Cost Savings Analysis Supplement: Return on Investment (ROI) Model for Increasing Investment for Worksite Health Promotion Programs in the Non-federal and Federal Sectors

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OVERVIEW

To estimate the economic impact of increasing the adoption of comprehensive worksite health promotion programs, we used the Truven Health Analytics (www.truvenhealth.com) Return on Investment (ROI) Model (www.truvenhealth.com/assets/ProductSheet_ROIModel.pdf). Below, we describe the empirical foundation for the Model, inputs into the Model and the assumptions underlying those inputs, and results. We then model two scenarios, one for large, non-federal employers (750+ employees), and one for a federal employer: the U.S. Office of Personnel Management (OPM).

For each modeling exercise, we first create a scenario that estimates cost savings derived from what we believe is the current state of health promotion program penetration among large non-federal and federal employers, termed "Current State." We estimate medical and productivity savings from effective programs that improve the risk profile of workers at large employers using evidence of program effects from studies published in the peer-reviewed literature. We also estimate the investment costs and program savings. We then assume that twice as many employers will adopt comprehensive, evidence-based worksite programs over the next 10 years, thus doubling the exposure of employees to these programs.

The intent of the Model is to demonstrate the potential for net savings and achievement of a positive ROI for U.S. employers in private industry (non-federal), as well as estimating the potential net savings for one federal employer. Given the potential for net savings, the aim of the proposals advanced in this paper is to increase the proportion of employers adopting best practice worksite health promotion programs so that their realized savings will impact the economy in a positive way. We expect that lowered health care costs resulting from improved employee health, and increased worker productivity created through reduced absenteeism and presenteeism (i.e., on the job productivity loss when employees have health problems that are not well managed but they still go to work), will lead to lower operating costs and make available additional human capital to businesses for investment purposes. Additionally, secondary gains from employer adoption of worksite health promotion programs include increased tax revenues, lower unemployment since more people will be hired to run worksite programs, and a general improvement in the competitiveness of the U.S. economy.

THE TRUVEN HEALTH ANALYTICS ROI MODEL

Truven Health Analytics, with support from Emory University, developed the ROI Model to help organizations project future cost savings and an ROI from successful risk reduction efforts in the workplace produced by comprehensive worksite health promotion programs. The Model predicts cost savings from programs designed to address the following 10 modifiable health risks prevalent in the U.S. workforce: high blood glucose, obesity, physical inactivity, poor nutrition/eating habits, tobacco use, high total cholesterol, high blood pressure, high alcohol consumption, high stress, and depression.[1]

[1] Although there are additional health risks common among workers (e.g., unsafe driving, drinking and driving, unsafe sex, inadequate sleep, poor ergonomic practices, poor social relations) only the 10 listed risk factors were considered, making the model somewhat more conservative in terms of all the potential risks that may be addressed in a worksite program.

The Model is built on empirical data derived from the original Health Enhancement Research Organization (HERO) study published in 1998 in the *Journal of Occupational and Environmental Medicine*[2] and updated in 2012 in a *Health Affairs*[3] article.

The basic premise of the Model is that health care costs and workplace productivity are influenced by workers' health risk profiles in addition to their demographic characteristics. For example, employees who smoke, are not physically active, and are obese – all of which put them at high risk for poor health outcomes – have higher health care costs and are less productive compared to employees with good health profiles (i.e., are at lower risk). By improving the health risk profile of their workers, employers can expect to see medical cost savings and productivity improvements among their workers. However, organizations also need to invest money in comprehensive, best practice worksite health promotion programs to achieve risk reductions. The Model predicts the financial return from best-in-class programs and calculates a benefit-to-cost ratio based on the information entered regarding employees' health risks, demographic characteristics, the amount spent on a robust worksite health promotion program, and the degree of risk reduction realized among program participants.

BASELINE SCENARIO - INPUTS FOR NON-FEDERAL EMPLOYERS

Data inputs entered into the Model are used to forecast an ROI, or desirable program savings to cost ratio, for different health promotion interventions. Below, we list the inputs used to model the *current state* for large non-federal employers.

HEALTH PROMOTION PROGRAM INPUTS FOR NON-FEDERAL EMPLOYERS

Number of eligible employees enrolled in the base year: The Model can be used to assess the experience of an aggregate population – i.e., snapshots in time of individuals exposed to the program – or a cohort group – i.e., the same individuals who are followed over time.

For our simulation, we assumed a consistent group of aggregate workers employed by large non-federal employers. Estimating the number of workers exposed to best practice programs was a complex exercise and is explained as follows.

Approximately 155 million people are employed in the U.S. and 120.9 million people worked in the non-federal sector in 2008.[4,5] Of those employed in the non-federal sector, 35% worked for "very small"

[2] Goetzel RZ, Anderson DR, Whitmer RW, Ozminkowski RJ, Dunn RL, Wasserman J. The relationship between modifiable health risks and health care expenditures. An analysis of the multi-employer HERO health risk and cost database. J Occup Environ Med. 1998 Oct;40(10):843-854.

[3] Goetzel RZ, Pei X, Tabrizi MJ, Henke RM, Kowlessar N, Nelson CF, Metz RD. Ten modifiable health risk factors are linked to more than one-fifth of employer-employee healthcare spending. Health Aff (Millwood). 2012 Nov; 31(12):2474-2484.

[4] U.S. Census Bureau, "Statistics about Business Size (Including Small Business) from the U.S. Census Bureau," last revised August 22, 2012. <http://www.census.gov/econ/smallbus.html>

[5] Based on data from 2008, the most recent year for which data are available.

employers (defined as having 1 – 99 employees), 18% for "small" employers (defined as having 100 – 749 employees), and 48% for "large" employers (defined as having 750 or more employees).[4]

To simplify our analysis, we focused on large businesses. For our purposes, we defined large employers as having 750 or more employees. Since businesses often have many worksites, our analysis is based on the implementation of comprehensive health promotion programs at the worksite-level. Using U.S. Census Bureau data for 2008 (the latest year for which data are available), we determined there were 12,409 large business firms, made up of 1,114,137 worksites, employing 57,527,800 workers.

Next, we estimated the number of workers at these worksites with exposure to comprehensive worksite health promotion programs as defined by Linnan et al.'s 2008 article.[6] We used the Linnan data because they were derived from a study surveying a valid nationally representative, cross-sectional sample of U.S. worksites. Linnan et al. found that only 6.9% of all employers offered comprehensive programs (as defined by Healthy People 2010). By size, Linnan et al. determined that 24.1% of large employers (defined as having 750+ employees) offered comprehensive programs.[6]

Combining U.S. Census data with Linnan et al.'s results, we utilized unrounded data to calculate the number of employees exposed to worksite health promotion programs. However, in this narrative we present rounded data. We calculated that approximately 268,507[7] large business worksites (24.1% of 1,114,137 worksites) offered comprehensive worksite programs and that each worksite employed an average of 52[8] workers.[4,6] Multiplying the average number of workers at large business worksites by the number of worksites offering comprehensive programs, we derived an estimate of 13,864,200[9] workers at large organizations with access to comprehensive programs.

In sum, we entered 13,864,200 as the number of workers at large businesses who are currently exposed to comprehensive worksite health promotion programs.

Annual change in the number of eligible employees: We did not alter the number of eligible workers considered by the model – meaning, we assumed the same number of workers would be exposed to the program over 10 years. However, the number of workers exposed can be modified either up or down in future iterations and sensitivity analyses.

Medical payment per eligible employee in the base year: We used the average per employee per year medical expenditures value ($4,692) derived from the Truven Health Analytics MarketScan Database for

[6] Linnan L, Bowling M, Childress J, et al. Results of the 2004 national worksite health promotion survey. Am J Public Health. 2008;98(8):1503-1509.

[7] Actual, unrounded value of 24.1% of 1,114,137 is 268,507.017.

[8] Actual, unrounded value used in calculations is 51.6344040275.

[9] Actual unrounded data were used to calculate the number of workers exposed to comprehensive worksite health promotion programs at large businesses (750+ employees). Using the unrounded data, the average number of workers at large business worksites multiplied by the number of large business worksites offering comprehensive programs is (268507.017 * 51.6344040275) = 13,864,199.79. This value was rounded to the nearest one, 13,864,200, as presented in the narrative.

2011.[10] The dollar value includes both the employer and employee costs (coinsurance, copayments, and deductibles) and the cost of pharmaceuticals. Note, this figure remains constant for the entire 10-year modeling period and is not influenced by medical inflation, which is unstable and therefore unpredictable.

Average daily wage: We entered the average daily wage of employees ($190.17) for 2010, which includes wages plus benefits as derived from the Bureau of Labor Statistics.[11]

Participation rate in the program: Typically, completion of a health risk assessment (HRA) with follow up feedback is the minimal level of program participation expected from comprehensive programs. Ideally, using Healthy People 2010 definitions,[12] adopted by Linnan et al.'s research, comprehensive workplace health promotion programs include all five of the following components: (1) health education, focused on skill development and lifestyle behavior change along with information dissemination and awareness building, preferably tailored to employees' interests and needs; (2) supportive social and physical environments, reflecting the organization's expectations regarding healthy behaviors, and implementing policies promoting healthy behaviors; (3) integration of the worksite program into the organization's benefits and human resources infrastructure; (4) linking related programs like employee assistance programs (EAPs) into worksite health promotion; and (5) screening programs followed by counseling, linked to medical care to ensure follow-up.

We assumed a "best practice" participation rate in worksite health promotion programs as derived from the HERO Scorecard database comprised of approximately 800 employers submitting data to HERO and Mercer.[13] We used a 62% participation rate in the Model meaning on average 62% of employees participated in *any* aspect of the health promotion program in a given year.

Program costs per eligible employee in the base year:

Here, we entered an average *per eligible* per year (i.e., per capita) program cost for a comprehensive health promotion program as informed by the HERO/Mercer survey, i.e., of $156.[14] It should be noted that the amount entered was for all eligible employees, not only participants in the program. The calculated annual *per participant* cost would be $252 (assuming a 62% participation rate). The costs for the program are defined as the incremental costs paid by the organization for offering the program – costs that the organization would not have incurred had the program not been in existence. This may include

[10] Average medical payment per employee in 2011. This includes medical and pharmacy payments for active employees (excluding dependents), ages 18-64 for approximately 16,000,000 active members in the Truven Health Analytics MarketScan database.

[11] Bureau of Labor Statistics, U.S. Department of Labor, Labor Force, Employment, and Earnings, 2010. Accessed on February 17, 2012 [http://www.census.gov/prod/2011pubs/12statab/labor.pdf].

[12] Healthy People 2010: With Understanding and Improving Health and Objectives for Improving Health. Washington, DC: US Dept of Health and Human Services; 2000 <http://www.healthypeople.gov/2010/Document/HTML/Volume1/07Ed.htm#_Toc490550857>

[13] Noyce, J., Noeldner, S.P. The HERO Employee Health Management Best Practice Scorecard. Report. HERO and Mercer University, 2010. Web. <http://www.the-hero.org/scorecard_folder/2010_annual%20report.pdf>.

[14] From HERO Scorecard data, the median cost per eligible employee per month for all components of employee health management programs implemented at high scorer organizations was $13. Annualizing this value gives a total median cost of $156 per year per eligible employee for an employee health management program.

all vendor costs, staff salaries, and any capital improvements to the physical worksite introduced in conjunction with the program. Participation incentives are excluded, since cash incentives are most often used to boost program participation rather than achieve behavior change.

Time horizon: We assumed a 10-year time horizon.

Number of years until program levels off: We assumed that the program impacts would be consistent over the 10-year time horizon, but the effects would be diminished by 20% in each year following program initiation.[15,16] For example, if health risks were reduced by one percentage point a year, that level of risk reduction would be shown in only the first year. In the second year, the risk would be reduced by .8 percentage point, in the third year the risk would be reduced .64 percentage point (.8 *.8), and so forth.

Discount rate applied for ROI calculation: The discount rate accounts for the value of money diminishing over time so that a dollar spent or saved in the future is valued less than a dollar spent or saved today. We applied a standard discount rate of 6%, recommended by economists at the Bipartisan Policy Center, which is higher than the 3% discount rate used by other economists.[17]

SUMMARY –NON-FEDERAL EMPLOYERS HEALTH PROMOTION PROGRAM INPUTS

Shown below are the inputs into the ROI Model (assuming 13,864,200 workers) for large non-federal businesses.

Number of employees in the base year	13,864,200
Annual % point change in number of employees	0.0%
Medical payment per employee in the base year	$4,692
Average daily wage	$190.17

[15] Bryne, DW, Goetzel RZ, McGown RW, Holmes, MC, Beckowski MS, Tabrizi, MJ, Kowlessar, N, Yarbrough, MI. Seven-year trends in employee health habits from a comprehensive workplace health promotion program at Vanderbilt University. J Occup Environ Med. Dec 2011; 53(12): 1372-81.

[16] Currently no studies have been conducted that report a *reliable* estimate of program diminished effects over-time. Program diminished effects for these models are based on personal communications with experts in the field.

[17] Brouwer WBF, van Hout BA, Rutten FFH. A fair representation of future effects: taking a societal perspective. *J* Health Services Res Policy. 2000; 5:1-5.

Participation rate of employees in the program	62.0%
Annual program cost per employee	$156.00
Time horizon	10
Number of years until program levels off	10
Discount rate applied for ROI calculation	6.0%

EMPLOYEE CHARACTERISTICS INPUTS FOR NON-FEDERAL EMPLOYERS

Demographics: We entered default demographic information related to age, gender, and job characteristics for individuals participating in worksite health promotion programs. Data were derived from the Centers for Disease Control and Prevention (CDC).[18]

U.S. Regions were defined as follows:

- Northeast includes the following states: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.
- North Central includes the following states: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.
- South includes the following states: Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, and Washington D.C.
- West includes the following states: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Salary Type: We specified the percent of employees who are salary vs. hourly (exempt vs. non-exempt).[19]

Plan Type: We specified the percent of employees enrolled in capitated plans (fully insured plans like HMOs).[20]

SUMMARY –NON-FEDERAL EMPLOYEE CHARACTERISTICS INPUTS

Below is the screenshot for the demographic inputs into the Model:

Age	18-34	33.5%
	35-44	25.9%
	45-54	22.5%
	55-64	18.1%

Gender	Female	51.3%
	Male	48.7%

[18] *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2010.

[19] Bureau of Labor Statistics. U.S. Department of Labor, Labor Force, Employment, and Earnings, 2010, February 17, 2012. <http://www.census.gov/prod/2011pubs/12statab/labor.pdf>

[20] 2012 Truven Health Analytics MarketScan database.

Region	Northeast	18.2%
	North Central	22.5%
	South	37.2%
	West	22.1%
	Unknown or Missing	0.0%
Type	Salary	47.6%
	Hourly	52.4%
	Other or Unknown	0.0%
Plan	Capitated health plan	14.0%

BASELINE RISK/ANNUAL CHANGE INPUTS FOR NON-FEDERAL EMPLOYERS

Health Risk Information: For this section of the Model, we entered information regarding the 10 modifiable health risks of participants at baseline (year 0), i.e., the percentage of participants at high risk. We also entered the changes that would occur if no program were put in place (the control or "do nothing" condition) and the risk reductions likely to be achieved from participating in best practice, comprehensive worksite health promotion programs (the treatment or intervention condition). The 10 modifiable health risks are defined in Appendix A.

Baseline Risks: We entered baseline risks for the U.S. working population as derived from data from the Centers for Disease Control and Prevention (CDC) Behavioral Risk Factor Surveillance Survey (BRFSS) from 2010[21,22] and 2009[23], CDC National Health and Nutrition Examination Survey (NHANES)[24], and American Heart Association[25]. Because data on population health risks are collected at different time intervals, different time periods were accessed to estimate baseline risk factors.

[21] Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Data. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2010.

[22] Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey - Health-Related Quality of Life (HRQOL) Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2010.

[23] Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2009.

[24] Egan, B., Zhao, Y., Axon, R. The Prevalence, Awareness, Treatment, and Control of Hypertension, 1988-2008. JAMA. May 2010; 303(20):2043-2050.

[25] Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics—2011 update: a report from the American Heart Association. Circulation. Epub 2011 Dec 15.

(Expected) annual change in risk factors with no program: We entered the annual changes in risks from baseline for individuals *not* exposed to a best practice worksite health promotion program (i.e., background changes in population risk). For example, -2.0% represents a decrease in risk of two percentage points each year for a given risk factor while a +2.0% indicates an increase in that risk.

The default values were derived from a literature search of background changes in health risk factors without a program intervention.[24,26-29] These data reflect general trends in risk factors over the past several years. As shown, some trends are improving (e.g., smoking rates) while others are worsening (e.g., obesity).

(Expected) annual change in risk factors with best-practice program: Here, we entered the expected annual changes in risk factors from evidence-based, comprehensive health promotion programs. These values were derived from a published literature review performed by the Community Guide to Preventive Services Task Force.[30] The Community Guide Task Force is a nonfederal, independent, unpaid group of experts in prevention, wellness, health promotion, and public health, who are appointed by the Director of the CDC, and mandated to identify community preventive interventions that increase health longevity, save lives and dollars, and improve quality of life.[31] The systematic review performed under the auspices of The Community Guide Task Force included research studies published through 2006. A more current literature review of worksite programs[32-37] was conducted by the Emory University Institute for Health

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[26] Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2003.

[27] Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2002.

[28] Thom T, Haase N, Rosamond W, et al. Heart disease and stroke statistics—2006 update: a report from the American Heart Association. Circulation. Epub 2006 Jan 11.

[29] Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey - Health-Related Quality of Life (HRQOL) Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2002.

[30] Soler RE, Leeks KD, Razi S, Hopkins DP, Griffith M, Aten A., et. al. A systematic review of selected interventions for worksite health promotion. The assessment of health risks with feedback. Am J Prev Med. 2010;38:S237–S262.

[31] USA.gov. "About US - The Community Preventive Services Task Force." Community Preventive Services Task Force. September 13, 2012. <http://www.thecommunityguide.org/about/task-force-members.html>.

[32] Pelletier, KR. A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: update VIII 2008 to 2010. J Occup Environ Med. Nov 2011; 53(11): 1310-1331.

[33] Bryne, DW, Goetzel RZ, McGown RW, Holmes, MC, Beckowski MS, Tabrizi, MJ, Kowlessar, N, Yarbrough, MI. Seven-year trends in employee health habits from a comprehensive workplace health promotion program at Vanderbilt University. J Occup Environ Med. Dec 2011; 53(12): 1372-81.

[34] Freak-Poli, R., Wolfe, R., Backholer, K., Courten M., Peeters, A. Impact of a pedometer-based workplace health promotion program on cardiovascular and diabetes risk profile. Prev Med. 2011;53: 162-71.

and Productivity Studies and values derived from the more current review complemented the work of The Community Guide Task Force.

SUMMARY – NON-FEDERAL EMPLOYERS BASELINE RISK/ANNUAL CHANGE INPUTS

Shown below are the inputs into the Model relating to non-federal firms' employees' health risks at baseline, assuming no program is in place (background trends), and assuming a best-practice program is in place at large businesses. In two categories, high total cholesterol and high blood glucose, we were unable to find credible data indicating that worksite programs were able to significantly influence these risk factors.

		Baseline Risk	Annual Change (% points)	
			No Program	With Program
Biometric	Obesity	27.5%	0.7%	-1.1%
	High Blood Pressure	3.4%	-0.3%	-2.8%
	High Total Cholesterol	15.0%	-0.5%	
	High Blood Glucose	8.7%	0.3%	
Behavioral	Poor Nutrition/Eating Habits	76.6%	-0.1%	-6.6%
	Physical Inactivity	49.0%	-0.6%	-4.1%
	Tobacco Use	17.3%	-0.7%	-1.2%
	High Alcohol Consumption	5.0%	-0.1%	-2.0%

[35] Goetzel, RZ, Roemer, EC, Short, ME, Pei, X, Tabrizi, MJ, Liss-Levinson, RC, Samoly, DK, Luisi, D, Quitoni, K, Dumanovsky, T, Silver, LD, Ozminkowski, RJ. Health Improvement from a Worksite Health Promotion Private-Public Partnership. . J Occup Environ Med. March 2009; 51(3): 296-304.

[36] Loeppke, R, Nicholson, S, Taitel, M, Sweeney, M, Haufle, V, Kessler, RC. The Impact of an Integrated Population Health Enhancement and Disease Management Program on Employee Health Risk, Health Conditions, and Productivity. Population Health Management. 2008; 11(6): 287-296.

[37] Milani, R.V., Lavie, C.J. "Impact of Worksite Wellness Intervention on Cardiac Risk Factors and One-Year Health Care Costs." The American Journal of Cardiology. 2008;4(2):421-26.

Psychosocial	High Stress	10.7%		0.2%		-3.4%
	Depression	10.7%		0.2%		-0.4%

A blank cell indicates there are no estimates from the literature that are statistically significant.

DIMINISHED PROGRAM IMPACT OVER TIME FOR NON-FEDERAL EMPLOYERS

As noted above, the Model allows the user to insert a value reflecting the extent to which the program effects diminish over time by using the item labeled "Change in Impact (%)." In the current model, we assumed a diminishing program effect of 80% following baseline, indicating a 20% annual attrition of program impact over the course of 10 years.

Change in Impact (%)
80.0%

PRODUCTIVITY INPUTS FOR NON-FEDERAL EMPLOYERS

The relationship between the presence of the 10 health risks in the model and diminished worker productivity were derived from an extensive literature search completed by Emory University. The review focused on risks that were not well controlled (e.g., high blood pressure or high blood glucose, unmanaged depression) and their relationships with decreased worker productivity, measured as increased absenteeism and presenteeism (on the job productivity loss due to a health problem). Articles that controlled for potential confounders and found statistically significant differences in productivity loss with and without the associated risk factor were included in the analysis.[38-50]

[38] Boles, M, Pelletier, B and W. Lynch, The relationship between health risks and work productivity. Journal of Occupational and Environmental Medicine, 2004. 46(7): p. 737.

[39] Burton, WN, et al., The association of health risks with on-the-job productivity. Journal of Occupational and Environmental Medicine, 2005. 47(8): p. 769.

[40] Goetzel, RZ, et al., Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting US employers. Journal of Occupational and Environmental Medicine, 2004. 46(4): p. 398.

[41] Goetzel, RZ, et al., *A multi-worksite analysis of the relationships among body mass index, medical utilization, and worker productivity.* Journal of Occupational and Environmental Medicine, 2010. 52(1S): p. S52.

[42] Henke, RM, et al., The relationship between health risks and health and productivity costs among employees at Pepsi Bottling Group. Journal of Occupational and Environmental Medicine, 2010. 52(5): p. 519.

[43] Hilton, MF, et al., Mental ill-health and the differential effect of employee type on absenteeism and presenteeism. Journal of Occupational and Environmental Medicine, 2008. 50(11): p. 1228.

[44] Kowlessar, NM, et al., The relationship between 11 health risks and medical and productivity costs for a large employer. Journal of Occupational and Environmental Medicine, 2011. 53(5): p. 468.

[45] Lerner, D, et al., The clinical and occupational correlates of work productivity loss among employed patients with depression. Journal of Occupational and Environmental Medicine, 2004. 46(6): p. S46.

[46] Loeppke, R, et al., Health and productivity as a business strategy: a multiemployer study. Journal of Occupational and Environmental Medicine, 2009. 51(4): p. 411.

Productivity loss was translated into days lost based on 240 working days per year [resulting from: (52 weeks per year * 5 days per week) minus approximately two weeks of vacation time]. Average days lost per year by risk factor was calculated by taking the average of combined loss (absenteeism and presenteeism) across articles in each health risk category.

The incremental number of productive hours (based on an 8-hour workday) lost annually due to absenteeism and presenteeism attributable to each risk factor is shown below. When there is no value shown (for example for high cholesterol), then the Model assumes no impact on productivity (either positive or negative) related to the risk factor.

SUMMARY –NON-FEDERAL PRODUCTIVITY INPUTS

The default values for productivity losses associated with the 10 risk factors in the Model are shown below:

Health Risks		Estimated Productive Hours Lost Annually	
		Absenteeism	Presenteeism
Biometric	Obesity	9.2	13.7
	High Blood Pressure	7.6	11.0
	High Total Cholesterol *		
	High Blood Glucose	26.0	8.9
Behavioral	Poor Nutrition/Eating Habits	0.8	23.7
	Physical Inactivity	12.3	27.2
	Tobacco Use	31.6	25.0

[47] Riedel, JE, et al., Use of a normal impairment factor in quantifying avoidable productivity loss because of poor health. Journal of Occupational and Environmental Medicine, 2009. 51(3): p. 283.

[48] Stewart, WF, et al., Cost of lost productive work time among US workers with depression. JAMA: The Journal of the American Medical Association, 2003. 289(23): p. 3135-3144.

[49] Stewart, WF, et al., Lost productive work time costs from health conditions in the United States: results from the American Productivity Audit. Journal of Occupational and Environmental Medicine, 2003. 45(12): p. 1234.

[50] Warner, KE, et al., Health and economic implications of a work-site smoking-cessation program: a simulation analysis. Journal of Occupational and Environmental Medicine, 1996. 38(10): p. 981.

	High Alcohol Consumption	27.8		9.2
Psychosocial	High Stress	19.4		59.7
	Depression	73.8		89.5

* There are no estimates from the literature that are statistically significant.

RESULTS – NON-FEDERAL EMPLOYERS

CURRENT STATE - NON-FEDERAL EMPLOYERS

Estimated medical and productivity savings per participant at large non-federal businesses were produced by the Model. For medical savings, these were estimated as the predicted medical cost without a program minus the predicted medical cost after implementation of a best practice worksite health promotion program. Similarly, productivity savings per participant were based on the differences in productivity for individuals with and without a given risk.

The Results page containing a high-level summary is shown below.

Cumulative savings, program cost, and ROI (all discounted):	
Cumulative medical cost, no program	$480,611,733,500
Cumulative medical savings, with program	$16,303,476,800
Cumulative productivity savings, with program	$35,609,234,900
Cumulative program cost	$15,918,508,100
Net Present Value (NPV), medical care	$384,968,600
NPV, medical + productivity	$35,994,203,500
Return on Investment (ROI), medical care	$1.02
ROI, workplace productivity	$2.24
ROI, medical care + workplace productivity	$3.26
Break even program cost, medical care only	$159.77
Break even program cost, productivity only	$348.97
Break even program cost, medical + productivity	$508.74

The table above presents the following results:

- Total medical costs for 13,864,200 workers regardless of participation, summed across 10 years = $480.6 Billion
- Total medical savings for program participants = $16.3 Billion

- Total productivity savings for program participants = $35.6 Billion
- Total program cost for all employees regardless of participation = $15.9 Billion
- Net present value in medical cost (medical savings minus program cost) = $385.0 Million
- Net present value in medical cost + productivity gain (medical savings plus productivity savings minus program cost) = $36.0 Billion
- ROI for medical cost, which is medical savings for participants divided by program cost for all employees, with a value of $1.00 indicating break even (i.e., $1.00 in medical cost saved for each $1.00 invested in the program) = $1.02 to $1.00
- ROI for productivity, which is productivity savings for participants divided by program cost for all employees = $2.24 to $1.00
- ROI for medical cost + productivity gain, which is medical savings + productivity savings for participants divided by program cost for all employees = $3.26 to $1.00

Note: All summary results are discounted and represent totals summed over the years of program operation from years 1 through 10.

Also shown are results pertaining to three hypothetical break even scenarios. First is the program cost per employee that would exactly break even compared with the savings in medical cost, holding constant the other Model settings. Second is the program cost per employee that would exactly break even compared with the productivity savings, holding constant the other Model settings. Third is the program cost per employee that would exactly break even compared with the combined medical and productivity savings, holding constant the other Model settings.

ANALYSIS OF LARGE NON-FEDERAL EMPLOYERS, EXCLUSION OF SMALL EMPLOYERS

We attempted to obtain inputs for small non-federal employers, specifically those businesses that employ 749 employees or fewer, by surveying key health promotion program contacts at small businesses. However, participation rates, program costs, and risk reduction outcomes for these businesses varied too greatly causing average input values to be unreliable and improbable. To date, there are no robust studies conducted at small business worksites that examine risk reduction due to implementation of a health promotion program. More research is needed so that accurate information regarding what a small employer spends on the program, how many employees participate, and how outcomes for program participants vs. non-participants differ can be determined. Therefore, our analysis excludes small employers due to unreliable input values, which, if used, would yield unreliable ROI estimates.

SCENARIO 1: ASSUMING A DOUBLING OF THE NUMBER OF EMPLOYEES GIVEN ACCESS TO COMPREHENSIVE WORKSITE HEALTH PROMOTION PROGRAMS

SCENARIO 1 INPUTS – NON-FEDERAL EMPLOYERS

We ran the Model again but this time assumed that twice as many workers employed by large non-federal businesses would gain access to a comprehensive worksite health promotion program, i.e., the proportion of large business worksites offering programs would double from 24.1 to 48.2 and the total number of workers would also double from 13,864,200 to 27,728,400.

Number of employees in the base year	27,728,400
Annual % point change in number of employees	0.0%
Medical payment per employee in the base year	$4,692
Average daily wage	$190.17
Participation rate of employees in the program	62.0%
Annual program cost per employee	$156.00
Time horizon	10
Number of years until program levels off	10
Discount rate applied for ROI calculation	6.0%

SCENARIO 1 RESULTS – NON-FEDERAL EMPLOYERS

The same assumptions used to determine the baseline scenario for large non-federal businesses as described above were used to produce the following results:

Cumulative savings, program cost, and ROI (all discounted):	
Cumulative medical cost, no program	$961,223,466,900
Cumulative medical savings, with program	$32,606,953,600
Cumulative productivity savings, with program	$71,218,469,800
Cumulative program cost	$31,837,016,300
Net Present Value (NPV), medical care	$769,937,300
NPV, medical + productivity	$71,988,407,000
Return on Investment (ROI), medical care	$1.02
ROI, workplace productivity	$2.24
ROI, medical care + workplace productivity	$3.26
Break even program cost, medical care only	$159.77
Break even program cost, productivity only	$348.97
Break even program cost, medical + productivity	$508.74

As shown, the same ROI ratios are produced but the magnitude of the dollars spent and saved is much greater:

- Total medical costs for 28,728,400 workers regardless of participation, summed across 10 years = $961.2 Billion
- Total medical savings for program participants = $32.6 Billion
- Total productivity savings for program participants = $71.2 Billion
- Total program cost for all employees regardless of participation = $31.8 Billion
- Net present value in medical cost (medical savings minus program cost) = $769.9 Million
- Net present value in medical cost + productivity gain (medical savings plus productivity savings minus program cost) = $72.0 Billion

From the analysis of large non-federal businesses, both at baseline levels and when assuming a doubling of employees exposed to worksite programs, a modest ROI of $1.02 is achieved by medical savings alone. However, savings are optimized by the addition of productivity gains; when medical and productivity savings are combined an ROI of $3.26 is achieved.

BASELINE SCENARIO – INPUTS FOR A FEDERAL EMPLOYER

The above analysis focused on non-federal workers at large businesses. The following analysis uses similar methods and is focused on workers employed by the U.S. government, specifically those working for the Office of Personnel Management (OPM).

Below, we list the inputs used in the current simulation.

HEALTH PROMOTION PROGRAM INPUTS FOR A FEDERAL EMPLOYER

Number of eligible employees enrolled in the base year: We used estimates published by OPM[51] for Fiscal Year 2011 (the latest figures available). On average, OPM employed 2,111,471 workers in 2011. In our communications with OPM, we learned that a WellCheck survey had been administered to federal agencies over the past two years (2011 and 2012). Data provided by OPM for the two years indicated that 162 out of 225 (72%) work locations in 2011 and 227 out of 363 in 2012 (63%) provided comprehensive workplace health promotion programs to their workers, a much higher proportion than the prevalence reported by Linnan et al. for large employers (24.1%). However, the Work – Life Office at OPM distributed the surveys to points of contacts (POCs) at worksites more likely to have robust programs in place, thus these estimates of prevalence are likely overstated.

As for the number of workers at the locations surveyed, the following data were provided: In 2011, 364,485 employees were at the 225 sites surveyed and in 2012, 294,915 workers were at the 363 sites surveyed. In our Model, we use an average of 329,700 workers or approximately 15.6% of the federal workforce. We therefore use the number derived (329,700) as the baseline number of eligible employees currently engaged in comprehensive worksite health promotion programs at OPM.

Annual change in the number of eligible employees: No change in employment.

Medical payment per eligible employee in the base year: We used the average per employee per year medical expenditures value ($4,692) derived from the Truven Health Analytics MarketScan Database for 2011[10] that include both the employer and employee costs (coinsurance, copayments, and deductibles) and the cost of pharmaceuticals.

Participation rate in the program: We used an average 58% participation rate in any aspect of the health promotion program, as informed by the Community Guide Task Force literature review conducted by Soler et. al.[30,52]

Program cost per eligible employee in the base year: Here, we entered an average per eligible employee per year (i.e., per capita) program cost of $165 as provided by Soler et. al.[30,52]

Time horizon: We assumed a 10-year time horizon.

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[51] (http://www.opm.gov/feddata/html/2010/December/table1.asp) and (http://www.opm.gov/feddata/ccog2011.pdf)

[52] The Soler et. al. review uses data from both public and private sector employers, as opposed to the HERO Scorecard data, which is only based on private sector employers. Therefore, we used data from Soler et. al.'s literature review for the OPM ROI analysis.

Number of years until program levels off: We assumed that the program impacts would be consistent over the 10 years but the effects would be diminished by 20% in each year following program initiation.

Discount rate applied for ROI calculation: We applied a standard discount rate of 3%.[21]

Shown below are the above inputs into the ROI Model (assuming 329,700 workers).

SUMMARY – FEDERAL EMPLOYER HEALTH PROMOTION PROGRAM INPUTS

Number of employees in the base year	329,700
Annual % point change in number of employees	0.0%
Medical payment per employee in the base year	$4,692
Average daily wage	$190.17
Participation rate of employees in the program	58.0%
Annual program cost per employee	$165.00
Time horizon	10
Number of years until program levels off	10
Discount rate applied for ROI calculation	3.0%

EMPLOYEE CHARACTERISTICS INPUTS FOR A FEDERAL EMPLOYER

Demographics: We estimated the demographics for federal workers as derived from tables found on the following OPM website (http://www.opm.gov/feddata/demograp).

SUMMARY – FEDERAL EMPLOYEE CHARACTERISTICS INPUTS

Below are the demographic inputs into the Model:

Age	18-34	30.7%
	35-44	12.1%
	45-54	35.8%
	55-64	21.4%
Gender	Female	44.2%
	Male	55.8%
Region	Northeast	8.9%
	North Central	46.2%
	South	37.4%
	West	7.5%
	Unknown or Missing	0.0%
Type	Salary	89.0%
	Hourly	11.0%
	Other or Unknown	0.0%
Plan	Capitated health plan	14.0%

BASELINE RISK/ANNUAL CHANGE INPUTS FOR A FEDERAL EMPLOYER

Health Risk Information: For this section of the Model, we entered information regarding 10 health risks of participants at baseline (year 0), i.e., the percentage of participants at high risk for 10 modifiable risk factors. We also entered the changes that would occur if no program were put in place (the control condition) and the risk reductions likely to be achieved from participating in best practice, comprehensive worksite health promotion programs (the treatment or intervention condition). The 10 modifiable health risks are defined in Appendix A.

Baseline Risks: We entered baseline risks for OPM using preliminary data collected for employees in the Washington, DC area as part of a larger project funded by OPM.

(Expected) annual change in risk factors with no program: We entered the annual changes in risks from baseline for individuals *not* exposed to a best practice worksite health promotion program (i.e., background changes in population risk) vs. individuals who *are* exposed to such a program (i.e., program impact).

The default values were derived from a literature search of background changes in health risk factors without a program intervention.[24,30-33] These data reflect general trends in risk factors over the past several years. As shown, some trends are improving (e.g., smoking rates) while others are worsening (e.g., obesity).

(Expected) annual change in risk factors with best-practice program: Here, we entered the expected annual changes in risk factors from evidence-based, comprehensive worksite programs. These values were derived from a published literature review performed by the Community Guide to Preventive Services Task Force.[30] A more current literature review of worksite programs was conducted by the Emory University Institute for Health and Productivity Studies and values derived from the more current review[32-37] complemented the work of The Community Guide Task Force.

SUMMARY – FEDERAL EMPLOYER BASELINE RISK/ANNUAL CHANGE INPUTS

Shown below are the inputs into the Model relating to employees' health risks at baseline, assuming no program is in place (background trends), and assuming a best-practice program is in place.

		Baseline Risk	Annual Change (% points) No Program	With Program
Biometric	Obesity	26.2%	0.7%	-1.1%
	High Blood Pressure	14.0%	-0.3%	-2.8%
	High Total Cholesterol	9.9%	-0.5%	
	High Blood Glucose	3.6%	0.3%	
Behavioral	Poor Nutrition/Eating Habits	59.1%	-0.1%	-6.6%
	Physical Inactivity	45.0%	-0.6%	-4.1%
	Tobacco Use	5.6%	-0.7%	-1.2%
	High Alcohol Consumption	22.2%	-0.1%	-2.0%
Psychosocial	High Stress	6.5%	0.2%	-3.4%
	Depression	2.2%	0.2%	-0.4%

DIMINISHED PROGRAM IMPACT OVER TIME FOR A FEDERAL EMPLOYER

In the current model, we assumed a diminishing program effect of 80% following baseline, indicating a 20% annual attrition of program impact over the course of 10 years.

Change in Impact (%)
80.0%

(i.e., annual change with program in year x+1 / year x)

PRODUCTIVITY INPUTS FOR A FEDERAL EMPLOYER

The relationship between the presence of the 10 health risks in the model and diminished worker productivity were derived from an extensive literature search by Emory University.[38-50] The incremental number of productive hours lost annually due to absenteeism and presenteeism attributable to each risk factor is shown below. When there is no value shown (for example for high cholesterol), then the Model assumes no impact on productivity (either positive or negative) related to the risk factor.

SUMMARY – FEDERAL EMPLOYER PRODUCTIVITY INPUTS

The default values related to productivity losses associated with the 10 risk factors in the Model are shown below:

		Estimated Productive Hours Lost Annually	
		Absenteeism	Presenteeism
Biometric	Obesity	9.2	13.7
	High Blood Pressure	7.6	11.0
	High Total Cholesterol *		
	High Blood Glucose	26.0	8.9
Behavioral	Poor Nutrition/Eating Habits	0.8	23.7
	Physical Inactivity	12.3	27.2
	Tobacco Use	31.6	25.0
	High Alcohol Consumption	27.8	9.2
Psychosocial	High Stress	19.4	59.7
	Depression	73.8	89.5

* There are no estimates from the literature that are statistically significant.

RESULTS – FEDERAL EMPLOYER

CURRENT STATE – FEDERAL EMPLOYER

Estimated medical and productivity savings per participant were produced by the Model. For medical savings, these were estimated as the predicted medical cost without a program minus the predicted

medical cost after implementation of a best practice worksite health promotion program. Similarly, productivity savings per participant were based on the differences in productivity for individuals with and without a given risk.

The results are shown below.

Cumulative savings, program cost, and ROI (all discounted):	
Cumulative medical cost, no program	$13,252,363,456
Cumulative medical savings, with program	$524,945,569
Cumulative productivity savings, with program	$919,070,427
Cumulative program cost	$464,047,299
Net Present Value (NPV), medical care	$60,898,269
NPV, medical + productivity	$979,968,696
Return on Investment (ROI), medical care	$1.13
ROI, workplace productivity	$1.98
ROI, medical care + workplace productivity	$3.11
Break even program cost, medical care only	$186.65
Break even program cost, productivity only	$326.79
Break even program cost, medical + productivity	$513.44

The table above presents the following:

- Total medical costs for 329,700 workers regardless of participation, summed across 10 years = $13.3 Billion
- Total medical savings for program participants = $524.9 Million
- Total productivity savings for program participants = $919.1 Million
- Total program cost for all employees regardless of participation = $464 Million
- Net present value in medical cost (medical savings minus program cost) = $60.9 Million
- Net present value in medical cost + productivity gain (medical savings plus productivity savings minus program cost) = $980.0 Million
- ROI for medical cost, which is medical savings for participants divided by program cost for all employees, with a value of $1.00 indicating break even (i.e., $1.00 in medical cost saved for each $1.00 invested in the program) = $1.13 to $1.00
- ROI for productivity, which is productivity savings for participants divided by program cost for all employees = $1.98 to $1.00
- ROI for medical cost + productivity gain, which is medical savings + productivity savings for participants divided by program cost for all employees = $3.11 to $1.00

Also shown are results pertaining to three hypothetical break even scenarios: 1) program cost per employee that would exactly break even compared with the savings in medical cost, holding constant the other Model settings, 2) program cost per employee that would exactly break even compared with the productivity savings, holding constant the other Model settings, and 3) program cost per employee that would exactly break even compared with the combined medical and productivity savings, holding constant the other Model settings.

SCENARIO 1: ASSUMING A DOUBLING OF THE NUMBER OF OPM EMPLOYEES GAINING ACCESS TO COMPREHENSIVE WORKSITE HEALTH PROMOTION PROGRAMS

We ran the Model once again but this time assumed that twice as many OPM workers would gain access to a comprehensive worksite health promotion program over 10 years, i.e., the total number of workers with access would double from 329,700 to 659,400.

SCENARIO 1 RESULTS – FEDERAL EMPLOYER

The same assumptions as those listed above were used to produce the following results:

Cumulative savings, program cost, and ROI (all discounted):	
Cumulative medical cost, no program	$26,504,726,912
Cumulative medical savings, with program	$1,049,891,138
Cumulative productivity savings, with program	$1,838,140,853
Cumulative program cost	$928,094,599
Net Present Value (NPV), medical care	$121,796,539
NPV, medical + productivity	$1,959,937,392
Return on Investment (ROI), medical care	$1.13
ROI, workplace productivity	$1.98
ROI, medical care + workplace productivity	$3.11
Break even program cost, medical care only	$186.65
Break even program cost, productivity only	$326.79
Break even program cost, medical + productivity	$513.44

The table above presents the following:

- Total medical costs for 659,400 workers regardless of participation, summed across 10 years = $26.5 Billion
- Total medical savings for program participants = $1.0 Billion
- Total productivity savings for program participants = $1.8 Billion

- Total program cost for all employees regardless of participation = $928.1 Million
- Net present value in medical cost (medical savings minus program cost) = $121.8 Million
- Net present value in medical cost + productivity gain (medical savings plus productivity savings minus program cost) = $2.0 Billion
- ROI for medical cost, which is medical savings for participants divided by program cost for all employees, with a value of $1.00 indicating break even (i.e., $1.00 in medical cost saved for each $1.00 invested in the program) = $1.13 to $1.00
- ROI for productivity, which is productivity savings for participants divided by program cost for all employees = $1.98 to $1.00
- ROI for medical cost + productivity gain, which is medical savings + productivity savings for participants divided by program cost for all employees = $3.11 to $1.00

Based on the analysis of OPM, both at baseline levels and when assuming a doubling of employees exposed to worksite programs, a positive ROI of $1.13 is achieved by medical savings alone. However, as was the same with non-federal employers, savings from worksite health promotion programs are optimized by the addition of productivity gains. The results indicate that an ROI of $3.11 is achievable for federal employers when the medical and productivity savings are combined.

CONCLUSION

In a series of economic models based on empirical research linking the health risk profile of workers and subsequent medical- and productivity-related expenditures, we created various models that projected cost savings resulting from expansion of evidence-based worksite health promotion programs. Our analyses suggest that implementing best practice worksite health promotion programs that appeal to workers and therefore produce high engagement rates may yield a reduction in employee health risks, lower healthcare spending, and increase worker productivity leading to a positive ROI for non-federal and federal employers. In each scenario, the potential for medical cost and productivity savings increased when the proportion of employees exposed to worksite health promotion programs was doubled over a 10 year time horizon. Therefore, efforts to increase the number of federal and non-federal employers that offer best practice worksite health promotion programs to their employees is good policy likely to yield good economic value for non-federal business entities and U.S. government agencies.

APPENDIX A: High Health Risk Definitions for the ROI Model

Health Risk Definitions	
Health Risks	**Definitions of High Risk for ROI Model**
Biometric	
Obesity	BMI of 30.0 or higher.[21]
High Blood Pressure	Based on stage 2 categorization of hypertension[53] as systolic blood greater than 159 mm Hg and/or diastolic BP greater than 99 mm Hg.[24]
High Total Cholesterol	Total cholesterol level greater than or equal to 240 mg/dL.[25]
High Blood Glucose	Adults who have been told by a doctor that they have diabetes.[21]
Behavioral	
Poor Nutrition/Eating Habits	Consuming fruits and vegetables less than 5 times per day.
Physical Inactivity	Less than 30 or more minutes of moderate physical activity less than five days per week, or vigorous physical activity for less than 20 or more minutes less than three days per week.[23]
Tobacco Use	Adults who are current smokers.[21]
High Alcohol Consumption	Adult men having more than two drinks per day.[21] Adult women having more than one drink per day.[21]
Psychosocial	
High Stress	The CDC's Health Related Quality of Life Behavioral Risk Factor Trend Data collects data on the national prevalence of mental health problems. For this source, mental health problems is an "all-inclusive" category that defines high risk for mental health as "adults who have had 14 or more mentally unhealthy days (including stress, depression, and problems with emotions) within the past 30 days (frequent mental distress)".[22]
Depression	The CDC's Health Related Quality of Life Behavioral Risk Factor Trend Data collects data on the national prevalence of mental health problems. For this source, mental health problems is an "all-inclusive" category that defines high risk for mental health as "adults who have had 14 or more mentally unhealthy days (including stress, depression, and problems with emotions) within the past 30 days (frequent mental distress)".[22]

[53] Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr., Jones DW, Materson BJ, Oparil S, Wright JT Jr., Roccella EJ, and the National High Blood Pressure Education Program Coordinating Committee. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. Hypertension. 2003; 42: 1206–1252.