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Understanding the Durability of a Fire Department Wellness Program

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Abstract

Objectives—To understand the influences associated with durability and diffusion of benefits of a fire service wellness program.

Methods—Qualitative assessment of group interviews.

Results—Five years following a controlled worksite wellness trial, behavioral improvements were durable and had diffused to control participants. These findings were associated with firefighters' team orientation, enacted healthy norms and competitiveness regarding the results of annual health assessments. The original intervention trial appeared to initiate individual change that coalesced into group effects. Secondary influences included increasing public awareness about health, newly hired younger firefighters, and a modicum of administrative support. Culture shift was achieved at the workplace.

Conclusions—Although the fire service is a unique occupation, these findings suggest general strategies to achieve durable positive health change in other occupational settings.

Keywords

worksite; dietary behaviors; physical activity; qualitative

Worksites are recognized as effective settings for health promotion, as interventions can be delivered, social norms altered, peer support recruited, and environments restructured.¹ Yet, even as a national initiative is underway to implement and expand evidenced-based worksite

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Conflict of Interest Statement

PHLAME is a program on the Cancer Control P.L.A.N.E.T. site for research-tested programs, and it is distributed through the Center for Health Promotion Research at Oregon Health and Science University (OHSU). OHSU and Drs. Elliot and Kuehl have a financial interest from the commercial sale of technologies described in this manuscript. This potential conflict of interest has been reviewed and managed by the OHSU Conflict of Interest in Research Committee.

wellness, the durability of benefits has received limited study.² A review of 33 worksite wellness programs with control or comparison groups found the majority had 2 or less years of follow-up.³ Assessment of dietary habits, physical activity behaviors, and weight loss maintenance is rare more than one or 2 years following an intervention, and in general, initial positive changes have not persisted.^{4–11}

Promoting Healthy Lifestyles (PHLAME) is an evidence-based worksite wellness and safety program designed specifically for firefighters. These workers' behavioral profiles are comparable to other employed adults, including ones having unhealthy diets and lacking regular physical activity.¹² Myocardial infarctions are the leading cause of firefighters' deaths while on duty;¹³ moreover, perhaps due to toxin exposure, their risk of cancer is increased.¹⁴ An initial PHLAME randomized, controlled intervention trial achieved significant favorable diet and exercise outcomes,¹⁵ and the program is listed on the Cancer Control P.L.A.N.E.T. evidence-based website (<http://cancercontrolplanet.cancer.gov/>).

To investigate the durability of the positive outcomes, a follow-up PHLAME II study was funded as one of 21 projects comprising the Health Maintenance Consortium (<http://hmcrc.srph.tamhsc.edu/default.html>). Rather than the expected attenuation of favorable program effects 4 years after the intervention, control and intervention participants continued positive trajectories regarding nutrition, physical activity, and body weight.¹⁶ PHLAME II's quantitative methods only generated speculation about the mechanisms of those findings. This report's qualitative research was conducted to understand why favorable results were sustained and extended throughout the worksite.

METHODS

PHLAME I – Intervention Trial (2000 – 2003)

The original PHLAME (Promoting Healthy Life-styles: Alternative Models' Effects) study randomized fire stations within participating departments to 3 conditions: (1) a control group that received usual care, (2) an intervention group that experienced a peer-led team-centered curriculum delivered to shifts of firefighters, and (3) a second intervention group that received individual one-on-one motivational interviewing. As indicated by the study's name, the interventions had different theoretical bases: social cognitive theory enhanced by firefighters' natural team structure¹⁷ and intrinsic motivation and self-determination theory,¹⁸ respectively.

The participants were 599 firefighters (N = 579 males, 20 females) from 5 fire departments in northern Oregon and southern Washington, pre-dominately white (90.5%) and married (79%), with a mean age of 40.7 years and 15.4 years experience in firefighting. Study enrollment was high at 86% of eligible firefighters, of whom 80% were retained at one year. At one year, both interventions achieved significant positive behavioral outcomes, and details of the interventions, analyses, and study findings have been reported.^{15,19}

PHLAME II – Quantitative Follow-up (2004 – 2008)

With support from the National Cancer Institute and the Office of Behavioral and Social Sciences Research, PHLAME II assessed participants for 4 additional years.¹⁶ PHLAME II offered no intervention other than annual assessment of anthropometric measures (height, weight, and body mass index [BMI]), aerobic capacity²⁰ and self-reported exercise habits and dietary behaviors.²¹ Firefighters were mailed their annual results in a manner similar to the reporting that might follow an individual's visit to a physician.

PHLAME II tracked findings for firefighters assigned to each of PHLAME I's 3 conditions, and the outcome trajectories across time were generally positive for all 3 groups.¹⁶ Although

an initial intervention effect was observed, that advantage dissipated, suggesting a diffusion of effects to control participants. For all 3 conditions, sequential values for age, BMI, measures of maximum oxygen uptake, self-reported exercise habits, and fruit and vegetable intake are shown in Table 1. Figure 1 shows those latter 3 variables for the entire PHLAME I follow-up cohort (all 3 conditions) as a percentage of the baseline. Only participants originally enrolled in PHLAME I were followed in each sequential assessment. The PHLAME II findings departed from the natural decline in fitness levels and increase in BMI anticipated in a maturing population.

PHLAME III – Qualitative Follow-up (2009 – 2010)

Fire stations usually are staffed by 3 4- to 8-member shifts, each working 24 hours followed by 48 hours off-duty. Firefighters are assigned to a station, and station transfers and contamination across study conditions was monitored closely in PHLAME I. However, over subsequent years, transfers resulted in mixing of study conditions at stations. By PHLAME III, shifts had participants from all 3 study conditions, along with new hires. A representative convenience sample of 12 shifts participated in the qualitative study. Of the 68 firefighters in group interviews, 75% (N = 51) also had participated in PHLAME I, whereas 17 (25%) had been hired thereafter. Of those who had participated in PHLAME I, a mix of study conditions was observed in each interview group. Although participants in PHLAME I were essential to understanding durability of health benefits, new hires added understanding of dissemination beyond the original study groups.

Ethics

PHLAME I, PHLAME II, and PHLAME III were separately approved by the Institutional Review Board of Oregon Health and Science University. Firefighters signed informed consent forms at the initial study enrollment (PHLAME I), prior to PHLAME II, and before the final group interviews.

Data Collection and Analysis

For PHLAME III, firefighters participated as shifts at their stations in anonymous group interviews lasting approximately 60 minutes. Trained interviewers used a semi-structured interview guide, which used open-ended questions in the domains of potential promoters and hindrances to the long-lasting health benefits recorded in PHLAME II. The strategy allowed comparison of responses across groups and probative follow-up questions. Interviews were audiotaped, transcribed, reviewed for accuracy, redacted of names, and assembled for analysis.

Thematic content analysis involved reiterative readings of interview transcripts to identify and code patterns and influences on the impact of the wellness program based on participants' actual experiences. Construction of themes and interpretations^{22–25} avoided the substantive bias inherent in *a priori* categorization, instead adapting the more inductive constant-comparative method typical of grounded theory.^{26,27} As the data set was subjected to micro-review in a search for data that might confirm or refute tentative interpretations, emergent themes evolved (Table 2). Preliminary findings were constructed, and to surface and evaluate rival explanations, theoretical triangulation²⁸ was undertaken involving expectancy frameworks and Bronfenbrenner's²⁹ ecological model.

Quality control to protect validity and avoid bias involved a 2-phase process. First, the first 2 authors independently developed and compared potential themes and interpretations. Second, a succession of drafts organizing discussion of the data according to the evolving themes with their corresponding findings, were reviewed by authors and revised until agreement was reached.

Organized thematically, the presentation of results emphasizes actual phrasing by participants, privileging this “incontestable data”^{23,25} to provide more immediate acquaintance with the firefighters’ experiences than is possible with a summarized discussion of data. The “vicarious experiences”^{22,24} provided by the interview excerpts are intended to enhance readers’ understanding³⁰ and the development of “tacit knowledge,” more influential than “propositional knowledge” for generalization to other occupational settings.³¹

RESULTS

Potential explanations for the durability and diffusion of the positive changes from the original PHLAME controlled intervention trial were identified through analysis of the qualitative interview data.

Intervention Awareness to Durable Change

Although firefighters generally expressed a good-natured openness to possibilities, many were initially skeptical about PHLAME. They had experienced previous fire department wellness initiatives that had little or no positive impact, and they doubted that another program would improve upon past performance. In this willing but wary atmosphere, the specific information provided in PHLAME interventions was enough to prompt dispositional change followed by altered behavior. One firefighter remarked, “Personally, I needed somebody to start saying, you know, like the number of fruits and vegetables” [recommended for daily intake]. Others were stirred to action by information so memorable that, more than 5 years later, one vividly remembered a demonstration of “how much fat was in mayonnaise. I love mayonnaise on my sandwich [but], every time I put it on, I think of that – like, ‘Oh, God, do I really want to do this?’”

Individual dietary changes could transfer to an entire shift through shared on-duty meals, intensifying group awareness and alterations in attitudes, which in turn, prompted a cascade of behavioral changes. Selection of healthier foods for on-duty meals was frequently reported, one firefighter noting a group decision to “substitute ground turkey for ground beef, you know – trying to pick smarter or healthier choices.” Another firefighter reported that entire categories of food moved onto shifts’ menus: “Fruits and vegetables weren’t available [then, so] we just ate what was there. But now, it’s more of a dedicated effort.”

A joking camaraderie was readily evident in interview transcripts, and PHLAME itself was the subject of good-natured ribbing. Significantly, the communal jesting had the effect of encouraging individual efforts to change: “We make fun of it, but then it still sticks in our head. When you’re at the store shopping ... instead of buying [bacon], ‘Okay, we’ll do some Brussels sprouts.’”

Firefighters increasingly analyzed what they were eating, with their alertness becoming routine: “The kind of food has been scrutinized a lot more.... *Organic* is not a bad word, anymore. Or, you know, *natural* is not something to be frowned upon. It’s kind of like, ‘Hey, let’s try that!’” Openness to further change expanded and led to eating “a lot more organic stuff and a lot more vegetable-based. I think people are more willing to try things now. [For example,] ‘Let’s not eat any meat today’ ... If you said that back then, you’d probably be knifed in the back [laughter].”

New priorities influenced a shift’s shopping habits: “We tend to buy more vegetables... to hit the periphery of the grocery stores ... unless we need, like, a can of reduced-sodium chicken broth or something.” Coupled with food choice came changes in food preparation, especially less frying, reported as “a marked change in our cooking.” Also, portion sizes

were adjusted downward. Prior to PHLAME, “everyone had 2 sandwiches or 2 hamburgers. Now, some people don’t even eat the whole hamburger.”

The durability was explained by one firefighter with deceptive simplicity: “Once you start eating better and stuff, I think you just continue doing it.” The altered behaviors became instinctive, bypassing conscious thought as automaticity developed: “We always have at least one banana a day, and the other stations – the same thing. Now, it’s just kind of like second nature.”

In group interviews, references to “we” and “everyone” drew nodding agreement or amplification, not contradiction, from other participants regarding the “drastic change in eating habits and our awareness.” Moreover, according to direct testimony, dietary improvement was throughout the department: “Some shifts are still 300% into the program, where others have come down – but everybody seems to be doing more of the mixed diet, the better eating.”

Durable dietary benefits were more robust than exercise improvements, and 3 findings explained that differential impact. First, firefighters’ inclination toward physical activity led some to dismiss need for additional exercise: “People that get into the firefighting field already have this tendency towards fitness.” Second, firefighters perceived the locus of control for workouts to be more individual than that for shared on-duty meals, often remarking, “People who are fit [are those who] want to be fit.” Third, exercising was less communal and less amenable to positive social reinforcement.

Still, a positive PHLAME effect for exercise was evident in comments such as: “We’ve always worked out, but [PHLAME] gave you a reason to work out.” That participants credited the program was also clear: “If it wasn’t for the whole PHLAME initiative, it would have never happened in my opinion.” According to some (but not all) interviewees, effects were sufficient for workplace exercise norms to have changed: “Now, you come in, and you’re expected to be in shape and work out. That’s just part of the day.”

Team Orientation and Reciprocal Reinforcement

One of PHLAME’s 3 conditions, the team intervention approach, dovetailed with the firefighters’ professional teamwork. They recognized this factor: “The whole team thing – I think that’s why this program has been successful here.” A positive reinforcement cycle developed as PHLAME stirred individuals toward dispositional and behavioral change, improvements that were manifest in on-duty conversation and actions and coalesced as group norms. With collective alterations, the resistance of malingerers eroded. So, in some cases, individual change catalyzed group change whereas in other cases, group change spurred individual change. This reciprocity resulted in revised values and priorities evidenced in behaviors. Once begun, individual and group change mutually reinforced one another.

Firefighters, dependent on each other for support during their work, exhibited a tendency to avoid conflict and even disagreement among themselves. Jollyng outliers into the fold, they amicably but relentlessly joked and teased each other into acceptance of group norms. Adopted into this psycho-social context, the new diet and exercise routines were invisibly but ably protected by a wall of good humor, as suggested by this dead-pan comment: “Yeah, it forces your hand. You’ve got to participate, or they’ll just beat you into the ground.” Analyzed from an ecological perspective,²⁹ change begun at the macrosystem level of understandings and values regarding health and fitness, quickly manifested as behaviors and interactions in the microsystem level (Table 3).

Competition Based on Annual Assessments

Within the mesosystem, the working relationships among firefighters included a team orientation and tendency toward competitiveness, both contributing to their improving wellness. Interviewees frequently acknowledged that firefighters “are all competitive by nature ... Like, if somebody runs something like 400 meters ... in 60 seconds, well, the rest of us are going to try and do it in 59.” Their desire to outperform each other was balanced by their interest in functioning as a team, which led them to work to improve aggregated group measures of health. Beginning in PHLAME I, participants had been assessed annually, and less extensive but comparable yearly evaluations had been conducted during PHLAME II. Firefighters appreciated the testing’s comprehensiveness and precision, which contrasted with their prior department-provided or individual personal physician-provided assessments. They acknowledged that they were “covered by insurance to go and have physicals. But, to tell you the truth, the physicals we get from the doctor’s office are kind of lame – not as thorough as what we did with PHLAME.” In their judgment: “We got some high quality information out of it. I mean, it was some pretty superior testing.” Recognition of the quality of the PHLAME test results “made a difference in our attitude. It was like, ‘Hey, we’re getting some realistic information here. I want to go harder and find out what my VO_{2max} really is.’”

The incontrovertible nature of the measureable results magnified the effect: “You get your numbers ... [and] you kind of go, ‘Oh, geez. I need to maybe make a few changes,’” and access to this information was galvanizing. One firefighter, who acknowledged that individualized results created a sense of personal urgency, ranked testing as the most transformative aspect of PHLAME: “The biggest change was [because of] test results.... I was right there on the borderline, [and my test results] made me eat more fruits and vegetables.”

Firefighters quickly grasped that “you’ve got to understand your body and what’s going on with the blood work, the VO_2 , [so that] ... from year to year, you know whether you’re going down or up or staying the same.” As reactions like these rippled through the department, “you could tell PHLAME was taken seriously.” Spontaneously, individuals began to compare their own results from one year to the next, engaging in intrapersonal competition based on tangible progress.

Even more electrifying was interpersonal competition in the casual camaraderie of the shift where “everybody always kind of compares notes. They look at your numbers... Then, ‘We’re going to take care of him.’” Statements such as this revealed that the measurements strengthened mutual support, in keeping with the firefighters’ team orientation, while also triggering interpersonal “competitions on how many points, which led to redoubled efforts and more exercise than there had been.” The effect was so strong that traces remained in memory more than a year after the assessments ceased at the end of PHLAME II. One firefighter, for example, remembered that the testing had been “great ... There was [sic] people that were, like, ‘Oh, man! I better get in there’” even as he lamented, “Now they’ve got rid of those.”

Changing Demographics and Society Norms

Many interviewees noted that the average age in their department had declined due to the hiring of younger firefighters and the retirements of older co-workers. The net effect was that attitudes “just slowly kind of switched over” in favor of wellness, helping to sustain change. Firefighters nearing retirement reported enduring pro-health priorities, one saying, “I try to eat more fruits and vegetables [and] I definitely do more physical activity... because I’m close to retirement, and I want to live longer.”

Newly hired firefighters infused the department with positive habits and perspectives: “We’re dealing with a much younger workforce ... a totally different generation [with a different] way of cooking – [people who] don’t even know how to deep-fry something.” One veteran noticed that young firefighters “bring different sets of core values and habits [from those] that my generation or the generation before me held. It definitely changes or influences the way that you act and behave.” The dispositions of incoming firefighters included a proactive element: “The younger ones have knowledge, and they want to be healthier. They are eating healthier, and they’re trying to motivate the rest.”

Their health-consciousness reflected a larger societal change: “Younger people coming in, I mean, they’re really aware, you know, and better at [choosing] healthier foods and ways to cook and all that stuff. I think that’s probably because, in society, you know, it’s everywhere.” Increased public access to health information rendered older firefighters susceptible to the efforts of newbies: “The information is out there more. You hear it more often. Just hearing it over and over again, it starts to sink in, I think.” Regarding the evolution within the fire department, one interviewee attributed improved health in the department solely to increased public awareness: “I’d say it was more of a cultural change in society, as opposed to PHLAME ... things you read in the paper, things on TV, things you hear on the news, in the mass media. To be quite honest with you, I don’t think PHLAME changed me, other than [giving] me the initial awareness, maybe. I think that society has ramped up.” Most, however, considered PHLAME part of a complex of interacting influences: “PHLAME did start generating ... people thinking in a different way.... Younger people and society, everywhere you look ... the information is out there to eat better and to exercise.”

Administrative Support and Off-duty Carry-over

Sustained impact was influenced to a lesser extent by administrative support at the exosystem level (Table 3). Less reliable as a positive factor, department administrators were sometimes considered “very pro good health,” one firefighter noting that “the big chief, he goes and does his exercise every shift.” More frequently, however, interviewees described “people wearing white shirts ... [as] some of the worst ... that are out of shape.” The few commendations about the department administration were overwhelmed by complaints that “management goes through the motions.” One firefighter dismissed any departmental role in the sustained health improvements, saying, “It’s not mandatory to take care of yourself... It ultimately falls on the individual.”

Some interviewees suggested that support was limited for reasons beyond administration control. For example, some considered constrained civic backing the nucleus of the problem: “I’m not faulting the chiefs or our administration, because they have to make the hard decisions. But I think that if we got more cooperation from the city ... [to] make sure they have dedicated money [for] wellness and fitness that would help a lot.” However, most were disinclined to countenance financial excuses: “I count on my partner to be in shape to help me if I get in trouble. The bureau doesn’t really seem interested.” Those interviewees who reported pro-health administrative action tended to credit PHLAME as a catalyst: “The only reason why it started was because you [PHLAME] guys got yourselves a grant and said, ... ‘Here’s something for free.’ ... The Bureau, after a couple years, decided, ‘OK, let’s put a little bit of budget into it.’”

The clinching point in firefighters’ overall reckoning that wellness “seems pretty unimportant for the administration” involved the loss of PHLAME’s highly regarded annual testing. Uniformly described as “great,” the loss of these assessments was typically blamed on the administration: “Now they’ve got rid of those.” Instead of continuing program benefits by providing an equivalent replacement, the department reportedly substituted “a

physical agility [test] this year that wasn't even mandatory. It was just voluntary." Even that was dropped: "We are no longer required to do annual physical agility tests ... [which] motivated people that were prone to becoming overweight ... to get back in shape so they could pass the physical." The firefighters were disappointed and confused: "I'm not sure why. I have no idea."

Evidence was mixed regarding the extension of on-the-job behavioral change to off-duty hours, with most of the reported carry-over involving diet. Most tended to agree that "we're better cooks here at work than we are at home.... Time is dedicated to cooking meals here." However, for some participants, PHLAME-related dietary improvements "helped me make better decisions on my days off." Others credited PHLAME with encouraging them to become informal health ambassadors to their families, for example: "I've taken quite a few recipes and tidbits back to my family, both my parents and my wife. They've heard countless PHLAME this and PHLAME that, don't eat this and don't eat that – stuff I've learned." A more direct role in altering family eating habits was described by one firefighter who explained, "I remember all the pamphlets and all that stuff we read about how many fruits and vegetables you should have every day.... I do most of the cooking at home, so I try to add more fruits and vegetables." Overall, dietary changes at home appeared more gradual than at the workplace, and changes in off-duty exercise appeared negligible.

Culture Shift

The reciprocity between early individual and subsequent group improvements encouraged laggards and guarded against backsliding. Program impact also benefitted from a natural fit between the objective annual test results and the participants' acknowledged competitiveness, eased by humor. Institutionalization of change was aided by demographic trends – retirements and the hiring of younger personnel immersed in a society offering ever more access to health information. Although individual off-duty adjustments proved more sporadic than communal worksite health improvements, evidence of a worksite culture shift was unmistakable.

DISCUSSION

Qualitative interviews revealed explanatory factors relating to the observed diffusion and durability of positive behavioral outcomes several years following a fire service wellness intervention trial. Findings suggest that as the interventions' specific and memorable information was provided, firefighters' awareness converted into momentum toward healthier actions. Influenced by a team orientation and the practice of communal meals on duty, individual and shift-wide change were reciprocally reinforcing, producing a continuous feedback loop that strengthened the durability of outcomes over time. Rigorous and highly regarded individual assessments inspired intra- and interpersonal competition that intensified wellness efforts. Despite lacking strong administrative support, the culture shift signaled by more than 5 years of lasting effects was sustained by the firefighters themselves.

The fire service was selected as a site for PHLAME I because workers are a higher risk group, stations offered a convenient unit of randomization, and the team-oriented shift structure is a natural fit for a team-centered intervention. Their work structure, competitiveness, and camaraderie all promoted durable change. Workplace change became institutionalized as greater awareness solidified into healthier norms regarding grocery shopping and cooking, and to a lesser extent, regular physical activity. The resulting value shifts sustained healthy attitudes and behaviors.

In the years following the original trial, firefighters had switched stations, and ranks were infused by health-conscious newcomers, so that shifts contained a mix of initial intervention conditions and new hires. The interview findings confirmed that benefits had diffused across the department. When PHLAME II's quantitative findings were reported, the fact that almost two-thirds had participated in initial effective interventions, a rate generally not seen in worksite wellness trials, was hypothesized as a factor leading to department-wide diffusion,¹⁶ noting that perhaps a tipping point for altered norms had been achieved. These qualitative results suggest mechanisms that facilitated diffusion.

Not all comments were positive, and as illustrated, some attributed change solely to personal factors, new hires and altered societal norms. The maintenance of exercise regimens over time was less robust than dietary measures, perhaps relating to more individual workout routines. Concerning altered demographics and a more health conscious society, those trends' effects are difficult to quantify, and comparable longitudinal data of firefighters are limited. In other settings, cross-sectional data indicate that, as expected, fitness generally declines as firefighters age.³² We recently completed a translational study of the PHLAME team curriculum, which involved assessing firefighters from 12 departments.^{33,34} Although not a primary outcome, each of those departments was younger on average than the PHLAME II longitudinal cohort, and each had higher average BMIs and lower fruit and vegetable intakes,³⁴ suggesting the durability and diffusion of health behaviors do not just reflect secular trends and the admix of younger, healthier firefighters.

Our findings have limitations. Responses may have been biased by the social desirability of over-reporting favorable behaviors,³⁵ and firefighters' cognitive dissonance resulting from the initial interventions.³⁶ To minimize that potential, interviewers' training included remaining neutral, monitoring for group polarization and being accepting of all responses.³⁷ Although the majority of quotes selected illustrate aspects that relate to durability with implications for other worksites, a range of responses also is illustrated. Finally, social desirability may be less of a factor, as when objectively assessed, self-reported actions were minimally biased and comparable to observed behaviors.³⁸

In the theoretical terms of an ecological analysis,²⁹ culture shift is contingent upon positive conditions in and positive reinforcement among each of 4 levels described in Table 3. Interview data showed substantially positive interdependence, for example, making clear that both teamwork and competitiveness (in the mesosystem) supported the firefighters' dispositional changes (in the macrosystem) and behavioral changes (in the microsystem) with at least minimal support from the administration (in the exosystem).

The influence of annual testing was unexpected as in general, assessments alone have tended to increase awareness with only limited effects on behavior.^{39–44} In a critical review, the Centers for Disease Control and Prevention concluded that assessment alone did not change behavior.⁴⁵ In the present case, however, synchronized annual testing reminded firefighters that they depended on each other, revealed vulnerabilities about their health, and heightened individual priority on fitness. Their results also tended to engender amiable, productive competition.

Whereas worksite wellness programs have been identified as beneficial to workers and their employers,^{1–3} factors associated with institutionalization, durability and diffusion of immediate positive outcomes have received little study.⁴⁶ Although the fire service is a unique occupation, these findings suggest generalizability to other settings. First, it appears advisable to identify preexisting worker and worksite characteristics – such as teamwork, communal activities and competitions – and to design program strategies that naturally fit with these conditions. Doing so promotes positive interactions between intervention factors

and context attributes. Enacted healthy behaviors, especially in an atmosphere of camaraderie and positive peer support, can shift norms. In addition, these results confirm the advisability of bottom-up efforts, rather than top-down compliance-driven mandates in revealing the power of individual values and supportive group efforts to create sustainable change.

Human Subjects Statement

PHLAME I, PHLAME II, and PHLAME III were separately approved by the Institutional Review Board of Oregon Health and Science University. Firefighters signed informed consent forms at the initial study enrollment (PHLAME I), prior to PHLAME II, and before the final group interviews.

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References

1. Task Force on Community Preventive Services. Recommendations for worksite-based interventions to improve workers' health. *Am J Prevent Med.* 2010; 38(2S):S232–S236.
2. Centers for Disease Control and Prevention. [Accessed December 1, 2012] Comprehensive workplace health programs to address physical activity, nutrition and tobacco use in the workplace. Available at: <http://www.cdc.gov/workplacehealthpromotion/nhwp/index.html#one>
3. Osilla KC, Van Busum K, Schnyer C, et al. Systematic review of the impact of worksite wellness programs. *Am J Manag Care.* 2012; 18(2):e68–e81. [PubMed: 22435887]
4. Ory MH, Smith ML, Meir N, Wernicke MM. The science of sustaining health behavior change: the Health Maintenance Consortium. *Am J Health Behav.* 2010; 34(6):647–659. [PubMed: 20604691]
5. Elfhag K, Rossner S. Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obes Rev.* 2005; 6(1):67–85. [PubMed: 15655039]
6. Wing RR, Tate DF, Gorin AA, et al. A self-regulation program for maintenance of weight loss. *N Engl J Med.* 2006; 355(15):1563–1571. [PubMed: 17035649]
7. Madden SG, Loeb SL, Smith CA. An integrative literature review of lifestyle interventions for the prevention of type II diabetes mellitus. *J Clin Nurs.* 2008; 17(17):2243–2256. [PubMed: 18705701]
8. Müller-Riemenschneider F, Reinhold T, Nocon M, et al. Long-term effectiveness of interventions promoting physical activity: a systematic review. *Prevent Med.* 2008; 47(5):354–368.
9. Brunner E, Rees K, Ward K, et al. Dietary advice for reducing cardiovascular risk. *Cochrane Database Syst Rev.* 2007; (4):CD002128. [PubMed: 17943768]
10. Hillsdon M, Foster C, Thorogood M. Interventions for promoting physical activity. *Cochrane Database Syst Rev.* 2005; (1):CD003180. [PubMed: 15674903]
11. Toobert DJ, Strycker LA, Barrera M Jr, Glasgow RE. Seven- year follow-up of a multiple-health-behavior diabetes intervention. *Am J Health Behav.* 2010; 34(6):680–694. [PubMed: 20604694]
12. Kales SN, Soteriades ES, Christophi CA, Christiani DC. Emergency duties and deaths from heart disease among firefighters in the United States. *N Engl J Med.* 2007; 356(12):1207–1215. [PubMed: 17377158]
13. Soteriades ES, Smith DL, Tsismenakis AJ, et al. Cardiovascular disease in US firefighters: a systematic review. *Cardiol Rev.* 2011; 19(4):202–215. [PubMed: 21646874]
14. LeMasters GK, Genaidy AM, Succop P, et al. Cancer risk among firefighters: a review and meta-analysis of 32 studies. *J Occup Environ Med.* 2006; 48(11):1189–1202. [PubMed: 17099456]
15. Elliot DL, Goldberg L, Kuehl KS, et al. The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) firefighter study: outcomes of two models of behavior change. *J Occup Environ*

Med. 2007; 9(12):204–213. Available at: <http://www.ohsu.edu/xd/education/schools/school-of-medicine/departments/clinical-departments/medicine/divisions/hpsm/research/upload/PHLAME-Study.pdf>. [PubMed: 17293760]

16. MacKinnon DP, Elliot DL, Thoemmes F, et al. Longterm effects of a worksite health promotion program for firefighters. *Am J Health Behav.* 2010; 34(6):695–706. Available at: <http://www.ohsu.edu/xd/education/schools/school-of-medicine/departments/clinical-departments/medicine/divisions/hpsm/research/upload/06NovDec0610MacKinnon1-2.pdf>. [PubMed: 20604695]
17. Perry, CL.; Baranowski, T.; Parcel, GS. How individuals, environments, and health behavior interact: social learning theory. In: Glanz, K.; Lewis, FM.; Rimer, BK., editors. *Health Behavior and Health Education: Theory Research and Practice*. San Francisco: Jossey-Bass; 1990. p. 161-186.
18. Vansteenkiste M, Williams GC, Resnicow K. Toward systematic integration between self-determination theory and motivational interviewing as examples of top-down and bottom-up intervention development: autonomy or volition as a fundamental theoretical principle. *Int J Behav Nutr Phys Act.* 2012; 9:23.10.1186/1479-5868-9-23 [PubMed: 22385828]
19. Ranby KW, MacKinnon DP, Fairchild AJ, et al. The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) firefighter study: testing mediating mechanisms. *J Occup Health Psychol.* 2011; 16(4):501–513. [PubMed: 21728433]
20. Eaton R, Lambrick D, Sheppard K, Parfitt G. Prediction of maximal oxygen uptake in sedentary males from a perceptually regulated, sub-maximal graded exercise test. *J Sports Sci.* 2008; 26(2): 131–139. [PubMed: 17852665]
21. Thompson FE, Subar AF, Smith AF, et al. Fruit and vegetable assessment: performance of 2 new short instruments and a food frequency questionnaire. *J Am Diet Assoc.* 2002; 102(12):1764–1772. [PubMed: 12487538]
22. Erickson, F. Qualitative methods in research on teaching. In: Wittrock, MC., editor. *Handbook of Research on Teaching*. 3. New York: Macmillan; 1986. p. 119-161.
23. Lincoln, YS.; Guba, EG. *Naturalistic Inquiry*. Newbury Park, CA: Sage; 1985.
24. Mabry, L. In living color: qualitative methods in educational evaluation. In: Kellaghan, T.; Stufflebeam, DL., editors. *International Handbook of Educational Evaluation*. Boston: Kluwer-Nijhoff; 2003. p. 167-185.
25. Mabry, L. Qualitative evaluation methods. In: Bamberger, M.; Rugh, J.; Mabry, L., editors. *Conducting Evaluation in the Real World: Overcoming Budget, Time, and Data Constraints*. 2. Newbury Park, CA: Sage; 2011. p. 289-318.
26. Glaser, BG.; Strauss, AI. *The Discovery of Grounded Theory*. Chicago: Aldine; 1967.
27. Strauss, A.; Corbin, J. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, CA: Sage; 1990.
28. Denzin, NK. *The Research Act: A Theoretical Introduction to Sociological Methods*. 3. Englewood Cliffs, NJ: Prentice Hall; 1989.
29. Bronfenbrenner, U. *The Ecology of Human Development*. Cambridge, MA: Harvard University Press; 1979.
30. Carter, K.; Delamont, S., editors. *Qualitative Research: The Emotional Dimension*. Brookfield, Vermont: Avebury; 1996.
31. Polanyi, M. *Personal Knowledge: Towards a Post Philosophy*. Chicago: University of Chicago Press; 1958.
32. Baur DM, Christophi CA, Cook EF, Kales SN. Age-related decline in cardiorespiratory fitness among career firefighters: modification by physical activity and adiposity. *J Obes.* 2012; 2012:710903. [PubMed: 22666557]
33. Elliot DL, Kuehl KS, Moe EL, et al. The IGNITE (investigation to guide new insight into translational effectiveness) trial: protocol for a translational study of an evidenced-based wellness program in fire departments. *Implement Sci.* 2010; 5:73.10.1186/1748-5908-5-73 [PubMed: 20932290]
34. Elliot DL, MacKinnon DP, Mabry L, et al. Worksite wellness program implementation: a model of translational effectiveness. *Trans Behav Med.* 2012; 2:228–235.

35. Holbrook AL, Green MC, Krosnick JA. Telephone versus face-to-face interviewing of national probability samples with long questionnaires: comparisons of respondent satisfaction and social desirability response bias. *Public Opinion Quarterly*. 2003; 67(1):79–125.
36. Festinger, L. *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press; 1957.
37. Nederhof AF. Methods of copying with social desirability bias: a review. *Eur J Soc Psychol*. 1985; 15:263–280.
38. Verdonk-Kleinjan WMI, Rijswijk PCP, Candel MJJM, et al. Agreement between self-reports and on-site inspections of compliance with a workplace smoking ban. *Nicotine Tob Res*. 2012; 14(9): 1121–1125. [PubMed: 22271612]
39. Anderson DR, Stauffer MJ. The impact of worksite-based health risk appraisal on health-related outcomes: a review of the literature. *Am J Health Promot*. 1996; 10(6):499–508. [PubMed: 10163313]
40. Sorensen G, Thompson B, Glanz K, et al. Work site-based cancer prevention: primary results from the Working Well Trial. *Am J Public Health*. 1996; 86(7):939–947. [PubMed: 8669517]
41. Tilley BC, Vernon SW, Myers R, et al. The Next Step Trial: impact of a worksite colorectal cancer screening promotion program. *Prevent Med*. 1999; 28(3):276–283.
42. Prior JO, van Melle G, Crisinel A, et al. Evaluation of a multicomponent worksite health promotion program for cardiovascular risk factors - correcting for the regression towards the mean effect. *Prevent Med*. 2005; 40(3):259–267.
43. Stonecipher LJ, Hyner GC. The effects of a comprehensive health risk appraisal, basic screening, and interpretation session on employee health practices: differences between participants and nonparticipants. *Am J Health Promot*. 1993; 7(3):167–169. [PubMed: 10146809]
44. Gornik MK, Oldenburg B, Simpson JM, et al. Composite cardiovascular risk outcomes of a work-site intervention trial. *Am J Public Health*. 1997; 87(4):673–676. [PubMed: 9146453]
45. Community Guide Branch, National Center for Health Marketing (NCHM), Centers for Disease Control and Prevention. [Accessed October 2, 2012] Assessment of Health Risks with Feedback to Change Employees' Health Behaviors. Available at: <http://www.thecommunityguide.org/worksite/RRahralone.html>
46. Sorensen G, Thompson B, Basen-Engquist K, et al. Durability, dissemination, and institutionalization of worksite tobacco control programs: results from the Working Well Trial. *Int J Behav Med*. 1998; 5(4):335–351. [PubMed: 16250700]

Figure 1.

Measured Endurance and Self-reported Exercise and Nutrition Behaviors

Note.

Mean values for PHLAME I participants from control and intervention conditions longitudinally followed at each annual assessment.

Table 1

Outcome Variables across All Waves and Groups (Mean [SD])

	PHLAME I baseline	PHLAME I 1 year	PHLAME I 2 year	PHLAME II Year 3	PHLAME II Year 4	PHLAME II Year 5	PHLAME II Year 6
Age (years)	MI ^b	41.8 (8.6)	42.4 (8.2)	43.1 (7.9)	43.3 (8.3)	45.5 (8.1)	46.2 (8.2)
	TEAM ^c	39.3 (8.69)	39.7 (8.7)	40.8 (8.4)	43.2 (7.2)	44.9 (7.4)	45.6 (7.2)
	Control	41.3 (8.83)	42.3 (8.4)	42.2 (8.7)	42.3 (7.5)	44.6 (7.5)	46.0 (8.4)
	Mean all	40.7 (8.8)	41.3 (8.4)	42.0 (8.3)	43.0 (7.7)	45.1 (7.7)	46.0 (7.9)
Maximum oxygen uptake (ml/kg/ min)	MI	38.9 (6.5)	41.0 (7.7)	43.2 (7.1)	46.1 (8.2)	47.0 (8.6)	44.4 (7.6)
	TEAM	38.1 (7.5)	41.3 (7.7)	42.8 (8.2)	44.4 (8.5)	45.5 (6.3)	44.8 (8.1)
	Control	37.4 (6.6)	39.1 (7.7)	42.4 (7.5)	43.3 (6.8)	42.7 (5.5)	41.2 (8.5)
	Mean all	38.2 (6.9)	40.6 (7.7)	42.9 (7.6)	44.8 (8.0)	45.4 (7.4)	43.8 (8.1)
Exercise habits ^a	MI	2.7 (1.5)	2.9 (1.5)	3.1 (1.4)	2.9 (1.5)	3.5 (1.4)	3.3 (1.4)
	TEAM	2.9 (1.5)	3.2 (1.5)	3.1 (1.4)	3.2 (1.4)	3.6 (1.4)	3.4 (1.4)
	Control	2.6 (1.4)	2.9 (1.5)	3.0 (1.5)	3.4 (1.5)	3.2 (1.5)	2.8 (1.3)
	Mean all	2.7 (1.5)	3.0 (1.5)	3.1 (1.4)	3.1 (1.5)	3.4 (1.4)	3.2 (1.4)
Intake fruits & vegetables (servings/day)	MI	5.6 (3.3)	6.2 (3.7)	6.6 (4.4)	6.8 (4.4)	6.6 (3.3)	6.6 (4.2)
	TEAM	5.8 (3.3)	7.3 (4.5)	6.8 (3.8)	7.4 (4.6)	8.5 (5.4)	8.3 (4.6)
	Control	5.6 (3.5)	5.8 (3.7)	6.3 (3.7)	7.4 (4.2)	6.6 (3.3)	6.6 (5.0)
	Mean all	5.7 (3.4)	6.6 (4.1)	6.6 (4.0)	7.2 (4.4)	7.2 (4.1)	7.1 (4.6)
BMI (Body Mass Index)	MI	27.2 (3.3)	27.3 (3.4)	27.5 (3.7)	27.3 (3.2)	27.0 (3.3)	27.4 (3.1)
	TEAM	27.8 (4.0)	27.5 (3.9)	27.7 (3.8)	27.4 (3.9)	27.3 (3.7)	27.1 (4.2)
	Control	28.3 (3.8)	28.4 (4.0)	28.1 (3.9)	27.9 (2.8)	27.6 (2.6)	27.9 (2.6)
	Mean all	27.8 (3.7)	27.7 (3.8)	27.7 (3.8)	27.5 (3.4)	27.2 (3.2)	27.4 (3.2)

Note.

^a Construct scaled on 1 to 7 (items and reliability available at: <http://www.public.asu.edu/~davidpm/ripl/Phlame.htm>)

^b MI is Motivational interviewing intervention

^c TEAM is peer-led, team-centered scripted curriculum intervention

Table 2

Analytic Development of Themes and Sub-themes

Preliminary Themes: Initial Data Analysis	Evolving Themes: Reiterative Micro-reviews	Finalized Themes: Data Matching and Thematic Refinement
<i>Diet</i>	<i>Attributing Improvement in Diet versus Exercise</i>	<i>Improving Diet and Exercise</i> (Chain reaction)
Knowledge		
Attitude and motivation		Awareness and momentum
Behavior	<i>Teamwork and Competition</i>	Team orientation and reciprocal reinforcement
		Competition based on annual assessments
<i>Exercise</i>	<i>Age and Demographics</i>	
Knowledge	Veterans facing retirement	<i>Durability</i> (Summary of factors)
Attitude and motivation	New hires and increasing	
Behavior	health-consciousness	Changing personnel demographics
		Administrative support
<i>Age</i>	<i>Durability</i>	Off-duty carry-over
	Lukewarm administrative support	Culture shift
<i>Administration</i>	Off-duty carry-over	
	Overcoming resistance to change	

Table 3

An Ecological Framework for Analyzing Culture Shift

	Levels of Analysis	Site Characteristics
Microsystem	Level of immediate behaviors: Decisions, actions, interactions	Changes in firefighters' choices, conversations, and behaviors
Mesosystem	Level of working relations: Cooperation or conflict	Shifts' teamwork and competitiveness, pro-health interactions with administration
Exosystem	Level of organization: Regulation, management, procedures	Daily schedules and assignments providing time for exercise, pro-health rules and expectations, fitness resources and allocations
Macrosystem	Level of ideology: Values, beliefs, priorities, attitudes	Changing values regarding diet, exercise, and health