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DEVELOPMENT OF A SAFETY COMMUNICATION AND RECOGNITION PROGRAM FOR CONSTRUCTION

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Abstract

Leading-indicator–based (e.g., hazard recognition) incentive programs provide an alternative to controversial lagging-indicator–based (e.g., injury rates) programs. We designed a leading-indicator–based safety communication and recognition program that incentivized safe working conditions. The program was piloted for two months on a commercial construction worksite, and then redesigned using qualitative interview and focus group data from management and workers. We then ran the redesigned program for six months on the same worksite. Foremen received detailed weekly feedback from safety inspections, and posters displayed worksite and subcontractor safety scores. In the final program design, the whole site, not individual subcontractors, was the unit of analysis and recognition. This received high levels of acceptance from workers, who noted increased levels of site unity and team-building. This pilot program showed that construction workers value solidarity with others on site, demonstrating the importance of health and safety programs that engage all workers through a reliable and consistent communication infrastructure.

Keywords

leading indicators; incentives; safety performance; program development

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In an effort to control the high rates of injuries on construction sites [1], many general contractors and owners use a range of health and safety approaches, including safety incentive programs [2–4]. Incentive programs utilize a safety performance metric to reward workers and management when performance meets a specific criterion for a given period of time [2, 3, 5, 6]. They aim to encourage increased hazard recognition and control by both workers and management in order to improve the physical working conditions of the worksite, thereby reducing the risk for injury [7].

Traditionally, safety incentive programs have rewarded workers based on lagging indicators of workplace safety, that is, measures of safety collected after an incident occurs such as number of days without recordable injury. However, these lagging indicator programs, which are classified as "rate-based programs" by the U.S. Government Accountability Office (GAO) [3], give only the illusion of lowering injury rates, as they can incentivize the underreporting of injuries rather than the actual reduction in injuries [8]. This type of

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incentive program is often used in commercially available behavior-based safety programs designed for implementation in various types of workplaces. These incentive programs stem from the theory that injuries result from the unsafe behavior of an individual worker [9, 10] and are aimed at “correcting” workers’ behavior through positive or negative incentives [10], rather than identifying and eliminating the hazard at the system or worksite level [4, 9]. As a result, these incentive programs are the focus of much controversy [9, 11], and have been criticized for “blaming the victim” and discriminating against injured workers [4, 12, 13]. Such systems often overlook the fact that unsafe conditions and job hazards (in addition to unsafe acts) are the result of organizational policies and programs.

In contrast, leading-indicator-based programs, which rely on measures of safety at the worksite level that precede an injury, such as unsafe working conditions or lack of safety management, provide an alternative safety performance metric for incentive programs [7, 8]. A leading indicator-based incentive program recognizes workers and management for participation in the safety improvement process through the recognition, reporting, anticipation, and control of unsafe working conditions [4]. These programs increase safety communication between workers and management through regular safety performance feedback and an incentive structure that is not tied to incident reporting. Such communication systems augment safety management programs through demonstrating increased management commitment, employee involvement, hazard identification, and recognized hazard control, all important components of an effective health and safety program [14].

Leading indicators are often measured on construction sites through the industry practice of walk-through safety inspections [15–20]. These safety audits include measures of both the controls in place and the uncontrolled hazards, as it is acknowledged that an overall worksite safety assessment should include metrics of both safe and unsafe work conditions [21]. However, while some anecdotal evidence exists from the field, we were not able to find rigorous studies in the existing scientific literature that describe the mechanics of such a program or test its effectiveness in changing safety conditions and injury rates.

Our long-term goal is to evaluate the impact of a leading indicator-based incentive program, referred to herein as a safety communication and recognition program, for the construction industry, through which data on safety conditions are shared regularly with foremen and workers on safety conditions and injury rates. As a first step however, we must develop a program that can be implemented and identify components that will make it acceptable to both worksite managers and the workers. Lessons learned through implementation of an intervention are often not discussed in the scientific literature; however, without such trials the evaluation of an intervention can only fail. Such development steps are imperative for a successful intervention development and are a necessary first step in the evaluation of an intervention.

Our goal for this article is therefore to qualitatively document the development and feasibility testing of a safety communication and recognition program in a dynamic work environment. We aim to share the process and our experiences in designing, piloting, redesigning, and re-piloting a safety communication and recognition program on a construction worksite; we will also document the final design. The lessons learned from this program development experience relate to program mechanics, feasibility of implementation, and potential for scientific evaluation that will inform our future studies on program effectiveness and can serve to inform others engaged in program design and development.

METHODS

Development and feasibility testing of the safety communication and recognition program were competed and evaluated through qualitative methods and consisted of the following iterative steps: 1) initial program design; 2) implementation; and 3) feasibility testing [22, 23]. All data collection methods used in this study were reviewed and approved by the Harvard School of Public Health's Office of Human Research Administration.

Step 1: Initial Program Design

The first step of the initial program development was to consult the scientific literature on safety incentive programs (both leading- and lagging-indicator-based), safety communication programs, systems of safety performance measurement, and safety behavioral change models [9–11, 24–26]. The literature review was supplemented by interviews with construction industry experts including construction project managers, health and safety managers, and academics in health and safety research to understand how incentive programs had been implemented in past and current practice, as well as how safety is measured and communicated on the worksite.

We then vetted the initial design with an expert panel of construction project managers and environmental health and safety (EH&S) practitioners in May 2010. The panel consisted of a safety inspector from the Harvard Construction Safety Group, two project managers from the Harvard Planning and Project Management department, and three EH&S managers from general contractor companies engaged in construction in the greater Boston area. All participants of the panel had several years of construction management experience on a range of worksites, with the majority of their current work focusing on medium- to large-scale commercial construction projects. Participants also all had experience with running varying types of safety incentive programs on construction sites. The panel provided feedback on the feasibility of implementing our program on a construction site and suggested ways to improve the design. We sought feedback on the perception of our program's fairness and its competitive reward distribution scheme in the context of the dynamic construction environment, where different companies, trades, and individuals are constantly coming and going from the worksite. Additional topics discussed included the type of recognition that should be distributed, the frequency of and the method of recognizing workers, and the unit of recognition (e.g., individual workers, subcontractor, or overall worksite).

Step 2: Implementation

The safety communication and recognition program was piloted on a 100,000-square foot construction site on the Harvard University campus with an average of 60 workers on site per month for two months during the summer of 2010. The site was selected because it was representative of the medium to larger construction sites on campus in terms of trade composition, budget, number of workers, and duration (Table 1).

Step 3: Program Feasibility Testing

Feasibility testing of the safety communication and recognition program involved several steps, all of which took place concurrently. First, we recorded aspects of the practicalities involved in administering the program. For example, we documented accessibility and timeliness in obtaining safety inspection scores from our partnering organizations. For the worksite itself we noted high-visibility places on site to hang program posters that delivered feedback. In terms of workload to manage the program given the resources, we documented the effort required to maintain the program feedback infrastructure. We also documented participant and site observation on program-related activities [27], such as how program elements appeared to be accepted by workers and management. Second, we conducted semi-structured interviews with workers and site management during lunches, breaks, and toolbox talks using convenience sampling methodology. Third, following completion of the two-month initial pilot, we held a focus group with eight workers and collected feedback on the on-site program, as well as information about past experiences with similar programs. All qualitative data were recorded and transcribed by project investigators.

Following the initial piloting, and based on lessons learned in the two-month implementation, we repeated these three steps to reach a final system design. First, we redesigned certain program elements. Second, we tested the feasibility of the redesigned program on the same construction site for six months (following a two-month break with no safety communication and recognition program on the worksite). The goal of the six-month implementation was to test the feasibility of the redesigned program, as well as to evaluate the program's sustainability for a longer duration. Third, we repeated our qualitative evaluation with a focus group and multiple key informant interviews with managers.

RESULTS

The iterative process for developing the program provided a set of key results for each step in the process including an initial program through formative research, limitations of the initial program discovered through testing its feasibility, and a redesigned program that addressed these limitations.

Step 1: Initial Program Design

The formative research resulted in an initial program design that consisted of communication with workers via their foremen and recognition of the top-performing subcontractors based on leading indicators of safety performance (obtained from safety inspections completed through worksite walkthroughs by a professional safety and health manager from the Harvard Construction Safety Group). At the time, practice dictated that these inspections were unannounced to site supervisors and foremen. They were completed at a minimum of once per week. These inspections followed a standardized protocol that assigned observations obtained during the walkthrough to one of 22 categories on a checklist

(Table 2). These categories included a range of common tasks and their associated hazards and controls (e.g. use of hand and power tools, electrical safety). The observations were then assigned to a subcategory (e.g., Electrical Safety: Cords in Good Condition) and determined to be either an unsafe or safe observation (referred to in the program as "unsafes" and "safes"). Unsafes were then assessed for severity and likelihood of injury based on a risk matrix of "low," "medium," "high," or "life-threatening" [28]. Each observation denoted the subcontractor and included where the observation occurred, the project's general contractor, and date of observation. All observations reflected both individual-level behaviors and overall worksite conditions. Since our program emphasized worksite conditions rather than individual actions, we created a weighting system to reflect this (Tables 2 and 3). Observations from the walkthrough were recorded into an online data management program called Predictive Solutions (Industrial Scientific, Oakdale, PA, http://www.predictivesolutions.com/solutions/SafetyNet/), formerly known as Design, Build, Own, and Operate (DBO2). Unsafes were also reported verbally by the Harvard safety inspector to site management and foremen in order to initiate immediately correction of the unsafe conditions.

Subcontractor safety performance was based on a weighted score, calculated as the ratio of the weighted number of safe observations to the weighted number of total observations recorded in the database assigned to the subcontractor. Unsafe observations of higher severity resulted in a greater deduction of points from the score than lower-severity observations (Table 3). Weighting of safe observations was based on the severity of an injury that could result from the hazard accounting for variability in task difficulty and risk level. Dangerous tasks observed to be performed safely received additional points, based on category of observation (Table 2). Weights assigned to the safe categories were determined based on expert opinion of what the likely severity of injury, should the task be performed unsafely. The weights for both safe and unsafe observations aimed to increase the accuracy of the safety inspection score as a reflection of site safety by acknowledging differences in risk for various work tasks.

These subcontractor performance scores were communicated weekly to workers and foremen via on-site posters and toolbox talks. The weekly subcontractor safety performance scores were displayed on a large graph prominently displayed on the worksite. The graph denoted each subcontractor's safety inspection score by a code in order to ensure confidentiality of the scores. Workers were informed of their subcontractor's identification code during the program introduction toolbox talk. We also held weekly toolbox talks with each subcontractor to provide feedback on their specific performance based on the inspection data. Since the project owner already required weekly 10-minute toolbox talks, the program simply augmented a procedure already in place. At the talks, inspection scores from the previous week that highlighted both the safe and unsafe observations were presented.

For the initial design, the unit of recognition was the individual subcontractor, as this was thought to encourage competition between subcontractors, as well as a team effort within each subcontractor. Recognition of top-performing subcontractors was based on their cumulative monthly safety performance score. Subcontractors with a monthly safety performance score above the predetermined threshold of 95.4 percent [17] were recognized with a free lunch at the end of the month. To determine the threshold value, we used the approach described by Sparer and Dennerlein [17] in which the threshold is the median monthly safety performance score for all construction projects under the same owner (in this case, Harvard University) over a 19-month period (January 2009 to July 2010) prior to program implementation. This method of using the median monthly safety performance score was found to result in a threshold that is competitive, attainable, fair, and consistent.

Recognition involved a catered on-site lunch and a public acknowledgement of the achievement made by each subcontractor that surpassed the threshold score. This is the final step outlined in the process flow depicted in Figure 1. The lunch was selected because it provided both individual and social reward elements, in gathering the group as a whole, but providing something specific to each worker. Rewards that provide a social incentive, such as a company lunch, a handwritten note of appreciation, or even verbal recognition from management have been found to have a larger impact than money in construction and manufacturing environments [25, 29].

Implementation and Feasibility Testing of the Initial Design (Steps 2 and 3)

The two-month pilot of the initial design identified several key weaknesses of the initial design, specifically the communication program’s reliance on toolbox talks, coding of the subcontractors, and the recognition of only the top performing subcontractors at the lunches. Introducing the program and providing the inspection data to workers via the toolbox talks was not feasible as these talks were not held at the same time each week and were often scheduled at the last minute. Furthermore, as the construction project grew in size and complexity, more subcontractors were on-site at one time (each with their own toolbox talks), which only added to the challenge of introducing the program to workers within their first few days on-site. In addition, it was apparent from conversations with workers and management that safety performance feedback from the researchers via these toolbox talks was not appropriate as the researchers were neither directly in charge of the workers nor conducting the inspections. For the posters, many workers commented that the poster coding of subcontractor’s safety performance score was confusing and that they often did not know which code corresponded to which company. As a result, they noted that they lost interest in the scores.

Recognizing only the top performers meant that there were a number of subcontractors who were excluded from recognition, which led to a very uneasy atmosphere, with many of those that qualified for recognition being unhappy with the separation and unclear as to the reasoning behind the exclusion. Many expressed resentment towards the program as a result of being excluded or seeing others excluded at the lunch. Qualitative data collected during the focus group indicated that even though the site was made up of different companies working on different time schedules and tasks, the work was perceived to be team-based effort and the worksite unity should be reflected in the program design.

While workers seemed to appreciate the recognition through a communal lunch, they noted that a larger reward might have more of an impact on-site, with many suggesting free parking due to the worksite’s urban location and the high cost of parking.

Redesigned Program (Repeat of Step 1)

In the redesigned program, the introduction to the program took place during new worker orientations and weekly foreman meetings, safety performance feedback was listed by subcontractor name on the weekly posters, a high-value item (free parking) was added to the recognition lunch, and the site was evaluated as a whole for overall safety performance at the end of a month. The structure for introducing the program to workers changed from toolbox talks to new worker safety orientations (mandatory meetings held twice per week), which allowed the capture of new workers from all subcontractors at a single event as they entered the worksite. In addition, in the redesigned programs, weekly foremen meetings, not toolbox talks, were used to convey safety performance feedback. Here, detailed reports were provided to foremen about the specific observations from recent inspections that related to their company. The foremen were then strongly encouraged by the research staff to share this information with their workers.

We continued to use posters to convey the safety performance scores; however, in addition to displaying the individual subcontractor scores, we plotted the score for the whole site. We also posted a list of the individual subcontractor scores, now with company names identified. Recognition of safety performance was provided for everyone on site if the safety performance score for the whole site exceeded the threshold. At the site-wide recognition activity (the lunch), we also added a raffle for a one-month parking spot at a local garage, valued at $247. All workers were eligible for the raffle, although only one individual worker received the parking spot prize. While the use of monetary items as a reward in safety incentive programs is controversial [30], we included a high-value raffle that included everyone on-site in this program largely based on worker feedback and the desire to encourage safe work practices and conditions at the worksite level. The combination of the social and individual reward elements of both the lunch and the raffle enabled the formal recognition of all workers for their achievements as a group. All other aspects of the program, such as the performance metric, the inspection process, and the timing of the recognition cycle, remained the same.

Implementation and Feasibility Testing of the Redesigned Program (Repeat of Steps 2 and 3)

During the revised program implementation, the cumulative safety performance score of the whole worksite exceeded the recognition threshold in three out of the six months, resulting in a 50 percent recognition frequency [17]. During each of the six months, there were some subcontractors whose individual safety performance score never exceeded the threshold value, others that exceeded the threshold each month, and others that varied from month to month. However, as the site was evaluated as a whole, it was only the overall cumulative score of all subcontractors that determined whether or not the site would be recognized. At each of the three safety recognition distributions, all workers on-site were invited to participate in the lunch and enter the parking spot raffle. We received positive feedback from workers and management at each safety recognition lunch.

Workers and management noted that the change in delivery of safety performance feedback and unit of recognition led to an improvement of the “camaraderie” and teambuilding at the worksite. Workers checked the safety performance poster regularly and frequently asked the safety manager for ways to improve the scores. They demonstrated collaborative competition through an expressed interest in improving their both their individual scores and the overall score (now displayed as a single value), as well as the scores of other subcontractors. Direct feedback from workers indicated that none of the subcontractors wanted to have the lowest scores of the week, so there was constant competition among the various companies on site to not be at the bottom of the list, yet each week there was also the desire to keep the overall score high. This meant that companies with higher scores had an interest in helping companies at the bottom to keep the scores high. This collaborative competition appeared to increase interactions between trades that previously did not communicate with one another. Foremen in particular noted that they found the individual subcontractor feedback helpful, as it provided detailed information on observations made during inspections that they could share with their team. Prior to the program implementation, details on the inspections, especially feedback from safe observations, was not readily available to foremen.

DISCUSSION

The goal of this paper was to document the development and feasibility testing of an alternative to the traditional lagging-indicator–based safety incentive program—one that instead relied on pre-incident worksite safety metrics to incentivize safety through communication and recognition. As described above, we developed an initial design, piloted the program mechanics on a construction site, redesigned the program, and re-piloted the improved redesign. Implementing the redesigned program was successful in that it was feasible for the research team to complete, was well received by everyone on the worksite, and led to worksite unity and team-building.

The lessons learned highlighted three important elements of a successful safety communication and recognition program: 1) the site should be evaluated and recognized as a whole; 2) safety performance feedback should target both individual subcontractors and the worksite as a whole; and 3) the program design and objectives should be clearly communicated to all workers. The redesigned program accounted for these elements and in turn, helped promote an approach to safety that emphasized teamwork and was well accepted by workers. In the redesigned program, we changed the focus of the program from the subcontractor level to the worksite level, which led to increased collaborative competition and team-building. Furthermore, the program was easily incorporated into the existing on-site health and safety structure.

While the program described here was developed to include communication and recognition components, we acknowledge that it was the modified communication structure of the redesigned program that was the integral part of the program's success, as it helped strengthen the link on safety-related issues both between workers and management, and among the various trades on-site. Safe working conditions and practices should be expected on all construction sites; safety should not be seen as an "extra" or something that occurs only because of extrinsic motivators. In many ways, the inclusion of the recognition component in the program serves as just another mechanism to facilitate safety communication between workers, foremen, and management. The program could probably be implemented with the recognition component; however, testing of a modified program was not part of the scope of this article. The program's multiple sources of safety performance feedback aimed to increase communication and improve safety through an emphasis on hazard recognition and control. The importance of safety communication as a driver of this program's success is supported by other research that demonstrates the strong link between safety communication and improvements in safety conditions at the construction site [31–35].

While the final program demonstrated many successful components, it is not without limitations. The final design relies on inspection data as the recognition metric, which may involve some observation bias. However, any bias is likely to be minimal, as the same individual conducted all inspections. The inspector was a representative of the site owner and their primary concern was to keep the site as safe as possible; therefore, they had no vested interest in manipulating the safety performance scores. While knowledgeable on the components of such safety audits, the inspector was still vulnerable to inherent biases associated with any observational set of data. In conversations with safety inspectors, multiple individuals noted that it is much easier to identify and record unsafe activities than safe activities. Thus, the inspectors acknowledged that any observer bias would most likely have led to an overestimation of the number of unsafes and cause a lower final safety performance score. This further strengthens the selection of a final program that evaluates the worksite as a whole, not by individual subcontractors, as it is the most equitable and unaffected by bias towards certain subcontractors or working conditions [17].

In addition, this is a qualitative study with no quantitative metrics to evaluate the program effectiveness; however, piloting the program and using a qualitative evaluation are necessary steps in program development, as they uncovered many of the logistical issues and opportunities. Without such implementation research, the evaluation step would be useless as the assumptions about the program design were incorrect and would have led to an unintended negative outcome. Once completed, the next step is of course implementation on multiple sites, which will help identify challenges faced with such a program on sites of varying sizes, duration, and scope of work, as well as with different general contractors and site owners in the Boston area. To do this, a large effectiveness study will be implemented in a future cluster randomized controlled trial (RCT) that compares worksite safety conditions, injury rates, and worker survey responses at sites with the program to sites without the program. There are major challenges to conducting RCTs on construction sites, including recruitment of worksites and individual workers and cross-contamination of workers between control and intervention projects. In the RCT, we plan to use some of the lessons learned during this pilot study to circumvent these challenges. For example, in order to reflect the finding about the importance in site solidarity, we will be recruiting pairs of worksites from general contractors and owners, and the entire worksite will be given either the control or intervention treatment. We plan to measure cross-contamination and related potential issues during data collection.

In conclusion, the lessons learned during this program development demonstrate the importance of providing a whole worksite safety performance metric, having a reliable and consistent communication structure for the program elements and inspection data feedback, and using recognition that is relevant and desired by workers at the specific program site (Figure 2). The final program design recognized the worksite as a whole and led to collaborative competition and a team approach to safety that took advantage of and promoted worksite unity.

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NOTES

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Biographies

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ROBERT F. HERRICK'S research focus is on the relationships between exposures, biomarkers of exposure, dose, and effects, and control measures targeted to reduce exposures. He has developed a research program in hazard assessment and exposure controls for emerging technologies, including projects in several construction settings, and in the semiconductor industry. Recently he investigated PCB exposures and biomarkers of exposure among construction workers and teachers exposed to PCBs from building materials. Dr. Herrick is past president of the International Occupational Hygiene Association, and current national chair of the American Conference of Governmental Industrial Hygienists. He has served on committees of the National Academy of Sciences, the International Agency for Research on Cancer, the EPA, and NIOSH. Since his appointment in 1994, he has trained approximately 250 students in courses in occupational health and industrial hygiene at Harvard School of Public Health, and he is author or co-author of over 100 peer-reviewed publications. Prior to his appointment at Harvard, he conducted investigations and managed research on a wide range of occupational and environmental health topics for 17 years with the U.S. Army and NIOSH. Contact him at herrick@hsph.harvard.edu.

JACK T. DENNERLEIN is Professor and Director of Research for the Department of Physical Therapy, Movement, and Rehabilitation Sciences in the Bouvé College of Health Science at Northeastern University. His research goals are preventing work-related musculoskeletal disorders and injuries as well as improving workers' health through integrated workplace health protection (ergonomics and safety) and promotion (wellness) intervention studies. Dr. Dennerlein holds degrees from the State University of New York at Buffalo, Massachusetts Institute of Technology, and the University of California, Berkeley. Contact him at j.dennerlein@neu.edu.

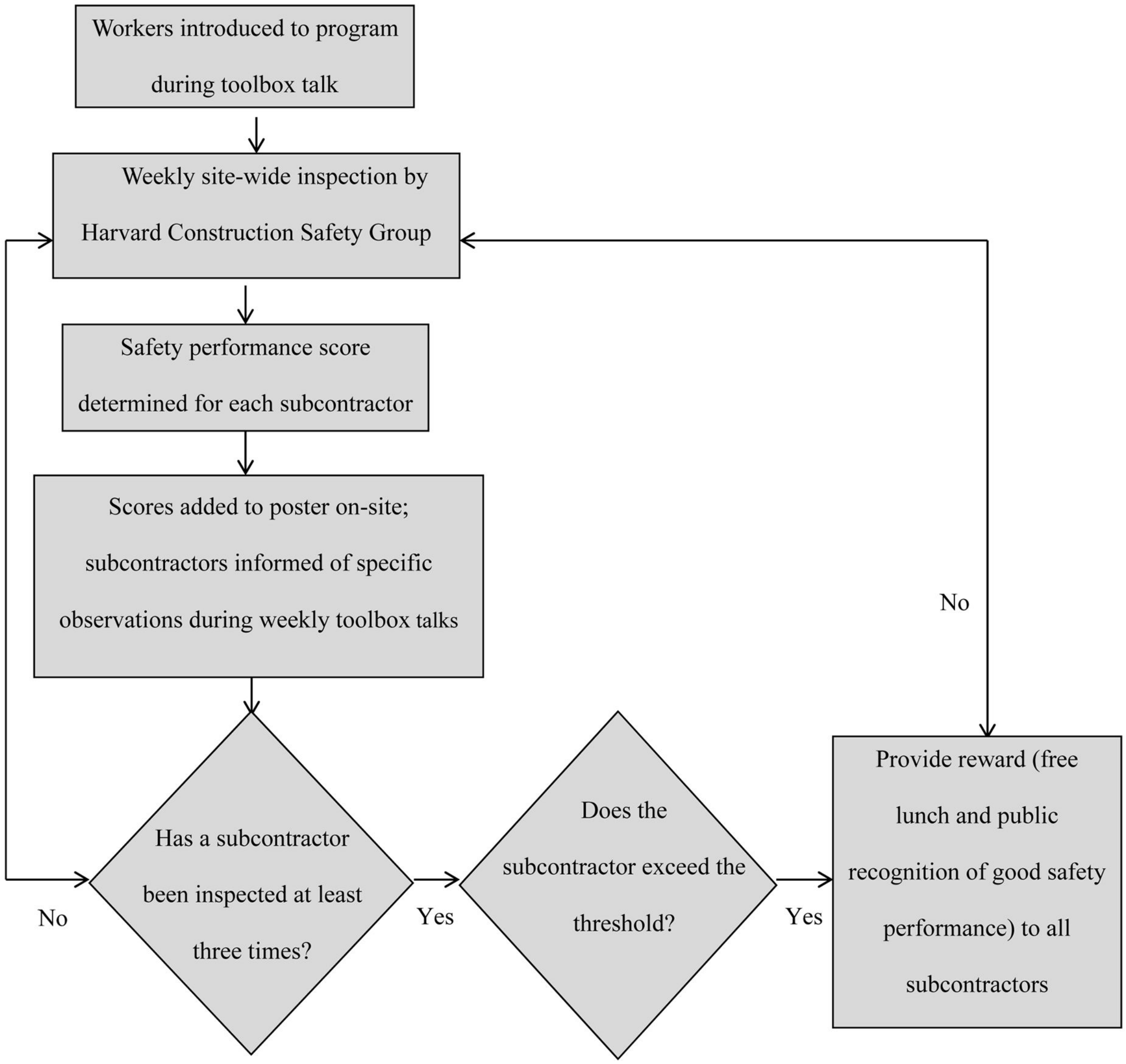

Figure 1.

Initial safety incentive and communication program design. Individual subcontractors were the unit of reward and the evaluation period was one month. At the end of the month, subcontractors who had scores that exceeded 95.4 percent received a reward. The evaluation and reward process would repeat for each month of the program.

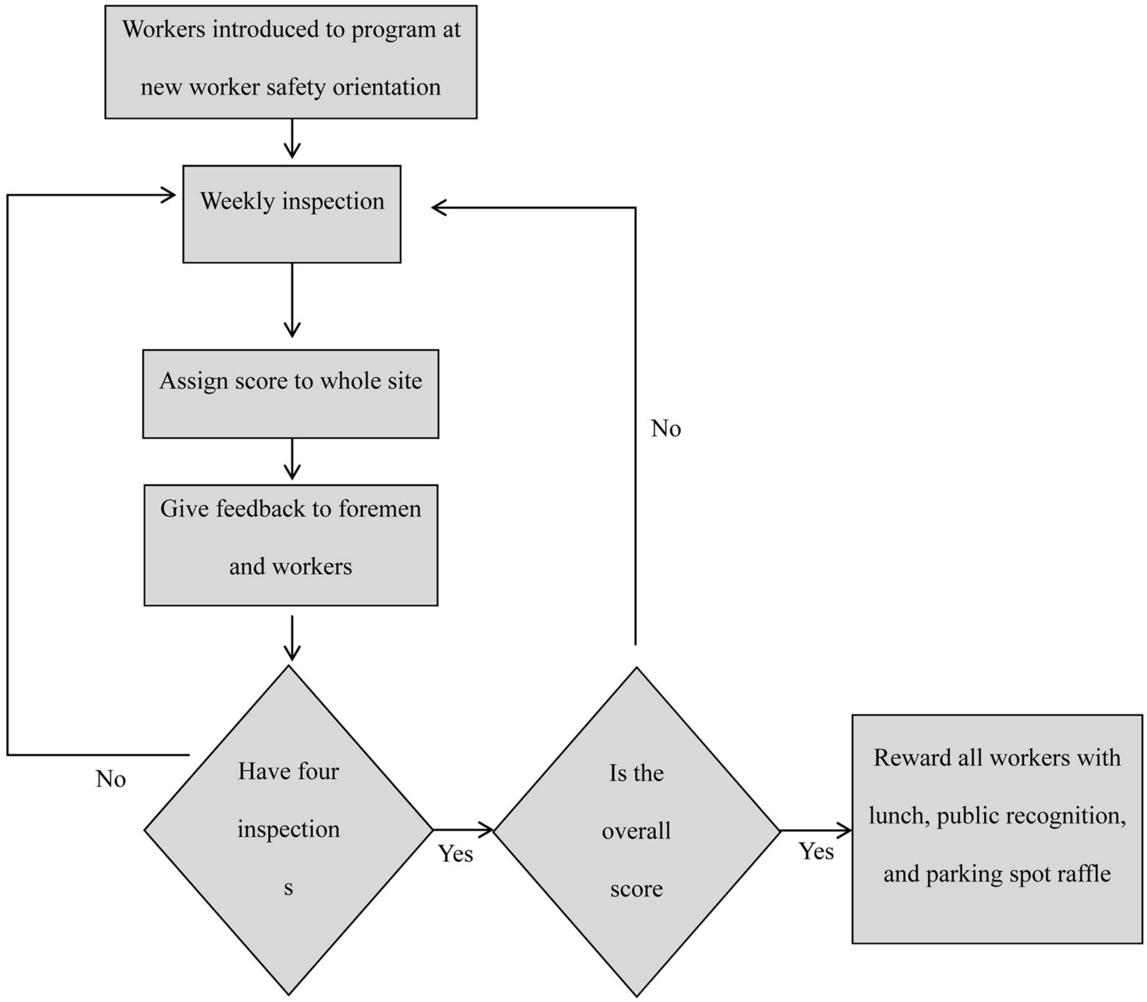

Figure 2.
The redesigned incentive program design. The whole site is now the unit of reward. If the entire site exceeds the threshold score at the end of the month, all subcontractors receive the reward.

Table 1

Comparison of Harvard University Construction Projects to Project Recruited for this Study

	Project duration (weeks)		Individual workers on-site at one time		Subcontractors on-Site at one time	
Harvard-owned projects between January 2009 and July 2010	Minimum	8	Minimum	10	Minimum	1
	Maximum	60	Maximum	175	Maximum	17
	Median	16.7	Median	45	Median	8
	Average	15.5	Average	35	Average	7
Recruited project	52		150		15	

Table 2

Safe Categories and Weights[a]

Safe observation category	Weight
Administration	1
Aerial lifts	2
Asbestos	2
Confined space	3
Control of hazardous energy	2
Cranes and hoisting equipment	3
Demolition	3
Electrical safety	2
Environmental	1
Excavation and trenching	3
Fall prevention and protection	3
Fire prevention and protection	2
Fire prevention and protection—hot work operations	2
Hand and power tools	2
Hazard communication	1
Heavy equipment	2
Housekeeping	2
Ladders	2
Personal protective equipment	1
Powder-actuated tools	2
Public protection	2
Scaffolding	3

[a]During the safety inspection, all safe observations were characterized into one of these categories. A weight was then assigned to the observation in order to calculate a safety performance score that was fair and reflective of the risks avoided, and placed greater emphasis on physical working conditions rather than individual behaviors.

Table 3

Unsafe Categories and Weights

Unsafe observation category[a]	Weight
Low	1
Medium	3
High	5
Life-threatening	10

[a]During the safety inspection, all unsafe observations are characterized into one of these categories. A weight is then assigned to the observation in order to calculate a safety performance score that is fair and reflective of the risks incurred.