Needlestick Injuries

The scope of the problem and possible solutions

By James D. Ramsay

SAFETY WORKS BEST when it is everyone's responsibility—from top management to each worker. Review of relevant regulations and current safety literature shows that employees carry a large responsibility for safety. In addition, the General Duty Clause of the OSH Act makes clear that employers must maintain a workplace free from recognized hazards and must train their employees. Although much has been learned about methods to preserve and protect worker safety and health since OSHA's inception, no singular strategy has emerged that will keep all employees safe and healthy in all industries. As a result, the safety world is replete with training and educational strategies, making it difficult for practitioners to know which to use or when.

As a general rule, anytime an SH&E practitioner can improve employee decision making and skills, the odds of protecting life and health increase. Similarly, anytime an SH&E practitioner maintains or enhances management's interest and participation in safety, the odds of protecting employees improve as well.

Despite its complexity and dynamic nature, the healthcare industry is no exception. Combinations of engineering, administrative and PPE controls working in tandem with management support provide the best setting in which to protect healthcare employees.

As with many standards and compliance programs, this was the hope of the Needlestick Safety and Prevention Act (NPA) of 2001. This article describes the problem of accidental percutaneous needlestick injuries (NSIs) among nurses before and after NPA. It also identifies currently available engineering controls and examines job safety analysis as an administrative control that in combination with appropriate PPE will reduce the frequency and severity of NSIs. Priorities for future research concerning NSIs in the healthcare industry are recommended as well.

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NSIs among Nurses in Healthcare

As the nature of the nursing profession would indicate, and given the fact that nurses face the hazard of bloodborne pathogens each day, NSIs among this population remain a critical problem. However, as an occupational hazard, NSIs have a substantial modifiable component. In fact, one could argue anecdotally that most NSIs can—and should—be prevented if nurses have access to appropriate PPE (e.g., gloves, universal precautions), administrative controls (e.g., training, education) and engineering controls (e.g., safer needle technology), and if healthcare administrators explicitly value and strongly encourage a culture of such controls.

To better understand the prevalence of NSIs in the healthcare industry, consider this brief analysis. Although it is difficult to quantify precisely, the U.S. Government Accounting Office (GAO) estimates the cost of post-exposure prophylaxis (PEP) in healthcare following an accidental needlestick ranges from $500 to $3,000 per NSI (GAO). Assuming a conservative estimate for the frequency of NSIs at 600,000 to 800,000 per year, these injuries may cost an estimated $300 million to $1.8 billion per year (GAO).

In addition, several well-designed studies have associated injuries from contaminated needles and other sharps devices used in healthcare settings with transmission of more than 20 different bloodborne pathogens to healthcare workers (Chiarello). Of these, HIV, HBV and HCV pose the greatest risk to healthcare workers (Ippolito, et al).

From a financial perspective, a health perspective and a labor-availability perspective, healthcare organizations must better anticipate, recognize and

Key Components of the Needlestick Safety & Prevention Act

The Needlestick Safety and Prevention Act (Public Law 106-430, "NPA") was signed into law Nov. 6, 2000. It directs OSHA to revise its Bloodborne Pathogens (BBP) Standard (29 CFR 1910.1030) to improve sharps safety. Before passage of this act, the BBP Standard required the use of engineering controls including safety devices designed to reduce and prevent needlesticks and accidents with sharps. In a Jan. 18, 2001, press release, OSHA suggested that by requiring healthcare organizations to select and use safer needle devices, NPA might be able to reduce NSIs by 62 to 88 percent in hospitals [OSHA(b)].

Therefore, it is reasonable to assume that NPA's main function was to create a heightened awareness and improved recordkeeping for a difficult, costly and largely preventable exposure among healthcare workers. According to EPINet (through the International Healthcare Worker Safety Center), NPA required OSHA to improve compliance actions for healthcare workers (e.g., workers at hospitals, clinics, urgent care centers, nursing homes) in the following ways:

- Provide safety-engineered sharps devices and needleless systems to employees in order to prevent and reduce occupational exposures to hepatitis, HIV and other BBPs.
- Broaden the definition of engineering controls in order to include devices that had built-in protection to the sharp or needle.
- Require each facility to develop and maintain a sharps injury log for all percutaneous injuries, which includes data on where the injury occurred, the brand and device involved in the injury, and an explanation of how the injury occurred.
- Require that the facility's exposure control plan be reviewed annually in order to suggest and make changes in available technology that can reduce the frequency and severity of BBP exposures.
- Require that frontline (nonmanagement) personnel participate in the identification and evaluation of safer needle and sharps technology and/or devices, and that this is reflected in the facility's exposure control plan.

control NSI intervention strategies. To that end, over the last five years, safer needle devices have been considered a widely available engineering control that is effective in reducing NSI risk to nurses.

Characteristics of Nursing Hazards

The U.S. healthcare system is a large and complex enterprise. The industry employs highly skilled and credentialed employees who use complicated, high-tech equipment and procedures each day, often under stressful conditions. In addition, the industry operates within and is subject to both governmental and external oversight and accrediting bodies as well as a rapidly changing legal environment. According to NIOSH, the healthcare industry is the second-fastest-growing sector in the U.S. today, with more than 12 million workers (NIOSH). Within the healthcare system, nurses hold about 2.3 million jobs (BLS) and play a critical role in the delivery of patient care. In addition, unlike other hazardous industries such as agriculture and construction, preventable injury rates in healthcare have increased during the past decade (NIOSH).

Nurses face a breadth of occupational hazards:

- **Bloodborne pathogens** (e.g., HIV, HCV, HBV). As noted, 600,000 to 800,000 percutaneous NSIs occur each year in all healthcare settings, with injections (21 percent), suturing (17 percent) and drawing blood (16 percent) being the leading exposures (Perry, et al).
- **Back injury.** Thirty-eight percent of nurses are affected by back injuries, due largely to the fact that nurses manually lift and move patients 98 percent of the time (Meier).
- **Work-related musculoskeletal disorders.** Studies of upper extremity musculoskeletal disorders among nurses have reported prevalence rates of shoulder problems in 43 to 53 percent of nurses (Lagerström, et al) and neck injuries in 31 to 48 percent (Ando, et al).
- **Chemicals.** The exposures are primarly because of glutaraldehyde and ethylene oxide (both used as sterilants) and latex allergies.
- **Workplace violence.** Compared to all other workers, nurses face a higher level of risk of violence. More than 9.5 percent of general nurses working in general hospitals are assaulted annually (Wells and Bowers).
- **Unmanaged stress.** In a recent American Nursing Assn. (ANA) survey, nurses cited stress and overwork as their top safety concerns (ANA).

Characteristics of Percutaneous NSIs

NSIs have long been identified as a serious problem in the healthcare industry. NPA was designed to address NSIs by modifying OSHA's Bloodborne Pathogens Standard (29 CFR 1910.1030). The sidebar above highlights NPA's key elements. In particular, NPA modified the definition of an engineering control found in 1910.1030 to read, "[an engineering control] means a control (e.g., sharps disposal containers, self-sheathing needles, safer medical devices such as sharps with engineered sharps injury protections and needleless systems) that isolates or removes the bloodborne pathogens hazard from the workplace." Furthermore, the employer must now identify and evaluate safer needle devices, train frontline employees (i.e., nurses) on the safe use and disposal of these devices, and implement appropriate engineering controls as a part of an exposure control plan.

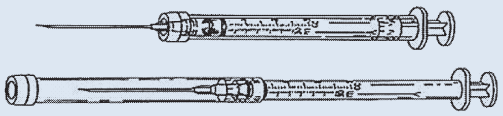
Of all healthcare workers, nurses (RNs and LPNs) are at greatest risk of needlesticks. In fact, the annual rates of occupational blood exposure were highest for nurses and midwives (6.5 per 100 compared to 3.5 of overall) and nurses tend to be exposed 4.27 times more often than physicians (Denis, et al). In the classic study of NSIs, Ippolito, et al examined 3,003 cases of NSIs in 63 hospitals. They found the distribution of NSI exposure types to be heavily skewed. Not surprisingly, they found that most NSIs occur during syringe use. Of these, most occurred from non-blood-filled needles or solid core devices.

Although generally high, the frequency of NSIs tends to change slightly from year to year. One study reported that the overall number of percutaneous NSIs in hospitals actually fell between 1999 and 2001 (from 2,025 to 1,929); yet, while RNs and LPNs accounted for 43.6 percent of the total number of injuries in 1999, that portion rose to 54.2 percent in 2001. The study also found that most nursing NSIs (37.8 percent) occur in the patient's room and that most exposures are due to direct patient contact (47.7 percent) in patient rooms (Perry, et al).

In a literal sense, not every NSI is avoidable. However, many can be prevented by using devices

Figure 1

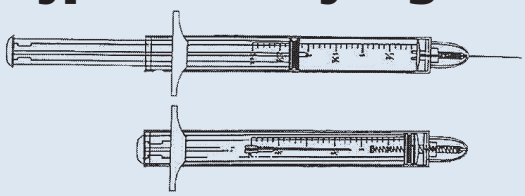
Self-Sheathing Needle



The sheath extends and completely covers the needle.

Figure 2

Retractable Hypodermic Syringe



The needle retracts into the barrel after use.

Figure 3

Self-Blunting Phlebotomy Needle

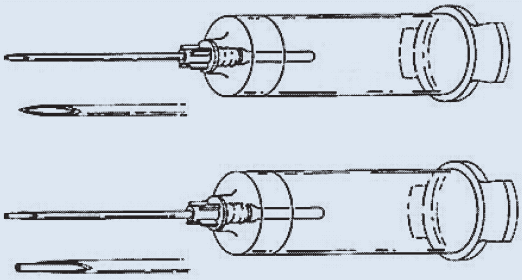
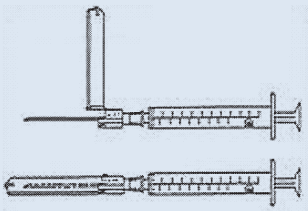
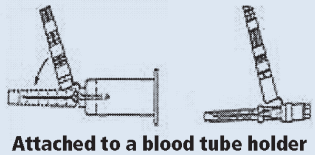


Figure 4

Add-Ons



Attached to a syringe needle



Attached to a blood tube holder

that have needles with safety features or by using technology that eliminates the use of needles altogether (such as needleless IV systems, self-resheathing needles, blunted phlebotomy needles and blunted surgical needles). Indeed, Jagger reports that most NSIs are caused by unsafe devices rather than by operator error [Jagger(b)], while Ippolito, et al suggest that as many as 82.8 percent of the injuries from hollow-bore needles (including suture needles, winged needles, phlebotomy needles, glass capillary tubes and hypodermic needles) may be potentially preventable by simply using better technology (Ippolito, et al).

Current NSI research indicates that a significant portion of needlestick injuries occur when manipulating IV lines or administering IV and intramuscular injections as well as after use and before disposal [Jagger(a)]. In fact, in 1992, Food and Drug Administration (FDA) published a safety alert regarding the use of hypodermic needles in the connection between two pieces of IV equipment. The alert stated that "piggyback" or "intermittent IV" tubing assemblies are associated with NSI rates about six times higher than those for disposable syringes. As a result, FDA encouraged the use of needleless IV systems or systems with recessed needles when needing to connect to adjoining equipment (FDA).

To prevent occupational exposures as pernicious as NSIs, a combination of engineering controls (as a first line of defense), administrative controls and PPE (as a last line of defense) are indicated. Currently available engineering controls include safer needle devices and technology, while job safety analysis (JSAs) is a potentially effective administrative control that should be used in combination with engineering controls.

Engineering Control: Safer Needle Devices & Technology

Conventional wisdom and experience suggest that neither PPE nor administrative controls alone are completely effective control strategies for reducing NSIs. Therefore, to most effectively prevent exposure to sharps/needles, engineering controls must be used to the fullest extent possible—and in conjunction with PPE and administrative controls. Safer needle devices (and technology) are the most logical form of engineering control with respect to preventing NSIs. In fact, NPA strongly states that engineering controls be used to reduce NSIs.

"Safer needle devices" is admittedly a broad term and includes devices that sheath the needle or that use no needle. In 1992, FDA recommended five design features that need to exist, although not simultaneously, for a device to be considered a "safer device":

- provide a barrier between the operator's hands and the needle after use;
- allow the operator's hands to remain behind the needle at all times;
- be an integral component of the device, and not an accessory;
- provide protection before, during and after use, and after disposal;
- be simple and self-evident to operators and require little training and no particular expertise (FDA).

These safer devices fall into four categories:

1) Passive device. Safety feature remains in effect before, during and after use; the operator does not need to "activate" the safety feature.

2) Active device. The operator must activate the safety mechanism; failure to do so leaves the operator unprotected.

3) Integrated safety design. The safety feature is included in the device's design—it cannot be removed or inactivated. This is the preferred safety feature.

4) Accessory device. This feature is external to the device itself and, therefore, must be fixed to the device at the point of use [Chiarello; OSHA(a)].

Figures 1 through 6 depict currently available safer devices and are excerpted from OSHA's 2001 outreach and education effort presentation [OSHA(a)]. (For a thorough review of safer needle technology, see Ippolito, et al.)

Administrative Control: Job Safety Analysis

In addition to an optimal combination of PPE and safer needle devices and technology, administrative

FIGURES COURTESY OF OSHA

Figure 5

Retracting Lancets

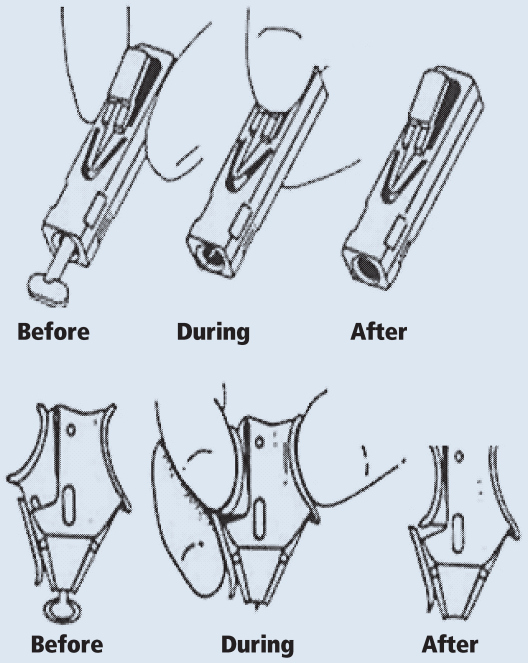
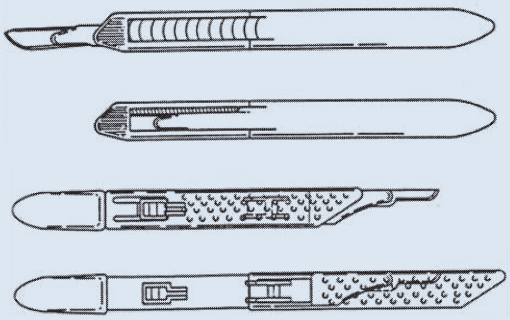


Figure 6

Disposable Scalpels



controls could materially protect nurses from NSIs. Well-designed administrative controls ultimately enhance both the organizational safety culture as well as employee decision making. Common administrative controls include job rotation and job enlargement. However, given the complexity and speed of change within a healthcare work setting, the skills specific to nurses and the exposures involved, neither of these common controls seems an adequate or practical approach to preventing NSIs.

JSAs, also known as job hazard analysis or job task analysis, may be an effective option. JSAs entail a systematic evaluation of each specific job task and identification of the inherent occupational safety or health hazards associated with each task, in addition to specification of a control strategy for each hazard. JSAs have been described as "employee/employer participation programs in which job activities are observed; divided into individual steps; discussed; and recorded with the intent to identify, eliminate or control undesirable events" (Kohn, et al).

A JSA should not be completed on job tasks that are too broad (i.e., helping sick people) or on tasks that are too narrowly defined (i.e., retrieving a pillow). Instead, a JSA should include the following four distinct dimensions:

1) Select the job to be evaluated based on clear criteria such as potential for or severity of exposure.

2) Define the steps required to complete the job task. These steps need to be identified and put in order from first to last. It is wise to limit the number of steps to 10 or fewer. This dimension requires that agreement between the employee and management be obtained regarding what is and is not a proper step. Job steps must be the result of observation and employee interviews and discussion.

3) Identify possible hazards associated with the performance of each step. Workers' compensation data or incident investigation data can help facilitate this process.

4) Develop appropriate control (engineering, administrative, PPE) strategies to eliminate the exposure to the extent possible.

As these dimensions demonstrate, proper JSAs should involve both the nurse and management. In this sense, the JSA process presents a great opportunity to devise improved job descriptions. This can lead to better nurse training and a more clearly specified responsibility for safety, as well as an enhanced ability to properly use available engineering control strategies. Furthermore, improved job descriptions may provide a better incentive for nursing supervisors to pay closer attention to safe work practices, since supervisors are often judged by the degree to which their employees perform their jobs.

When JSAs are completed properly, then used to both enhance employee training and modify the formal job description, both the employee and supervisor are directly responsible for safety. Thus, JSAs can be a significant administrative control that allows employees to better protect themselves from hazards inherent in their jobs—and helps those involved better address the question of who is responsible for safety.

In the healthcare industry, conventional wisdom suggests that JSAs may not be routinely completed for nursing positions. Without proper and thorough analyses, it may be more difficult to perfectly train nurses as to how they might best protect themselves from the many inherent occupational safety and health exposures their jobs present. The precise degree to which JSAs are completed for nurses is unknown, nor is it fully known why SH&E practitioners in the healthcare industry do not use this tool more regularly. One might surmise that there may not be either the expertise or the disposition (or both) to complete a proper JSA. However, this appears to be an empirical question deserving of its own study.

Exposure Control Plan

A well-designed and functional exposure control plan is central to compliance with OSHA's Bloodborne Pathogens (BBP) Standard, and NPA which is nested inside that standard. The standard mandates that in every workplace which poses a potential for exposure to blood or other potentially infectious materials (OPIM), employers must identify which workers might be exposed and what tasks or procedures can cause exposure. American Federation of State, County and Municipal Employees (AFSCME) suggests the following steps be in place in order to develop a compliant exposure control plan:

Opportunities to test the efficacy of a given piece of safety and health legislation and to revise it as needed are rare and should not be easily dismissed.

•Worker input in device selection [1910.1030 (c)(1)(v)]: Employers must solicit the input from nonmanagerial workers that provide direct patient care concerning the identification, evaluation and selection of effective safety needles and other engineering controls.

•Safety equipment (engineering controls) [1910 .1030(d)(2)(i)]: Employers must evaluate and provide safer needles to prevent injuries and possible exposure to bloodborne pathogens. The employers must continually evaluate and select the safest devices on the market.

•Information and training [1910.1030(g)(2)]: Workers must be trained on the proper use and limitations of safety devices, work practices and PPE. Workers with occupational exposure must receive training during workhours when they are hired and at least once per year afterwards.

•Prohibited practices [1910.1030(d)(2)(vii)]: The standard prohibits bending, recapping or removing contaminated needles unless the employer can demonstrate that no alternative is feasible or that such action is required by a specific medical or dental procedure.

•Disposal of needles, materials and protective equipment [1910.1030(d)(2)(viii); (d)(2)(xiii); (d)(3)(viii)]: Contaminated materials must be discarded immediately or as soon as possible. Containers must be closed, puncture-resistant, leak-proof and color-coded.

•Hepatitis B vaccination [1910.1030(f)(2)]: Employers must make the hepatitis B vaccine available at no cost to all workers who have potential occupational exposure to blood or OPIM. Workers may decline the vaccine but must sign a written "declination form." A worker may change his/her mind at any time, and the employer must then provide the vaccination (AFSCME).

Implementing NPA

When revising its BBP standard, OSHA recognized a key challenge: Clinical staff buy-in is central to the success of the BBP standard's (and, therefore, NPA's) implementation at the worksite. This requires involvement and evidence of an annual evaluation by front-line healthcare workers (i.e., nurses). Historically, this was the purview of purchasing officers. This issue was highlighted in a recent complaint alleging that purchasing patterns of safer needle devices indicates that hospitals may be more concerned with group purchasing organization rebates and contract compliance than worker safety (Novation Watch). To ensure buy-in by those who will be using safer needle devices, healthcare organizations must modify decision-making processes to allow for combinations of strategies that solicit input from nonmanagerial healthcare staff including:

•informal NSI problem-solving groups;

•safety audits or worksite inspections with interviews and exposure incident investigations;

•committees that analyze exposure incident data or process hazard analysis data;

•evaluation of devices through pilot testing;

•facility safety and health committees that have been properly constituted and operated in conformance with the national Labor Relations Act.

When soliciting employee input, employees responsible for direct patient care and who are potentially exposed to injuries from contaminated sharps or needles must be included. Employees involved in administering treatment or performing any procedure in the presence of an individual receiving care are considered to be involved in direct patient care.

Once safer devices have been selected, hospital management must monitor their effectiveness and acceptance. Under 29 CFR 1904 (OSHA's Recordkeeping Standard), NSIs must be recorded. The level of detail in those records should be sufficient to allow immediate identification of the device, the location and the circumstances surrounding the incident (e.g., procedure being performed, body part affected, objects or substances involved, and how they were involved) so that the risk and device effectiveness can be evaluated. However, when collecting information concerning OSHA recordable incidents involving sharps or needles, the privacy of the injured or exposed employee must be maintained. Specifically, personal identifiers such as the person's name must be available only on a need-to-know basis.

Research Priorities

Evidence suggests that engineering controls reduce the rate of NSIs among healthcare workers. In a 1997 study, Centers for Disease Control and Prevention determined that blunt suture needles reduced NSIs by 86 percent and safer phlebotomy needles reduced NSIs among phlebotomists by up to 76 percent (CDC). According to Perry, et al, in 2001, the average percutaneous injury rate per 100 occupied beds in hospitals was 26 compared to 40 in 1999.

Although NPA brought new attention and real legal enforcement to the NSI problem in the U.S., and despite new technologies, much remains unknown. Thus, the author recommends three research priorities:

1) NPA provides an opportunity to empirically test the efficacy of a piece of public safety and health legislation. Since the most current data on NSIs among healthcare workers is now several years old, a current estimate is needed for:

a) frequency of percutaneous NSIs in hospital and nonhospital (i.e., clinic or urgent care) settings;

b) costs of post-exposure prophylaxis associated with an NSI per setting.

2) Testing NPA's efficacy might include the following steps:

a) Compare post-exposure prophylaxis cost and frequency data for 2001 and 2002 by region and healthcare setting to pre-NPA data, also by region and healthcare setting.

b) Estimate costs of implementation of NPA, and compare morbidity costs pre-NPA to post-NPA, and perform either a cost-benefit or cost-effectiveness analysis.

c) Revise NPA based on the outcome of these analyses.

3) Thoroughly investigate the effectiveness of completing JSAs for nurses as an administrative control for NSIs. Better use of administrative controls is warranted because despite access to PPE and knowledge of universal precautions, as well as an increasing acceptance and use of better engineering controls for several years, NSIs remain a problem in healthcare and for nurses in particular. Within this investigation, it should be determined why JSAs are not typically completed for nurses, then solutions should be devised to ensure that they are.

Conclusion

Exposure prevention remains the single most important control against NSIs. Therefore, NPA has three distinct interested publics: 1) the federal government, as the main payer of healthcare and the initiator of all legislative oversight for the healthcare industry; 2) healthcare organizations, as the primary group needing to reduce the frequency and severity of preventable injuries, and workers such as nurses, as the group most interested in how best to comply with regulatory changes that affect its practice patterns; and 3) the SH&E academic community, which needs to train future practitioners to understand the issues underlying compliance with current regulations and who will need the requisite skills to identify and reduce preventable morbidity within the workplace.

The occupational safety and health community has an excellent opportunity to test the effectiveness of a piece of federal legislation. Implementation of NPA has created a natural pre/post research design for the SH&E field. Therefore, a coherent NSI prevention research program should be established to include representatives of the federal government, industry and the SH&E academic community. The main focus of this NSI prevention program should be to address the recommended research priorities. However, although hospitals and clinics regularly consider strategies to reduce the impact of NSIs,the author is unaware of either a state or federal agency or other organization that has developed a coherent research program focused on evaluating the relative effectiveness of NPA. This article is a call for that research to occur.

Opportunities to test the efficacy of a given piece of safety and health legislation and to revise it as needed are rare and, therefore, should not be easily dismissed. Lessons learned from such an evaluation would certainly educate the development and/or implementation of future SH&E legislation. ■

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