CONCISE COMMUNICATION

Chinks in the Armor: Activation Patterns of Hollow-Bore Safety-Engineered Sharp Devices

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A retrospective review of secondary injury data was used to evaluate the characteristics of percutaneous injuries from safety-engineered sharp devices. Injury rates and safety device activation rates differed by healthcare provider type. Approximately 22.8%–32% of injuries could have been prevented had an available safety feature been activated after use.

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The Needlestick Safety and Prevention Act[1] (NSPA) was enacted in 2001 and incorporated into the Occupational Safety and Health Administration (OSHA) bloodborne pathogen standard. The OSHA standard specifies that the preferred engineering control to prevent percutaneous bloodborne pathogen exposures is to eliminate sharp devices from medical procedures when possible.[2] When needle elimination is not possible or practical, safety features that protect users from contaminated sharp devices should be integrated into the devices.

Widespread integration of safety-engineered sharp devices (SESDs) has reduced percutaneous injury (PI) rates by nearly half.[3] It is important to note, however, that SESDs will still cause a residual fraction of injuries. Although these residual injuries occur most frequently during use of the item or during activation of the safety mechanism,[4] Mendelson[5] found that 21% of injuries from SESDs occur after use when an available but unengaged SESD could have prevented the injury. Activation rates of SESDs described in the literature range from 17% to 98% depending on the facility in which the devices were implemented and the type of device used. Iinuma et al,[6] Tosini et al,[7] and Mendelson et al[5] found that SESDs required no action on the part of the user to be more effective in preventing injury than those that required user manipulation to activate. Stringer and Haines[4] offer the assumption that nonactivated SESDs have a similar risk profile as conventional devices. As such, 100% activation is an ideal safety target for all devices with special consideration for hollow-bore devices accessing veins or arteries, which pose the highest risk for bloodborne pathogen transmission. This article reviews device activation patterns of PIs reported by physicians, nurses, and phlebotomists/venipuncture team members, because these healthcare workers (HCWs) are the most frequently injured by contaminated needles.

METHODS

Injury data from 3,297 PIs involving hollow-bore SESDs in 62 hospitals between 2001 and 2009 (after NSPA implementation) were included in this study. Two hundred thirteen injuries from surgical SESD instruments were omitted from analysis, as injuries occurring in the surgical setting are unique and require separate study. The study sample represents hospitals that voluntarily reported exposure data to the EPINet surveillance system and reflect a cumulative average daily census of 47,746. EPINet was developed in 1991 to provide a standardized method for recording and tracking PIs and other blood and body fluid exposures.[8] Participating EPINet hospitals are geographically diverse and include university, teaching, and community hospitals ranging from 36 to 1,758 beds (mean, 62). Because data contained in the EPINet database rely on voluntary reporting from both facilities and individual HCWs, these data do not represent a statistically derived sample. Frequency distributions and cross-tabulation, including χ^2 statistical testing, was conducted for key variables. All analyses were conducted on aggregated data using STATA 11.2.

RESULTS

The proportion of PIs attributable to SESDs increased from 32.4% in 2001 to 65% in 2009, reflecting widespread implementation of SESDs after implementation of the NSPA. Sixty-four percent (n = 2,101) of PIs from SESDs were sustained by nurses, a frequency that exceeds all other HCW categories combined. Phlebotomists reported 12.1% (n = 398) of all hollow-bore needle injuries, and physicians reported 3.7% (n = 121) of injuries. Across all job categories and devices, 56.1% of injuries from SESDs occurred after use of a device, when the safety feature should have been in effect.

The percentage of injuries occurring before or during safety feature activation varied significantly by job type. Physicians experienced a higher percentage of injuries from nonactivated SESDs than any other HCW category (Figure 1). No significant differences were seen between nurses, phlebotomists, or other HCWs with regard to injuries from nonactivated devices. Important differences exist between physicians and other healthcare personnel, however, regarding when injuries occur during the use-disposal cycle (Figure 2). Of injuries to physicians, 65.4% (n = 83) occurred during use of the SESD or between steps of a multistep procedure, a time when device activation is neither possible nor appropriate. In contrast, 41.8% (n = 888) of SESD injuries to nurses and 45.8% (n = 181) of SESD injuries to phlebotomists occurred during device use or between procedural steps (Figure 2). Excluding injuries that occurred before device activation was possible,

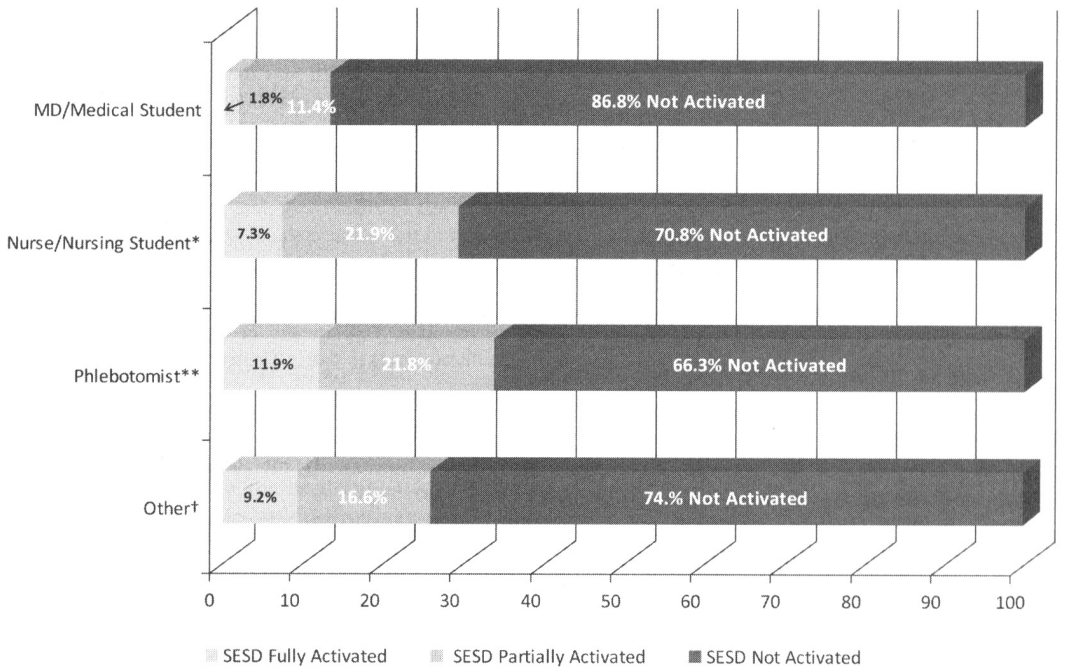

FIGURE 1. Injuries from activated, partially activated, and nonactivated safety-engineered sharp devices (SESDs) (2001–2009). χ^2 comparisons of fully/partially activated vs not activated: asterisk, MD vs nurse (χ^2, 13.7; $P < .01$); double asterisk, MD vs phlebotomist (χ^2, 17.9; $P < .01$); dagger, MD vs other healthcare worker (χ^2, 8.5; $P < .01$); nurse vs phlebotomist (χ^2, 2.9; $P > .05$); nurse vs other (χ^2, 2.5; $P > .05$); phlebotomist vs other (χ^2, 2.8; $P > .05$).

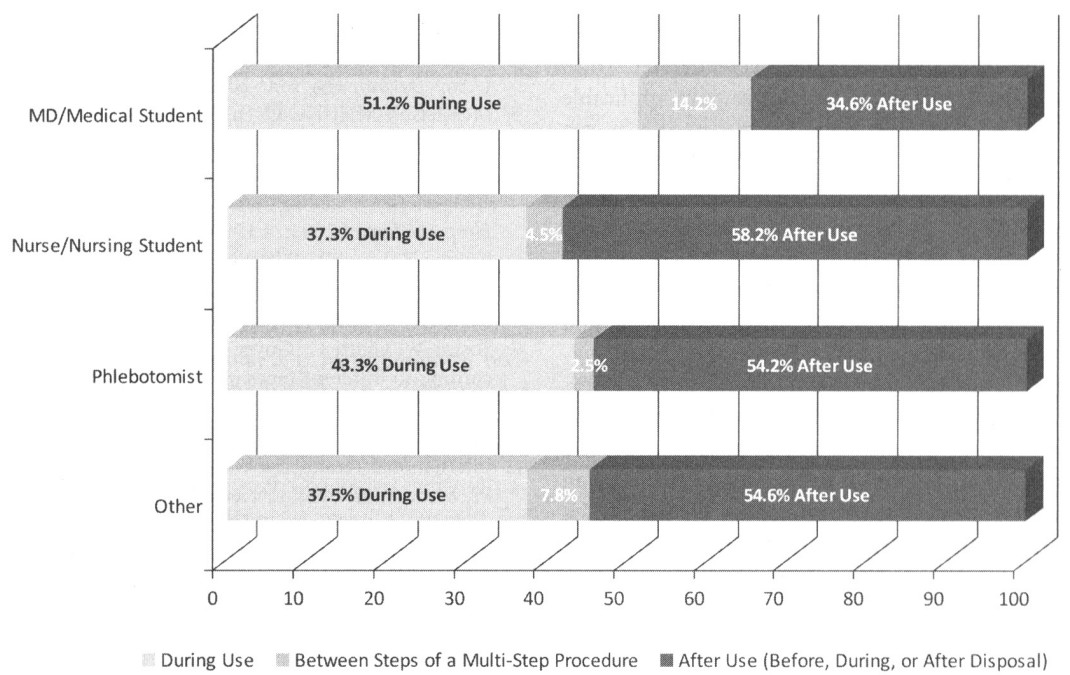

FIGURE 2. Occurrence of injuries from hollow-bore safety-engineered sharp devices (SESDs) by job category (2001–2009). χ^2 comparisons during use/between steps vs after use: asterisk, MD vs nurse (χ^2, 27.1; $P < .01$); double asterisk, MD vs phlebotomist (χ^2, 14.7; $P < .01$); dagger, MD vs other HCW (χ^2, 16.9; $P < .01$); nurse vs phlebotomist (χ^2, 2.2; $P > .05$); nurse vs other (χ^2, 2.5; $P > .05$); phlebotomist vs other (χ^2, .02; $P > .05$).

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22.8% (n = 29) of physician injuries, 32% (n = 679) of injuries to nurses, and 22.3% (n = 88) of phlebotomy injuries occurred when an available SESD was not activated. These injuries therefore were likely preventable.

DISCUSSION

The NSPA had a documented impact in increasing the adoption of SESDs in US hospitals. Nevertheless, challenges remain with regard to consistent activation of SESDs. Although the overall number of injuries from SESDs is less than that reported for nonsafety devices, these injuries represent a preventable fraction of injuries and are a sizable target for further advances.

A limitation of these data is that they do not document activation rates of SESDs by HCWs; rather, they document the injuries that occurred from nonactivated devices. It is not known whether the HCW intended to activate the device, or if the HCW attempted but failed to activate the device that caused the injury. Physicians were significantly more likely to be injured by nonactivated SESDs than nurses or phlebotomists. Nurses and phlebotomists generally receive more extensive training in the performance of needle-based procedures. The "see one, do one, teach one" philosophy, however, often is used in skill training for physicians, particularly for medical residents. Training of all users for the proper use and disposal of SESDs remains as essential now as when they were first introduced and should stress the importance of activating all SESDs.

There has been great progress in the development and availability of a new generation of SESDs. The safety design principles first described in 1988[9] that were derived from observations relative to nonsafety needles remain applicable to SESDs today. If it is possible to eliminate a needle from a procedure, then this remains the optimal solution. More than a decade of experience with SESDs has confirmed that minimizing manipulation of needles after use, and reducing or eliminating user choice in the activation of SESDs are important injury prevention principles.[7,9] These principles remain central to ongoing efforts to reduce needlestick and sharp injuries. Additionally, employers must ensure compliance with OSHA requirements by including frontline workers in the evaluation and selection of SESDs, and by providing comprehensive training to ensure the devices selected are properly activated. It is also important to ensure that a given safety device is appropriate for the procedure for which it is used. Adhering to these principles and practices will move us closer to the goal of reducing, to the maximum extent possible, healthcare worker exposures to bloodborne pathogens.

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