341**	-0.154**	-0.246**	-1.486**
	(17.115)	(5.342)	(13.342)	(16.769)
Male (0/1)	-0.300**	-0.260**	-0.403**	0.215*
	(15.551)	(9.233)	(22.860)	(2.315)

	PMPM Costs			
	Total	**Rx**	**Outpatient**	**Inpatient**
Region = South (0/1)	-0.006	-0.002	-0.036	0.160
	(0.272)	(0.043)	(1.627)	(1.762)
Region = Midwest (0/1)	0.021	0.109**	-0.058**	0.249**
	(1.050)	(3.268)	(3.001)	(3.129)
Region = West (0/1)	-0.064*	-0.154**	-0.093**	0.194
	(2.350)	(2.823)	(3.560)	(1.755)
Baseline Charlson Comorbidity Indicators:				
Myocardial infarction	1.289**	0.820**	1.065**	2.538**
	(7.294)	(8.727)	(5.928)	(8.757)
CHF	0.769**	0.382**	0.856**	1.389**
	(5.888)	(4.536)	(7.194)	(5.279)
Peripheral vascular disease	0.817**	0.219	0.850**	1.212**
	(8.138)	(1.924)	(8.966)	(3.960)
Cerebrovascular disease	0.795**	0.391**	0.756**	1.444**
	(14.778)	(5.749)	(13.261)	(8.692)
Chronic pulmonary disease	0.664**	0.544**	0.581**	1.076**
	(28.280)	(9.531)	(23.112)	(13.422)
Rheumatic disease	0.768**	0.920**	0.564**	0.103
	(13.197)	(6.712)	(7.976)	(0.596)
Peptic ulcer disease	1.130**	0.563**	1.104**	2.010**
	(18.636)	(7.158)	(18.252)	(12.405)
Metastatic solid tumor	0.733**	0.143	0.867**	0.392
	(11.866)	(1.213)	(12.429)	(1.786)
Hemiplegia or paraplegia	1.029	0.516	0.372	2.082*
	(1.576)	(1.957)	(0.648)	(2.076)
Renal disease	-0.241	0.735**	0.390	1.088**
	(0.618)	(3.105)	(1.505)	(2.811)
AIDS/HIV	1.663**	2.246**	0.484**	0.819
	(15.942)	(12.445)	(3.890)	(1.011)
Diabetes	0.686**	0.934**	0.493**	0.759**
	(30.403)	(25.946)	(19.351)	(8.160)
Moderate or severe liver disease	0.798**	0.338	0.895**	1.117**
	(15.091)	(1.810)	(16.766)	(7.015)
Year = 2005	0.054*	0.329**	-0.116**	0.503**
	(2.155)	(17.455)	(4.132)	(3.400)
Year = 2006	0.067**	0.347**	-0.081**	0.386**
	(2.817)	(17.132)	(2.946)	(2.709)
Year = 2007	0.068**	0.338**	-0.070*	0.352*
	(2.828)	(15.737)	(2.471)	(2.478)
Year = 2008	0.062*	0.316**	-0.047	0.222
	(2.541)	(14.355)	(1.625)	(1.584)
Year = 2009	0.126**	0.364**	0.010	0.331*
	(5.222)	(16.525)	(0.354)	(2.366)
Year = 2010	0.120**	0.301**	0.047	0.200
	(4.779)	(11.798)	(1.569)	(1.405)

	PMPM Costs			
	Total	Rx	Outpatient	Inpatient
Year = 2011	0.078**	0.287**	0.040	-0.081
	(2.964)	(10.360)	(1.351)	(0.496)
Constant	5.835**	4.237**	5.440**	3.467**
	(152.059)	(75.792)	(132.444)	(22.135)
n	196,234	196,234	196,234	196,234

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the regression coefficients from estimating Equation 4 with a GLM for the lifestyle management program. Age 55–64 is the omitted age category, East is the omitted region category, and 2004 is the omitted year. SEs clustered at the person level are in parentheses.
* p<0.05; ** p<0.01

Table B21. Regression Coefficients from GLM Estimation for Predisease Management Program Dose Response Effects on Medical Costs (Zero Predisease Management Sessions Is the Omitted Dose Category)

	PMPM Costs			
	Total	Rx	Outpatient	Inpatient
1 to 4 sessions/year (0/1)	0.033	0.033	0.033	0.105
	(1.473)	(1.235)	(1.397)	(0.714)
5+ sessions/year (0/1)	0.105**	0.112**	0.107**	0.077
	(4.293)	(4.203)	(3.906)	(0.531)
Ever participate (0/1)	0.261**	0.260**	0.230**	0.298**
	(12.239)	(8.388)	(10.306)	(3.850)
Baseline total PMPM costs	0.000**			
	(10.986)			
Baseline Rx PMPM costs		0.001**		
		(8.387)		
Baseline outpatient PMPM costs			0.000**	
			(6.769)	
Baseline inpatient PMPM costs				0.000**
				(3.913)
Age 18–34 (0/1)	-0.555**	-0.914**	-0.400**	-0.719**
	(15.229)	(18.025)	(10.089)	(4.953)
Age 35–44 (0/1)	-0.295**	-0.500**	-0.208**	-0.393**
	(10.526)	(13.901)	(6.763)	(3.688)
Age 45–54 (0/1)	-0.091**	-0.201**	-0.072*	-0.015
	(3.526)	(6.252)	(2.380)	(0.149)
Employee (0/1)	-0.343**	-0.250**	-0.279**	-1.118**
	(12.429)	(6.259)	(10.183)	(11.142)
Male (0/1)	-0.240**	-0.168**	-0.333**	0.076
	(9.514)	(4.314)	(13.008)	(0.759)
Region = South (0/1)	-0.006	0.024	-0.046	0.181
	(0.190)	(0.514)	(1.551)	(1.385)
Region = Midwest (0/1)	0.055*	0.131**	-0.025	0.312**
	(2.051)	(3.058)	(0.925)	(2.630)
Region = West (0/1)	-0.050	-0.124*	-0.078*	0.321*
	(1.320)	(2.239)	(2.028)	(2.110)

	PMPM Costs			
	Total	**Rx**	**Outpatient**	**Inpatient**
Baseline Charlson Comorbidity Indicators				
Myocardial infarction	1.176**	0.771**	0.890**	2.466**
	(6.646)	(6.713)	(4.473)	(7.932)
CHF	0.653**	0.339**	0.918**	1.131**
	(4.876)	(3.829)	(6.950)	(3.547)
Peripheral vascular disease	0.666**	-0.117	0.827**	0.779*
	(7.096)	(0.386)	(9.430)	(2.161)
Cerebrovascular disease	0.804**	0.382**	0.806**	1.324**
	(12.830)	(6.352)	(10.270)	(6.395)
Chronic pulmonary disease	0.574**	0.346**	0.547**	0.794**
	(18.768)	(4.672)	(16.759)	(7.156)
Rheumatic disease	0.722**	0.909**	0.718**	0.300
	(7.897)	(6.501)	(6.836)	(1.227)
Peptic ulcer disease	0.806**	0.137	0.870**	1.385**
	(9.554)	(0.556)	(8.767)	(6.470)
Metastatic solid tumor	0.663**	0.421**	0.834**	0.825**
	(8.050)	(4.992)	(8.933)	(3.213)
Hemiplegia or paraplegia	1.023	0.406	-0.306	2.197
	(1.431)	(1.252)	(0.451)	(1.861)
Renal disease	0.705*	0.670**	0.712	1.641**
	(2.082)	(2.840)	(1.636)	(3.518)
AIDS/HIV	0.976**	1.654**	0.618**	0.515
	(2.598)	(5.877)	(3.904)	(0.555)
Diabetes	0.604**	0.804**	0.420**	0.863**
	(22.851)	(17.556)	(14.411)	(9.120)
Moderate or severe liver disease	0.863**	0.486**	0.886**	1.361**
	(11.139)	(4.716)	(9.475)	(6.191)
Year = 2005	0.068*	0.379**	-0.122**	0.419*
	(2.320)	(23.566)	(3.525)	(2.166)
Year = 2006	0.123**	0.393**	-0.054	0.475**
	(4.198)	(20.433)	(1.547)	(2.672)
Year = 2007	0.144**	0.415**	-0.045	0.511**
	(4.739)	(19.199)	(1.259)	(2.852)
Year = 2008	0.137**	0.377**	-0.014	0.371*
	(4.488)	(17.421)	(0.387)	(2.129)
Year = 2009	0.185**	0.431**	0.051	0.326
	(5.899)	(19.100)	(1.376)	(1.793)
Year = 2010	0.214**	0.418**	0.094*	0.336
	(6.740)	(17.636)	(2.435)	(1.931)
Year = 2011	0.133**	0.366**	0.047	-0.229
	(4.220)	(13.209)	(1.285)	(1.160)
Constant	5.662**	4.148**	5.370**	3.104**
	(124.783)	(61.076)	(104.287)	(16.098)
N	86,281	86,281	86,281	86,281

SOURCE: RAND analysis of Fortune 100 employer data.
NOTE: Each column contains the regression coefficients from estimating Equation 4 with a GLM for the predisease management program. Age 55–64 is the omitted age category, East is the omitted region category, and 2004 is the omitted year. SEs clustered at the person level are in parentheses.
* p<0.05; ** p<0.01

Long-Term Gains in Health from Program Participation

To project the long-term gains in health from program participation, we created a microsimulation model. The model population was obtained from the 2009–2010 NHANES. Specifically, we extracted all individuals ages 20–64 with complete data for all biometric variables either required by the stroke and cardiovascular risk equations or of interest to us as an outcome variable for wellness program participation. The final NHANES sample that we utilized contained 1,533 unique individuals. Outcomes in the model were weighted using the two-year medical examination component fasting subsample weights,[60] which make the population we simulated nationally representative of individuals ages 20–64 in the United States.

Risk equations were used to predict stroke and cardiovascular events. For stroke events, the risk equation was obtained from D'Agostino et al. and Wolf et al.[61] For cardiovascular events, the risk equation was obtained from D'Agostino et al.[62] The effect of wellness program participation on outcomes such as BMI, SBP, and total cholesterol were obtained from the RAND *Workplace Wellness Programs Study*.[63] We also used unpublished estimates generated from that study and from the recent RAND analysis of PepsiCo's wellness program.[64] The estimates from these prior studies were generated using a series of lag variables, which allow us to the model the effect of participation on a given outcome in the current year, the prior year, as well as two and three years ago. In other words, as the simulation model uses one-year cycles (as described in greater detail below) we are able to take into account the effect of participation in prior model cycles in current and subsequent cycles.

The simulation model uses one-year cycles. In each cycle, each person in the NHANES sample has probabilities for various events. If events have associated costs—such as participating in a wellness program—these costs are applied at the end of each cycle. All costs are discounted at 3 percent per year and were adjusted as needed to 2013 U.S. dollars using the Consumer Price Index from the Bureau of Labor Statistics (all urban consumers; U.S. city; all items).[65]

The events considered in the model are: 1) participating in a wellness program, 2) the occurrence of a stroke event, 3) the occurrence of a cardiovascular event and 4) the occurrence of

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[60] We use the weight of the smallest sample subpopulations, which in this case would be the morning fasting subsample weight. For more details, see Centers for Disease Control, *Key Concept About Weighting in NHANES,* undated.

[61] D'Agostino et al., 1994; Wolf et al., 1991.

[62] D'Agostino et al., 2000.

[63] Mattke et al., 2013.

[64] Caloyeras et al., 2014.

[65] Bureau of Labor Statistics, Consumer Price Index database, undated. Search was conducted using all urban consumers, U.S. city, all items.

all-cause death. Event costs are applied for program participation, which uses a default value of $150 per-person per-year, as well as for stroke and cardiovascular events (each are stratified by the various types of stroke and cardiovascular events that can occur). Stroke and cardiovascular event costs were obtained from the published literature.[66] Event costs were adjusted to 2013 USD using the Consumer Price Index from the Bureau of Labor Statistics (all urban consumers; US city; all items).

Limitations of the Fortune 100 Employer Analyses

Several limitations remain despite our efforts to address the endogeneity between program participation and the outcomes of interest such as health care costs. Although we used the best research designs and analytic approaches available to us, there may be residual bias in our estimates that we were unable to control for in our analyses. Key limitations include:

- The Fortune 100 employer is large and has a well-established program. Results may not be generalizable to smaller employers or to employers with less mature or less comprehensive wellness programs. For example, predictors of participation, the impact of incentives on participation, and the effects of participation on outcomes such as health care costs likely differ by employer size and industry, as well as by comprehensiveness and maturity of the wellness program offered.
- As we analyzed data from one employer, we had limited variation in job classification, education, and other employee characteristics. Further, we had no variation in wellness programs to make comparisons across programs. For example, we could not compare the impact of nonparticipation surcharges introduced by the Fortune 100 employer we analyzed to that of employers with wellness programs but without nonparticipation surcharges. More variation in our results would allow us to make broader and more accurate statements about such factors as the impact of incentives on program uptake.
- Many of the variables used in our analyses were obtained through HRAs. While some of the HRAs conducted by the employer used trained clinical staff for measuring risk factors such as weight, blood pressure, and cholesterol, it is possible that some of these risk factors reflect self-reported data. Other variables from the HRAs—like job

[66] M. W. Russell, D. M. Huse, S. Drowns, E. C. Hamel,, et al. "Direct Medical Costs of Coronary Artery Disease in the United States," *American Journal of Cardiology*, Vol. 81, No. 9, 1998, pp. 1110–1115; D. Thompson, J. Edelsberg, G. A. Colditz, A. P. Bird, et al. "Lifetime Health and Economic Consequences of Obesity," Archives of Internal Medicine, Vol. 159, No. 18, 1999, pp. 2177–2183; G. Oster, D. M. Huse, M. J. Lacey, and A. M. Epstein, "Cost-Effectiveness of Ticlopidine in Preventing Stroke in High-Risk Patients," *Stroke*, Vol. 25, 1994, pp. 1149–1156; G. W. Petty, R. D. Brown Jr., J. P. Whisnant, J. D. Sicks, et al. "Survival and Recurrence After First Cerebral Infarction: A Population-Based Study in Rochester, Minnesota, 1975 through 1989," *Neurology*, Vol. 50, No. 1, 1998, pp. 208–216.

classification, education, and ethnicity—were likely all self-reported. Thus, limitations of self-reported data apply to many of our analyses.

- Restrictions required for our analyses considerably reduced the size of our final analytic samples. For example, our participation analyses required the use of health care cost and utilization data from the prior year in predicting participation in the current year, meaning that only individuals with two years of consecutive data could be used. Using detailed employee characteristics collected from the HRAs—for example, ethnicity and job classification—further limited our samples for analysis because not all employees completed an HRA. We included employee years only when 12 full months of data were available, because linear extrapolation of partial-year data could be problematic. We also excluded employee years if employees were enrolled in a capitated plan.
- We were unable to directly control for factors related to program maturation and development. For example, it is possible that strategies for recruiting eligible employees to participate in the program were changed over time, or that algorithms for identifying individuals eligible for the disease management program changed. Such factors likely influence many of the outcomes we studied, such as the decision to participate in the program.
- We could not control for certain unobserved employee-level characteristics, such as motivation to improve health. As participants are typically more motivated to change their health behaviors and thus participate in a program, we may have overestimated the impact of participation on outcomes such as costs.
- Much of our analysis relied on ITT assumptions, whereby we ignore the fact that some individuals who participate in wellness programs may not participate fully or every year. Although ITT is appropriate in this setting, treatment effects might be understated to the extent that noncompliers dilute the true effects. For example, 67 percent of individuals in the lifestyle management program participate for only one year.
- The passage of the ACA may modify many aspects of workplace wellness programs. For example, the ACA allows employers to use 30 percent of the cost of employee health insurance coverage as an incentive (up from 20 percent pre-ACA); for programs focused on tobacco use, the maximum permissible incentive is 50 percent of the cost of coverage. With the individual cost of employee coverage hovering at an average of more than $5,000 annually (for family plans, it is well over $10,000), it is clear that the incentives employees may face in the future could be much larger than those offered by the Fortune 100 employer used in our analyses. Larger incentives may produce results that differ from those presented in this report. For example, participation rates could increase, as could employee engagement in wellness programs. Conversely, employees—when faced with large incentives—may find it less expensive to purchase their health coverage on the individual market (rather than accept the plan offered by

their employer that features large incentives) through an insurance exchange as plans on the individual market are not allowed to use wellness incentives.

- The simulation model applies average effects of participation to all individuals. In reality, individuals will respond differently to participating in a program. For example, some may participate with more intensity than others, while others may have more difficulty modifying their weight or blood pressure due to such factors as family history. Our model projects average effects and does not capture individual-level differences in the effects of program participation on risk factors such as blood pressure.
- The simulation model assumes the effect of participation does not change over time. In other words, participating today has the same effect as participating in 15 years. In reality, participation effects likely change over time, as they are likely a function of such factors as whether an individual participated in the past.
- The simulation model only translates the benefits of wellness program participation into changes in risk for stroke and cardiovascular events. In reality, wellness program participation—when projected in the longer run—might affect other conditions and aspects of health, which our model ignores. For example, losing weight by participating might reduce the risk of developing joint complications in the knee or the risk for onset of diabetes.
- The simulation model ignores a variety of costs. For example, we assume there is only a $150 cost of participating in the hypothetical wellness program modeled. In reality, an employer incurs other costs when offering a program, such as that of human resource staff managing the program, or the employee time spent participating (for example, if work breaks are given to attend an onsite exercise class). Similarly, we ignore a variety of cost reductions that might result from participation, such as reductions in absenteeism or improvements in work attendance.
- The simulation model uses a nationally representative population of working-age adults in the United States. In reality, the health of employer workforces may be greater or less than the U.S. average. Further, not all working-age individuals actually work, meaning our results may be biased. The gains from participation for a healthier workforce—at least as measured by predicted stroke and cardiovascular events—are likely less than they would be for a very unhealthy workforce. Thus, the achievable costs and savings for real employers should be expected to differ from those of our model.

References

ADP Research Institute, *Why You Should Care About Wellness Programs,* Roseland, N.J., 2012. As of August 6, 2014: http://www.adp.com/tools-and-resources/case-studies-white-papers/~/media/White%20Papers/WellnessFinal22112.ashx

Aon Hewitt, *2012 Health Care Survey,* Chicago, Ill., 2012. As of August 6, 2014: http://www.aon.com/attachments/human-capitalconsulting/2012_Health_Care_Survey_final.pdf

Baicker, K., D. Cutler, Z. Song, "Workplace Wellness Programs Can Generate Savings," *Health Affairs,* Vol. 29, No. 2, 2010, pp. 304–311.

Bolnick, Howard, Francois Millard, and Jonathan P. Dugas, "Medical Care Savings from Workplace Wellness Programs: What Is a Realistic Savings Potential?" *Journal of Occupational and Environmental Medicine,* Vol. 55, No. 1, 2013, pp. 4-9.

Bureau of Labor Statistics, *Consumer Price Index database*, undated. As of May 3, 2013: http://www.bls.gov/cpi/data.htm

———, *New Quarterly Data from BLS on Business Employment Dynamics by Size of Firm*, Washington, D.C., 2013. As of August 6, 2014: http://www.bls.gov/news.release/pdf/cewfs.pdf

Caloyeras, John, Hangsheng Liu, Ellen Exum, Megan Broderick, et al., "Managing Manifest Diseases, But Not Health Risks, Saved PepsiCo Money Over Seven Years," *Health Affairs,* Vol. 33, No. 1, 2014, pp. 124-131.

Centers for Disease Control and Prevention, *Key Concept About Weighting in NHANES,* undated. As of August 8, 2014: http://www.cdc.gov/nchs/tutorials/nhanes/SurveyDesign/Weighting/OverviewKey.htm

———, *National Healthy Worksite Program*, Atlanta, Ga., February 10, 2014. As of August 6, 2014: http://www.cdc.gov/nationalhealthyworksite/index.html

Chapman, L. S., "Meta-Evaluation of Worksite Health Promotion Economic Return Studies: 2005 Update," *American Journal of Health Promotion*, Vol. 19, No. 6, 2005, pp. 1–11.

Charlson, M. E., P. Pompei, K. L. Ales, and C. R. MacKenzie, "A New Method of Classifying Prognostic Comorbidity in Longitudinal Studies: Development and Validation," *Journal of Chronic Diseases,* Vol. 40, No. 5, 1987, pp. 373–383.

D'Agostino, Ralph B., Mason W. Russell, Daniel M. Huse, R. Curtis Ellison, et al., "Primary and Subsequent Coronary Risk Appraisal: New Results from the Framingham Study," American Heart Journal, Vol. 139, No. 2, 2000, pp. 272–281.

R. B. D'Agostino, P. A. Wolf, A. J. Belanger, W. B. Kannel, "Stroke Risk Profile: Adjustment for Antihypertensive Medication: The Framingham Study," *Stroke,* Vol. 25, No. 1, 1994, pp. 40–43.

Deloitte Center for Health Solutions, Deloitte Consulting, *2012 Deloitte Survey of U.S. Employers: Opinions About the U.S. Health Care System and Plans for Employee Health Benefits,* New York, July 2012. As of August 6, 2014: http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/us_dchs_employee_survey_072512.pdf

Everitt, B., S. Landau, M. Leese, and D. Stahl, *Cluster Analysis, 5th ed.,* Chichester, UK: John Wiley and Sons, 2011.

Gowrisankaran, Gautam, Karen Norberg, Steven Kymes, Michael E. Chernew, et al., "A Hospital System's Wellness Program Linked to Health Plan Enrollment Cut Hospitalizations But Not Overall Costs," *Health Affairs,* Vol. 32, No. 3, 2013, pp. 477–485.

Henke, Rachel M., Ron Z. Goetzel, Janice McHugh, and Fik Isaac, "Recent Experience in Health Promotion at Johnson & Johnson: Lower Health Spending, Strong Return on Investment," *Health Affairs,* Vol. 30, No. 3, 2011, pp. 490–499.

Hoovers, a Dun & Bradstreet company, *Index,* web page, undated (subscription required). As of March 7, 2013: http://subscriber.hoovers.com/H/home/index.html

Horwitz, Jill R., Brenna D. Kelly, and John E. DiNardo, "Wellness Incentives in the Workplace: Cost Savings Through Cost Shifting to Unhealthy Workers," *Health Affairs,* Vol. 32, No. 3, 2013, pp. 468–476.

Imbens, Guido W., and Jeffrey M. Wooldridge, "Recent Developments in the Econometrics of Program Evaluation," *Journal of Economic Literature,* Vol. 47, No. 1, 2009, pp. 5–86.

"Incentives for Nondiscriminatory Wellness Programs in Group Health Plans," Washington, D.C. Federal Register, 78(106), 2013.

Kaiser Family Foundation/Health Research and Educational Trust, *Employer Health Benefits: 2010 Annual Survey*, Menlo Park, Calif; Chicago, Ill., 2010.

———, *Employer Health Benefits: 2013 Annual Survey*, Washington, D.C., 2013. As of August 6, 2014: http://kff.org/private-insurance/report/2013-employer-health-benefits/

Liu, K. M. Harris, S. Weinberger, S. Serxner, et al., "Effect of an Employer-Sponsored Health and Wellness Program on Medical Cost and Utilization," *Popular Health Management,* Vol. 16, No. 1, 2013, pp. 1–6.

Massachusetts Executive Office of Health and Human Services, *Massachusetts Wellness Tax Credit*, Boston, Mass., 2014. As of August 6, 2014: http://www.mass.gov/eohhs/consumer/wellness/health-promotion/massachusetts-wellness-tax-credit.html

Mattke, S., H. Liu, J. P. Caloyeras, C. Y. Huang, et al., *Workplace Wellness Programs Study*, Santa Monica, Calif.: RAND Corporation, RR-254-DOL, 2013. As of August 6, 2014: http://www.dol.gov/ebsa/pdf/workplacewellnessstudyfinal.pdf

Niessen, Maurice A. J., Eva L Laan, Suzan J. W. Robroek, Marie-Louise Essink-Bot, et al., "Determinants of Participation in a Web-Based Health Risk Assessment and Consequences for Health Promotion Programs," *Journal of Medical Internet Research,* Vol. 15, No. 8, 2013.

Nyman, J. A., J. M. Abraham, M. M. Jeffery, and N. A. Barleen, "The Effectiveness of a Health Promotion Program After 3 Years: Evidence from the University of Minnesota," *Medical Care*, Vol. 50, No. 9, 2012, pp. 772–778.

Oster, G., D. M. Huse, M. J. Lacey, and A. M. Epstein, "Cost-Effectiveness of Ticlopidine in Preventing Stroke in High-Risk Patients," *Stroke*, Vol. 25, 1994, pp. 1149–1156.

Patient Protection and Affordable Care Act. Public Law No: 111-148: H.R. 3590. § 10408 (2010).

Petty, G. W., R. D. Brown Jr., J. P. Whisnant, J. D. Sicks, et al. "Survival and Recurrence After First Cerebral Infarction: A Population-Based Study in Rochester, Minnesota, 1975 through 1989," *Neurology*, Vol. 50, No. 1, 1998, pp. 208–216.

Russell, M. W., D. M. Huse, S. Drowns, E. C. Hamel, et al. "Direct Medical Costs of Coronary Artery Disease in the United States," *American Journal of Cardiology*, Vol. 81, No. 9, 1998, pp. 1110–1115.

Seaverson, Erin L. D., Jessica Grossmeier, Toni M. Miller, and David R. Anderson, "The Role of Incentive Design, Incentive Value, Communications Strategy, and Worksite Culture on Health Risk Assessment Participation," *American Journal of Health Promotion,* Vol. 23, No. 5, 2009, pp. 343–352.

Taitel, Michael S., Vincent Haufle, Debi Heck, Ronald Loeppke, et al., "Incentives and Other Factors Associated with Employee Participation in Health Risk Assessments," *Journal of Occupational and Environmental Medicine,* Vol. 50, No. 8, 2008, pp. 863–872.

Thompson, D., J. Edelsberg, G. A. Colditz, A. P. Bird, et al. “Lifetime Health and Economic Consequences of Obesity,” *Archives of Internal Medicine,* Vol. 159, No. 18, 1999, pp. 2177–2183.

Wolf, P. A., R. B. D'Agostino, A. J. Belanger, and W. B. Kannel, “Probability of Stroke: A Risk Profile from the Framingham Study,” *Stroke,* Vol. 22, No. 3, 1991, pp. 312–318.