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Improving Anesthesia Nurse Compliance with Universal Precautions Using Group Goals and Public Feedback

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ABSTRACT

Universal Precautions (UPs), procedures to reduce the likelihood of accidental exposure to blood-borne pathogens, were observed among seven Certified Nurse Anesthetists and one anesthesia technician during intravenous line procedures. After six weeks of base-line measures, nurses participated in training, goal setting, and feedback targeting hand sanitizing practices. Three weeks later immediate needle disposal was targeted. Hand sanitizing behaviors increased from a group baseline percentage of 24% to 65% during the intervention, and 52% during withdrawal. No significant increases in immediate needle disposal were found. Participants disposed of needles immediately 53% of the time during baseline, 58% during the intervention phase, and 45% during withdrawal. Non-targeted UP behaviors also increased as a result of the intervention: Recapping needles with on-hand increased from 45% during baseline to 61% during the intervention phases; removing gloves from inside out increased from 61% to 93%; and wearing gloves when discarding waste increased from 31% to 52%. Auxiliary behaviors such as nurse and patient interactions remained consistently high throughout the study.

ARTICLE

Health care workers, including physicians, nurses, emergency medical personnel, operating room personnel, laundry workers, and lab technicians, are routinely at risk for exposure to blood-borne pathogens (BBPs). BBPs are infectious microorganisms present in human blood that can be fatal to infected persons (Occupational Safety and Health Administration, 1999). BBPs include Human Immunodeficiency Virus (HIV) and Hepatitis B Virus (HBV). There is an estimated 0.3% risk of infection with HIV after percutaneous exposure (often through accidental needle stabs through the skin) to HIV-contaminated blood (Gershon, Vlahov, Felknor, Vesley, Johnson, Delclos, & Murphy, 1995) although this risk has been estimated as high as .5% (Linn, Kahn,&Leake, 1990). The risk of contracting Hepatitis B after exposure is 30% and Hepatitis C (HCV) is 6 to 10% (Gershon et al., 1995). In addition to HIV, HBV and HCV, 20 other pathogens may be transmitted through exposure to blood-borne pathogens (Gershon, Karkashian, & Felknor, 1994).

As of 1998, the Centers for Disease Control (n.d.) documented a total of 54 cases of health care employees in the United States who had acquired HIV infection at work. As many as 134 additional cases may have occurred but could not be directly linked to an occupational exposure incident. The Exposure Prevention Information Network (EPINet; 1999) reported 590,164 annual percutaneous injuries for health care workers in hospital and non-hospital settings (Perry, 2000). Additionally, Hersey and Martin (1994) reported data on percutaneous injuries among health care workers in 1991. Seven percent of exposures occurred when needles

had been set down while completing a procedure and 6% occurred while inserting an intravenous or peripheral line. Nurses are an especially at-risk group. In one year in the United States, there were 13 documented occupational transmissions of AIDS/HIV infection and 15 possible occupational transmissions among nurses (Gershon et al., 1994).

To reduce risk of exposure, all health care employees are required by the Occupational Safety and Health Administration (OSHA) to receive hepatitis vaccinations and practice Universal Precautions (UPs). UPs are specific employee practices and behaviors that help prevent occupational exposure to infectious blood and bodily fluids.

Handwashing, proper disposal of needles, and wearing personal protective equipment are three critical work practices defined by OSHA to reduce exposure to blood-borne pathogens (OSHA, 1999). Personal protective equipment, such as gloves, should be worn when employees may have hand-contact with blood or other infectious materials. Gloves may not prevent needle sticks but they do reduce the chances of coming into contact with bodily fluids through non-intact skin (OSHA, 1999). Hand sanitizing should be done after glove removal because it decreases the chances of infection if the employee had been exposed to bodily fluids through non-intact skin. Furthermore, sharps or needles should not be bent or recapped. Engaging in bending or recapping needles increases the health care worker's risk of being stuck. If the needle is laid down instead of being immediately disposed of, it is possible that the individual will accidentally get stabbed when they pick the needle up again after completing the procedure. Contaminated sharps or needles should be disposed of

immediately after use in puncture-resistant and leakproof containers clearly marked as “biohazard.”

UP COMPLIANCE

Despite these established precautions, health care employees are generally noncompliant with Universal Precaution guidelines. A study by Willy, Dhillon, Loewen, Wesley, and Henderson (1990) found that of 1,562 midwives surveyed, only 37% disposed of needles correctly; only 49% wore gloves to start intravenous lines; and 69% wore gloves when they had cuts or abrasions on their skin. Furthermore, 44% of midwives said they did not practice UPs at all. Gershon et al. (1995) reported hand washing after glove removal and needle disposal among physicians, nurses, and lab technicians. Although hand washing was highly practiced, 88% to 94% across four hospitals, reported compliance with needle disposal was poor. Only 66% to 79% of respondents disposed of needles correctly.

Hersey and Martin (1994) found only 62% of patient care staff and 54% of doctors reported washing their hands after glove removal. Fifty-five percent of health care workers reported that they sometimes recapped needles after giving injections (against UP guidance) and 45% reported that they sometimes recapped after drawing blood. Physicians had even lower compliance rates with correct needle disposal (i.e., not recapping used needles). Only 25% correctly disposed of needles after giving injections and 35% correctly disposed after drawing blood. Finally, Becker, Janz, Band, Bartley, Synder, and Gaynes (1990) found

that needles in disposal boxes were recapped an overall average of 25% of the time in one hospital and as much as 50% of the time in individual hospital units.

Most measurement of UP compliance has been accomplished by surveying health care workers. The current study observed numerous individual occurrences of UP behavior among seven nurse anesthesiologists while preparing patients for surgery. This type of behavioral observation of single subjects allows for a more accurate assessment of changes in targeted behaviors necessary for UP compliance.

Reasons for poor compliance with UPs vary. Some workers are confused about the UP policies. For instance, Becker et al. (1990) found that 25%-50% of hospital workers agreed with statements that recapping needles protects themselves and coworkers against accidental needle sticks. Some workers are not familiar with UPs, Becker et al. (1990) found only 56% of workers considered themselves very familiar with UPs. Forty percent of workers reported they were too busy to comply with UPs and 50% claimed forgetfulness as a reason for noncompliance. Gershon et al. (1995) found that workers' perception of their organization's commitment to safety (i.e., safety climate), risk-taking personalities, beliefs about the effectiveness of UPs, work-related stress, and safety training were all related to compliance.

An analysis of the three-term contingencies (Daniels & Daniels, 2004; Geller, 1998; Sulzer-Azaroff, McCann, & Harris, 2001) associated with the lack of UP compliance suggested that the correct behaviors

were often associated with response costs such as added time to complete a procedure and decreased dexterity (c.f. Willy et al., 1990). Alternate behaviors required by the job such as interacting with patients (c.f. Willy et al., 1990) and maintaining pressure on open veins can reduce the likelihood of some UP compliant behaviors. Antecedents for UP compliant behaviors often involve verbal cues during annual training and/or the occasional poster in common areas. Finally, the consequences of working without engaging in UP compliant behaviors are negative and severe (e.g., illness as a result of exposure to pathogens) yet very improbable. The percentages of illness and death due to the infrequent exposure to human blood are small enough that the likelihood of any worker coming into contact with these contingencies is rare. Furthermore, workplace contingencies such as manager feedback, rewards, or discipline tend to be very limited.

Increasing UP Compliance

A number of behavioral approaches have been successfully applied to employee performance issues such as safety. McAfee and Winn (1989) summarized major research findings of 24 studies on behavioral approaches to improve workplace safety, such as wearing protective clothing in occupations such as coal mining, manufacturing, maintenance, transit, weaving, police, and metal fabrication. Likewise, Ludwig and Geller (2000) outlined and partially tested 26 combinations of behavior change strategies that were used to influence safety-related behaviors among occupational drivers. These include techniques such as

verbal instructions (Alavosius&Sulzer-Azaroff, 1990; Matheson, Danner, Grant,&Mooney, 1993), awareness training (Geller, Eason, Phillips,& Pierson, 1980), reminder posters (Komaki, Barwick, & Scott, 1978; Thyer, Geller, Williams, & Purcell, 1987), feedback (Alavosius & Sulzer-Azaroff, 1986; Austin, Kessler, Riccobono, & Bailey, 1996; Chhokar & Wallin, 1984; DeVries, Burnette, & Redmon, 1991), reinforcers (Austin et al., 1996), and goal setting (Cooper, Phillips, Sutherland, & Makin, 1994; Ludwig & Geller, 1997).

Goal Setting and Feedback

Goal-setting and feedback strategies have been applied frequently in organizational settings to improve individual and group performance (see Alvero, Bucklin, & Austin, 2001; Balcazar, Hopkins, & Suarez, 1986; Geller, 1998; and Locke & Latham, 1990, for reviews). Goal setting involves specifying a standard or level of performance to achieve (Sulzer-Azaroff & Mayer, 1991). This level of performance should be both challenging and attainable (Locke & Latham, 1990). Goals act as antecedents in that they can prompt behavior as well as indicate a level of improvement to achieve. Goal attainment can also serve as a consequence if or when the stated level of performance is attained (Ludwig& Geller, 2000).

Feedback is provided through the presentation of data, often aggregated over time, that describes an individual's or group's performance. When goal setting is added to a feedback strategy, the desired behavior(s) is not only defined but a desired frequency of the behavior(s) is

also specified. Furthermore, a comparison can be made between the desired goal level and the current level of performance. Feedback can serve as a reinforcer in these situations and influence behavior change. For example, feedback can lead to self-reinforcement when progress toward a goal or successful attainment of the goal is apparent (Sulzer-Azaroff & Mayer, 1991). In addition, positive statements from others (e.g., coworkers, supervisor, etc.) about performance improvement can act as reinforcers.

Combinations of goal setting and feedback have been used extensively in behavioral programming for safety (e.g., Austin, Kessler, Riccobono, & Bailey, 1996; Cooper, Phillips, Sutherland, & Makin 1994; Fellner & Sulzer-Azaroff, 1984; Ludwig & Geller, 1997; Reber & Wallin, 1984; Sulzer-Azaroff et al., 1990) Generally, using feedback in combination with other procedures such as antecedents, behavioral consequences, and goal setting produces more consistent effects in performance than does feedback alone (Alvero, Bucklin, & Austin, 2001). Additionally, feedback is most effective when it is specific and related to the employee's performance, individualized, related to goals, and graphically displayed (Ludwig & Geller, 2000).

Goal Setting and Feedback in Healthcare. Despite success in other settings, goal setting and feedback have been used in only a few behavior change studies in a health care setting. Alavosius and Sulzer-Azaroff (1990) provided feedback to six direct care staff workers in a state residential school for the mentally retarded. Safe techniques of client lifting and transfer were examined during baseline followed by weekly feedback

and written suggestions for improvement. Most measures of client lifting and transfer improved substantially after the initial feedback session and continued to improve over time.

DeVries et al. (1991) measured glove use among four nurses in an emergency room. During the intervention in which feedback on glove wearing was delivered to participants once every two weeks, overall glove use increased from 40% to 73%. Of all situations where glove use was warranted, nurses had the poorest glove wearing improvement while giving injections.

Babcock, Sulzer-Azaroff, Sanderson, and Scibak (1992) studied the glove use of five supervisory nurses and 12 nursing assistants in a head-injury treatment center. Supervisors were trained to provide positive written feedback to their assistants regarding infection-control practices, glove use, and avoidance of contact with bodily fluids. Weekly and long-term goals were created for supervisory nurses. Overall glove use among nurses increased from 37% to 67%.

The present study focused on improving safety among nurse anesthetists in a hospital setting. Six safety practices were examined prior to, during, and after the intervention was implemented. An intervention consisting of training discussions, goal setting, and individualized feedback was provided for two targeted UPs in a multiple baseline design. It was expected that these intervention techniques would increase nurses' compliance with UPs. In addition, it was predicted that improvement in targeted UPs would generalize to other safety behaviors.

METHOD

Participants and Setting

Participants (n = 7) were six Certified Registered Nurse Anesthetists (CRNAs) and one anesthesia technician from a rural, acute care 147-bed hospital. CRNAs are independently-licensed professionals who have a master's degree and must undergo recertification biannually (American Association of Nurse Anesthetists, n.d.). They are responsible for anesthesia preparation and patient induction, maintenance, and recovery. CRNAs are a suitable population in which to study UP compliance because they frequently come into contact with patient body fluid substances.

The participating nurses, all from the same day shift, ranged in age from 32 to 54, had worked at the hospital between 1 and 20 years, and had between one to eight years of post-high school education. All nurses had mandatory UP training after hire and were required to attend annual refresher courses.

Observations took place in the pre-operation area of the operating room (OR) equipped with five stations, each with space for a patient gurney, a table for anesthesia supplies, and a curtain that could be used for privacy. One sink was located near the last station in the pre-operation area. Wall-mounted hand sanitizer dispensers, disposable glove containers, and sharps containers were located in each of the five patient pre-operation areas. Supplies for anesthesia administration including

gloves, bandages, intravenous catheters, and a sharps disposal container were located on each nurse's portable cart. Medications for anesthesia were centrally located in a locked cabinet near the sink. Patients were wheeled into a station already in hospital gowns and on gurneys. After the intravenous line, epidural, or peripheral block procedures were complete, the patient was wheeled into an assigned operating room where the surgery took place.

UP Behaviors

Task analysis is a method of identifying small, trainable, and concrete behaviors that make up a more complex behavior (Kazdin, 1994). In this study, task analyses of anesthesia administration procedures were constructed from interviews with the head nurse anesthetist at the experimental site and two nurse anesthetists in another hospital. First, nurses were asked to describe the steps involved in the intravenous line insertion procedure. Second, nurses were questioned to identify those steps with the highest risk for accidental exposure to bodily fluids. Lastly, nurses were asked to name and describe which UPs are used to prevent such exposures.

A behavior checklist for intravenous line insertion for drug administration was constructed from this task analysis. The checklist outlined the steps of intravenous line insertion from the beginning to end of the procedure and highlighted the points at which the observer was to record an occurrence or nonoccurrence of UP behaviors. Of particular interest were those steps in each procedure that had the potential to expose

participants to body fluid substances.

The specific UP behaviors observed included: (1) hand sanitizing, whereby the nurse washed his/her hands before touching the patient; (2) glove wearing, whereby the nurse put on gloves before inserting the intravenous catheter; (3) not recapping, whereby the catheter needle was not recapped after use (using a one-handed recapping method was acceptable); (4) immediately discarding catheter needle, whereby the needle was not laid down before disposal; (5) glove wearing, whereby the nurse wore gloves while discarding of used materials for the procedure; and (6) hand sanitizing, when the nurse washed his/her hands after glove removal.

Additional nurse behaviors on the checklist that did not fall into the UP category included measures of the nurses' bedside manner and safety behaviors that protect the patient's health and well-being. These behaviors included greeting the patient, explaining the anesthesia procedure to the patient, asking the patient if he/she had questions, asking appropriate questions to the patient when filling out hospital forms, and disinfecting areas on the patient's body where needles will be inserted. These auxiliary behaviors were observed and recorded by research assistants at the same time as they conducted the ongoing UP behavior observations.

Behavioral Observations

Research assistants received three hours of training to reliably and

ethically observe nurses using the behavior checklists. Training consisted of an explanation of each behavior, an orientation to the operating room wing and hospital procedures, and practice observation sessions. Observers were blind to the specific behaviors targeted, the onset of intervention phases, and intervention operations.

Maintaining the confidentiality of participants was stressed during observation training. Before beginning observations research assistants signed a confidentiality statement that prohibited them from discussing information about patients or hospital employees. In addition, observers completed and passed a competency quiz about hospital policies such as confidentiality, safety, and security. Research assistants had no physical contact with patients or staff, stayed in the operating room preparation area, wore protective clothing at all times, and provided the hospital with their immunization records. Lastly, observers wore identification badges with their name, picture, and the word “observer” printed on them.

Data collection occurred Monday through Friday in two-hour shifts between 7:00 am and 1:00 pm in the preparation area of the operating room (OR) wing of the hospital. Observers stood within five feet from the foot of the patient gurney and discreetly made note of nurses’ safety behaviors on observation checklists. Observers recorded whether UP behaviors were performed by the nurse at specific points during the procedure. Each UP behavior measured occurred only once during most procedures with the exception of hand sanitizing which was recorded as two occurrences instead of being aggregated into one measure. When a

UP behavior occurred twice during a procedure (e.g., a second needle was used and had to be discarded), observers recorded only the first occurrence of the behavior. A new behavior checklist was started with each patient or when another nurse took over the procedure. In addition, observers recorded the date, the nurse anesthetist's name, start and end time of the procedure, whether the patient was male or female, and how many procedures were occurring at the same time by other nurses. Only pre-operation anesthesia procedures were recorded because all post-operation procedures were completed in the operating room itself or in the patient's private room.

Inter-rater reliability checks were conducted by having two research assistants independently observe the same participant during a procedure. Inter-observer agreement percentages were calculated by dividing the total number of observations agreed upon by two independent data collectors for a particular data category (e.g., hand sanitizing, needle disposal) by the total number of agreements and disagreements, and multiplying the result by 100. The percentages for days when reliability data were collected were then averaged to give overall inter-observer reliability estimates. Agreement scores of 80% or higher were considered acceptable. If the agreement score was below 80%, the principal investigator conducted additional training sessions on how to complete the observation checklist until an 80% agreement level was attained. Overall agreement for all data categories was 88%. Observers agreed on instances of hand sanitizing 93% of the time and immediate needle disposal 72% of the time.

Baseline and Informed Consent

At the beginning of baseline, the nurse anesthetists were told that the observers were university students observing the anesthesia procedures. After four weeks of baseline measures, the principal investigators met with the targeted nurses to describe the study and obtain informed consent. At this meeting nurses were told that student observers had been recording their behaviors during anesthesia procedures. They were not given specific information about what behaviors were being observed. At this point nurses were asked to participate in a study that involved goal setting and feedback.

Data collection continued during weeks 4 through 6, as a modified baseline. The purpose of an additional two weeks of baseline after informed consent was to assess any potential impact of the informed consent process and to assess potential reactivity to the obtrusive observations.

Intervention

The intervention was evaluated using an ABA multiple baseline across behaviors with a non-treatment control sample of other hospital personnel who also conducted the pre-operative anesthesiology procedures in the same room. The two UP behaviors with the most stable baseline variance and in most need of improvement were used as targets of the intervention. The first UP behavior, hand sanitizing, was intervened upon beginning on week 6 and immediate needle disposal was

targeted three weeks later.

Intervention meetings took place in a Surgery Department office during regularly scheduled staff meeting times. Training posters and graphic feedback were displayed on a bulletin board in the pre-operation area.

Hand Sanitizing Training Session. A training session for the group of nurses occurred during a regularly scheduled staff meeting. A poster was displayed that included “hand sanitizing” in the title along with three discussion questions and a graph depicting group and individual performance listed by the nurses names. The investigator then posed three questions to the nurses for a facilitated discussion:

1. How do you practice hand sanitizing?
2. In what situations would you practice hand sanitizing?
3. What are the risks of not practicing hand sanitizing?

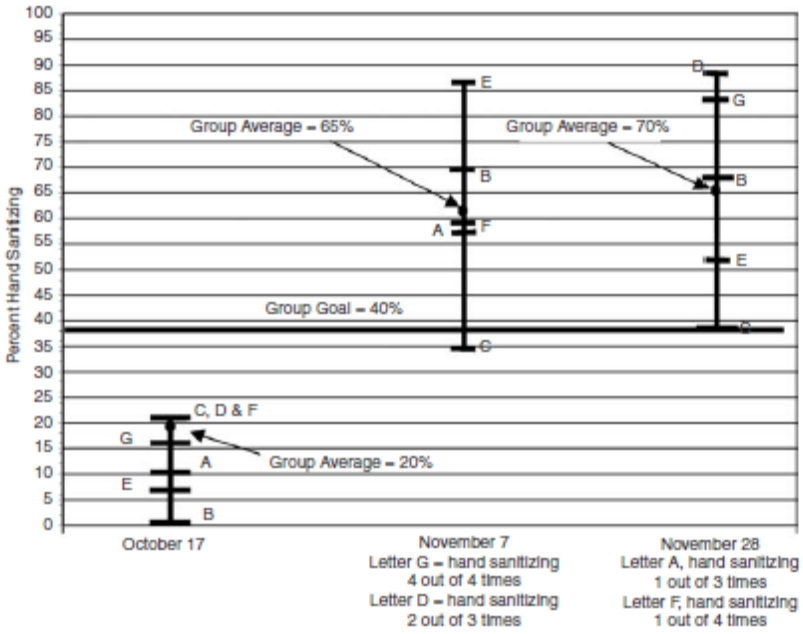
During the discussion, the facilitator repeated the employee’s response or asked for other reactions. At the end of the discussion the facilitator reviewed a list of hand sanitizing facts published by OSHA (1999) that were not otherwise mentioned in the previous discussion.
The nurses were then asked to set a “challenging yet attainable” group hand sanitizing goal. A decision on a 40% hand washing/sanitizing goal was made through a consensus vote (incidentally, they reported selecting the 40% goal because it was twice their current average). A red line depicting this goal was horizontally drawn on the graph. The meeting lasted for 26 minutes and all nurses participated in the discussion.

Feedback on Goal Progress. The training poster containing the feedback graph was posted on a bulletin board in the pre-operation preparation room. Hand sanitizing feedback for the group of nurses was graphically displayed every three weeks. Feedback data were calculated by dividing the total number of times participants sanitized their hands by the total number of opportunities they had to sanitize their hands. This score was multiplied by 100 to obtain a hand sanitizing percentage. Group scores were computed by taking an average of all nurses' hand sanitizing percentages.

Individual feedback was publicly displayed on the same graph with group feedback. Individual nurses' behavioral percentages were plotted vertically above and below the group feedback along with a letter. Each nurse was assigned a participant code letter during the first training session. Nurses referred to their letter to confidentially locate their individual progress on the graph. Figure 1 provides a facsimile of the final posted feedback graph.

Immediate Needle Disposal Training. After the first training session, the next training session was conducted three weeks later. The training session procedure was identical to the first session except that immediate needle disposal after IV insertion was targeted and graphed. A group goal of 84% was adopted to increase compliance with immediate needle disposal (i.e., twice the baseline average). The needle disposal meeting

FIGURE 1. Sample feedback graph that was posted in the OR preparation room depicting weekly percentages of hand sanitizing among participating nurse anesthetists.

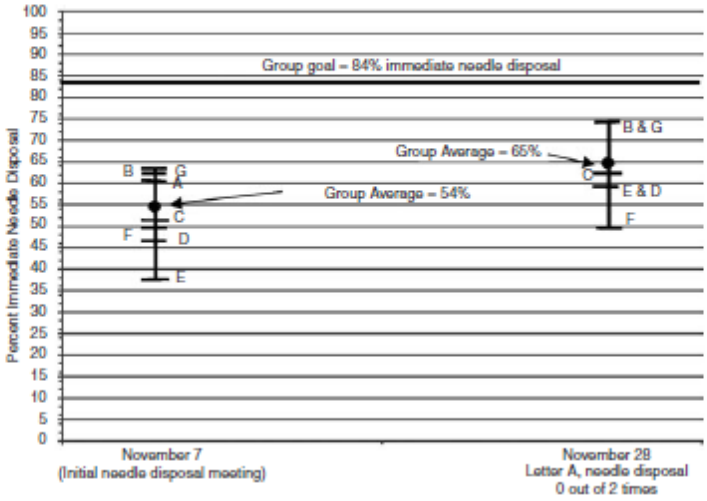


lasted for a total of 15 minutes. Hand sanitizing continued to be graphed while immediate needle disposal was graphed on a separate poster. Figure 2 provides a facsimile of the immediate disposal feedback graph.

Three weeks after immediate needle disposal was targeted, the principal investigator met with the nurses to provide them with feedback on both of the targeted behaviors. Because there were limited observations, in some cases a few nurses did not have their percentages graphed. Instead, they were provided with raw scores (e.g., 1 out of 3 times) for each targeted behavior.

Both UP meetings were audio taped and a content analysis was completed by independent judges using a structured checklist. The checklist was compiled to evaluate the meeting for verbalizations of both targeted

FIGURE 2. Sample feedback graph that was posted in the OR preparation room depicting weekly percentages of immediate needle disposal among participating nurse anesthetists.



and non-targeted behaviors by either the investigator or participants. The audiotapes were reviewed by two assistants who noted the content mentioned during the discussion. These content items were randomly transcribed onto a checklist that was subsequently used to analyze the audiotapes.

Because one target nurse was not present at the intervention meetings, memos summarizing the meeting were given to each of the nurses. The letters included a description of the UP under discussion, the current group performance level, the group goal, and UP issues raised by nurse colleagues during the meeting (contact the authors for a copy of this memo).

Withdrawal Observations. At week 10, all intervention materials were removed. Two weeks of withdrawal observations were gathered

followed by a five-week hiatus in data collection. Nurses were no longer provided with any group or individual feedback about their behavior. Follow-up questionnaires were administered to participants at this time to conduct a manipulation check, assess for confounds (e.g., “did you know you were being observed?”), and assess for social validity.

After the data collection hiatus, follow-up observations on hand sanitizing were conducted for three weeks. Additionally, after all observations ended, a debriefing session was conducted to reveal all aspects of the study, questionnaire responses, and show the results of the study after follow-up measures had ceased.

RESULTS

A total of 354 observation check-sheets were collected over the course of 12 weeks. Table 1 displays the percentage of observations during which nurses performed observed behaviors during each phase of the present study.

Hand Sanitizing

Figure 3 depicts the percentage of observations during which hand sanitizing occurred for each week of the study. Overall, the nurse anesthetists sanitized their hands 24% of the time during baseline, 65% during the intervention phase, 52% during withdrawal, and 54% during the follow-up observations. It is noteworthy that hand sanitizing percentages during the intervention exceeded the group goal of 40%.

Cumulative graphs depicting occurrences of hand sanitizing among participating nurses are presented in Figure 4. Participant A sanitized hands 30% of the time during baseline and 64% following the intervention. Participant B performed hand sanitizing behaviors 20% during baseline and steadily increased to 73% over the course of the study. It should be noted that after signing the informed consent, Participant B increased these behaviors substantially (this participant knew about the study prior to signing the informed consent). Participant C sanitized hands 17% during baseline and after several plateaus increased to 22%;

TABLE 1. Mean occurrences of desirable behaviors across experimental phases.

	Baseline	Intervention	Withdrawal
*α Hand washing or hand sanitizing before and after	24 (35/138)	65 (74/113)	52 (11/21)
*α Needle discarded immediately	53 (50/95)	58 (22/38)	45 (5/11)
α Gloves are worn	51 (45/88)	46 (31/68)	64 (7/11)
α Needle is not recapped or is recapped with one hand	45 (25/53)	61 (31/51)	63 (5/8)
α Gloves are worn while discarding waste	31 (22/70)	52 (20/38)	88 (7/8)
α Gloves are removed inside out	61 (37/61)	93 (28/30)	100 (5/5)
∞ Patient greeted	98 (86/88)	95 (60/63)	100 (12/12)
∞ Nurse explains procedure	93 (75/81)	98 (60/61)	92 (11/12)
∞ Nurse asks if patient has questions	86 (66/77)	75 (33/44)	100 (11/11)
∞ Nurse explains each step during the procedure	88 (68/77)	83 (44/53)	100 (10/10)
∞ Nurse asks questions while completing form	90 (62/69)	90 (56/62)	91 (10/11)
∞ Needle area is disinfected	99 (78/79)	100 (63/63)	100 (11/11)

*Behavior targeted for intervention
αUniversal Precaution (UP) behavior
∞ Auxiliary behavior

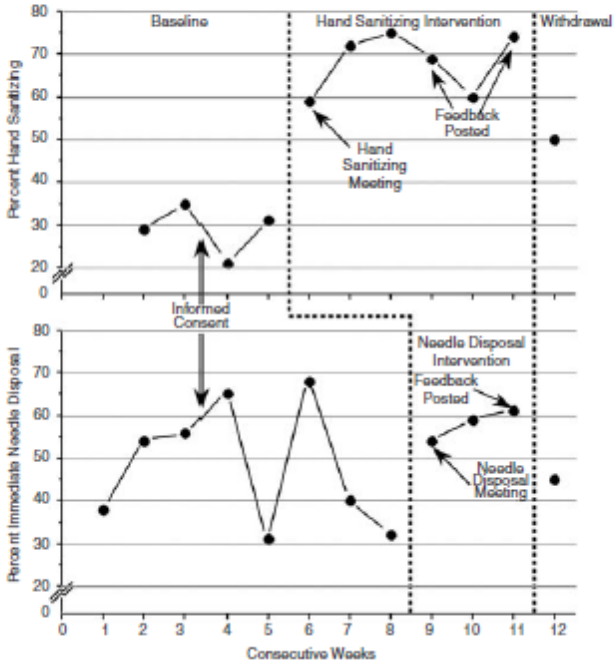
Note: The number of occurrences and observations appear in parentheses. All targeted, non-targeted, and auxiliary behavior means were calculated with the 5-week baseline period, 6 week intervention period (i.e., corresponding with the hand sanitizing intervention), and 2-week withdrawal (follow-up observations for hand sanitizing not shown here). However, behavior means for "Needle discarded immediately" are calculated with a longer baseline observation period (i.e., 9 weeks) and with an intervention of 3 weeks corresponding to the discarding needles intervention period.

Participant D increased from 20% during baseline to 48% post-intervention; Participant E had a baseline level of 16% which slowly increased to 42%; Participant F had a dramatic increase from 18% to 86%;

and Participant G had the highest baseline level of 50%, which increased to 82% by the end of the study.

During the follow-up observation period (beginning 7 weeks after the intervention ended and 5 weeks after previous obtrusive observations ended), participant observation scores remained relatively high. Participant A had a withdrawal hand sanitizing percentage of 13%; Participant B, 67%; Participant C, 33%; Participant D, 81%; Participant E, 50%; Participant F, 43%; and Participant G, 60%.

FIGURE 3. Weekly percentages of hand sanitizing and immediate needle disposal occurrences among participating nurse anesthetists.



Immediate Needle Disposal

Figure 3 above also depicts the percentage of time the targeted nurses

disposed of used needles immediately and correctly for each week of the study. Overall, participants disposed of needles immediately 53% of the time during baseline, 58% during the intervention phase, and 45% during withdrawal. Immediate needle disposal remained consistent throughout the study, thus the group goal of 84% was not met. Withdrawal percentages on immediate needle disposal were not computed due to low frequency of observations on this behavior after the intervention.

FIGURE 4. Cumulative frequency of individual participant hand sanitizing occurrences.

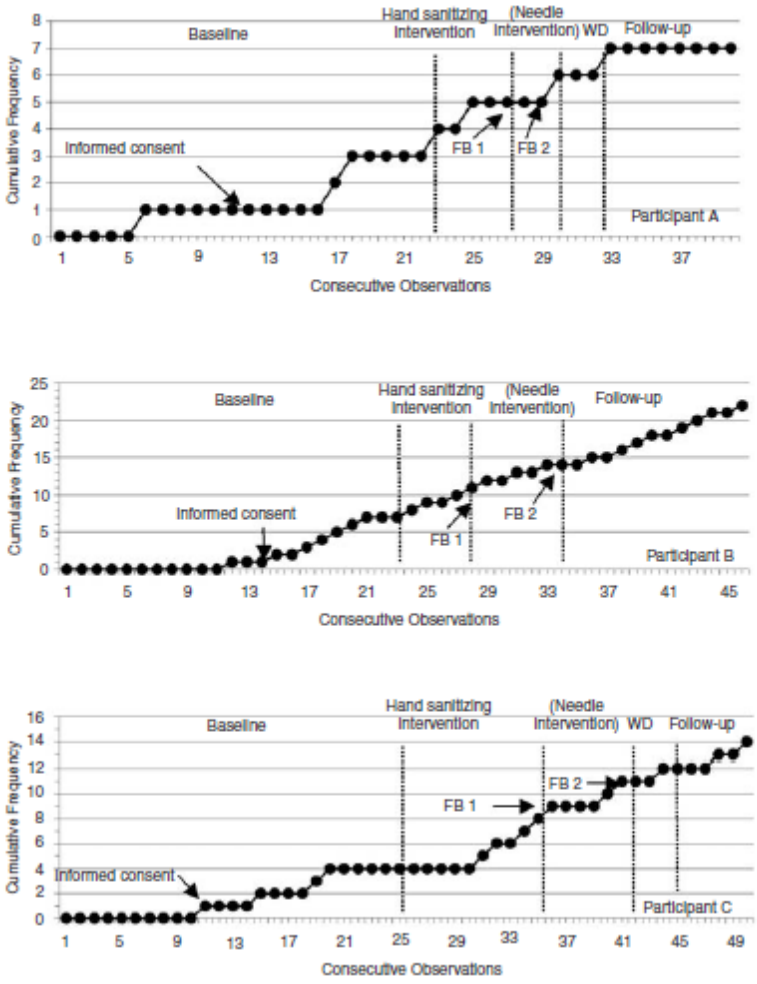
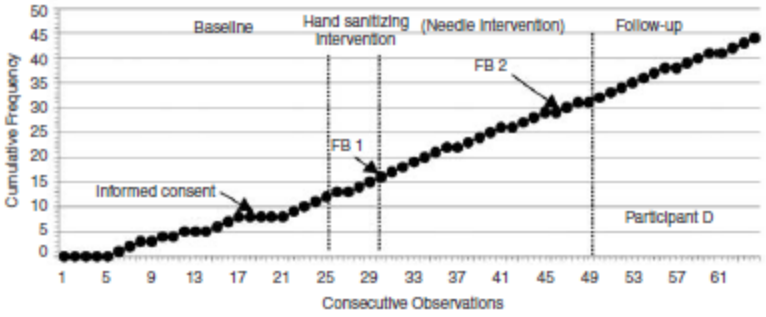
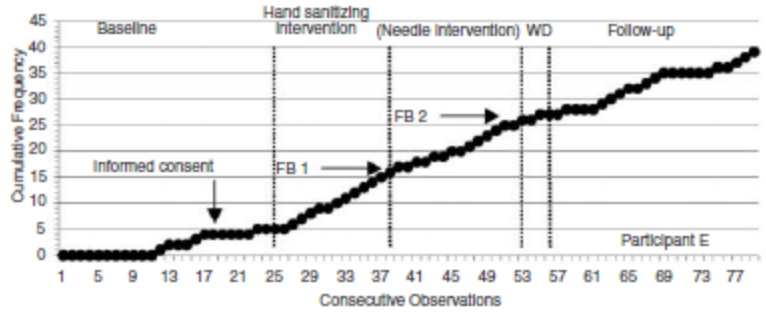
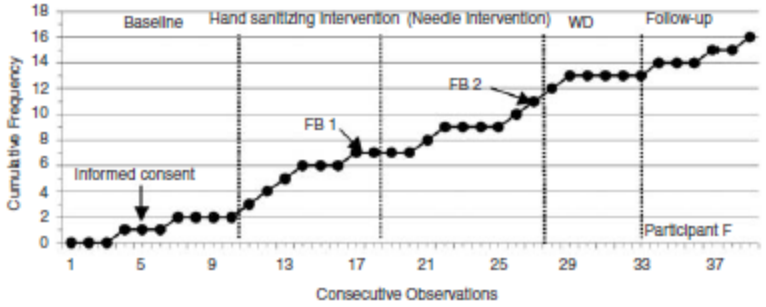
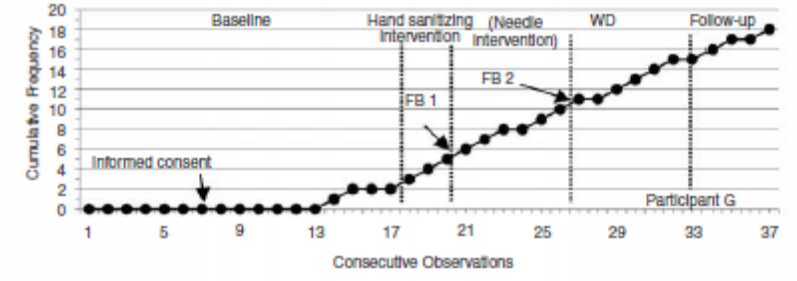


FIGURE 4 (continued)









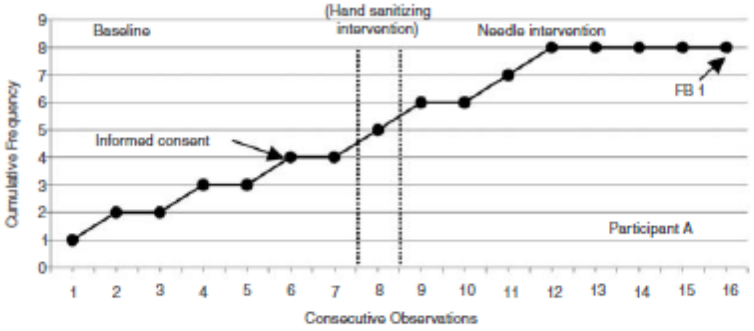
Cumulative graphs depicting occurrences of immediate needle disposal for each participating nurse are presented in Figure 5. Most nurse immediate needle disposal data were consistent throughout the intervention and the withdrawal period. Baseline and intervention scores were 63% and 57% for Participant A; 38% and 56% for Participant B; 50% and 42% for Participant D; 57% and 63% for Participant F; and 50% and 54% for Participant G. Participant E dropped from 64% at baseline to 30% post-intervention as did Participant C, 60% at baseline and 33% post-intervention.

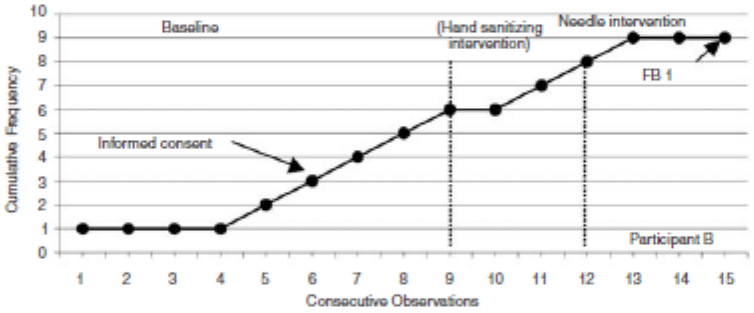
Non-Targeted Behaviors

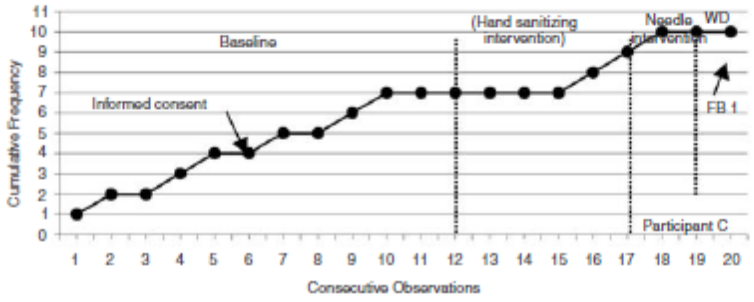
Non-Targeted UP Behaviors. There were moderate increases in a non-targeted UP, “needle is recapped with one-hand,” from an average of 45% during baseline to 61% during the intervention phases. If immediate needle disposal was not feasible, recapping with one-hand may have served as an intermediate step prior to needle disposal. Although not endorsed by OSHA, recapping with one hand is safer than recapping using two hands, where accidental needle sticks are more likely.

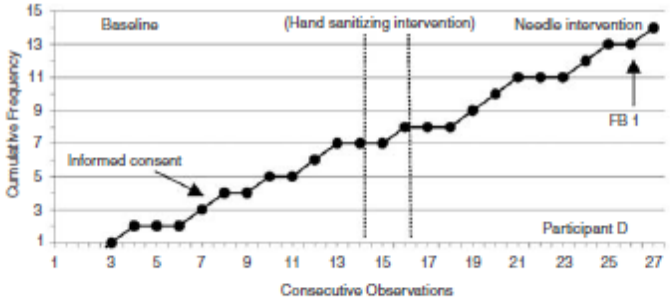
Certain other non-targeted UP behaviors increased concurrently with the hand sanitizing intervention (see Table 1), demonstrating a spread of effect from the intervention. These are behaviors that reduce the likelihood of exposure to body substance through non-intact skin. For example, “gloves are removed inside out” increased from a baseline level of 61%to 93%during the intervention phases. In addition, “gloves

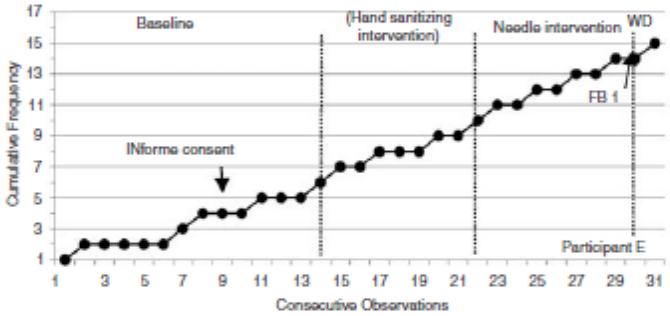
FIGURE 5. Cumulative frequency of individual participant immediate needle disposal occurrences.











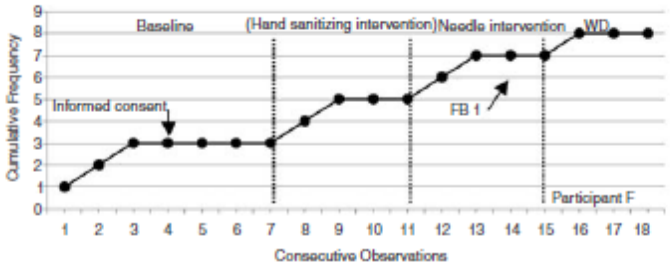
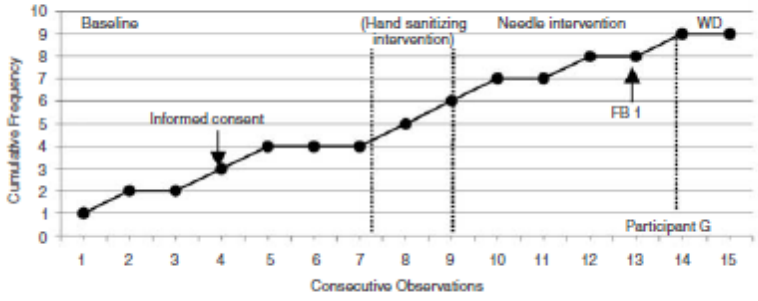


FIGURE 5 (continued)



are worn while discarding waste" increased from 31% to 52% during the intervention phase.

Non-Targeted Auxiliary Behaviors. Non-targeted auxiliary (i.e., non-UP) behaviors, specifically those related to nurse and patient interactions were high and consistent throughout the study. For example, "nurse explains each step during the procedure" was 88% during baseline, 83% during the intervention phase, and 100% during withdrawal. Additionally, "needle area disinfected," a procedure that reduces patient risk of infection, was nearly 100% across all phases.

Two Baseline Periods

An assessment was conducted of participant reactivity to the informed consent session where nurses were informed that their behaviors were being observed. To do this the baseline percentages of observed behaviors were compared before and after the informed consent session. No changes were observed in participants' hand sanitizing from pre-consent baseline (i.e., 22%) to post-consent baseline (i.e., 28%). Immediate needle disposal behaviors were both 50% before and after the informed consent meeting.

Content Analysis of Intervention Meeting

Two raters reviewed the audiotapes of the intervention meetings to evaluate verbalizations of behaviors listed on the behavior checklist (listed in Table 1). Raters agreed 87% of the time on specific verbalizations presented at a particular meeting. The term "Universal Precautions"

was used seven times in the hand sanitizing meeting (five times by the investigator and two times by nurses). The terms “hand washing,” “cleaning hands,” and “sanitizing” were used 27 times during the hand sanitizing meeting (10 times by the investigator and 17 by the nurses). One particularly relevant point raised by the nurses was the convenience of the alcohol-based hand sanitizer units located on their carts. The availability of these units saved nurses’ time, thus making it more likely that they would practice this UP.

Glove wearing was mentioned one time by a nurse in the context of sanitizing hands after removal of gloves. No other mention of glove wearing, glove removal, needle disposal, or needle recapping occurred during the hand sanitizing meeting. Nurses mentioned patient interaction behaviors (also listed in Table 1) eight times during the meeting. The hand sanitizing meeting lasted 26 minutes and 2 seconds. During this time nurses spoke 13 minutes and 22 seconds.

During the needle disposal meeting the term “Universal Precautions” was used three times (all by the investigator). The terms “recapping,” “needle discarding,” and “setting or laying needle down” were used 21 times during the needle disposal meeting (16 times by the investigator and five by the nurses). No other mention of glove wearing, glove removal, hand washing or sanitizing occurred during the needle disposal meeting. Two questions outside of the meeting were asked about the hand sanitizing feedback graphs. Nurses mentioned patient interaction behaviors (also listed in Table 1) five times during the meeting most notably regarding the need to maintain physical patient contact during the

procedure to avoid discharge of blood. The needle disposal meeting lasted 16 minutes and 55 seconds. During this time nurses spoke 5 minutes and 48 seconds.

Manipulation Check and Social Validity Surveys

When asked, all participants were able to identify and list the first and second UP behaviors targeted. However, most questions where participants were asked to identify group goals and group and individual performance levels were not answered correctly. Two participants (Participants A and E) correctly recalled the hand sanitizing goal set for the unit and none of the participants were able to state the immediate needle disposal goal. Three participants (A, E, and G) were able to correctly identify the initial and final group performance levels for hand sanitizing.

Most of the participants did not answer questions about personal initial and final levels of performance for hand sanitizing, when they did they were incorrect. For example, Participant G said that her final performance for hand sanitizing was 70%, although it was close to 85%. Participant E stated his final hand sanitizing performance was 80% when it was closer to 50%.

The results from a set of Likert scale questions regarding safety are presented in Table 2. Approximately half of the nurses considered changing other UP behaviors in addition to those targeted. These included glove wearing and facial/eye protection in the operating room. Most participants agreed that their work environment provided them with the necessary supplies to prevent accidental exposure to bloodborne

pathogens. In addition, all agreed that using Personal Protective Equipment and practicing UPs decreases their risk of acquiring infections. Less consistent results were reported regarding the program's effectiveness, helpfulness of the training sessions, wanting the program to continue, and redesigning one's work environment to facilitate safety behaviors. However, most participants (86%) agreed that they had discussed the safety behaviors and/or graph with others.

DISCUSSION

The results of this study partially confirmed the hypotheses and replicates findings by DeVries et al. (1991) and Babcock et al. (1992). Hand

TABLE 2. Percent of participants answering strongly agree/agree to questionnaire statements.

Statement	Percentage
The safety program was worth the effort.	57
I would like the program to continue.	14
The training sessions were not helpful to me.	14
I believe my safety behaviors improved as a result of the program.	43
I am more satisfied with my job as a result of the program.	14
The program was stressful to participate in.	0
I personally intended to achieve the unit goals.	57
I discussed the safety behaviors and/or graph with others.	86
I looked at the graph after each update.	43
I liked receiving individual feedback about my performance.	29
My work environment is designed and organized to facilitate safe job performance.	57
All of the necessary supplies to help prevent accidental exposure to body substances are readily available for my use.	86
I redesigned my work set-up to remind myself to practice the safety behaviors.	14
My safety practices are considered when I receive performance evaluations by my supervisor.	57
Management (immediate supervisor and higher) show concern and commitment regarding safety issues.	71
I worry about the risk of contracting hospital-acquired infections through my work.	43
Using Personal Protective Equipment (PPE) decreases my risk of contracting hospital-acquired infections.	100
Practicing Universal Precautions (UPs) decreases my risk of contracting hospital-acquired infections.	100
Following UP practices is too time-consuming.	14
Following UP practices decreases my dexterity.	43
I would contact my supervisor or Employee Health if I were accidentally exposed to body fluid substances at work.	100

sanitizing increased in frequency for each of the seven participants as a result of the training, goal setting, and posted individualized feedback intervention. The group hand sanitizing goal of 40% was met and exceeded. Hand sanitizing remained above baseline levels throughout the withdrawal phase of the study. Immediate needle disposal, the second behavior targeted for intervention, appeared to be unaffected throughout the study.

Hand Sanitizing. Many of the nurses stated that they sanitized their hands much more frequently than the 20% reported to them during their

initial training session. Noting this gap they mentioned that they usually washed their hands in a bathroom down the hall after completing the procedure and cleaning up. However, during the intervention meeting they agreed that hand sanitizing must be conducted immediately after patient contact was completed. Otherwise any objects or personal effects they touch before entering the bathroom may become contaminated causing a safety concern for themselves and other hospital personnel. Thus, these nurses may have already been washing their hands frequently prior to the intervention but they were not doing so while the research assistants were observing their behavior. Therefore, behavioral changes observed during this study suggest an increase in immediate hand sanitizing at or near the patient gurney.

Immediate Needle Disposal. The lack of behavior change during the needle disposal intervention may be attributable to the nature of the anesthesia task. During the intervention meeting many nurses stated that immediate needle disposal was not possible given the nature of the intravenous line procedure. Their primary concern was securing the IV catheter in the patient's arm first. Disengaging contact with the patient to dispose of the needle could cause the catheter to discharge blood putting the nurses at greater risk for exposure to blood-borne pathogens. Thus, three participants said that immediate needle disposal was "unrealistic" given the need to secure the IV line in the patient prior to disposal.

For these reasons, many nurses were observed to use the one-handed recapping technique as an intermediate step prior to needle disposal.

Ongoing observations over the course of the study revealed a moderate increase in the frequency of one-handed recapping. Evidently, the nurses did not comply with the immediate needle disposal objective of the second intervention, but did increase UP compliance regarding needle use practices with another, more practical, behavior (recapping with one hand). One-handed recapping compensated for a lack of change in immediate needle disposal occurrence.

In any case, a more powerful intervention strategy may be needed to change needle-handling behaviors more significantly (Ludwig & Geller, 2000). For example, the nurses suggested that the hospital would have to supply more accessible needle boxes to increase their compliance with this UP. Although nurses had a needle box on their portable cart in addition to the station needle box, they said they rarely used their cart needle box. Another variable mentioned by the nurses was the availability of self-protective medical devices, such as self-sheathing needles that may remedy the problem of accidental needle sticks. While currently used in other departments in the hospital, self-sheathing needles had not been introduced to the Anesthesiology Department.

Non-Targeted Behaviors

Certain non-targeted UP behaviors increased as a result of the intervention. The most notable improvements were “gloves are removed inside out,” which was performed by the nurses 93% of the time by the end of the study and “Gloves are worn while discarding waste” which

doubled during the intervention.

The finding that non-targeted UP behaviors improved as a result of the intervention is similar to demonstrations of "response generalization" (Ludwig, 2001; Ludwig & Geller, 2000). It is notable that the analysis of the content of the meeting audiotapes showed there were minimal verbalizations of glove wearing or other UPs during the nurse/ investigator discussions suggesting another factors may be influencing these non-targeted behaviors. Ludwig (2001) argued that the non-targeted behaviors most likely to change are those that are maintained by the same naturally occurring contingencies as the targeted behaviors and/or have been associated with the targeted behaviors as a result of topography, prior training, or concurrent antecedents and consequences. In this setting, hand sanitizing and proper glove use may be topographically similar and have been trained together in the past as part of the UP policy instruction each nurse received during their employment.

Nevertheless, this spread of effect to other UP behaviors has implications for future studies and application to health care settings. Focusing on one behavior can also improve other safety behaviors that nurses and other health care providers perform. Certainly, this result will need to be replicated and future studies in this area should include observations of numerous non-targeted behaviors to further evaluate this finding.

Social Validity

Social validity refers to the practical application and acceptance of

the various intervention components of the intervention process (Winett, Moore, & Anderson, 1991). Socially validating an intervention typically involves assessing the ethical and societal outcomes of an intervention. Often, the best method of assessing social validity is to ask employees directly their impressions of the intervention procedures. Participants reported no increase in occupational stress as a result of the program nor did any participant report that participating in the program was stressful. Participant C even agreed that he was more satisfied with his job as a result of the safety program.

It is important that behaviors specific to nurse-patient interactions did not decline with the introduction of the interventions. Incidents of nurse-patient interactions, such as “patient greeted,” “nurse explains procedure,” “nurse asks if patient has questions,” “nurse explains each step during the procedure,” “nurse asks questions while completing form,” and “needle area is disinfected” were initially high and remained stable throughout the study. Bedside manner may reduce patient anxiety and provide for a more successful intravenous line insertion. It is important that interventions such as the one examined in this study do not negatively impact other critical employee behaviors.

Incidentally, nurses mentioned that environmental factors may have contributed to their responsiveness to the interventions. One unique environmental factor that likely influenced participant behavior were the terrorist attacks of September 2001. One nurse commented that he was more aware of his UP behaviors as a result of the Anthrax contamination scare.

SUMMARY

This study systematically replicated existing literature on performance management and health care behaviors, specifically those of DeVries et al. (1991) and Babcock et al. (1992) by demonstrating that a behavioral approach to safety improved targeted UP behaviors. However, goal setting and feedback techniques were slightly different in this study. Neither DeVries et al. (1991) nor Babcock et al. (1992) used goal setting as part of the intervention. In this study goal setting was employed during each intervention meeting through group collaboration and agreement. Goals may have been salient antecedents to prompt hand sanitizing behavior and may have specified a level of improvement to achieve.

The nature of feedback delivery varied from Babcock et al. (1992) who provided weekly feedback and DeVries et al. (1991) who provided feedback every two weeks. In this study, due to observation limitations, feedback was only provided once every three weeks. More frequent feedback may allow nurses to make more accurate evaluations of their performance in relation to the goal and to make adjustments to their behavior(s) when necessary.

In DeVries et al. (1991) and Babcock et al. (1992), immediate supervisors met with nurses individually to provide private written feedback. The present study publicly displayed individual performance levels along with group performance averages, although private code letters

instead of names were used. Feedback was provided verbally, graphically, and in memo format. Multiple methods of feedback may help participants become more aware of individual and colleague performance levels. As a result, nurses may have influenced each other to reach the group goal. Lastly, DeVries et al. (1991) and Babcock et al. (1992) targeted one UP behavior, glove wearing, whereas this study focused on two UP behaviors, hand sanitizing and immediate needle disposal, in a multiple baseline format.

Several limitations of this study should be noted. One limitation of this study was a lower than optimal interrater reliability for immediate needle disposal (i.e., 72%). Some confusion was reported among the observers recording immediate needle disposal. In such cases observers were trained to leave the item blank on the datasheet possibly underestimating the amount of correct needle disposal. With this confusion, it was difficult to obtain an adequate number of observations during each phase of the study.

The obtrusive observation method may be another limitation. This study sought to measure a possible independent “observation effect” by delivering the informed consent and revealing the observers’ role in the midst of the baseline phase. In the remaining two weeks of baseline after the informed consent meeting, only one participant (Participant B) showed any notable behavior change. The reactivity in Participant B could be due to his involvement in the development of the behavior checklist before baseline observations began. Nevertheless, researchers considering future studies may want to investigate UP practices unobtrusively

(e.g., through video cameras) to reduce the potential reactivity (Kazdin, 1994) due to the obtrusive observation.

Finally, to better decrease the risk of accidental needle stick injury, the nature of the intravenous line procedure needs to be examined in more detail and other relevant behaviors may be targeted. Intermediate steps, such as the one-handed recapping technique, may be targeted to ensure successful completion of the intravenous line procedure and to increase the likelihood of compliance with UPs.

Health care workers are routinely at risk for exposure to blood-borne pathogens. Although UP practices have been established to help prevent accidental exposure, noncompliance remains a problem in hospitals around the country. Training, goal setting and feedback appear to be effective ways to increase the frequency of some UP behaviors. Increasing employee compliance to UP behaviors using methods evaluated in this study may ultimately decrease accidental exposure incidents and reduce costs incurred from lost work time and post-exposure treatments. The unique contribution of this study is that it included direct observations of several UP behaviors and demonstrated that certain UP behaviors not targeted by the goal setting and feedback intervention can also be impacted.

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