The Association of Technology in a Workplace Wellness Program With Health Risk Factor Reduction

Ron Loeppke, MD, MPH, Dee Edington, PhD, Joel Bender, MD, PhD, MSPH, and Ashley Reynolds, MSN, RN

Objective: Determine whether there is a relationship between level of engagement in workplace wellness programs and population/individual health risk reductions. **Methods:** A total of 7804 employees from 15 employers completed health risk appraisal and laboratory testing at baseline and again after 2 years of participating in their personalized prevention plan. Population and individual health risk transitions were analyzed across the population, as well as by stage of engagement. **Results:** Of those individuals who started in a high risk category at baseline, 46% moved down to medium risk and 19% moved down to low risk category after 2 years on their prevention plan. In the group that only engaged through the Web-based technology, 24% reduced their health risks ($P < 0.0001$). **Conclusions:** Engaging technology and interactive Web-based tools can empower individuals to be more proactive about their health and reduce their health risks.

Chronic illness and health care costs are advancing at a staggering rate worldwide. The World Economic Forum, in its *Global Risk 2010* report, indicated that the impact on developing countries as well as advanced economies from the "silent pandemic" of chronic illnesses (like diabetes, heart disease, and cancer) is a critical global risk that is destructive and debilitating to individuals as well as nations and that the only sustainable solution is a greater emphasis on prevention. These dramatic increases are largely attributable to lifestyle- or behavior-related causes such as unhealthy eating habits, smoking, or sedentary lifestyles. Given the converging epidemiological, political, cultural, and financial trends, driving accountable care organizations and patient-centered medical home initiatives is the need for better health at lower cost. This requires a sustainable prevention strategy in concert with effective population health management interventions to reduce the growing burden of health risks leading to the expanding burden of chronic illness as not only a fiscal imperative but also a clinical and moral imperative.[1–3]

The current sick care model in the United States is not designed to meet the real health and wellness needs of people. Therefore, employers fund the majority of the economic burden of this broken system, because they pay for the ever increasing costs of medical care while our system spends less than $0.05 of every health care $1.00 on prevention to help promote a healthier, safer, more productive workforce. A large percentage of 137 million employees in the United States receive health benefits at work; therefore, employers have a unique opportunity to play a stronger role because lifestyle risks and medical conditions directly influence productivity. Workplace health and wellness initiatives now reach millions of workers, with occupational health professionals designing and delivering wellness and prevention services typically impacting employees many hours per month compared with the minutes spent in a primary care physician's office each year. Occupational health providers are a critical medical resource for the nation's workers and their dependents. With its emphasis on prevention, the relevance of occupational health and its sphere of influence on population health management are a great resource of medical support for patient-centered medical homes and accountable care organizations. By embracing a prevention and health promotion strategy, employers have the capability and expertise to meet the challenges of creating a more resilient, healthier workforce and improving their bottom line.

US Preventive Medicine, Inc (Brentwood, TN), has created an innovative information technology solution for a personalized prevention solution, the Prevention Plan. The Prevention Plan leverages social cognitive concepts such as efficacy building and self-regulatory mechanisms like goal setting and self-monitoring, which facilitate health behavior change.[4] This Web-based prevention plan allows individual users to complete a health risk appraisal (HRA), biometric reporting, and laboratory testing to develop a customized prevention plan. The plan provides users with knowledge of their health risks as well as suggestions to reduce those risks. In addition, each user is provided a suite of support tools, recommended risk-reduction activities, and information that allows them to translate knowledge into action.

Users were able to complete an HRA, virtual coaching, live coaching, or social challenges to reduce their risks and were able to determine for themselves what level of engagement they preferred. All coaching programs were structured using risk-based educational modules. Live coaches completed these modules telephonically, while virtual coaching was completed using the same content, through self-directed online programs. Both coaching interventions used recommended action programs related to the risks identified from the risk appraisal, laboratory testing, and biometric screening. They were focused on identification of barriers, goal setting, and self-monitoring activities aimed at increasing self-efficacy. Live coaches used motivational interviewing as a method for engaging members in the coaching process, which was the only significant difference from the virtual coaching intervention.

NATURAL FLOW OF HEALTH RISK

The tool used to initiate awareness of health, determine health risk status of populations, and raise consciousness about health is the HRA. The health risks and cutoff points used in the HRA have been described previously.[5] The most commonly used risk stratification is low-risk status (zero to two risk factors), medium-risk status (three to four risk factors), and high-risk status (five or more risk factors). The first HRA provides baseline information to individuals, with future HRAs indicating the direction individuals are moving on a continuum of health.[6] The transition of individuals or percentage of individuals moving from one risk status to another when individuals are not engaged in wellness programs has been described by Dr Dee Edington as the natural flow of health risks. The transitions are measured using Markov chain analyses, a mathematical technique used to examine longitudinal data from the same individuals, which is described in our previous work.[7] The risk transitions for the population studied in this article were also analyzed using this same type of Markov chain analyses. It becomes obvious from the diagrams used to display the risk transitions that slowing upward migration into

From US Preventive Medicine, Inc (Drs Loeppke and Bender and Mr Reynolds), Brentwood, Tenn; and Health Management Research Center (Dr Edington), University of Michigan, Ann Arbor.

The authors declare no conflict of interest. No funding was received. Dr Ron Loeppke, Dr Joel Bender, and Mr Ashley Reynolds are employees of US Preventive Medicine, Inc, and Dr Dee Edington is a consultant and member of the US Preventive Medicine International Advisory Board.

Address correspondence to: Ron Loeppke, MD, MPH, 5166 Remington Dr, Brentwood, TN 37027 (RLoeppke.MD@USPM.com).

DOI: 10.1097/JOM.0b013e3182898639

higher-risk status and keeping low-risk individuals at low-risk status are key solutions to better health and lower health costs. Studies have shown that health costs follow health risks, with cost savings of $215 in medical costs and $950 of productivity costs saved per health risk reduced per person per year, as well as up to a six to one return on investment from comprehensive wellness programs.[8–10] Thus, a comparison of health risk transitions in individuals engaged in wellness programs to the natural flow of health risks is an important measure of success.

We previously published the compelling health risk reductions in a cohort of 1298 people participating in The Prevention Plan for 2 years, demonstrating reduction from high risk in 14 of 15 health risk factors, with a few of the notable findings as follows: 90% improved physical activity, 89% lowered blood pressure, 78% reported fewer health-related sick days, 76% lowered cholesterol, 74% reduced stress, 70% improved fasting blood glucose level, 23% quit smoking/tobacco use, and 17% lowered body mass index measures.[8] A description of health risks defined for this study can be found in Table 1. Although these risks differ slightly from Edington's prior risk descriptions, they are defined to be congruent with our most recent work, thereby maintaining consistency and comparability to previously published studies.

The purpose of this study was to assess whether risk reductions observed in prior studies were sustainable across many employers with varied benefit and incentive approaches and whether there were differences in health risk reductions when evaluated by level of engagement. To accomplish this, we sought to answer the following questions: (1) Are the risk reductions observed in the population cohorts from our previous published studies comparable with a much larger population from a diverse group from multiple employers? and (2) Is there a relationship between level of engagement and risk reduction; and if so, how do those health risk reductions compare with expected risk reductions defined by the Edington Natural Flow model?

TABLE 1. Health Risk Definitions

Health Risk Measure	High Risk Criteria
Alcohol	More than 14 drinks per week or binge drinking once or more in past month
Blood pressure	Systolic, >139 mm Hg or
	Diastolic, >89 mm Hg
Body mass index	27.8 (men)
	27.3 (women)
Cholesterol	>239 mg/dL
Existing medical problems	Heart problems, cancer, diabetes, or stroke
Fasting blood glucose	Fasting glucose borderline high (≥100 and <126 mg/dL) or high (≥126 mg/dL)
Fatty diet	High-fat foods consumed once a day, several times a day, or several times a week
HDL cholesterol	<35 mg/dL
Illness days	≥4 days last year
Perception of health	Fair or poor
Physical activity	Never
Safety belt usage	Safety belt never or sometimes used
Smoking	Current smoker/tobacco user
Stress	High
Use of drugs for relaxation	Weekly or almost every day
Total risks assessed	15
Overall risk levels	
Low risk	0–2 high risks
Moderate risk	3–4 high risks
High risk	5 or more high risks

HDL indicates high-density lipoprotein.

METHODS

There were 15 distinct employers of different sizes (M = 1704; SD = 2917) from various industries represented in this study. These included global benefit consulting, public services, academic institutions, manufacturing, and health care. Participants were located in 49 states and the District of Columbia, with more than 60% residing in Illinois, Florida, Arkansas, Nevada, Texas, Tennessee, and California. Furthermore, participant medical plans included preferred provider organizations and high deductible, consumer-directed, and traditional health care benefit plans. Incentives used by employers to encourage participation in wellness programs included contributions to health savings accounts ($500), tiered health insurance premium credits ($300 to $950), or gift cards ($50 to $150). The average participation rate across all employers was 53% (SD = 24%; Table 2).

A total of 92,186 members were registered with The Prevention Plan at the start of this investigation. Of those registered members, 11,689 had participated for at least 2 years, submitting at least a baseline HRA and two sequential annual follow-up HRAs. In addition to submitting the HRAs, 7804 members completed fasting laboratory testing at a US Preventive Medicine, Inc, partner laboratory or with their physician. If a physician completed the fasting laboratory testings, they were scanned and uploaded into the system as part of the laboratory test reporting. The 7804 members who comprised the study population sample were those who had baseline HRA/laboratory tests (at T_1) and then after 2 years of sequential participation in their personalized prevention plan with a follow-up HRA/laboratory tests (at T_2). As this study population was drawn from 15 different employers with varying enrollment cycles, those T_1 and T_2 measures occurred over a 4-year period from 2008 and 2011.

The study sample included administrators, clerical workers, teachers, nurses, accountants, and various other white-collar workers. A majority of them were employed full-time (n = 6554) or part-time (n = 492), while the rest were retired or volunteering (n = 756). The mean age of participants was 49 (SD = 11), with nearly two thirds (n = 5152) were women. The sample was primarily white (86%), followed by black (4%), Asian (4%), Hispanic

TABLE 2. Participation Rates by Employer Group

Employer, Group	Total Population, n = 60,273	Participation, n = 25,560	Rate, %
1	18,584	9,072	49
2	3,705	440	12
3	66	44	67
4	94	58	62
5	2,163	1,251	58
6	411	160	39
7	13	6	46
8	414	109	26
9	551	481	87
10	370	88	24
11	23,900	7,997	33
12	11	11	100
13	160	97	61
14	8,272	4,660	56
15	1,558	1,086	70

(3%), and others (2%). Nearly all participants (98%) spoke English as their primary language, followed by Spanish, Russian, and other languages totaling 2%. Overall, self-rated health among participants was positive, with respondents indicating their health as "excellent" ($n = 1483$), "very good" ($n = 2986$), "good" ($n = 2738$), "fair" ($n = 558$), or "Poor" ($n = 39$).

THE INTERVENTION

Employees were offered The Prevention Plan, a comprehensive prevention/wellness program that identifies an individual's top health risks and designs a customized personal prevention plan to reduce those risks. The Prevention Plan provided a suite of innovative tools and services that encompass an integrated primary prevention (wellness and health promotion), secondary prevention (biometric and laboratory screening, as well as early detection/diagnosis), and tertiary prevention (early intervention and evidence-based chronic condition management). This study evaluated the impact of The Prevention Plan on health risks in a cohort of 7804 individuals across multiple employers who were engaged in the plan for 2 years. The Prevention Plan participants completed an online HRA, which is a comprehensive questionnaire (totaling approximate 77 questions) about their current health risks, health status, and lifestyle.

After completion of the HRA, cohort participants completed a blood test (at a minimum, this included a lipid profile and fasting blood glucose). Professionals from a national laboratory performed blood draws in the workplace or at an off-site clinical laboratory. Biometric measurements including height, weight, and blood pressure were taken. On the basis of the results of the HRA, blood tests, and biometric measures, each member received a personalized prevention plan. Top health and lifestyle risks were identified, and each individual was provided with step-by-step recommendations to lower health risks and prevent health conditions from developing. The Prevention Plan also provided recommendations about screenings, tests, and other follow-up exams that were based on the age and sex of the member and accepted evidence-based clinical practices.

After the initial assessment as described, The Prevention Plan provided members with the support and empowerment necessary to adopt healthy behaviors and lifestyle changes. These included areas such as increased exercise, smoking cessation, or following a low-fat diet. Support services included 24/7 nurse hotlines, one-on-one health coaching, contests, group events, and employer incentives/rewards. Each participant also received a customized and personal health dashboard on his or her personalized prevention plan Web site to help each individual meet his or her health risk reduction goal. Members had the option of completing action programs, typically 8- to 10-week educational programs, that addressed key health areas such as nutrition, weight management, smoking cessation, depression, and lowering cholesterol. E-mail and telephone alerts, as well as reminders about needed screenings, were also used to motivate and assist members. A robust health library, symptom checker, medical animations, and daily health news were all made available to members.

Within their personalized Web site, each participant had a password-protected Prevention Score, which provided an instant snapshot of prevention efforts as well as progress toward completion of educational tutorials, screenings, participation in other activities, and adherence to recommended programs. As the member engaged in The Prevention Plan during the course of the year through the challenges, action programs, activity trackers, or registered nurse coaching, the Prevention Score increased. Although protecting employee personal health information, the score level achieved was then linked to customized rewards and incentives such as prizes, gift cards, or health insurance premium reductions.

The primary goal of a health promotion program is to influence the behavior of individual employees so that they can make personal choices for a healthy lifestyle. Nevertheless, sustainability requires organizational change and commitment that supports behavioral change. Sustainable results cannot be achieved without the support of senior leadership to create the vision for a healthy culture, align workplace policies, provide tools for improvement, reinforce the culture of health through incentives, and measure outcomes that drive success.[7] As part of the implementation, US Preventive Medicine, Inc, provided consultative expertise to participating employers to explain aggregate results of The Prevention Plan (baseline and annual results), worked with clients on longer-term health care benefit plans, assisted in the design of incentive strategies to drive results, developed communication strategies with the clients, and conducted short organizational assessments. Edington Associates has developed a comprehensive software to assess the strengths and gaps in the supportive culture and environment. The use of these types of corporate health assessments is an important step in understanding the strengths and weaknesses of the organization and the capacity to create a corporate culture of health. In fact, there are cost implications if an organization lacks a culture of health and has weak communication/branding of their workplace wellness programs. As shown by Taitel et al,[11] to achieve at least a 50% participation rate in the individual health risk assessments, companies without leadership commitment to a culture of health and strong communications and branding required a cash incentive value that is 300% higher than companies that have these characteristics.

Furthermore, because employers are seeking new ways to increase engagement in wellness programs and encourage employees to change health behaviors, interest in outcomes-based incentives is increasing. Nevertheless, there are important regulatory requirements, including new rules articulated in the Patient Protection and Affordable Care Act, that need to be addressed when using outcomes-based incentives. Guidance for a reasonably designed employer-sponsored wellness program using outcomes-based incentives has been published in a Consensus Statement of the American College of Occupational and Environmental Medicine, Health Enhancement Research Organization, American Cancer Society and American Cancer Society Cancer Action Network, American Diabetes Association, and American Heart Association.[12]

RESULTS

We analyzed the population health risk transitions for our cohort, using Markov chain analyses as compared to the expected transitions as defined by the Edington Natural Flow model from prior published studies.[12–14] The dramatic population health risk reductions in those 7804 individuals who participated in their personalized prevention plans for 2 years showed that 23% of that population significantly ($P < 0.0001$) reduced their health risks. In following the transitions of risk across the total population study group, those at low risk moved from 60% at baseline to 71% at year 2; those at medium risk moved from 29% at baseline to 23% at year 2; and those at high risk moved from 11% at baseline to 6% at year 2 (see Tables 3 and 4). Also, of those individuals who started in a high risk category at baseline, 46% moved down to medium risk and 19%

TABLE 3. Population Health Risk Category Transitions Between Baseline and After 2 Years on a Personalized Prevention Plan, $n = 7804$

Health Risk Category	Baseline Year, *n*	Baseline Year, %	Year 2, *n*	Year 2, %
Low	4,666	60	5,531	71
Medium	2,291	29	1,775	23
High	847	11	498	6

TABLE 4. Individual Health Risk Reductions After Participating in Their Personalized Prevention Plan for 2 Years, $n = 7804$

Individual Risks	People and Overall Population (7,804) With High Risk at Baseline Year, *n* (%) [*M* (SD)]	People and Overall Population (7,804) With High Risk at Year 2, *n* (%) [*M* (SD)]	People and the Baseline High Risk Group Remaining at High Risk After Year 2, *n* (%) [*M* (SD)]	People and the Baseline High Risk Group Reducing Risk out of High Risk After Year 2, *n* (%) [*M* (SD)]
Blood pressure	923 (12) [142/90 (13/9)]	500 (6) [141/89 (13/8)]	179 (19) [143/90 (12/8)]	744 (81) [123/77 (9/7)]
HDL	328 (4) [31 (3)]	235 (3) [30 (4)]	134 (41) [30 (4)]	194 (59) [41 (8)]
Cholesterol	836 (11) [263 (24)]	676 (9) [261 (22)]	353 (42) [265 (24)]	483 (58) [208 (25)]
Fasting blood glucose	1,616 (21) [116 (30)]	1,713 (22) [116 (29)]	926 (57) [123 (35)]	690 (43) [92 (6)]
Body mass index	3,338 (43) [33 (5)]	3,258 (42) [33 (6)]	2,937 (82) [34 (6)]	401 (12) [26 (2)]
Use of drugs for relaxation	73 (1)	69 (1)	13 (18)	60 (82)
Physical activity	881 (11)	295 (4)	185 (21)	696 (79)
Alcohol	901 (12)	524 (7)	303 (34)	598 (66)
Safety belt usage	106 (1)	55 (1)	36 (34)	70 (66)
Stress	1,023 (13)	730 (9)	373 (36)	650 (64)
Health-related illness days	1,286 (16)	979 (13)	508 (40)	778 (61)
Perception of health	842 (11)	608 (8)	387 (46)	455 (54)
Smoking/tobacco use	489 (6)	372 (5)	320 (65)	169 (35)
Fatty diet	4,553 (58)	3,572 (46)	2,989 (66)	1,564 (34)
Existing medical condition	910 (12)	971 (12)	751 (83)	159 (17)

HDL indicates high-density lipoprotein.

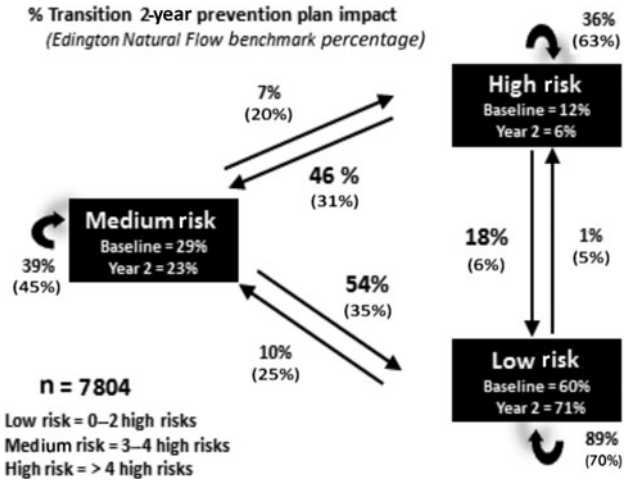

FIGURE 1. Population health risk transitions after 2 years on a personalized prevention plan compared with natural flow transitions.

moved down to low risk category. Equally impressive is the number and percentage of individuals remaining low risk (88%; see Fig. 1). Getting a population transition to low risk and then helping them remain at low risk will essentially eliminate the impact of risk factors on costs and can lead to zero trends.[6]

STAGES OF ENGAGEMENT ANALYTIC RESULTS

We grouped engagement types into stages on the basis of how a user interacted with the Prevention Plan. Stage I engagement was informational in nature and included the completion of health risk assessment (HRA) and laboratory testing. Web site access provides basic health-related information as well as a description of identified health risks and targeted messaging suggesting actions to reduce risks. Stage I engagement was further categorized into 3 subcategories defined by the number of times a user logged on to his or her personalized prevention plan Web site—stage I (a) = 1 log-in; stage I (b) = 2 to 4 log-ins; and stage I (c) = 5 or more log-ins.

Stage II engagement was defined as virtual, social, or both types of engagement and was composed of completing one or more virtual coaching action programs, social challenges or both. Virtual coaching was accomplished through completion of self-directed activities, automated messaging, and targeted reminders included as part of a risk-based action program. Social engagement was through the use of group challenges aimed at physical activity or healthy eating to track their progress and provide online comments of support to their teammates, as well as observe their ranking compared with other teams.

Stage III engagement included live coaching interactions. We differentiated between live coaching alone and live coaching plus virtual, social, or both types of engagement through the use of subcategories. Stage III (a) was live coaching without virtual, social, or both types of engagements, while stage III (b) included virtual, social, or both types of engagement as well as live coaching interaction.

The analysis revealed (see Table 5) that increased engagement resulted in greater health risk reductions at a statistically significant ($P < 0.0001$) level compared with natural flow for all stages except stage I (a). Even though stage III engagement with live coaching yielded the greatest health risk reduction, stage I engagement demonstrated a dose response in improved health risk reduction based on the number of times people logged in to their prevention plan, and stage II engagement with virtual coaching/social engagement was also associated with health risk reductions significantly ($P < 0.0001$), better than the expected natural flow.

DISCUSSION

The stages of engagement results in this study support the concept that leveraging technology with a Web-based health management program with virtual coaching and social engagement

TABLE 5. Population Health Risk Reduction by Stage of Engagement, $n = 7804$

	Study Sample Reducing Health Risk, %
Natural Flow	16
Stage I (a)	18 (NS)
Stage I (b)	22 ($P < 0.0001$)
Stage I (c)	24 ($P < 0.0001$)
Stage II	21 ($P < 0.0001$)
Stage III (a)	26 ($P < 0.0001$)
Stage III (b)	30 ($P < 0.0001$)
Total Average	23 ($P < 0.0001$)

NS indicates not significant.

are effective health risk reducing alternatives to live coaching interaction.

For years, the health care industry has typically sought to address the burden of health risks and chronic illness by using live coaching interventions, which required significant bidirectional human interaction. Therefore, many traditional disease management and wellness/health promotion organizations have struggled to provide significant return on investment because they often use high-cost staff to engage their populations. Technology advancements have provided new channels for health intervention delivery that are broader in reach, more reliable, and less expensive than traditional methods.[13] In fact, there is emerging evidence that technology-mediated behavior change can be as effective as human interaction.[15]

The use of the Internet as a channel for health communication delivery is not new; nevertheless, with the addition of interactivity, targeted messaging, and decision support, it has evolved into a platform that is able to guide behavior change in a similar fashion to a live health coach.[14,16–18] These "virtual" coaching platforms are emerging as effective alternatives to the live coaching experience. Nonetheless, differences exist between Internet interventions based on how extensively behavior change theory was incorporated into their frameworks. In a meta-analysis of Internet-based behavior change interventions, Webb et al[19] found that study effect sizes associated with low theoretical use ($d = 0.16$; 95% confidence interval, 0.09 to 0.23) were significant, though smaller than those with strong theoretical frameworks ($d = 0.36$; 95% confidence interval, 0.15 to 0.56). Thus, Internet interventions should be built in support of behavior change theory to improve effectiveness.

This research adds to the current knowledge about Web-based interventions; nevertheless, rapid advancements in mobile and wireless technologies are driving new innovations and should therefore be considered as part of a comprehensive engagement plan. Users of all ages including older adults are adopting mobile technologies to stay healthy.[20] With more than 160 million adults predicted by 2020 to have a medical condition monitored and managed remotely by using wireless devices, further research needs to be done to ensure their efficacy, safety, and accessibility.[21] An entire wireless health ecosystem is emerging in the industry and transformation of our health care system is underway.[22]

Therefore, in mobilizing the types of total population health management strategies required in the emerging accountable care organizations and patient-centered medical home initiatives, there should not only be the traditional disease/care management (tertiary prevention) components that typically impact 15% to 20% of the population but also leveraging the tools of technology with the power of prevention in wellness/health management (primary and secondary prevention) components that can impact 100% of the population.

STUDY LIMITATIONS

Because participation in the program was voluntary, there may be some selection bias through self-selection. Edington has shown that the risk status of nonparticipants in wellness programs generally fall between low- and medium-risk status. There is some evidence that individuals actively engaged in The Prevention Plan have levels of higher risk than those who do not consistently participate. Certain groups of employees may be underrepresented in the cohort, which may also impact the results. Also, the sample population was fairly homogenous, composed primarily of white women English speakers, thereby limiting the generalizability of these findings to other groups. Further study is needed with stronger diversity in the sample. In addition, participants may report better answers in the HRA for no apparent reason other than that they are being questioned. Our results may be impacted because our 15 risk factors were not an exact match to the ones from the Edington Natural Flow model, in which some of the questions were asked differently, and that others had different options for answers. A comparison to the Edington Natural Flow model as opposed to a nonparticipating cohort of employees in the employer groups may also have been a limiting factor. Lastly, risk factors such as high blood pressure or elevated cholesterol may represent health conditions and not just health risk factors, which may be influenced by treatment and not by lifestyle changes alone. Lack of adjustment for age and sex to the natural flow further limits the nature of our conclusions.

CONCLUSIONS

Large-scale, population-based changes in health behaviors require a comprehensive and multipronged approach that sustains interest and promotes engagement. Participants in The Prevention Plan have shown excellent improvements in risk transitions toward a healthier status and reductions in absolute adverse health risks. It will take more time to determine which specific interventions or innovative tools truly lead to better health outcomes and subsequent lower overall health care costs. Nevertheless, various stakeholders—from government entities to private businesses, as well as the consumers and the providers—must all play a role in working toward this goal. One of the key elements of successful population health management will continue to be the education and engagement of each individual to manage their health behaviors and health risks. In fact, translating information into knowledge and knowledge into action at the individual level will empower better personal health management as well as population health improvement that will be a fundamental factor influencing the success of accountable care organizations and patient-centered medical home strategies. With the power of the Internet, mobile phones, wireless applications, and renewed interest creating a culture of health, we have the ability to directly reach the vast majority of Americans and gain momentum toward better health and lower costs. This study provides strong evidence that an innovative personalized prevention intervention with engaging technology and interactive Web-based tools, as well as high-touch outreach by health coaches on a limited, as needed basis, can reduce health risks by engaging individuals to be more proactive about their health. Furthermore, this study yields more evidence for the business case that prevention is an investment to be leveraged rather than a cost to be justified. It also supports the importance of moving beyond our current reactive, illness-oriented sick care system toward a more proactive, wellness-oriented health care system built on the pillars of prevention.

ACKNOWLEDGMENTS

The authors thank Marjorie Kovacs, Sara Kennedy, and Martin Bates for their significant contributions to this article through their rigorous multivariate, person-centric analysis of the data for this study.

REFERENCES

1. Loeppke R. The value of health and the power of prevention. *Int J Workplace Health Manage*. 2008;1:95–108.
2. Loeppke R, Taitel M, Haufle V,, Parry T, Kessler RC, Jinnett K. Health and productivity as a business strategy: a multiemployer study. *J Occup Environ Med*. 2009;51:411–428.
3. McLellan RK, Sherman B, Loeppke RR, et al. ACOEM Position Statement. Optimizing health care delivery by integrating workplaces, homes, and communities: how occupational and environmental medicine can serve as a vital connecting link between accountable care organizations and the patient-centered medical home. *J Occup Environ Med.* 2001;54:504–512.
4. Bandura A. *Self-Efficacy, The Exercise of Control*. New York, NY: WH Freeman and Company; 1997.
5. Loeppke R, Edington D, Beg S. Impact of The Prevention Plan on employee health risk reduction. *Popul Health Manage.* 2010;13:275–284.
6. Edington D. *Zero Trends: Health as a Serious Economic Strategy*. Ann Arbor, MI: University of Michigan–Health Management Research Center; 2009.
7. Edington DW. Emerging research: a view from one research center. *Am J Health Promot*. 2001;15:341–349.
8. Loeppke R, Edington DW, Bég S, Bender J. Two-year outcomes show effectiveness of the prevention program in lowering health risks and costs [Letter to the Editor]. *Popul Health Manage*. 2011;14:265.
9. Burton WN, Chen CY, Conti DJ, Schultz AB, Edington DW. The association between health risk change and presenteeism change. *J Occup Environ Med*. 2006;48:252–263.
10. Baicker K, Cutler D, Song Z. Workplace wellness programs can generate savings. *Health Aff*. 2010;29:304–311.
11. Taitel M, Haufle V, Heck D, et al. A cross-sectional analysis of factors associated with employee participation in health risk assessments. *J Occup Environ Med*. 2008;50:863–872.
12. Guidance for a reasonably designed employer-sponsored wellness program using outcomes-based incentives: consensus statement of the Health Enhancement Research Organization (HERO), American College of Occupational and Environmental Medicine (ACOEM), American Cancer Society and American Cancer Society Cancer Action Network, American Diabetes Association, and American Heart Association. *J Occup Environ Med*. 2012;54:889–896.
13. Noar S, Harrington N. *eHealth Applications: Promising Strategies for Behavior Change*. New York, NY: Routledge; 2012.
14. Cassell M, Jackson C, Cheuvront B. Health communication on the Internet: an effective channel for health behavior change? *J Health Commun*. 1998;3:71–79. doi:10.1080/108107398127517.
15. Watson A, Bickmore T, Cange A, Kulshreshtha A, Kvedar J. An internet-based virtual coach to promote physical activity adherence in overweight adults: randomized controlled trial. *J Med Internet Res*. 2012;14:e1.
16. Svensson M, Lagerros YT. Motivational technologies to promote weight loss from Internet to gadgets. *Patient Educ Couns*. 2010;79:356–360. doi: 10.1016/j.pec.2010.03.004.
17. Hunter CM, Peterson AL, Alvarez LM, et al. Weight management using the Internet: a randomized controlled trial. *Am J Prev Med*. 2008;34:119–126. doi:10.1016/j.amepre.2007.09.026.
18. Bickmore TW, Caruso L, Clough-Gorr K, Heeren T. 'It's just like you talk to a friend', relational agents for older adults. *Interact Comput*. 2005;17:711–735. doi:10.1016/j.intcom.2005.09.002.
19. Webb LT, Joseph J, Yardley L, Michie S. Using the Internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *J Med Internet Res*. 2010;12:e4.
20. Center for Technology and Aging. *mHealth Technologies: Applications to Benefit Older Adults*. Mobile Health (mHealth). Available at: http://www.techandaging.org/mHealth_Position_Paper_Discussion_Draft.pdf. Accessed October 20, 2012.
21. Johns Hopkins University. *Chronic Conditions: Making the Case for Ongoing Care*. Available at: http://www.partnershipforsolutions.org/DMS/files/chronicbook2004.pdf. Accessed October 20, 2012.
22. Topol E. *Creative Destruction of Medicine: How the Digital Revolution Will Create Better Health Care*. New York, NY: Basic Books, A Member of the Perseus Books Group; 2012:285.