A safety information campaign to reduce sharps injuries: Results from the Stop Sticks campaign

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ABSTRACT

Injuries from medical sharps devices and blood-borne pathogen (BBP) exposure are a significant risk to many healthcare workers. Risk awareness communications and sharps safety strategies are key components of BBP exposure prevention efforts. The research reported here includes an evaluation of a large-scale communication intervention aimed at raising awareness among healthcare workers regarding the risks of sharps injuries and BBP exposure, as well as methods of prevention. The Stop Sticks campaign was a multi-media communication intervention targeted at multiple healthcare facilities in Columbia, South Carolina. Following a comprehensive needs assessment in each facility, tailored communications were delivered via several channels. Samples included individual hospital departments, an entire hospital, and a nursing home. Results indicate high levels of knowledge and communication channel recall, minimal attitude and behavior change, and a strong association between sharps-related safety behavior and safety climate. Overall, this research suggests the blitz approach is viable for raising awareness of occupational safety and health issues. Based on these findings, several recommendations are offered for conducting safety campaigns in healthcare facilities.

Keywords: blood-borne pathogen (BBP) exposure, healthcare, needle-stick, sharps, safety climate, safety communication intervention

INTRODUCTION

Injuries from medical sharps devices are a threat to healthcare workers (HCWs) worldwide. In addition to the trauma of the experience, contaminated sharps injuries may result in infections with blood-borne pathogens (BBPs), such as hepatitis and HIV. The Centers for Disease Control and Prevention (CDC) estimates there are about 385,000 occupationally-related sharps injuries to HCWs in US hospitals every year.[1] Estimates are not available for other types of facilities. Injuries occur to both clinical and non-clinical workers. They occur during medical procedures and during the disposal process. The rates of infection from these injuries vary. For example, the risk of HIV infection from a contaminated sharps injury has been calculated at about 1 in 300, or 0.3 percent.[2] However, the risk of hepatitis infection is much larger, ranging from 6 to 30 percent.[2] The monetary, administrative, and emotional costs of such injuries, whether infection results or not, can be substantial to both the HCW and the healthcare organization.

Although such injuries have always been part of healthcare processes, the severity of the HIV epidemic in the general public contributed to concerns about occupationally-related sharps injuries, beginning in the 1980s.[3] A number of issues related to occupational exposures demanded attention including injury epidemiology, post-exposure prophylaxis, source-patient testing, HCW-to-patient transmission, the effectiveness of work practices such as double-gloving and hands-free sharps passing, the development of sharps devices with safety features, and sharps disposal containers. Professional and employee groups, employers and their associations, licensing and regulatory organizations, medical device manufacturers and academics all took actions to contribute to reducing sharps injuries. Medical sharps devices with safety features are now common in many healthcare facilities, as are protective administrative and work practices that include exposure control plans, injury reporting systems, post-exposure protocols, and universal precautions.

These developments have resulted in

substantial communication responsibilities for employers. New technologies such as sharps devices with safety features must be communicated about and then evaluated by frontline HCWs before they are adopted. Work practices such as sharps injury reporting and hands-free instrument passing methods should be introduced, evaluated, practiced, and adopted. Exposure control plans and post-exposure protocols must be communicated and followed, but sharps injury prevention can easily be neglected or forgotten because of competing safety and health priorities until a spike in the number of sharps injuries reorients HCW and management priorities. Employers should also pay attention to the climate in which they do this communicating. Safety communications are often considered to be more effective when employees perceive a supportive environment for preventing occupational injuries.[4]

Preliminary results from a study of a sharps injury prevention communications program are reported below. The 'Stop Sticks' campaign applied information campaign methods[5] to address sharps injury prevention objectives. Those methods involve establishing strategic partnerships, working to understand audiences, planning and developing multiple messages, delivering messages through multiple channels, and evaluating campaign effects. Although healthcare facilities often use information campaign practices for customer, investor, crisis, media, and general employee communications, they are applied less often to employee safety and health issues.

The framework of this study expected that safety-related communications delivered through multiple channels would be associated with positive safety attitudes and behaviors. It was also expected the characteristics of both employees and employers would be important in understanding the effects of campaigns on employee safety behaviors. In the following sections the effects of a safety-communication campaign on knowledge, behaviors, and attitudes of HCWs are examined, as well as the relative effects of individual and organizational predictors on sharps safety behaviors in the context of this safety-communication campaign that was conducted across a number of healthcare facilities in a single city. Finally, recommendations for mounting practical and effective safety communications campaigns for HCWs about preventing sharps injuries are provided.

METHOD

The Stop Sticks campaign

The Stop Sticks campaign was a sharps injury and BBP exposure prevention information campaign conducted in healthcare facilities in Columbia, South Carolina. All facilities used consistent communication methods across multiple media channels, and content that while consistent with regulations and safe clinical practice, was suited to each facility's individual needs. Columbia was chosen as the project site because of its relatively high prevalence of HIV in the general population among cities its size. At the start of the project in 2000, Columbia's AIDS case rate was the second highest in the nation among Metropolitan Statistical Areas with a population under 2 million. In addition, Columbia was selected because of significant partnership opportunities. As the state capital, a significant number of safety and health-related organizations existed that had the capacities to assist National Institute of Occupational Safety and Health (NIOSH) researchers. Those included South Carolina Occupational Safety and Health Administration (OSHA), Palmetto

Hospital Trust Services (PHTS), Ltd (a workers' compensation provider to healthcare facilities in the state), the South Carolina Nurses' Association, and the South Carolina Department of Health and Environmental Control. Stop Sticks staff from NIOSH consisted of one or two health educators, supplemented by one or two research staff during data gathering activities.

Information and training activities were conducted at both the city level and within cooperating healthcare facilities. However, primary evaluation efforts took place within healthcare facilities, where researchers worked with managers to conduct brief information-intensive components of the overall campaign, called 'safety blitzes'. Although research protocols originally called for executing blitzes throughout entire facilities, it was found that relevance of the issue of sharps injury prevention was limited and a blitz in one department within a hospital was often substituted. Researchers were able to secure the cooperation of four surgical services departments and one emergency department. These departments generally had higher sharps injury rates than other departments. Facility-wide blitzes were conducted in the city's largest acute-care hospital and a large, state-run nursing home.

Safety blitzes ranged in length from four to eight weeks, depending on the number of campaign objectives. Short blitzes helped NIOSH researchers accommodate the full schedules, heavy workloads, and other priorities of HCWs and managers. Managers were generally not willing to commit to longer or larger efforts. Campaign brevity also helped NIOSH researchers schedule around competing priorities such as Joint Commission inspection preparations, medical error prevention programs, National Nurses' Week, and wellness fairs. Another feature of the blitz concept is kick-off and closing events — definite starts and stops that help focus the attention of both employees and campaigners on a concentrated and coherent set of messages. The blitz concept allowed for a group of risk and prevention messages to be connected to an overall theme. That way, individuals may change their attitudes and/or behaviors in any number of ways which contribute to overall sharps injury reduction goals.

Project staff solicited organizational participation by talking with managers in relevant departments — infection control, risk management, employee health, safety, and specific clinical departments — explaining the objectives of the proposed prevention activity and the research project, and seeking top managers and opinion leaders to support the effort. Existing internal groups such as patient care committees, sharps injury task forces, and nursing leadership councils were given briefings about the Stop Sticks campaign.

The support of at least one top manager of the organization was a mandatory minimum commitment. However, leadership for each safety blitz came from a different place within each organization. For example, when one hospital was approached, the vice-president for nursing and two nurse educators in the surgical services department took primary leadership on a blitz in surgical services. In another surgical department, the department nurse manager provided most of the leadership. At the nursing home, the infection control professionals spearheaded that facility-wide blitz. When the community's largest hospital was approached about doing a facility-wide blitz, it was the hospital's risk manager who led the project. In each case, people who had both an appreciation of the safety problem and sufficient influence within their organization were selected to manage the blitz and the related data collection efforts.

Needs assessment and campaign planning

Three needs assessment methods were used to identify appropriate messages and channels for each safety blitz. First, sharps injury and blood and bodily fluid (BBF) exposure data were used as a proxy for potential exposures to blood-borne pathogens (BBPs), and this distinction between the terms should be noted throughout the text of this paper. Exposure data were gathered from employee health, infection control, and/or department managers. Data were analyzed to determine what types of injuries and exposures were occurring, how they were occurring, which categories of workers were affected, and the circumstances surrounding the incidents. Secondly, at two of the surgical departments, behavioral observations were conducted to identify use or non-use of safety behaviors. At each location, a surgical technologist and nurse were asked to observe 10 surgery cases, independently counting observations of particular safety behaviors. Thirdly, HCWs from across the city were recruited for focus groups, and focus groups were also conducted within targeted facilities and departments. Groups were organized by job classification (eg, housekeepers, nurses). Discussion included areas such as perceived risks of injury and exposure, perceived benefits and barriers to various protection methods, and preferred means to receive occupational safety and health information. Staff safety concerns revealed in the focus groups were not always consistent with management's safety concerns, which were gathered informally by NIOSH research staff. For example, at one surgical department, management cited recapping and hand-to-hand passing as areas of concern. However, staff members stated they were more concerned about exposures resulting from an antiquated BBF disposal system.

Data from all three needs assessment methods were analyzed to identify prevention methods that were appropriate for the most important problems so relevant information could be included among the blitz messages. Examples of blitz content included: awareness of BBP exposure risk, the importance of engaging safety features on medical sharps devices, reporting all blood and body fluid exposures, proper disposal of sharps, evaluation of sharps with safety features, and use of personal protective equipment.

Safety blitzes were planned to address selected content areas, typically addressing one content theme per week. Communication channels were identified for dissemination of each message. Multiple channels were used because the needs assessments revealed different workers' access information through different channels. The number and types of channels used varied according to the facility. Existing media channels such as newsletters and department communication logs were included whenever possible. After dates for the blitz were chosen, they were placed on organizational calendars. Reservations for meeting rooms and auditoriums were made and responsibilities for blitz leaders were determined as part of the planning process.

Implementation

Most blitzes were four weeks in length, although some were longer to accommodate management's campaign objectives and scheduling conflicts. Each week, the module focused on a distinct safety message, with different printed materials and activities. Most blitzes began with a presentation at a staff meeting to maximize exposure and generate interest. Management encouraged staff to participate in the blitz activities through memos and appearances at activities, while campaign staff maintained high visibility at the

Figure 1 Sample posters used for the theme regarding the risks of passing and loading sharps

facility throughout the campaign, through frequent meetings with management, attending campaign activities, and spending time in the facility.

Campaign staff worked with managers and/or education specialists at each facility to develop blitz materials, distribute them, conduct awareness activities, and collect evaluation data. Usually, small (8½ × 11 inch) posters were designed to communicate each week's theme message. For example, posters featuring graphs of facility-specific sharps injury data were used during the week for which risk awareness was the theme. Posters showing pictures of both correctly and incorrectly assembled sharps disposal containers, and overfilled containers were used if sharps disposal was the week's theme. See Figure 1 for a generic example of a poster used for the theme of the risks associated with passing and loading of sharps. The posters were desk-top published and displayed in staff lounges, locker rooms, nurses' stations, above scrub sinks, and on bulletin boards and doors. At the nursing home, posters were also used to communicate injury stories from staff at the home who had sustained sharps injuries or experienced near-misses. In addition, three general sharps injury prevention posters were developed and used across all facilities.

Sales representatives from device manufacturers were invited to participate in device fairs. During a designated length of time, representatives displayed and demonstrated sharps safety products and gave staff members the opportunity to test and evaluate them. Additionally, promotional items including pens, mugs, and tote bags were distributed to staff members throughout each of the blitzes. Examples of these items appear in Figure 2.

While extensive effort was put into planning each blitz to make it successful, there were activities that did not work as well as others. For example, for the facility-wide hospital blitz, a dialogue was planned between two physicians on the benefits and barriers of using a neutral zone or hands-free passing technique. However, limited promotion of the dialogue and poor attendance limited the effectiveness of that activity.

Management at some facilities took a more active role in campaign implementation than others. At the hospital, management developed its own knowledge reinforcement activity for one of the messages that was of major concern to them. They also took the initiative to hang all posters and advertise events themselves. At

Figure 2
Promotional items distributed to staff members during blitz activities

one of the department settings, certain activities, such as the safety device fair were made mandatory for staff to attend. In contrast, at another department setting, Stop Sticks campaign staff advertised campaign activities and hung posters for the first two weeks of the blitz and then the project staff took the lead role in the second half of the campaign.

Evaluation methods

Data were collected on a number of variables from staff members at each facility where a safety blitz was conducted. Paper and pencil questionnaires were used at all facilities. In addition, laptop computers were used for data collection at two of the facilities. Participation was voluntary and anonymous. To increase participation, some abbreviated versions of the questionnaire were administered through hallway intercept. Public health graduate students conducted those solicitations. Data collection methods and questionnaires were reviewed and approved by human subjects review boards at NIOSH, the University of South Carolina, and at each of the hospitals. The nursing home did not have a board. A study information page was attached to the front of each questionnaire (and as the opening page of the computerized form), but signed consent was not required.

Data were collected on the first day of each safety blitz, prior to the start of blitz activities. At that time, respondents were asked to think of an identifying code number or phrase known only to them for use on the first questionnaire and a follow-up questionnaire that would be administered after the safety blitz. Respondents were given a small, self-adhesive circle of paper on which to write their selected code for future reference. A second questionnaire was administered two to four weeks after the end of each safety blitz. Counter to our expectations, most respondents who had responded to the first questionnaire did not remember their code at the second administration. A description of how this circumstance was dealt with is provided in the results section.

Constructs were measured in seven areas: *attitudes* toward BBF exposure prevention, *knowledge* of BBF exposure and prevention information, previous exposure to relevant prevention information *(information exposure), safety climate, safety behaviors, BBF exposure history*, and *demographics*. Demographics were measured with single items about gender, experience in healthcare, experience in current facility, occupation, and use of sharps medical devices as a part of job responsibilities ('always, often, sometimes, never'). In addition, some of the operating room staff were asked what percentage of the time they 'scrubbed' versus 'circulated', which was intended to distinguish potential for BBF exposure based on job tasks.

Attitudes

Attitudes were measured with a series of six to nine items. Respondents rated amount of agreement with these statements using a 4-point Likert scale ('strongly disagree, disagree, agree, strongly agree'). Examples of attitude items included: 'I worry about being exposed to blood/body fluids at work'; 'My facility will have difficulty with the higher cost of sharps devices with safety features'; 'Patient care is more important than the safety of healthcare workers'; and 'Frontline healthcare workers must be involved in the selection of sharps devices with safety features for their department'. OR staff were asked some attitude questions that were more closely applicable to their work, eg, 'Neutral zone or hands-free passing technique should be used whenever it is in-keeping with good clinical practice'; Sharps with safety features reduce the quality of surgical care'.

Knowledge

Knowledge was measured with three or four multiple choice questions, which varied according to the material covered in each safety blitz and questionnaire time restrictions. Questions used included: 'Which percentage of sharps injuries are related to the disposal process: 3, 22, 50 or 68 percent?'; 'According to the Infectious Waste Disposal Policy at [facility name], sharps disposal containers are to be changed when they are [67, 75, 85 or 100 percent] full'; 'What is the risk of hepatitis C (HCV) infection given an injury with a contaminated sharps device: 1 in 3, 1 in 30, 1 in 300, or 1 in 1 million?'

Respondents were asked yes/no questions about their exposure to five different kinds of information about sharps with safety features and sharps injury prevention over the previous two months. In the post-blitz questionnaires, they were also asked where they saw such information from a list of 10 different message channels, eg, NIOSH Needlestick Alert, medical safety device fair, poster(s). As a validity-check, one or two of the items listed were not used as part of the safety blitz.

Safety climate

Safety climate, was measured with five statements with which the respondent was asked to 'strongly agree, agree, disagree, or strongly disagree' (eg, 'Senior medical leadership at [facility name] has created policies designed to limit blood/body fluid exposures').

Safety behaviors

Safety behaviors were measured by self-report with items asking respondents how often they performed specific techniques such as: 'Report exposure to blood/body fluid to my supervisor' and 'Wear protective eyewear whenever a case is underway'. There were five response options to these questions: 'Always, frequently, sometimes, never, not applicable'.

BBF exposure history

BBF exposure history was measured with two questions each about four different

types of exposures. Researchers asked respondents how many times they *experienced* exposures to BBF in the last year and the number of times they reported *exposures*. The four categories were splashes to the face, cuts, needlesticks, and skin exposures.

RESULTS

Due to changes in the surveys, two departments were not included in this analysis. The other three departments will be considered as one sample because of similarities in intervention and population. The samples included 353 standard surveys returned from the three departments (197 total pre-test: 29, 62, and 106 from each respective department; and 156 post-test: 19, 46, and 91 from each respective department); 455 from the hospital (221 pre-test, 234 post-test); and 555 from the nursing home (278 pre-test, 277 post-test). (Abbreviated surveys were also returned by 25 people in the department pre-tests and by 456 people in the hospital post-test). Survey participation as a proportion of total staff size was higher in the clinical departments (73–97 percent) than it was at the hospital (16 percent) or at the nursing home (51 percent), in part reflecting the limitations on data collection across an entire facility. For analysis purposes, surveys were removed from one test as necessary to ensure independence. The independent sample sizes were as follows: 231 department surveys (136 pre-test, 95 post-test); 329 hospital surveys (214 pre-test, 115 post-test); and 373 nursing home surveys (195 pre-test, 178 post-test).

Missing data were treated in two ways. For incomplete scales, scores were imputed using the individual's mean response to those scale questions which had answers. Other incomplete surveys for which imputation was not possible due to complete lack of response for entire scales were excluded from analysis. The final sample sizes were as follows: 191 department surveys (105 pre-test, 86 post-test); 196 hospital surveys (111 pre-test, 85 post-test); and 216 nursing home surveys (107 pre-test, 109 post-test). For demographic description purposes, the pre-tests and post-tests were aggregated at each location. Pre-test and post-test samples are similar unless otherwise noted.

Demographics

The department sample included only clinical workers. Nurses made up 42 percent of the sample, physicians represented 1 percent, and other clinical workers made up 52 percent, while 5 percent were unknown. All respondents reported that they had potential exposure to blood and body fluid, and 88 percent said they use sharps devices 'frequently' or 'always' in their jobs. A total of 58 percent of respondents had worked in the healthcare field for more than 10 years, while only 25 percent had worked in their department for more than 10 years. Some 85 percent of respondents were female.

The hospital sample had 34 percent non-clinical workers, along with 41 percent nurses, 5 percent physicians, and 20 percent other clinical workers. The percentage that reported potential exposure to BBF was 92 percent, which is slightly lower than in the department sample. The sharps usage was also lower, with 59 percent of respondents reporting they use sharps devices 'frequently' or 'always' in their jobs. A total of 52 percent of respondents had worked in the field for more than 10 years, while 36 percent had worked at the hospital for more than 10 years. Some 77 percent of respondents were female.

The nursing home sample had 13 percent non-clinical workers, along with 30 percent nurses, 2 percent physicians, and 55 percent other clinical workers. Some

88 percent of respondents reported potential exposure to BBF. Sharps usage was much lower than in the other two samples, with only 33 percent of respondents reporting they 'frequently' or 'always' use sharps devices, while 29 percent said they 'never' use sharps devices in their jobs. Also, 80 percent of respondents had worked in the healthcare field for more than 10 years, while 40 percent had worked at the nursing home for more than 10 years. Some 88 percent of respondents were female.

All three samples were similar in several ways. Nurses and other clinical workers represented the largest part of all samples. Most respondents were likely to have potential exposure to BBF. At the departments and the hospital, respondents reported very high levels of sharps usage. Participants were likely to have worked in the healthcare field for a long time, but were not likely to have spent a long time at their current facility. All three samples were predominantly female.

Some of the differences among the samples resulted from the presence of non-clinical workers. For example, at each facility, non-clinical workers were less likely to report they had potential for exposure than clinical workers (hospital: $\chi^2_{(1)} = 9.25$, $p = 0.002$; nursing home: $\chi^2_{(1)} = 8.31$, $p = 0.004$).

Most-remembered communication channels

Since intervention details differed in terms of specific content included in messages, the results did as well (Table 1). Overall, the mean percentage of the message channels used that were remembered was 56 percent at the nursing home and 54 percent at the departments. The mean percentage at the hospital was lower (32 percent). In the departmental interventions, posters were the most remembered channel, remembered by 100 percent of respondents. Demonstrations and evaluations of safety devices and methods were the second most remembered channel (95 percent); followed by announcements at staff meetings (92 percent); the NIOSH Needlestick Alert or other HCW brochures (80 percent); campaign promotional items such as mugs and tote bags (74 percent); a memo from facility management (72 percent); and flyers with staff quotes about sharps injuries (54 percent). Only four legitimate channels were remembered by less than half of the appropriate respondents: articles (41 percent); a video entitled 'A Nurse's Story' (27 percent); a device fair (26 percent); and a game in which participants seek to gather all items on a list, called a scavenger hunt (16 percent). At the hospital, only one channel was remembered by more than half of respondents: posters, with 72 percent. In order, the other legitimate channels remembered were: the NIOSH Needlestick Alert (38 percent); training in the respondent's unit (35 percent); campaign promotional items (35 percent); memo from the manager (34 percent); a facility-wide presentation (25 percent); an information table in the cafeteria (25 percent); a medical device safety fair (20 percent); and a wellness fair (9 percent). At the nursing home, six channels were remembered by more than half of the respondents: the memo from facility management (85 percent); NIOSH publications, such as the Needlestick Alert (64 percent); campaign promotional items (63 percent); presentations on sharps injury prevention information (56 percent); personal testimony (56 percent); and promotional roses and balloons (55 percent). Other channels which were used included posters (45 percent) and a medical device fair (19 percent).

At all locations, a channel was also introduced into the survey which had not actually been implemented. These chan-

Table 1: Group means for main constructs by sample and time

Facility type	*Time*	*Channels (%)*	*Mean number of six safety topics remembered*	*Knowledge (%)*	*Behaviors (SD)*	*Attitudes SD)*	*Safety climate (SD)*
Departments	Pre-test		4.21	48.8	2.96 (0.48)	3.32 (0.33)	3.29 (0.45)
	Post-test	54.4	5.76	52.4	3.13 (0.52)	3.31 (0.32)	3.33 (0.42)
Hospital	Pre-test		2.16*	49.5	2.77 (0.96)	3.01 (0.37)	3.18 (0.60)
	Post-test	32.1	3.28*	48.8	3.00 (0.67)	3.08 (0.40)	3.03 (0.55)
Nursing Home	Pre-test		3.77	32.1	2.60 (1.13)	3.05 (0.35)	3.07 (0.63)
	Post-test	55.5	5.30	40.7	2.85 (1.07)	3.06 (0.34)	3.21 (0.51)

Behavior: 1, Never; 2, Sometimes, 3, Frequently; 4, Always.
Attitudes, Safety Climate, and Organizational Culture: 1, Strongly Disagree; 2, Disagree; 3, Agree; 4, Strongly Agree.
*Mean number of five safety topics remembered.

nels had very low rates of 'remembrance', although they were 'remembered' by between 16 percent and 21 percent of respondents in the different samples. They ranked lowest or second-lowest in all three samples.

Pre-test/post-test comparisons

Message exposure

Respondents were asked whether they had seen or heard anything about five or six safety subjects (subjects covered by their blitz) over the previous two months (Table 1). The mean number of blitz topics remembered was higher in the post-test than in the pre-test for all samples (departments: 4.21 pre-test, 5.76 post-test, $t_{(146)} = -8.49$, $p < 0.001$; nursing home: 3.77 pre-test, 5.30 post-test, $t_{(181)} = -6.24$, $p < 0.001$; hospital: 2.16 of five topics pre-test, 3.28 of five topics post-test, $t_{(194)} = -4.54$, $p < 0.001$). In the department sample, each topic was remembered by a significantly higher proportion of respondents in the post-test than in the pre-test. At the nursing home, five of the six topics (evaluation of sharps disposal containers, evaluation of sharps with safety features, sharps injury prevention, activation of sharps with safety features, and the Stop Sticks campaign) were recalled by significantly higher proportions of respondents. (The sixth topic, sharps injury reporting, was recalled by a higher proportion, but not significantly higher.) At the hospital, two of the five topics (sharps injury prevention and the Stop Sticks campaign) were recalled by significantly higher proportions of respondents. (The other three topics, evaluation of sharps devices with safety features, sharps disposal procedures, and sharps injury reporting, were recalled by higher proportions, but not significantly higher.) One topic, the Stop Sticks campaign, was recalled by dramatically higher numbers of respondents in every sample, from pre-test levels between 28 percent and 65 percent to post-test levels between 87 percent and 98 percent. Across all of the blitz locations, the messages which consistently showed the largest increases in recall, were the Stop Sticks campaign and sharps injury prevention.

Knowledge

For the knowledge questions, very few significant differences were noted in correct responses over time (Table 1). At the

nursing home, the composite knowledge scores were significantly increased from the pre-test to the post-test (32 percent pre-test, 41 percent post-test, $t=-2.34$, $p=0.021$). There were significantly more correct answers to a question about how often sharps disposal containers are to be changed (48 percent pre-test, 72 percent post-test, $t_{(214)}=-3.67$, $p<0.001$). In the department sample, percentages of correct answers to one question significantly increased: the percentage of people who were able to correctly identify whether a HCW is more likely to contract HIV, HBV, or HCV from a contaminated sharps injury increased from 47 percent pre-test to 70 percent post-test ($t_{(107)}=-2.42$, $p=0.017$). The highest knowledge scores overall were observed at Department B, where the questions had been formulated to be less numerically oriented.

Safety behaviors

A significant increase in composite behavior scores from pre-test to post-test was found in the departments (2.96 pre-test, 3.13 post-test, $t_{(189)}=-2.37$, $p=0.019$) (Table 1). Other significant differences were observed in individual behaviors. In the departments, three behaviors were significantly increased: 'Evaluate sharps with safety features' (2.28 pre-test, 2.53 post-test, $t_{(177)}=-2.37$, $p=0.0129$); 'Communicate with team members when passing sharps devices' (2.99 pre-test, 3.39 post-test, $t_{(142)}=-2.71$, $p=0.008$); and 'Encourage use of a neutral zone or hands-free passing technique whenever it is in keeping with good clinical practice' (2.29 pre-test, 2.61 post-test, $t_{(137)}=-2.05$, $p=0.043$). One behavior was significantly increased in the nursing home sample: 'Report exposures to blood/body fluid to my supervisor' had a pre-test mean of 2.71 and a post-test mean of 3.25 ($t_{(185)}=-3.18$, $p=0.002$). Some behaviors had high means in the pre-test, leaving little room for improvement. (For example, in the department sample, 'Wear protective eyewear whenever a case is underway' had a starting mean of 3.8 on a 4-point scale.)

Attitudes

Significant differences were noted in some individual attitudes, although no significant differences were found in composite attitude scores (Table 1). Mean responses to the item 'Frontline healthcare workers must be involved in the selection of sharps devices with safety features for their department' increased at the hospital, from a pre-test mean of 3.35 to a post-test mean of 3.58 ($t_{(192)}=-2.17$, $p=0.031$). There were two significant decreases as well. At the hospital, mean responses to the item '[Facility name] will have difficulty with the higher cost of sharps devices with safety features' decreased from 2.80 to 2.50 after reverse coding ($t_{(189)}=2.44$, $p=0.016$). In the department samples, the item 'I worry about exposure to HIV and hepatitis when operating the hopper' decreased from a pre-test mean of 3.50 to a post-test mean of 3.20 ($t_{(106)}=1.99$, $p=0.049$). As with behaviors, several attitudes had high means on the pre-test (eg, 'All sharps injuries at work should be reported as soon as they happen' had starting means higher than 3.7 in all samples).

Safety climate

Principal component analysis was explored on all three samples. All groups showed similar results. Principal component analysis was used on five questions that measured safety climate. The principal axis method was used to extract components. Only the first component had an eigenvalue >1; a scree test also indicated only that factor was meaningful. Therefore, only this factor was retained, accounting for between 56 percent and 67 percent of the total variation. All five questionnaire items loaded on this com-

Table 2: Descriptive statistics and matrix of significant correlations

Departments Hospital	*Nursing home*											
Variable	Mean (SD)	Mean (SD)	Mean (SD)	1	2	3	4	5	6	7	8	9	10
1. Gender	1.15 (0.36)	1.23 (0.42)	1.12 (0.33)	….									
2. Experience at facility	1.96 (0.94)	2.08 (1.11)	2.38 (1.07)		….								
3. Experience in the field	2.69 (1.05	2.58 (1.15)	3.21 (0.92)		0.54								
					0.69	....							
					0.56								
4. Potential BBF exposure		0.92 (0.27)	0.88 (0.33)				….						
5. Sharps usage		2.53 (0.61)	2.04 (0.79)	*0.18*		*0.18*	**0.35**	….					
							0.32						
6. Attitude	3.31 (0.32)	3.04 (0.38)	3.06 (0.35)			*0.16*		*0.13*	….				
7. Knowledge	0.50 (0.24)	0.49 (0.23)	0.36 (0.27)					*0.20*	….				
8. Exposure to safety topics	0.82 (0.26)	0.53 (0.36)	0.76 (0.33)	0.15						….			
9. Safety climate	3.31 (0.43)	3.12 (0.58)	3.14 (0.57)						0.20		0.22		
						0.20					0.17	….	
							0.17				*0.17*		
10. Behavior	3.04 (0.50)	2.87 (0.85)	2.72 (1.11)	–0.14					0.18		0.22	0.334	
							0.28	**0.35**			**0.15**	**0.19**	....
									0.39		*0.18*	*0.23*	

Plain text, Department correlation; Bold text, Hospital correlation; Italic text, Nursing home correlation.

ponent, so safety climate was used as a scale consisting of the mean of the items. Cronbach's alpha for this scale had values from 0.804 to 0.873. There were no significant differences in safety climate scores from pre-test to post-test in any of the samples.

Regression

Separate regression analyses were conducted on the independent groups in each sample, with behavior as the dependent variable. The independent variables considered for the model were attitude, knowledge, exposure to safety topics, safety climate score, gender, length of experience in the field, and length of experience at the facility. For the hospital and the nursing home, usage of sharps devices and potential exposure to blood and body fluid were also used as independent variables. These variables were not used in the department regression because of lack of variation and because the questions had not been asked on some surveys.

Bivariate correlations

In the department sample, behavior was significantly positively correlated with attitude score, safety climate score, and higher exposure to safety topics (Table 2). It was also significantly correlated with gender, with men having lower behavior scores. At the hospital, behavior was significantly positively correlated with safety climate score, higher exposure to safety topics, usage of sharps devices, and potential exposure to BBF. At the nursing home, behavior was significantly positively correlated with safety climate score, higher exposure to safety topics, and usage of sharps devices. Length of experience in the field and length of experience at the facility were highly positively correlated in all three samples; exposure to safety topics was also significantly positively correlated with safety climate score. At the hospital

Table 3: Final models predicting behavior by facility

Facilities	*Predictor*	*Coefficient*	*Beta*	*t*	*Uniqueness index*	*F*	*Semi-partial correlations*
Hospital	1. Sharps usage	0.39	0.28	4.04***	0.069	16.3***	0.351
	2. Safety Climate	0.28	0.19	2.89**	0.035	8.4**	0.192
	3. Potential BBF exposure	0.57	0.18	2.66**	0.030	7.1**	0.280
Nursing Home	1. Sharps usage	0.58	0.42	6.41***	0.154	41.2***	0.386
	2. Safety Climate	0.41	0.21	3.44***	0.044	11.8***	0.230
	3. Potential BBF exposure	-0.54	-0.16	-2.43*	0.022	5.9*	0.012
Departments	1. Safety climate	0.34	0.30	4.30***	0.083	18.5***	0.339
	2. Exposure to safety topics	0.34	0.18	2.54*	0.029	6.5*	0.219
	3. Gender	-0.23	-0.16	-2.39*	0.026	5.7*	-0.143

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

and the nursing home, use of sharps devices and potential exposure to blood and body fluid were also positively correlated, as were attitudes and use of sharps devices. Significant correlations were generally very close across the three samples.

Multiple regression

Multiple regression, using forward selection, was used to find the simplest adequate model at each location (Table 3). For the departments, the final model included three predictor variables: safety climate score, exposure to safety topics, and gender ($R^2 = 0.16$, $R^2_a = 0.15$). The semi-partial correlations and uniqueness indices indicate safety climate makes the greatest contribution to the regression, followed by exposure to safety topics and gender.

At the hospital, the final model contained three predictor variables: use of sharps devices, safety climate score, and potential exposure to BBF ($R^2 = 0.19$, $R^2_a = 0.17$). Semi-partial correlations show sharps usage is the most influential independent variable, followed by potential for exposure to BBF and safety climate score. However, the uniqueness indices indicate safety climate score contributes more to the regression than potential for exposure to BBF.

At the nursing home, the final model included three predictor variables: safety climate score, use of sharps devices, and potential exposure to BBF ($R^2 = 0.21$, $R^2_a = 0.20$). Semi-partial correlations and uniqueness indices again indicate sharps usage is the most influential independent variable, followed by safety climate score and potential exposure to BBF. Potential exposure to BBF is not significantly correlated with behavior in this sample, but is strongly positively correlated with use of sharps devices. In the regression, the sign of its coefficient is negative, unlike the coefficient of use of sharps devices.

DISCUSSION

Overall, the results of this study indicate the campaign approach does have merit for approaching occupational safety and health issues in healthcare settings. One of the primary aims of this research was to raise awareness among HCWs regarding the risks of sharps injuries and BBP exposure, and several of the results presented here support the efficacy of the Stop Sticks campaign in achieving this aim.

Specifically, this research demonstrates that delivery of safety communications via multiple channels is associated with positive safety attitudes and behavior, although the improvements are minimal and this is likely due to the rather brief duration of the intervention. Another aim of this research was to identify variables associated with sharps-related safety behaviors, and several individual and organizational predictors were identified.

Message exposure and recall

The data presented here suggest HCWs who were exposed to multiple communication channels were able to recall the messages they received, and how they received them. The pre- and post-test comparisons suggest the number of safety topics recalled significantly increased across all three settings. Furthermore, over half of the communication channels were recalled in both the departments and the nursing home, and the nearly one-third of messages recalled in the hospital sample is also relatively high when the proportion of HCWs for whom the messages are relevant is taken into consideration. That is, given the much higher proportion of non-clinical HCWs in the hospital sample, it is not a surprising finding the overall rate of message recall is lower for this group.

Among the various channels used, posters were the most often remembered, while several other channels were widely recalled across the different settings. In the hospital and department settings, announcements at unit/department-level meetings were relatively well-remembered, while at the nursing home nearly all channels were recalled by more than half of the respondents. Additionally, memos from management and promotional items were relatively well-remembered across all three types of settings. These findings suggest that using multiple channels to communicate a single message is an effective method for reaching a target audience.

Increased sharps safety awareness

The information blitz approach was effective in increasing awareness of the risk of exposure to BBP among HCWs with the potential for such an exposure. Across each setting, various measures of knowledge, behaviors, and attitudes demonstrated significant increases from pre- to post-test evaluations. For example, composite knowledge scores demonstrated significant increases (9 percent overall increase) in the nursing home, and department responses indicated a 24 percent increase in HCWs correctly identifying the specific risk of hepatitis versus HIV infection.

Sharps-related safety behaviors increased across all settings, despite the limitation of ceiling effects. That is, although reported safety behaviors were already occurring at a relatively high rate, post-test results indicated slightly increased levels of safety behaviors across settings. It is most noteworthy that the departments, which included the highest proportion of employees who use sharps on a daily basis (100 percent), reported significantly increased safety behaviors overall. This result is likely due to the blitz campaign in the departments being more focused specifically on the personnel with the greatest risk of BBP exposure, and therefore these participants had greatest potential to benefit from communications about safety.

Additionally, although overall changes in attitude were minimal, some specific items within attitude measures demonstrated small, positive shifts in attitudes in both the hospital and department settings regarding sharps and BBP exposure safety. As with behaviors, potential for improvement in overall attitude scores was also limited by a ceiling effect.

Altogether, these data suggest HCWs

who received the blitz communication intervention may have gained increased knowledge regarding risk of BBP exposure, acted more safely in situations of acute risk for sharps injury BBP and exposure, and experienced some positive attitude changes regarding BBP exposure-prevention practices.

Predicting sharps safety behavior

Across all three settings, perceived safety climate was found to be the best predictor of individual safety behaviors. Regression analyses revealed safety climate was the strongest predictor of safety behavior in the departments, and it was the second most influential predictor in the hospital and nursing home. However, in each of these two settings, sharps usage was included in the model and predicted the largest amount of variance, whereas sharps usage was not included in the model for the departments, as 100 percent of participants in this setting reported daily sharps use. Although safety climate was the second most influential predictor in the model for both the hospital and nursing home settings, it did contribute the greatest proportion of unique variance to the model. Other individual and organizational variables, such as gender and sharps usage, did significantly correlate with behavior in some of the samples. For example, findings presented here from the department sample suggest men are less likely to engage in sharps safety behavior than women, and data from the hospital and nursing home suggest sharps usage is moderately correlated with sharps safety behavior. However, these variables are less useful for predicting safety behavior across the organization, as gender and job-related tasks are not truly manipulatable variables without consideration of selection and job-task design issues. Thus, safety climate seems to be the most useful and influential variable in predicting sharps safety behaviors.

This finding is supported in much of the general safety literature,[6,7] as well in literature specific to HCW safety.[8] Indeed, in the prevention of injury and illness across many sectors of industry, building and maintaining a strong safety culture is a common recommendation, and safety climate is considered to be a 'snapshot' of an organization's current state of safety, measured by questionnaire surveys of employees' perceptions, attitudes, and beliefs about risk and safety. Safety culture is a more enduring trait which reflects an organization's fundamental values, norms, assumptions and expectations.[9] Individual HCWs perceptions of what their organizations do for employee safety and health are certainly influenced not only by what is communicated by managers and co-workers, but also by what safety and health behaviors individual HCWs observe themselves and others engaging in on a regular basis.

Achieving culture change

Creating or improving an organization's safety culture means finding ways to influence employee attitudes and behaviors. It also means reducing environmental hazards. Specifically, the following directives are suggested by the CDC1 for creating and/or improving an organization's safety culture: (1) Ensure there is a commitment to safety at all levels of the organization, beginning with management; (2) Involve employees in planning and implementing activities that promote a safe healthcare environment; (3) Identify and remove sharps injury hazards in the work environment; (4) Develop communication and feedback links to increase safety awareness; and (5) Promote individual accountability.

The safety blitz approach used in this study certainly fits within this framework for promoting a culture of safety. The multiple channels of communication ensured commitment across all levels of management was clearly communicated, employ-

ees were involved in the development and execution of the blitz campaign, and relative risk was communicated with data based on the target audience's actual performance. The relatively brief duration of the blitz was much too short to gauge the impact with measures of safety climate, as evidenced by the lack of significant increases from pre- to post-tests across all samples.

The blitz format should not be expected to be the lone solution to transforming the safety culture of an organization, but instead should be viewed as a way to jump start or boost ongoing efforts. HCW health and safety improvement efforts stand to benefit from the rigorous collection of data on critical safety behaviors, which are used to provide timely feedback communications. Additionally, feedback should highlight successes, provide sincere and productive suggestions for improvement where necessary, and be received within a non-blaming atmosphere.

Limitations

The safety blitz approach used here does seem to be useful for raising awareness about sharps injuries and BBP exposure, but this study does present some limitations. The duration of the blitz activities was not long enough to adequately measure any long-term effects the safety blitz intervention may have had. For example, it is possible some shift in safety climate may have taken effect during the several months after the blitz was discontinued, as employees' perceptions, attitudes, and beliefs about risk and safety as well as their safety behaviors were likely influenced by the blitz activities long after the conclusion of data collection for this study. This is a limitation of many safety improvement studies[10] and highlights the need for more long-term investigations of intervention effectiveness.

This study is also somewhat limited in the variables used for the regression analysis. The prediction of safety behaviors explored here only allows for conclusions about concurrent prediction. While it is valuable to demonstrate evidence for the relationship between safety climate and safety behaviors, the question of how to improve safety performance is not completely addressed. While one may conclude that improving the safety climate of an organization may increase safe behavior, it may also be the case that increasing safe behavior leads to an improved safety climate. A more fine-grained analysis of intervention components is needed to disentangle the relationships among safety climate and behavior, and other variables, such as knowledge and attitudes.

Additional limitations include potential bias inherent in self-report data about knowledge, behaviors, and attitudes. Given that some employees knew the purpose of the Stop Sticks campaign, they may have responded to questionnaires with some expectancy biases. Another limitation is the lack of clear evidence for the impact of this campaign on the ultimate goal of reduced sharps-related injuries. The aforementioned potential unreliability of self-report data often leads program evaluators to collect observational data to alleviate some of this concern, and Stop Sticks campaign staff did this on a limited basis. Yet, observed prevention behavior increases do not automatically imply reduced incidence rates, and it is often difficult to find available personnel for this task.

Lessons learned

Based on the specific findings of the research reported here, as well as what was learned from conducting the Stop Sticks campaign, the following recommendations are offered to healthcare professionals

aiming to improve sharps safety in their facilities and reduce the risk of exposure to BBPs:

Triage the departments in your facility for interventions

The strongest results of our intervention efforts were found with the department-level blitzes. In most facilities, certain departments such as the surgical or emergency departments experience a greater level of risk for BBP exposure. Those departments at the highest risk should be targeted for routine safety blitz efforts.

Conduct a thorough needs assessment based on exposure data

The messages to be included in a blitz should be based on the needs of the target audience. Sharps injury and BBP exposure data should be analyzed to determine the types of injuries and exposures employees are experiencing, the types of medical sharps devices involved, and the circumstances surrounding the incidents. This process enables the identification of intervention targets with the greatest potential for impacting the risk of sharps injuries and BBP exposures.

Plan information campaigns with multiple messages through multiple channels over time

Relative risk, prevention strategies, and treatment options are common messages in occupational health, but each message must be chosen to fit the situation. Keep your messages clear and simple and repeat them frequently. If you find that different sub-groups need different messages (such as surgeons and scrub techs), then be sure to develop your messages simultaneously to avoid contradictions and confusion. Creative messages almost always attract more attention, but you should pilot your messages to make sure your creative concepts achieve your objectives.

Empower departments to think for themselves about safety

Involving managers and employees from the target population in developing the intervention package is considered a crucial component to creating effective safety programs which can be maintained.[11] The Stop Sticks campaign involved both managers and employees in discussions regarding their concerns in regard to BBP exposure, as well as familiar and preferred channels of receiving occupational safety and health information. As findings of this study indicated, staff safety concerns revealed in the focus groups were not always consistent with management's safety concerns. Thus, it is important to involve not only managers, but frontline HCWs as well.

Use posters throughout the department and change them often

Results of this study indicated posters were the most well-remembered communication channel out of the several channels we used in the Stop Sticks campaign. The posters were created using simple desktop publishing and printed using standard desktop printers and thus were inexpensive and easily produced. The simplicity of creating the posters allows for several different posters to be used throughout the duration of the blitz. Varying the poster messages increases the novelty of the posters, makes them more likely to capture HCWs attention, keeps HCWs engaged in the blitz activities, and provides HCWs with awareness of the safety issue, thus improving their function as an activator for safety behavior.

Collect baseline and follow-up data on attitudes, behaviors, exposures, and perceptions of safety climate

It is important to collect meaningful data to demonstrate the impact of blitz efforts. Comparing pre- and post-test data enables

blitz administrators to document and evaluate employee health and safety improvement interventions. Additionally, the data can be shared with the blitz participants to communicate successes and to start conversations about how to improve intervention efforts.

Future directions

Given the valuable impact the Stop Sticks campaign had on the participating facilities in South Carolina, there is clearly a need to produce a guide to the blitz concept. NIOSH researchers are currently developing a dissemination package to make such a guide available to healthcare managers across the nation. Facility personnel are very capable of conducting their own safety blitz activities, and a clear set of instructions along with templates for creating blitz materials will allow several more healthcare facilities to raise awareness of the risks of sharps injuries and BBP exposures. The blitz concept was only tested in hospitals and nursing homes, but this concept may be applicable to other areas of healthcare, such as clinic and physician's office settings.

CONCLUSION

The safety blitz approach, as used in the Stop Sticks campaign, is a viable option for healthcare professionals charged with raising awareness about occupational safety and health concerns, including the risks of sharps injuries and BBP exposure. The results of this study suggest the best predictor of sharps-related safety behavior is safety climate. Thus, safety improvement efforts in healthcare settings should target safety culture improvement as a means to increasing safe behaviors, and it should follow that the risk of sharps injuries and BBP exposure decreases. The safety blitz approach is only one piece of the puzzle when it comes to safety culture improvement, but it can be a valuable approach when a 'shot in the arm' is needed to jump-start safety activities.

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