Literature Review: Cost Benefit Analysis

A Review and Analysis of the Clinical and Cost-effectiveness Studies of Comprehensive Health Promotion and Disease Management Programs at the Worksite: 1995–1998 Update (IV)

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Editor Note: *This is the fourth in a series of articles written by Dr. Kenneth R. Pelletier summarizing the results of studies examining the impact of comprehensive health promotion and disease management programs on health and cost. Our intention is to continue publishing updated summaries of the impact of comprehensive health promotion programs on health and financial outcome measures periodically and to include all studies published in rigorous peer-reviewed journals. If we have missed a study, please send the author a copy to include in the next update.*

BACKGROUND

According to a 1997 survey by Hewitt Associates, 89% of 1050 employer survey respondents reported having some form of health initiatives in place, ranging from 78% with education and training, to 76% with health risk screenings, to 39% with incentives.[1] Given the similar survey of 1992,[2] the trend is clearly toward employers introducing initiatives that are increasingly targeted toward specific "disease management" interventions, because most employers need to demonstrate that their managed health initiatives generate value. These programs are more likely than general programs to generate return on investment, because they focus on individuals who typically impact medical or related costs, such as absenteeism and productivity, in the near term.

Increasingly, the evidence supporting both the clinical effectiveness and the cost-effectiveness of such programs are becoming more compelling. Previous literature reviews of the clinical and cost outcomes of comprehensive, health promotion, and disease management programs at the worksite have been published by this author[3–5] and other researchers[6] and, in an ongoing series, by Chapman.[7] Based on these reviews of overall comprehensive health promotion and disease management programs at worksites, 77 studies have been cited in a previous series of three reviews.[3–5] Also, 47 studies were cited in another review,[8] with overlaps in citations between the 77 and 47 cited studies.

There have been three reviews since 1995: (1) Heany and Goetzel's[8] 1997 review of 47 studies based on 35 programs, with their conclusion that the evidence for positive outcomes was "indicative/acceptable"; (2) an overview of a number of reviews by O'Donnell[9] later in 1997 that assessed 36 studies, with two-thirds of them rating four stars (comparison group but not randomized) to five stars (randomized control group). (Based on these studies, the area of multicomponent programs was again rated "indicative to acceptable."); and (3) a review by Aldana[10] in 1998 that cited five studies demonstrating positive cost outcomes of such programs. Collectively, these reviews indicate that multicomponent or comprehensive interventions rank third in effectiveness to single-factor programs such as smoking cessation and hypertension interventions that are rated as conclusive in terms of both clinical and cost outcomes.

For purposes of this analytic review, comprehensive worksite-based health promotion and disease management programs are defined as "those programs that provide an ongoing, integrated, program of health promotion and disease prevention that integrates the particular components (i.e., smoking cessation, stress management, lipid reduction, etc.) into a coherent, ongoing program that is consistent with corporate objectives and includes program evaluation."[3–5,7] This review is limited to articles that meet these criteria. Single-risk-factor interventions, even though they might be reported as clinical and cost-effective, such

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as smoking cessation and hypertension screening, are not reviewed.

METHODS

For this review of multifactorial health promotion programs at worksites focusing on risk factor and/or disease management, a literature search was conducted using a multistage process that included MEDLINE, ERIC, ADI, EDGAR, CARL, Inform, and Lexis-Nexis bibliographic searches of databases, a manual search of specific journals, a reference list search, and direct inquiries to worksite health promotion researchers. Analysis consists of an analytic overview of data from new studies since 1995 as well as relevant findings from earlier studies from previous reviews. Such an approach is not a formal meta-analysis, which would combine the results of all of the trials and reanalyze the data as if they were derived from a single large study. Although meta-analysis is a sophisticated methodology, there are inherent limitations, potential biases, noncomparability of populations, widely divergent interventions, lack of standardization and operationalization of terms, and other issues which do not necessarily render a meta-analysis more representative of a given area than a sound analytic literature review.

Inclusion and Exclusion Criteria

For purposes of this analytic review, comprehensive worksite-based health promotion and disease management programs are defined as those programs are defined as provide an ongoing, integrated, program of health promotion and disease prevention that integrates the particular components (i.e., smoking cessation, stress management, lipid reduction, etc.) into a coherent, ongoing program that is consistent with corporate objectives and includes program evaluation. This review is limited to articles that meet these criteria, while single-risk-factor interventions, even thought they might be reported as clinical and cost-effective, such as smoking cessation and hypertension screening, are not reviewed. Only studies that were based on experimental or quasi-experimental designs were included. Anecdotal, purely descriptive, and qualitative studies were excluded. All cited research has been published in peer-reviewed journals between 1995 and 1998, plus one previously uncited study from 1994. Within these criteria, the review is structured to be inclusive, rather than exclusive *per se,* in order to provide an overview of the current state of the research and outcomes in this area. This search resulted in the identification of 11 studies that examined the clinical and/or the cost impacts of such multifactorial programs.

Findings Extraction and Analysis

Findings are summarized here in a table format (Table 1) adapted from the previous reviews that describes each study by: (1) corporate site, (2) study author(s), (3) purpose of the evaluation, (4) employee population, (5) number or percentage of program participants, (6) number of employees included in the evaluation, (7) intervention, (8) evaluation design, (9) evaluation period, (10) outcomes, (11) research rating, and (12) findings. Reported findings were excluded if they were anecdotal and/or not evaluated. Because it is crucial to consider the rigor of the research methodology included in each study, the table only includes research that fulfills one of two categories: (1) properly conducted study with a nonrandomized comparison or control group (****); or (2) properly concluded study with a randomized comparison or control group (*****). Other recent reviews contained in a special issue of the *American Journal of Health Promotion* (*AJHP*) (July/August 1996) have been conducted and adapted this table format. Among the worksite-based research areas reviewed in the previous *AJHP* special issue are: (1) overall health outcomes,[11] (2) nutrition and cholesterol reduction,[12] (3) health risk appraisals,[13] (4) weight control,[14] and (5) fitness and exercise.[15] Also, one of a recent series of reviews, sponsored by the Centers for Disease Control and Prevention in conjunction with the *AJHP,* utilizes this format in reviewing general worksite health promotion and disease prevention programs.[8] In this review, the studies that are methodologically sound and that seem to offer the best evaluation of the health effects of worksite health promotion programs will be briefly detailed.

Methodological Critique

Previous reviews of worksite health promotion and disease management programs have pointed out the lack of methodological rigor in the evaluation designs of many of the studies.[3–5,16–18] Previous reviews of worksite programs suggested that the more rigorous the evaluation design, the smaller and less consistent are the effects.[16–18] Such observations raise the possibility that the more rigorously designed research may result in less favorable program effects than do the evaluation designs that utilize no comparison group.[19–23] Results of nonexperimental studies may be influenced by a number of threats to validity. Comparison groups in the quasi-experimental and experimental studies often show a reduction in risk.[16–19] This is consistent with the possibility that the results of simple before-and-after comparisons are benefited or artificially enhanced by strong secular trends.[20–24] On the other hand, in the context of strong secular trends, it is encouraging that a substantial majority of the experimental and quasi-experimental studies, as well as all 10 of the studies reviewed here, have demonstrated predominantly positive results.

On a positive note, the methodological rigor of worksite health promotion evaluation and disease management studies has evolved considerably over the years. Methodological challenges are great, and further innovation and refinement are necessary. All of the currently reviewed studies indicate both favorable clinical and cost outcomes in both experimental and quasi-experimental designs. Despite the many limitations of current methodologies, the vast majority of the research to date does indicate: (1) favorable clinical and cost outcomes,[3–6,8,10] (2) that more recent and more rigorously designed research tends to support rather than refute earlier and less rigorously designed studies,[5,6,10] and (3) that rather than interpreting

he methodological flaws and diversity as preemptively ıegative, the positive findings, despite the flaws, may be :qually indicative of robust phenomena evident at many ypes of worksites, with diverse employees, different inter-'entions, and varying degrees of methodological sophisti-:ation.[5,6,10] In any case, even the most rigorous methodol-›gy cannot compensate for predictable, unsophisticated nterventions that do not take into account over 15 years ›f increasingly precise multifactorial, effective interven-ion strategies.

Research Design

Studies reviewed here are highly heterogeneous in de-ign methodology and statistical analyses, with the exclu-ion of purely qualitative designs. Sample size ranged rom a few hundred employees[84] to over 43,000.[91] Studies vith small sample sizes evidenced minimal power to de-ect program effects. Even when an adequate number of nultiple sites were randomly assigned to experimental nd control conditions, the evaluation designs typically lid not appropriately use the worksite, as opposed to em-›loyees, as the unit of analysis. One recent (1998) study ›y Byers[87] did randomize 40 worksites with a focus on :holesterol reduction. A majority of the studies used the ndividual employee as the unit of analysis, even when the ınit of randomization was the worksite.

Intraclass correlation[25–27] due to employees working at :he same worksite was not addressed. However, it is impor-tant to note that the theoretical threat to validity due to individual level vs. worksite level analysis has not been thoroughly assessed empirically. The only paper specifical-ly addressing this issue was one study examining intraclass correlations for body mass index (BMI), smoking, and ex-ercise both cross-sectionally and longitudinally for 32 worksites.[28] This study found excess variance, over and above individual variance, associated with worksite cross-sectional analysis. However, change over time in response to the intervention had a negligible worksite variance component.

A final difficulty in drawing conclusions from this het-erogeneous literature is presented by the differences in how variables are defined. Participation has a wide range of definitions ranging from merely filling out a health risk appraisal (HRA) at one extreme to completing a series of repeated, individualized interventions at the other.[29] De-nominators of the effect calculations also vary widely. In part, this is due to differences in response rates to the evaluation instruments and to investigator decisions about how to define "eligibility."[30–31] Clinical outcomes as well as their operationalized definitions vary considerably from one risk factor to another.[32–34] Cost-effectiveness is also widely variable, as investigators rarely use the same meth-ods for imputing intervention costs or cost savings associ-ated with changes in risk factors.[35–36] This variability in op-erationalizing cost outcomes is detailed in a later section of this review.

Duration of Follow-up

Follow-up in the studies reviewed here ranged from 6 months[93] to as long as 10 years.[25] Although a few of the studies only conducted an immediate postintervention as-sessment, the vast majority of the studies used a reason-able follow-up period of at least 1 year postinterven-tion.[37–42] Extending the length of follow-up does seem to be associated with a positive, measurable impact of the in-tervention.[43–46,85,89–92,94] Such outcomes underscore the ne-cessity of long-term ongoing support to sustain short-term changes in risk factors.

Several studies included multiple sequential follow up assessments. These studies help to evaluate the extent to which early intervention effects endure over time.[86,89–91,94] Only one of the studies utilized direct measures of mor-bidity or mortality outcomes.[25] Future studies should focus more on long-term outcomes to determine the causal in-fluence of risk factor modification on morbidity and mor-tality.

In one study by Baier and colleagues,[37] the interven-tion consisted of a single screening and counseling activi-ty. Virtually all of the risk reduction was accomplished pri-or to the 3-month follow up. Results from the Gomel et al.[46] study are more complex. Overall, the interventions in the Gomel study were concentrated in the first 3 months, followed by offering of incentives over 6 months in the most intensive intervention condition. For several of the targeted risk factors, there were detectable reductions dur-ing the first 3 months. However, these reductions re-gressed to baseline levels by the end of the first year. Oth-er studies also demonstrated a tendency for risk reduc-tions to regress to the mean over time. These findings support the necessity of maintaining behavior changes over time by implementing sustained and repeated strate-gies for assisting employees in sustaining their initial risk factor reductions.

Another limitation of many worksite studies is the reli-ance on intensive, highly structured, and expensive inter-ventions delivered by highly trained research staff.[46–49] One area in which such programs have evidenced both clinical and cost outcomes is in mammography screen-ing.[89–90] Such a set of conditions may be difficult to repli-cate and therefore limits the generalizability of some oth-er programs.[50–53] A further limitation arises from the diffi-culty in differentiating intervention effects from other var-iables such as secular trends, other contextual factors, including state or local health policy changes such as in-door air acts, and changes in medical benefits plans.

Participation Rates

Self-selection remains a complex, confounding issue. Virtually all worksite programs are voluntary, and the issue of self-selection is of the utmost importance. It has re-ceived considerable attention from researchers and practi-tioners.[5,6,54,55] Evaluations that focus only on changes among the active participants overlook the fact that the program may not attract the participation of large num-bers of employees, especially those who may be at elevat-ed or even high risk.[56,57] None of the published studies of the comprehensive worksite programs has been imple-mented with dependents and/or retirees. None of the studies has considered differential responses from the

Table 1

Summary of Comprehensive Worksite Health Promotion Programs, 1995–1998

Study	Purpose of Evaluation	Employee Population	No. or % of Program Participants	No. of Employees Included in Evaluation	Intervention Design	Evaluation Design	Evaluation Period	Outcomes	Research Rating	Findings
Southern California Edison[84]	Determine cost effectiveness of an employee assistance program (EAP)	2321 employees of the San Onofre Nuclear Generating Station in 1990 and 2470 in 1991	6.8% in 1996 and 7.5% in 1991	158 in 1990 and 185 in 1991	Full time in-house EAP psychologist	Observational study tracking voluntary utilization of EAP	2 y	(1) increase in employee self referral; (2) fixed costs offset by increased utilization	****	Post *ad hoc* data concluded EAP to be cost effective
Wellpower of UNUM Life Insurance Company[85]	Evaluate health and cost-effectiveness of Wellpower, started in 1984	4000 employees	Approximately 50% average over 10 y	All participants in various programs ranging from EAP to child care and work family policies	Comprehensive HP/DP program consisting of: EAP, occupational health and safety, work-family policies such as flex time, child care, health education, screening, exercise and recreation, and the work environment	Selective tracking of various cohorts	10 y since 1985	Smoking decreased from 21% to 12%; employees maintained weight and exercise levels; use of seat belts increased from 54% to 88%	****	UNUM reported (1) estimated annual cost savings of $132,000 to $237,000 annually for smoking cessation, and (2) cost-benefit analysis of 1993 and 1994 medical claims indicated ROI of 1:1.81

Table 1

Continued

Study	Purpose of Evaluation	Employee Population	No. or % of Program Participants	No. of Employees Included in Evaluation	Intervention Design	Evaluation Design	Evaluation Period	Outcomes	Research Rating	Findings
Union Pacific Railroad[86]	Evaluate clinical and cost outcomes of a cardiovascular program entitled "Project Health Track" (PHT)	All employees of U.S. sites in St. Louis, North Little Rock and Fort Worth, with 1103 screened	St. Louis: 305; North Little Rock: 355; Fort Worth: 134	794	Counseling conducted monthly by phone or in person for 15 min or referral to medical care over 22 mo	High risk employees (multiple-risk-factor screening) were randomly assigned to one of two groups: counseling in PHT or referral	22 months (April 1992–January 1994)	83% of eligibles completed post screening	*****	Used "Wellcast" ROI software; total program costs $111,757 for 2 years. Referral ROI for white collar 1:5.10 and 1:6.41 for blue collar. Counseling ROI for white collar 1:2.93 and blue collar 1:2.76. Overall ROI 1:3.24
Small business worksites in four states[87]	Assess impact and costs of a nutrition education program following a cholesterol screening	All employees of 40 small worksites through state health departments in Colorado, Minnesota, Missouri, and Washington	Men in "usual" AHA program: 283; women: 180. Men in "special" program: 201; women: 182	846	40 worksites randomly assigned to (1) "usual" 25 min of counseling or (2) "special" 2-h behavioral intervention and video	Randomized clinical trial (RCT) without a control/comparison group	1-y costs and cholesterol measured at baseline, 6 and 12 mo	Behavioral intervention resulted in 3.5% cholesterol reduction; men had better outcomes than women	*****	Costs were $50/person for the behavioral intervention
First Chicago NBD Corp.[88]	Evaluate worksite mammography programs	All female employees	2192	2192 women from under 40 to over 70 y of age	Free mammography screening at the worksite following an ACS education program	Cumulative case study	1991–1994	Seven newly diagnosed breast cancers. Cost of treatment averaged $18,526 for participants (7) and $35,031 for nonparticipants (15)	****	Workdays lost for participants was 33.9 vs. 74.5 for nonparticipants; program determined to be cost effective

Table 1

Continued

Study	Purpose of Evaluation	Employee Population	No. or % of Program Participants	No. of Employees Included in Evaluation	Intervention Design	Evaluation Design	Evaluation Period	Outcomes	Research Rating	Findings
Coors[89]	Assess "coor-screen" breast cancer screening program	10,600 employees	Participation rate of 83% of all eligibles	3729 employees, spouses, and retirees	On-site mammography following a worksite education program	Prospective cohort	8 y (1985–1993)	43 early detections and 4 late (total of 10 malignancies)	****	Net cost savings of $2,411,190 over 8 y
Coors[90]	Link impact of changes in health practices on medical costs	10,600 employees	796	796	HRA completed in 1985 and 1988 and employees sorted into high vs. low risk categories	Prospective cohort	1985–1987 and 1988–1990 (two sets of cohorts of 3 y each)	High risk employees decreased from 31.8% to 25.3% from 1985 to 1988	****	Greatest reduction in medical costs with employees moving from high to low risk
Citibank[91]	Evaluate the financial impact of the Citibank health management program	All Citibank employees and early retirees	22,933 in medical study and 21,749 in absenteeism study	22,933 in medical study and 21,749 in absenteeism study	Initial screening of entire population followed by high vs. low risk intervention/education programs (Healthrac)	Nonrandomized quasi-experimental cost–benefit analysis	Median of 26–38 months beginning in 1994	Medical expenditures and expenditures for illness absenteeism	****	ROI of 6.47 to 8.81 for every dollar invested
Procter & Gamble[92]	Compare total and lifestyle-related medical expenditures in a worksite health promotion program (WHP); participants vs. nonparticipants	All active employees who were employed continuously from 1990 to 1992	8334 (53% male; 48% female)	Participants: 3993; nonparticipants: 4341	Voluntary participation in a worksite health promotion (WHP) program	Quasi-experimental	3 y	Medical costs: inpatient, hospital admission, and hospital days	****	Adjusting for age and gender, participants had lower (29% to 36%) medical costs than did nonparticipants

Table 1

Continued

Study	Purpose of Evaluation	Employee Population	No. or % of Program Participants	No. of Employees Included in Evaluation	Intervention Design	Evaluation Design	Evaluation Period	Outcomes	Research Rating	Findings
White collar employee groups[93]	Compare programs directed at specific high risk groups against each other and against comparison groups receiving standard Healthtrac programs	Employees database of 50,576 and senior database of 39,076	Consecutive high risk: 2586	2586	Voluntary enrollment in health promotion and/or high risk programs (Healthtrac)	Observational study (nonrandomized)	6 mo	Overall risk, doctor visits, hospital days, sick days, and medical costs	****	High risk (HR) improved HRA score by 11% vs. 9% in comparison group; HR MD visits decreased by 1.6 visits/y; HR hospital days decreased by 0.1 days; sick days decreased by 1.8/y; at 6 mo, HR costs were reduced by $608 vs. $113 and $139 in comparison groups
Chevron[94]	Evaluate the impact of Chevron's "Health Quest" fitness program on medical expenditures	7590 employees eligible	12.5%, or 950 participants	950	Exercise and fitness programs, HRA, back care, weight control, nutrition, and stress management	Quasi-experimental, using descriptive and multivariate statistical analyses	2.5 y	Expenditures for inpatient care and pharmaceutical services	****	Expenditures for participants were significantly lower for those who used the fitness center at least twice weekly

**** Properly conducted study with a nonrandomized comparison or control group.
***** Properly conducted study with a randomized comparison or control group.

"working poor" or racial and/or ethnic subpopulations at the worksites.

Participation rates are defined and operationalized in numerous variations. Among the most common criterion for defining a participant was simply completion of an initial risk assessment and screening. Participation rates of studies that used this criterion ranged from a previously cited low of 9.5% to a reported level of >80%[86] in the present studies. Copayments for the program paid by the employee may have an important influence on employees' decisions regarding participation.[60,61] Other studies have operationalized more rigorous criteria for participation, such as having to verify the completion of a minimal proportion of the program.[62,63,93] Under these more stringent conditions, the participation rates were uniformly lower.

Although some of the studies distinguish between high risk and low risk employees, relatively few documented the differential participation by these two distinct groups of employees.[90,91,93] For a program to be effective in reducing overall morbidity and mortality, it needs the sustained involvement of high risk employees. In this domain, there is a recent trend toward focusing on high risk employees with positive results reported in employee assistance program (EAP) referral,[84] cardiovascular risk,[86] cholesterol,[87] and mammography screening programs.[89,90] Although the southern California Edison study of 1994 indicated the cost-effectiveness of a targeted EAP program,[84] the long-term effects of increased employee self-referral may or may not be cost-effective.

One promising future area indicated in studies to date is an emphasis on disease management and secondary prevention with high risk individuals after an overall worksite screening and intervention program is established. Such an intervention is taking place in a General Electric worksite in conjunction with the Stanford Center for Research in Disease Prevention and is funded by Blue Shield of California (W. Haskell, J. Farquhar, K. R. Pelletier, et al., unpublished data, 1999). This project is the HEAR2T at the General Electric Nuclear Energy (GENE) site in San Jose, California. Overall, the primary objective of this project is to evaluate the operational feasibility and effectiveness of an intensive multifactorial cardiovascular risk management program in a worksite environment for persons at increased risk of having a clinical cardiac event. This program, based on the Stanford Coronary Risk Intervention Program (SCRIP),[58] is designed to provide a clinical and cost-effective approach integrating the use of lifestyle changes and medication.

At the General Electric nuclear power facility, there are approximately 1200 employees and 60 retirees and spouses living locally who are eligible for the program. HEAR2T emphasizes effective risk screening of employees and retirees, general risk reduction programs, and services of personal physicians or clinics for high risk persons, tracking and follow-up assessment of high risk persons, and integration/enhancement of corporate and community health promotion services for use by all employees. To date, over 1000 employees have responded to the initial screening. Approximately 600 have been triaged into an intermediate or high risk category and invited to participate in a subsequent biometric screening, followed by multiple-risk factor intervention. Also, corporate policies related to employee heath are being evaluated, and changes are being recommended where indicated.

Attrition from the Sample

Attrition from the sample confounds the internal validity of virtually all of the studies reviewed. This is primarily due to inadequate participation in the postintervention assessments. In several studies, the nonresponse to follow-up assessments was greater for the intervention condition than for the comparison condition. Paradoxically, attrition was often greater in the more intensive interventions. If this differential attrition is due to high risk employees in the intensive interventions dropping out of the study, then the effectiveness of the programs may be inflated. Statistical techniques have been developed to adjust for differential attrition between experimental conditions, but these can be complex and are not necessarily effective. Use of archival data, if available, in combination with pretest values could be used to minimize this limitation. In fact, it has been argued that the attempts to adjust for attrition may actually result in greater distortion of the intervention outcomes.[25,30] One study conducted with city workers of Birmingham, Alabama, has instituted mandatory assessments as a prerequisite for receiving employer-sponsored health benefits.[59,60] While such a mandatory program remains controversial, it appears to have a dramatic positive impact on both compliance and adherence to follow-up. Extensive follow-up efforts that utilize incentives have also proven to be effective.[61–64] Among the possible solutions to the problem of attrition is to fully inform employees of the participation requirements.[65–67] This also ensures that management support for the program is sustained over time and provides incentives to employees for completion of the program.

Multiple-Risk-Factor Interventions

Numerous clinical interventions and epidemiological studies of chronic disease clearly indicate that behavioral risk factors play an essential role in the etiology of disease. Overall, the evidence from this review indicates that multifactorial, comprehensive worksite health promotion and disease management programs focusing on multiple risk factors are likely to reduce employee risks for chronic disease.[68–76,84–94] By extension, such interventions may be both a clinical and cost-effective means to deliver comprehensive risk reduction programs to additional worksites ranging from small to large employers.

First of all, one unequivocal caveat is that a public health model of exposing the entire employee population to such programs is a necessary but not sufficient condition to achieve enduring risk reduction. Interventions that depend solely on educating the general employee population are relatively inexpensive. However, they do not appear to be as effective as a more intensive and expensive approach that adds sustained, periodic individual counseling and support.[77–83,86–89] Every program included in this review that focused on high risk offered individualized risk reduction counseling to high risk employees in the

context of a worksite risk reduction education for all employees. Surely, the general health promotion and disease prevention environment of a worksite appears to be a necessary but not sufficient prerequisite to engender sustained risk reductions among high risk employees.

Following directly from this observation is that once such a supportive worksite environment is established, the most significant clinical and cost outcomes are likely to be evidenced when a subsequent intervention is introduced that focuses on identified individualized risks. Such a disease management intervention needs to provide focused, consistent, sustained behavioral change, plus appropriate medical oversight.[62,63,87–89] Such a multiple-risk-factor intervention model is also applicable to single risk factors, such as smoking and hypertension, as well as to other chronic conditions (i.e., stress, arthritis, musculoskeletal disorders, VDT disabilities, back injuries or pain, and cancer) that also constitute major clinical and cost liabilities to employers.[88–90] One recent study at Chevron by Goetzel[94] in 1998 reported reduced pharmaceutical expenditures. This is a significant outcome, since pharmacy remains one of the most rapidly rising, unchecked areas of medical expenditures.

Comprehensive, Mutlifactorial Cardiovascular Disease Interventions and Cost-Effectiveness Analyses

Since comprehensive cardiovascular intervention programs are among the most well developed and evaluated, it is useful to briefly consider the applications and limitations of such programs for other chronic diseases in terms of both clinical and cost outcomes. From the onset, it is essential to note that none of the comprehensive cardiovascular risk management interventions has used the worksite as the assignment and/or analysis in order to analyze cost effectiveness outcomes. With this major caveat clearly in mind, it is illustrative to cite briefly the few comprehensive, multifactorial, cardiovascular disease management interventions that have analyzed cost-effectiveness. These studies can provide insights into both the limitations and applications of adding cost-effectiveness outcomes in future studies of any comprehensive multifactorial interventions with the worksites as the unit of randomization and analysis.

One study focused on a 32-worksite consortium of government, finance, education, and manufacturing companies in the Minneapolis/St. Paul metropolitan area that participated in a randomized worksite trial. This program focused on weight reduction and smoking cessation as cardiovascular risks.[70] Of a total of approximately 10,000 employees, 2041 enrolled in a weight control program and 270 participated in a smoking cessation program over 2 years. Among program participants, weight loss averaged 4.8 pounds, and 43% of the smoking program participants quit. There was a significant net, 2-year reduction smoking prevalence in the treatment vs. control sites. There were reductions of 2.1 percentage points in cross-sectional and 1.3 percentage points in the cohort surveys, respectively. There were no significant treatment effects for the weight loss program. Cost of the smoking program was estimated at $1500 for 2 years per site, resulting in 8 to 16 extra quits. Thus, the cost for each quitter was estimated to be $100 to $200. In 1993, the same investigators analyzed their data to determine the effect of these two programs on absenteeism.[40] According to this study, the percentage of employees reporting illness-related absences in the last month decreased approximately 3.5% more at the intervention than at the control sites. Further analyses also indicated that the effect was most pronounced on workers who smoked at baseline.

To date, perhaps the best evaluated quasi-experimental series of worksite studies focusing on multiple-risk-factor reduction interventions for the management of cardiovascular disease is the sequence of five studies conducted at General Motors by the late Jack Erfurt, the late Andrea Foote, and Max Heirich with their colleagues at the University of Michigan. Starting in 1987, Erfurt, Foote, and colleagues focused on using four different levels of intensity of intervention for both wage and salaried employees of General Motors. Their initial study addressed weight loss and smoking cessation among 7804 employees in four different GM worksites over a 3-year intervention period.[63–65] Four worksites, but not individuals, were randomized in a quasi-experimental design, with three worksites being given regular classes, two with additional individual counseling, and one control site. At the two sites with counseling, participation was 46% in smoking cessation and 54% in weight loss. Offering classes without individual counseling attracted only about 10% of the at-risk groups, the same percentage as at the control site. In 1987, the research team attempted to identify strategies for effectively engaging at-risk employees in risk reduction activities, and to assess effects of frequency of follow-up counseling on reduction of risks. Working with approximately 2000 white-collar, clerical, and blue-collar manufacturing employees with hypertension, smoking, and/or overweight risk factors, they intervened in two comparable worksites without a control site. They compared participants in risk reduction activities and changes in risks receiving more vs. less follow-up counseling. Overall, they concluded that more frequent worksite counseling is associated with greater participation in smoking cessation and weight loss and greater reduction in blood pressure among hypertensives.

From a public health point of view, a major strength of the comprehensive, multifactorial disease management interventions reviewed here is the ability to reach relatively large, stable populations and to engage them in sustained disease management changes. Although data on participation in health improvement activities in the general population are limited, it is generally conceded that few high risk individuals voluntarily seek out such services.[5–8,43,77] In a recent study of mail-based recruitment in the general population to smoking cessation and weight loss programs, sign-up rates for were less than 1% of households for smoking and 3% to 5% for weight loss.[49] Unit costs of recruiting a program participant ranged from a prohibitive cost of approximately $11 for weight loss to $62 for smoking cessation. In contrast, participation rates in similar programs in the worksite studies cited in this review have generally been 5 to 10 times as high, with a resulting

decease in the cost per participant. Even if the success rates in worksite programs are considerably less than those among participants in clinic-based programs, the numbers of people favorably affected is much higher.

Cost Outcomes

Noting the general success of comprehensive worksite programs should not, however, be interpreted as a blanket endorsement of every program that has been attempted to date. One study by Erfurt and Holtyn[65] has clearly demonstrated that participation in worksite programs is sensitive to cost. Asking or requiring employees to pay out of pocket for such programs dramatically reduces participation rates. An important contribution that future researchers could make to improvement of interventions would be to systematically evaluate the various components or combinations of components from multifactorial interventions. This would permit the more efficient use of limited intervention and financial resources.

It is evident that there is a profound lack of standardization of what constitutes either costs or benefits in such interventions and their subsequent evaluations.[84–87,89,91,94] Costs for things such as space, utilities, salaries of onsite health personnel, paid time for employee participation, and other significant cost variables are not standardized. Additionally, these variables are often either included in or excluded from cost considerations in an arbitrary manner.[43] Likewise, the benefits of such programs in terms of cost savings specific to individuals, savings to the corporation, decrease in the rate of medical expenditure, and overall impact on areas of absenteeism, performance, and productivity are often equally arbitrarily defined and selected.[5–8,43,72,77] This observation is not to be critical of any specific study but to point out a methodological issue that limits compatibility and generalizability. One additional caveat is that cost-effectiveness is often based on assigning a dollar value to specific risk factor reductions. Although this is a common procedure, such extrapolations are tenuous at best. Given the high degree of variability in the operational definitions of both the cost and benefits, interstudy comparisons are difficult to determine.

It is also extremely important to note the issue of "high cost analysis."[76] High cost analysis is based on the observation that medical claims data are highly skewed and violate the statistical assumption of normality. Since a small percentage of employees incur the largest percentage of medical costs, the standard deviation is large and skews the claims data to the upper end of the normal curve continuum. As a result, the mean is generally much higher than the median. This "inappropriate" use of means in cross-sectional studies underestimates sample bias, overestimates the descriptive difference in cost for high risk and low risk employees, and underestimates the statistical significance of large differences observed between the means for the two groups.

These worksite studies engender the problems cited above, along with two additional issues. Using statistical measures of arithmetic means assumes that an intervention that appears to lower costs for participants achieved a small effect among all high risk participants. However, it may in fact have substantially reduced the costs for a small number of high risk employees. This failure to address high risk employees dilutes the cost-effectiveness of the intervention[84,86,91,92,94,95] While comprehensive, multifactorial programs will and should continue, it is increasingly clear that programs of secondary prevention focusing on high risk individuals will be increasingly important in disease management and managed care.

Intervention programs and their subsequent evaluations must be of sufficient duration to demonstrate clinical and/or cost outcomes. Results from this review and others strongly suggest that a program must be sustained for a minimum of 1 year to bring about risk reductions among employees and for 3 to 5 years to demonstrate cost effectiveness.[85,88–92] A majority of such long-term studies indicate that program effects were maintained after the program was completed with UNUM over 10 years[85] and with Coors over 8 years.[89] Clearly, the preponderance of evidence suggests that program effects are more likely to be maintained if the employer continues to support and reinforce employee risk reductions. Ideally, worksite health promotion programs should be supported by senior management so that they can become part of the underlying fabric and culture of the organization. Studies of the Johnson & Johnson "Live for Life" program,[49–52] as well as studies of similar well-executed large-scale corporate initiatives,[83–86,88–92,94] demonstrate that when such programs are well integrated into the human resource strategy of an organization and accepted as the "norm" for the organization, they are likely to be well implemented and effective.

DISCUSSION AND FUTURE RECOMMENDATIONS

None of the multifactorial comprehensive intervention programs reviewed here reduced all indicators of risk. However, the majority of programs of sufficient intensity, breadth, and duration did result in a decrease in an adequate number of the risks to result in an overall risk reduction.[85–94] One major advantage of comprehensive, multifactorial programs is that different employees can benefit from the same program in different ways by focusing on one particular risk factor such as controlling hypertension, reducing cholesterol, managing stress, or quitting smoking. Future interventions and evaluation efforts should give more attention to developing other nonspecific outcome measures, improved overall health status, and enhanced functional status that will better reflect overall reductions in risk and improvements in general health status. Most importantly, future assessments of cost outcomes for a given clinical intervention must address the potential financial impact in terms of integrated disability management. Interventions may impact not only medical costs *per se,* but also related costs including absenteeism, sick days, sales/revenue losses per employee, replacement costs of temporary workers, performance, and productivity. While such factors have been demonstrated to be affected by interventions in a piecemeal fashion, the potential economic impact is yet to be determined in an integrated model. As such integrated approaches evolve, the cost-effectiveness of comprehensive worksite-based interventions is likely to evidence even greater return on investment.

Few of the interventions cited here focused on the physi-

cal, psychosocial, or policy work environment and its role in employee health. Based on earlier reviews of comprehensive health promotion and disease prevention programs at worksites,[3–5,9,10] it is evident that employees need to know that their organization is seriously concerned about their health. Also employees need to be afforded the flexibility necessary to participate in worksite health promotion programs. Employees need to perceive that their senior management, supervisors, and coworkers have positive attitudes toward health, since these factors have all been associated with improved employee health status.[85–92,94] Feeling valued as an employee, having control over job performance to reduce "job strain," and being satisfied with work appear to be significant predictors of employee health and health behaviors. Interventions and evaluations of worksite programs should benefit from including such components and measures of the work environment in order to determine the influence of such factors on the overall clinical effectiveness and cost-effectiveness of these interventions.

Every intervention cited here, as well as virtually every study in the worksite health promotion and disease management literature, was provided to active employees only. Numerous medical insurance surveys have cited the fact that the actual medical expenditures for a corporation are greatest for retirees and dependents rather than for their active employees. This is partially due to the growing ratio of the number of retired vs. active employees, as well as to the overall aging of the population. Since chronic disease increases with age, resulting in greater morbidity, mortality, and cost to employers, a future significant direction would be to extend such programs to both retirees and dependents. Also, such interventions need to be focused on and evaluated relative to the unique characteristics of the working poor and racial and/or ethnic subpopulations at the worksite.

Other unaddressed issues in worksite-based prevention are the durability of the effects over time and potential impacts on medical care costs. If such programs are to be self-supporting over time, it must be demonstrated that: (1) A mature program that is in place over a period of years results in a healthier work force. Virtually all of the research to date has addressed effects over short time intervals of a year or two. (2) Effects have seldom been evaluated using the entire work force. None of the studies has taken into account changes in work force size and composition as a result of turnover and changes in medical benefits plans. (3) New research focusing on this issue by utilizing the worksite as the unit of both randomization and analysis would be very useful in evaluating the full potential of this type of intervention. (4) A longer timescale, of at least 3 to 5 years, is also important in evaluating the potential cost-effectiveness that may accrue from comprehensive worksite health promotion.[85,89,90] This is true because health care costs tend to be distributed unevenly, as in "high cost" analyses, and may be manifested most strongly in later years of life, after active employees have retired.

In reviewing the studies here, the most promising future directions appear to be with disease management programs that combine comprehensive plus high risk interventions and those interventions that focus on a dose–response model of increasing levels of intensity.[86,87,90,91,93,94] Although difficult and expensive to conduct, randomized trials comparing combinations of comprehensive public health approaches combined with individualized behavioral counseling would be instrumental in furthering our understanding of what constitutes an effective intervention. Such studies should also incorporate more detailed descriptions of the process of the intervention and more explicit objectives and outcomes of each of the program's activities. Including specific data points and measures for each objective in the evaluation plan will help identify at what point in the process the hypothesized linkages are breaking down.[18] Rather than only being able to make statements about the program as a whole, such evaluations can more precisely pinpoint the strengths and weaknesses of specific components of the program. Additionally, the inclusion of qualitative evaluation methods could aid in identifying the strengths and weaknesses of programs from the perspective of the employees.

CONCLUSIONS

Comprehensive health promotion and disease management programs have evolved significantly in both large and small worksites over the last 2 decades. Large self-insured and self-administered corporate medical plans are prototypes of the increasing emphasis on comprehensive health promotion and disease prevention programs in managed care plans. Inherent to managed care is increasing emphasis on both clinical effectiveness and cost-effectiveness. Studies cited in this article and in previous reviews are providing corporations, insurance providers, consulting firms, and government with the preliminary data to guide program design, implementation, and evaluation. With the second generation of worksite programs comes a greater emphasis on disease management with high risk employees, combinations of public health and individualized behavioral risk management, harnessing of telemedicine delivery technologies, and extension of such interventions to dependents, retirees, and racial and ethnic minorities, as well as the working poor. Results of the comprehensive multifactorial risk and disease management interventions at worksites reviewed here provide cautious optimism about the clinical effectiveness and cost-effectiveness of these worksite programs. Also, they provide initial insights regarding the critical components and characteristics of successful programs. At this time, the most salient issue for insurers and corporations to address is not whether worksite health promotion and disease management programs should be implemented to reduce risks and enhance productivity, but, rather, how such programs should be designed, implemented, and evaluated in order to achieve optimal clinical effectiveness and cost-effectiveness.

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