ABSTRACT

OBJECTIVE: To compare the proportion of recapped needles, an injury surrogate measure, in disposal boxes on two different types of hospital units, both before and after an intervention.

DESIGN: Prospective nonrandomized intervention trial.

SETTING: A major public teaching hospital.

PARTICIPANTS: Specific hospital units. We selected two types of hospital units for study: the first type of hospital unit (medical-surgical ward) had existing mounted in-bathroom needle disposal boxes, and the second type of hospital unit (intensive care unit) had unmounted needle disposal boxes in the room but not necessarily near the patient’s bedside.

INTERVENTION: The installation, in the medical-surgical wards only, of mounted needle disposal boxes on the wall near the patient’s bed. The box location in the intensive care units remained the same.

RESULTS: The baseline proportion of recapped needles in the first medical-surgical unit was 32.6% (±3.8%) and in the second medical-surgical unit it was 27.4% (±4.0%) in the bathroom needle disposal boxes, which was similar to the observed proportion (34.7 ± 6.4%) in the intensive care unit boxes. Following the intervention, the proportion of recapped needles was significantly reduced in the disposal containers adjacent to the bedside in medical-surgical units, to 27% (a difference of 2.9 standard errors of the baseline distribution) in the first unit and 18.2% (a difference of 4.6 standard errors) in the second. In the intensive care unit, where boxes were not moved but new mailbox-types were simply substituted, no significant change was noted (36.6%, a difference of 0.59 standard errors). A statistically significant reduction was

From the Center for Occupational and Environmental Health, University of California, San Francisco, California. This study was supported, in part, by grants from ERC, Inc. and Universitywide AIDS Research Program.

The authors thank the hospital workers who cooperated with this study, Lewis Reese and the housekeeping staff at San Francisco General Hospital, Blanca Cantu, RN, June Fisher, MD, Margaret Grade, PhD, Kurt Mueller, MD, Wendy Smith, RN, Tom Lorey, MD, Charles Becker, MD, and Jane Lipscomb, PhD.

This article is dedicated to the memory of Thomas Ficarotto, PhD, whose work inspired us all.

Address reprint requests to James E. Cone, MD, MPH, 2241 Channing Way, Berkeley, CA 94704.
INTRODUCTION

Less than a decade ago, the issue of occupational injury and infection to healthcare workers received little attention in the field of occupational medicine. The 1980s witnessed a major turning point. The first study to describe the epidemiology of needlestick injuries in healthcare workers was published in 1981 by McCormick and Maki. Two of the major preventable causes of injury identified in this study involved needle disposal and recapping. The authors suggested that needles not be recapped, that a new needle disposal system be instituted, and that all injuries be reported. Interval disposal (what to do with a needle when it cannot be discarded immediately) has been identified by several studies as a serious threat to healthcare workers. In one study of needlestick injury, 69.6% of the injuries occurred after the procedure was over, but before the needle was discarded. In a study of 45 surgical instrument-related injuries, Jaggar et al found that 64.4% of the injuries occurred during this time interval.

Although the problem of injury related to disposal boxes and their location is often mentioned in needlestick injury research, the early results of studies on such disposal systems indicated that change in the sharps containers themselves had little effect on injury. Research by Krasinski et al at Bellevue Hospital was somewhat discouraging because an extensive effort to improve the disposal system and educate the healthcare workers seemed to have no impact on injuries.

Ribner and Ribner recently reported an intervention study in which they developed an educational program, moved the needleboxes from the central nursing station to patients' rooms, and informed the nurses that they would be monitoring their recapping rate by inspecting the needle boxes. This study thus involved simultaneous educational and environmental interventions, with intensive high-profile surveillance of needle-recapping rates. This study was quite small, involving only one hospital unit. Over a 12-month period, the authors reported a reduction in recapping of needles used for venipuncture and percutaneous medication injection from 61% to 16%. Most important is the methodological issue raised by this study, in that recapping rates, as measured by needlebox counts, rather than needlestick injuries, were used because needlestick injuries were too few in number to detect any change related to the intervention.

Linnemann et al recently demonstrated that simply instituting an intensive educational campaign led to an increase in reported recapping-related injuries as one would expect. Next, rigid sharps containers were installed in all patient rooms, resulting in a 50% reduction in reported recapping injuries. This decrease in reported injuries was noted in nurses but not in other healthcare workers. The decrease in reported needle-recapping injuries persisted following institution of Universal Precautions, although the total number of reported injuries increased slightly.

No study, however, including the latest study by Linnemann et al, has yet demonstrated a positive effect of environmental changes alone, without accompanying educational efforts. Therefore, the current study was designed to evaluate the effect of an intervention of changing the environmental factors alone, using needle-recapping rates as the measure of effect, combining needle-box counts with direct observation, comparing three different hospital units over a six-month period.

METHODS

As part of a larger study of preventive strategies for needlestick injury, we studied one major metropolitan hospital's attempt to create a safer workplace environment through a simple intervention: installing additional sharps containers closer to the patients' bedsides, in order to reduce the hazards associated with needle disposal.

We studied the rate of recapped needles relative to the total number of needles in disposal boxes before and after the intervention. We used the rate of recapped needles as an "injury surrogate" similar to studies of punctured gloves in surgery suites. Recapped needles represent indicators of injury or violations of blood and body substance protocol that are not reported through official procedures and that occur on a relatively frequent basis.

The hospital had historically placed the needle disposal boxes in the bathrooms on medical-surgical ward bedsides, in order to reduce the hazards associated with needle disposal. However, the hospital had recently moved the needleboxes from the central nursing station to patients' rooms, in order to reduce the hazards associated with needle disposal. This study thus involved simultaneous educational and environmental interventions, with intensive high-profile surveillance of needle-recapping rates. This study was quite small, involving only one hospital unit. Over a 12-month period, the authors reported a reduction in recapping of needles used for venipuncture and percutaneous medication injection from 61% to 16%. Most important is the methodological issue raised by this study, in that recapping rates, as measured by needlebox counts, rather than needlestick injuries, were used because needlestick injuries were too few in number to detect any change related to the intervention.

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wards. After some years of pressure from nurses and physicians, boxes in these units also were installed at the patients' bedside, where the needles are actually used. A second environmental intervention simultaneously occurred in the units under study: the box-type disposal container was changed from a rounded container to a mailbox-slit type container.

In the intensive care units, the location of disposal boxes was not changed during the time of the study, as boxes were usually kept on tables in the corner of patients' rooms. This was done because of the need for flexibility in the intensive care unit environment and because there are no bathrooms attached to the intensive care unit rooms. Thus, in the intensive care unit areas, box placement was not changed, although the box type was changed to the mailbox-slit type container. This enabled us to study the effect of a change in needle-box type alone, without change in location.

The change in the physical location and type of sharps disposal boxes was made in July 1990. Prior to the change, a sample of boxes was collected from two medical-surgical areas and one intensive care area immediately before the change was made, and another sample was obtained six months later.

Baseline Measures Prior to Intervention

The areas of the hospital selected for study included one surgical ward, a medical ward, and an intensive care unit (cardiology). We studied the observed proportion of recapped needles compared with the total number of observed needles in disposal boxes on each study unit. Boxes were picked up with the assistance of housekeeping staff from each unit. On the day of the intervention, 20 partially or completely filled boxes in each medical and surgical unit were collected, and a random sample of 50% of the boxes were counted until 10 boxes or a total of at least 500 needles were counted in each unit. Mean and standard deviation of recapped needles were calculated for each box counted. A total of 7 boxes were collected from the intensive care unit, and all needles from these boxes were counted.

Boxes were marked with indelible ink and autoclaved for sterilization. The following personal protective equipment was used to reduce the hazards of handling infectious waste: 24-inch tongs, leather gloves, protective goggles, and organic vapor dual cartridge respirator (to reduce odor exposure). All procedures involving the needle boxes were conducted in a well-ventilated room in the hospital morgue. Each box was opened, and then tongs were used to transfer needles and other waste to another needle disposal box.

Follow-Up Measures After Intervention

Boxes were collected from the identical hospital units six months after the change had been instituted in each unit. Twenty boxes were collected from one large unit (9 boxes from the bathrooms and 11 boxes from patient rooms) and 11 boxes from the second smaller unit (6 from the rooms and 5 from the bathrooms). Eleven boxes were collected from the intensive care unit. These boxes were collected over a two-day period. Box counting was performed using the identical procedure as during the preintervention phase.

Criterion Measures

The number of recapped needles was divided by total needles in all the boxes of the unit collected on a given day. This recapping frequency was modified to reflect an observed practice, whereby healthcare workers filled a syringe with medication, recapped the needle, then carried the needle and medication to the bedside, disposed of the needle and cap, and used the syringe in an intravenous port to administer medication. Given the widespread use of this practice, these "needles with cap only" were recorded, and the recapping frequency rate was revised by deleting these needles completely from the analysis, although we performed the analysis with and without such needles, and observed similar overall findings.

Statistical Analysis

Standard errors of the proportion were calculated for each comparison of pre- and postintervention needle-recapping ratios using the preintervention as the population proportion hypothesis. The probability values associated with the standard errors of the proportion were derived from the proportions of the normal curve.9

RESULTS

The Table shows the proportion of recapped needles in the ward 1 bathroom boxes prior to the intervention, 194 (32.6%) of 595. Following installation of new disposal boxes in the patients' rooms and changing the type of box to the mailbox type, the proportion of recapped needles in the bathrooms increased significantly (53/137, 38.7%, a change of 3.2 standard error, p = .0007), but the proportion dropped significantly to 47 (27%) of 174, in the in-room disposal box (a change of 2.9 standard errors of the baseline distribution, p = .0019).

The Table also shows the proportion of recapped needles in ward 2 bathroom boxes prior to the intervention, 142 (27.4%) of 519. Following installation of new disposal boxes in patient rooms and changing the type of box to the mailbox type, the proportion of
recapped needles in the bathrooms did not change significantly (125/418, 29.9%, a change of 1.25 standard errors, \( p = 0.1056 \)), but the proportion dropped significantly to 79 (18.2%) of 433 in the in-room disposal box (a change of 4.6 standard errors, \( p < .0001 \)).

In the intensive care unit, the preintervention proportion was 75 (34.7%) of 216, recapped needles in the disposal box. After changing only the box type to the mailbox-style box, but keeping the boxes in the identical location, the proportion was 147 (36.6%) of 402 (a change of 0.59 standard errors, \( p = .276 \)). When the combined preintervention proportion for the two wards (336/1,114, 30.2%) is compared with the combined postintervention proportion (304/1,162, 26.2%), a statistically significant overall drop in the proportion of recapped needles is found (a change of 2.9 standard errors, \( p = .0019 \)).

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The hospital modifications left a set of boxes mounted in each of the bathrooms, and the recapping rate actually increased in one ward’s bathroom-mounted boxes (an increase of 3.2 standard errors, \( p = .0007 \)), although the increase was not statistically significant in the other wards’ bathroom-mounted boxes (an increase of 1.25 standard errors, \( p = .1056 \)).

DISCUSSION

It should first be noted that the experiment achieved its aims: as boxes were installed closer to bedside, the recapping proportion in the two units affected was significantly reduced. No significant difference in proportion of recapped needles was noted when the type of container was simply changed from the round top to the mailbox type container in the intensive care unit.

Why do nurses and physicians dispose of needles farther away than necessary? One explanation may be that bathroom-mounted boxes may still be used due to overflow of patient room boxes. Healthcare workers in interviews on the ward reported that boxes are often either full or perceived as full. Even a box that is only three quarters full may appear to be full, especially if paper or bulky syringes force sharps close to the top of the box. In our inspection of nearly 150 boxes, we found that nearly all boxes had at least some paper waste, and often held bottles, tubes, and other used equipment. Many healthcare workers who have been injured by needles sticking out of such boxes automatically look for an emptier container. However, the ward 2 needleboxes contained more than four times as many needles per box as those in ward 1, making the theory that overflow results in use of bathroom needleboxes less plausible at least for ward 1.

Another possible reason for use of the bathroom needle disposal box may be that healthcare workers often walk to the bathroom area to wash their hands and therefore may decide to carry the used needle into the bathroom. This is a well-developed habit in some healthcare workers due to the historical location of the boxes there. If the decision is made to carry the needle to the bathroom, as Jagger et al. have said, recapping may appear to be a less dangerous alternative than walking with an unsheathed needle.

Strengths of the Current Study

Stability. It should be noted that there is a remarkable stability to the observed recapping rates. In the unit where no change in box location occurred (the intensive care unit) and where there are no bathrooms, the recapping rate remained virtually the same (a change of .137 standard errors, \( p > .85 \)). Although recapping practices may vary considerably from one healthcare worker to the next, a random sample of a unit produced a normally distributed average rate that can be tested and retested over a six-month period.

Small changes detectable. The testing instrument was able to detect behavioral changes within the range of 5 to 10 percentage points. The effectiveness of subtle intervention measures can thus be tested.

TABLE

<table>
<thead>
<tr>
<th>Ward</th>
<th>Prior to Intervention</th>
<th>After Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Recapped Needles*</td>
<td>No. of Total Needles</td>
</tr>
<tr>
<td>Ward 1 bathroom</td>
<td>194</td>
<td>595</td>
</tr>
<tr>
<td>Ward 1 next to bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ward 2 bathroom</td>
<td>142</td>
<td>519</td>
</tr>
<tr>
<td>Ward 2 next to bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>75</td>
<td>216</td>
</tr>
</tbody>
</table>

*Needles with caps only were eliminated from this analysis.
with statistical reliability, once the assumptions underlying the research instrument are accepted. Observation is crucial to the process. There are procedures at use in specific units where it appears that a needle has been recapcd, but this is not the case: where a syringe is filled with medication, recapcd in order to carry to the patient, and then the capped needle is disposed, and the medication is administered directly from the syringe into a flexible angiocatheter. Inspection of boxes without associated observation may result in an overly simplified view of needle-handling on a given unit, which this study attempted to avoid.

CONCLUSION

This study is the first to demonstrate the positive effect of environmental changes alone on needle disposal practices of hospital workers. We used a combination of nonobtrusive measurement with direct observation to identify the proportion of needles that were recapcd. Limitations of this study include the fact we were not studying injuries, but injury surrogates. Studies that have attempted to use reported injury rates, however, are severely limited by the rarity of their occurrence and significant under-reporting. A recent study of the housestaff at the University of California San Francisco showed that only 30% of the injuries to housestaff are reported. We were not able to correct for one-handed recapcd due to the small rate of one-handed recapcd in our hospital (5%), which was observed too rarely to allow unit-by-unit correction of the rate.

Future studies should evaluate the effects of current educational interventions compared with innovative educational techniques alone and in combination with further environmental changes, including removal of disposal boxes from the bathrooms, more frequent changes of boxes in patient rooms, changes in needle technology, and disposal box types.

REFERENCES