



Needlestick and Sharps Injury Prevention

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Abstract

Every day while caring for patients, nurses are at risk to exposure to bloodborne pathogens potentially resulting in infections such as HIV or hepatitis B and C. These exposures, while preventable, are often accepted as being a part of the job. In the United States, needlestick injuries have begun to decrease from an estimated one million exposures per year in 1996 to 385,000 per year in 2000. This decline has resulted from the protections afforded by the Occupational Safety and Health Administration's (OSHA) Bloodborne Pathogens Standard. Reasons for the success in decreasing needlestick and sharps injuries may be attributed to the elimination of needle recapping and the use of safer needle devices, sharps collection boxes, gloves and personal protective gear, and universal precautions.

The prevention of needlestick injuries has made slow progress over the past 20 years since the HIV epidemic drew attention to the deadly nature of health care work and to protection of health care worker health and safety. In Africa, where the AIDS virus originated and where the prevalence of the human immunodeficiency virus (HIV) among hospitalized patients is highest in the world, attention has been directed only recently at protecting health care workers. Nurses, especially those infected from a preventable exposure, have been at the forefront of advocacy for prevention.

This article includes a review about the hazard of exposure to bloodborne pathogens and epidemiology of occupational infection. The author discusses how to apply standard methods of occupational health and industry hygiene using the hierarchy of controls framework to prevent exposure to blood, and discusses evidence-based prevention and efficacy of particular control measures. Legislative progress and implementation of enforceable policy to protect health care workers is outlined.

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Key words: bloodborne pathogens, HIV, needlestick, nurse safety, occupational health and safety, occupational injury and illness, safety device/sharps, universal precautions, work practice controls

...2.5% of HIV cases among health care workers and 40% of hepatitis B and C cases among health care workers worldwide are the result of occupational exposure.

Every year, hundreds of thousands of health care workers are exposed to deadly viruses such as hepatitis and the Human Immunodeficiency Virus (HIV) as a result of needlestick and sharps injuries. These preventable injuries expose workers to over 20 different bloodborne pathogens ([CDC, 1998a](#)) and result in an estimated

1,000 infections per year, the most common being hepatitis B, hepatitis C and HIV (International Health Care Worker Safety Center, 1998). In November 2002, the World Health Report published data demonstrating that 2.5% of HIV cases among health care workers and 40% of hepatitis B and C cases among health care workers worldwide are the result of occupational exposure ([WHO, 2002](#)). A WHO report describing the global burden of disease from sharps injuries to health-care workers detailed the data from the previous year's World Health Report ([Prüss-Üstün, Rapiti, & Hutin, 2003](#)).

Needlestick Injuries and Exposure to Bloodborne Pathogens: Scope of the Problem

In developing countries, where the prevalence of HIV-infected patients is the highest in the world, the number of needlestick injuries is also highest. African health care workers suffer on average two to four needlestick injuries per year and over half of the hospitalized patients in South Africa are HIV positive ([Prüss-Üstün et al., 2003](#)). In some regions of Africa and Asia close to half of all hepatitis B and C infections among health care workers are attributable to contaminated sharps. In some areas of the Eastern Mediterranean region over two-thirds of hepatitis B and C infections in health care workers are attributable to contaminated sharps. Over two-thirds of all hepatitis B in Central and South American are the result of occupational exposure ([Prüss-Üstün et al.](#)).

[Table 1](#) lists the risk of infection following a needlestick injury from a contaminated needle: ([CDC, 1998a](#)).

Table 1. Risk of Transmission of Bloodborne Infection	
Occupational Exposure	Risk of Transmission
HIV	0.3% (or a 1 in 300 chance of infection)
Hepatitis B Virus (HBV)	2-40%
Hepatitis C Virus (HCB)	2.7-10%

Factors surrounding the circumstances of a needlestick injury when combined can increase the risk of HIV infection to a 1 in 20 (or 5%) risk. These factors include: a deep injury, visible blood on the device, high viral titer status of the patient such as in newly infected patients or those in a terminal state, and the device being used to access an artery or vein ([Cardo et al., 1997](#)). Post-exposure prophylaxis (PEP) with zidovudine (AZT), in a case control trial, demonstrated a reduction in the risk of transmission by 80% ([CDC, 2001](#)). The use of the newer antiretroviral drugs for PEP is likely to be even more effective for prevention because these drugs are much more effective for treatment.

While the risk of HIV infection is very low, the risk of infection with hepatitis, especially hepatitis B among unimmunized workers is very high. According to the WHO, in some areas of the world, over 80% of health care workers have NOT been immunized against hepatitis B despite its 95% efficacy rate ([Pruss-Ustun et al., 2003](#)). As a result of the 1991 U.S. Occupational Safety and Health Administration (OSHA) Bloodborne Pathogen Standard (BPS), employers are required to provide hepatitis B immunization to health care workers. As a result of this standard the number of infections and deaths from hepatitis B among health care workers in the United States has dropped significantly from thousands of infections per year to less than twenty ([Mahoney, Stewart, Hu, Coleman, & Alter, 1997](#)).

The Centers for Disease Prevention and Control (CDC) estimates 385, 000 needlesticks and other sharps injuries per year among hospital workers in the United States.

There is no immunization for HIV or hepatitis C, and no recommended post-exposure prophylaxis for hepatitis C. The only solution is to prevent infection by preventing the exposure. Symptoms of HCV often do not emerge for 20-30 years after viral transmission occurs; thus the disease may be undiagnosed for 20 years or more. As many as 85% of those infected with HCV develop chronic liver infection and are at risk for cirrhosis and liver cancer (CDC, 1998b), possibly requiring a liver transplant.

Post exposure prophylaxis (PEP) for reducing the chance of HIV infection should be started immediately (within 2 hours of the exposure to blood) and continue for a month to be most effective. PEP rapidly loses its effectiveness if delayed and some reports indicate that if delayed more than 72 hours it is not effective (CDC, 2001). Health care workers taking PEP need additional support from occupational health providers to manage the symptoms and side effects of the drugs.

The Centers for Disease Control and Prevention (CDC) estimates 385,000 needlesticks and other sharps injuries per year among hospital workers in the United States (CDC, 2004). This has increased from 600,000 to 800,000 the number of injuries reported in 1999 by the CDC's National Institute for Occupational Safety and Health (NIOSH, 1999).

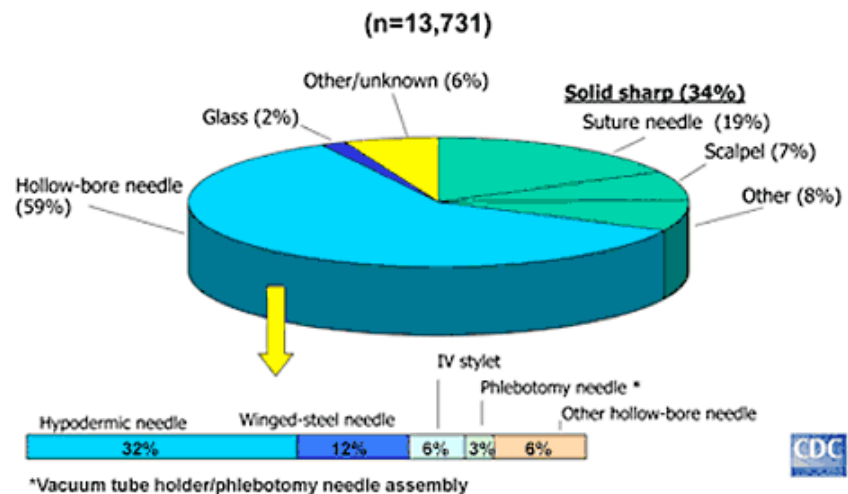
Unreported needlestick and sharps injuries are a serious problem and prevent injured health care workers from receiving post-HIV exposure prophylaxis shown to be 80% effective against HIV infection. According to researchers, 40-70% of all needlestick injuries are unreported, thus the statistics are only estimates (CDC, 1997b; Osborn, Papadakis, & Gerberding, 1999). Without documentation of the injury, the worker is unlikely to receive worker's compensation benefits if later becoming infected with the human immunodeficiency virus (HIV) or hepatitis.

Causes of Needlestick Injuries

Nurses experience the majority of needlestick injuries in the world including half of the exposures that occur in the US (CDC, 2004; Prüss-Üstün et al. 2003), and 70% of exposures occurring in Canada (CCOHS, 2000). Other individuals at risk include frontline patient care providers such as physicians, phlebotomists, and support personnel (housekeepers and laboratory staff).

The United States National Surveillance System for Health Care workers (NaSH) identified six devices that are responsible for the majority of needlestick and other sharps related injuries. As depicted in Figure 1, these are hypodermic needles (32%), suture needles (19%), winged steel needles (butterfly) (12%), scalpel blades (7%), IV catheter stylets (6%), and phlebotomy needles (3%) (CDC, 2004).

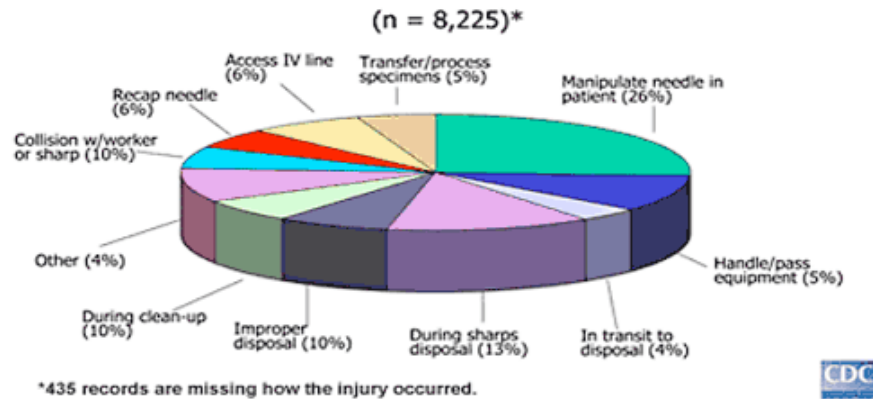
Figure 1. Devices Involved in Percutaneous Injuries



Percutaneous or needlestick injuries contaminated with blood or body fluids pose the highest risk and cause the most common exposures among health care workers (Prüss-Üstün et al. 2003). These blood-filled devices account for 59% of all NaSH reported injuries and 90% of the HIV seroconversions documented by the CDC (CDC, 2004).

The most common circumstances that cause injuries in NaSH hospitals involve hollow bore needles which are the most risky because the needle can be filled with blood. Figure 2 depicts these needle injury situations which include: manipulating the needle in the patient (26%), disposal (23%), collision with worker or sharps (10%), during clean-up (10%), accessing IV line (6%), and recapping needles (6%) (CDC, 2004).

Figure 2. Circumstances Associated with Hollow-Bore Needle Injuries
(CDC NaSH 6/95-12/01)



Characteristics of devices that increase the risk of injury include (NIOSH,1999):

- Devices with hollow-bore needles.
- Needle devices that need to be taken apart or manipulated by the health care worker such as blood-drawing devices that need to be detached after use.
- Syringes that retain an exposed needle after use.
- Needles that are attached to tubing such as butterflies that can be difficult to place in sharps disposal containers.

Work organization factors that contribute to injury and to prevention include: short staffing and a poor safety climate.

Work organization factors that contribute to injury and to prevention include: short staffing (Clarke, Sloane, & Aiken, 2002), and a poor safety climate (Gershon et al., 2000). Clarke et al. demonstrated a relationship between short staffing and needlestick injuries. Nurses from units with low staffing and poor organizational climates reported twice as many needlestick injuries than nurses on well-staffed units. Thus, adequate staffing is not only safer for patients and prevents medical errors but it is also safer for nurses too.

Preventing Needlestick Injuries

Preventing needlestick injuries and resulting infections is possible and necessary to provide quality health care. While Clarke et al. (2002) demonstrated the relationship between short staffing and needlestick injuries, appropriate staffing is difficult to maintain when health care workers are unable to work due to work-related injuries and illness. Nursing shortages are exacerbated by uncontrolled occupational hazards and further made worse by the nurses' fear of bringing a life-threatening illness home to their families. In 2000, 88% of nurses responding to a web based occupational health survey, indicated that the risk of occupational hazards determine whether they will continue to work in nursing and in what clinical area (ANA, 2001b).

Needlestick Prevention and the Hierarchy of Controls

Prevention of needlestick injuries is possible by analyzing the hazards and applying control measures using a hierarchy of controls starting with the elimination of unnecessary sharps and injections to eliminate the hazard. Needleless IV systems, recommended by the Food and Drug Administration in 1992 (FDA, 1992) remove an unnecessary sharp and reduce the risk of injury (Gartner, 1992; Yassi, McGill, & Khokhar, 1995). Eliminating unnecessary injections by using oral instead of injectable medications eliminates the hazard.

Engineering controls are the second most effective measure in the hierarchy of controls. The 2000 U.S. Needlestick Safety and Prevention Act established the requirement for health care settings to use engineering controls known as safer needle devices (OSHA, 2001a). Safer needle devices have been shown to reduce 62 to 88% of all needlestick injuries (CDC, 1997b; Jagger, 1996). These devices blunt, sheath, or retract the needle immediately after use and are available in injection equipment (syringes), IV access devices, lancets, and phlebotomy needles.

Effective needlestick injury prevention measures include administrative and work practice controls such as

educating workers about hazards, implementing universal precautions, eliminating needle recapping, and providing sharps containers for easy access that are within sight and arm's reach ([Jagger, 1996](#); [Haiduven, DeMaio, & Stevens, 1992](#)). In a study involving three Virginia hospitals, Jagger found a 59% reduction in IV access needle injuries following an education program and implementation of universal precautions. There was an additional 84% reduction in injuries after implementation of a safety IV catheter ([Jagger, 1996](#)). Management commitment to occupational health is important for prevention. Management commitment to safety can be demonstrated through allocation of necessary resources and delegation of authority to a needlestick prevention committee charged with monitoring the exposure control plan and the evaluation and selection of control measures including safer needle devices ([Gershon et al., 2000](#); [Fisher, 1994](#)).

Desirable Characteristics of Safer Needle Device

Safety feature characteristics listed by NIOSH for evaluating and selecting needlestick injury prevention products ([NIOSH, 1999](#)) include:

- The device is needleless
- The safety feature is an integral part of the device.
- The device preferably works passively (requires no activation by the user). If user activation is necessary, the safety feature can be engaged with a single-handed technique and allows the worker's hands to remain behind the exposed sharp.
- The user can easily tell whether the safety feature is activated
- The safety feature cannot be deactivated and remains protective through disposal.
- The device performs reliably.
- The device is easy to use and practical.
- The device is safe and effective for patient care.

As the use of safer devices reduces the number of injuries in clinical areas, the operating room is also emerging as the site with an increasing proportion of total injuries ([CDC, 2004](#); [NIOSH, 1999](#)). While solid core sharp injuries from suture needles and scalpels are less risky than injuries from blood-filled hollow bore needles, transmission of HIV and hepatitis has been documented as a result of these exposures. Blunt suture needles for suturing internal fascia can reduce the number of suture needle injuries ([CDC, 1997a](#)). The work practice control called the "neutral zone" is a technique for passing instruments on a basin or tray instead of from hand to hand and serves as an effective method for reducing injuries in the surgical setting ([Davis, 1999](#)).

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Many tools are available for assisting nurses' involvement in product evaluation and selection, including the ANA Needlestick Safety and Prevention Guide available on-line at www.nursingworld.org/ ([ANA, 2002](#)). The ANA guide describes a three-step process for device selection with includes screening devices, simulation exercises, and pilot testing prior to making the final decision.

Evidence-Based Prevention

The use of the data collected about the nature of the needlestick injuries and near misses help guide needlestick prevention at the unit or institutional level and help make recommendations for new practices and devices for prevention and reoccurrence of injuries. In 2004, the CDC published a web based resource: Workbook for Designing, Implementing, and Evaluating a Sharps Injury Prevention Program ([CDC, 2004](#)). The workbook describes the use of Root Cause Analysis, a process for identifying causal factors to use in needlestick prevention and suggests that the institution's needlestick prevention committee ask key questions (What happened?, How did it happen?, Why did it happen?, What can be done to prevent it from happening in the future?) to get at the "root" of situations resulting in injuries, thus identifying areas for change ([CDC, 2004](#)). By identifying where and how injuries occur in specific settings, interventions can be easily recognized and prioritized. Reporting injuries and documenting all bloodborne exposures is essential for having the evidence to analyze for prevention.

Legislative Impact

A new era for prevention began in November 2000 when President Bill Clinton signed the Needlestick Safety and Prevention Act shifting the focus in exposure control from behavior to devices. The law became effective in April 2001 and amended the OSHA Bloodborne Pathogens Standard to require the use of engineering controls known as safer needle devices to prevent exposure to bloodborne pathogens and to require documentation of all needlestick injuries ([OSHA, 2001a](#)). Similar efforts are underway in Europe where on International Nurses Day, May 12, 2004, a call for action to European institutions and policy makers was publicized by the Standing

Committee of Nurses of the European Union (PCN) and others. A major goal is the use of 'Sharps Protection' Technology ([Eucomed, 2004](#)). This announcement and previous reports of the first documented deaths in 2003 from occupationally-acquired HIV in the National Health Services in the United Kingdom (UK), add momentum to a drive for safer needle devices led by the Royal College of Nurses and the UK health care worker union, UNISON ([RCN, 2003](#)).

...the Needlestick Safety and Prevention Act...require[s] the use of...safer needle devices to prevent exposure to bloodborne pathogens and...documentation of all needlestick injuries.

The movement for achieving passage of the U.S. 2000 Needlestick Safety and Prevention Act was a step-by-step, state-by-state approach, gathering allies and momentum for success. Nurses were key to the success. Nurses across the country were involved in conversations with colleagues and elected officials about the need to protect health care workers. This not only raised awareness about the hazard of HIV and hepatitis in the workplace, but also raised general awareness about the hazards faced by health care workers and the impact on the nursing shortage. By the time the federal law was enacted, 17 states had passed legislation requiring safety devices.

The law includes groundbreaking language requiring the involvement of frontline health care workers in the evaluation, selection and implementation of safer needle devices. The American Nurses Association (ANA) assisted in the writing and lobbying of the legislation that provided frontline nurses the power to participate in selecting devices that would be most effective for their own safety and the safety of the patients ([ANA, 2002](#)).

On July 1, 2004, further advances were made when Medicare began to enforce compliance with the OSHA Bloodborne Pathogens Standard including the new provisions required by the Needlestick Safety and Prevention Act, in all public hospitals not previously covered by OSHA ([Medicare Prescription Drug, 2003](#)). Since federal OSHA has jurisdiction only in the private sector (not-for-profit or for-profit health care settings), and 23 states enforce OSHA standards in state, county and municipal health care settings through their own OSHA-approved state plans, public hospitals in non-state plan states, for the first time, fall under the requirements of the OSHA Bloodborne Pathogens Standard and are subject to the same fines. Table 2 lists the standard coverage and describes how the federal bloodborne pathogens standard applies to particular populations of workers in the private and public sector depending on the state where the individual works and the specific legislation or regulation. The bloodborne pathogens standard, first implemented by the federal Occupational Safety and Health Administration (OSHA) in 1992, is the regulation that protects health care workers and governs the responsibility of the employer to enforce guidelines and provide supplies, immunization and post-exposure follow-up ([OSHA, 1991](#)). This standard only applied to private sector workplaces (for profit or not-for profit health care settings) when it was first published and implemented. In the following six months, protection was extended to public sector health care workers (e.g. state, county, or municipal employees) in states where federal OSHA has approved a state occupational health and safety program). The remaining workplaces were not governed by the OSHA BPS until 2004 when the Medicare Modernization Act (MMA) extended coverage to public hospitals in states without OSHA state plans.

Table 2. OSHA Bloodborne Pathogens Standard Coverage ([Wilburn, Copyright, 2004](#))

Legislation/Regulation Effective Date	Settings Where Workers Are Covered
Federal OSHA <i>Original Bloodborne Pathogens Standard effective 1992 with amendments directed by the Needlestick Safety and Prevention Act effective April 2001.</i>	Private sector health care settings (for-profit or not-for profit)
OSHA Approved State Plans	In the 23 states with OSHA approved state plans,

(23 States are approved by OSHA see www.osha.gov/fso/osp/index.html) Effective 6 months following the federal standard	the state, county, and municipal public employees are protected under the Bloodborne Pathogens Standard.
Medicare (Medicare Prescription Drug Improvement and Modernization Act of 2003 , Section 947.) Effective July 1, 2004	All public hospitals not previously covered by the above as a condition of participation in Medicare.

Since implementation of the 2000 Needlestick Safety and Prevention law in April 2001, OSHA has conducted hundreds of inspections of hospitals, clinics and nursing homes, to determine compliance and has cited 123 institutions for violations of the standard. The most common violations include absence or lack of engineering controls, annual review of the Exposure Control Plan, sharps injury controls, documentation of employee involvement in device evaluation and selection, annual review of medical devices, and post-exposure medical evaluation ([Arbury & Williams, 2004](#)).

Assuring compliance with the law. OSHA inspectors known as Compliance Safety and Health Officers (CoSHO) use the OSHA Compliance Directive ([OSHA, 2001b](#)) entitled "Enforcement Procedures for the Occupational Exposure to Bloodborne Pathogens" as a guide during an inspection. The checklist in ANA's Needlestick Prevention Guide can assist health care institutions to prepare for an inspection ([ANA, 2002](#)). OSHA requires evidence documented in the Exposure Control Plan on an annual basis, that the institution has evaluated the effectiveness of their current control measures, including safer needle devices, and has considered new, potentially more effective alternative devices. The CDC Workbook for Designing, Implementing, and Evaluating a Sharps Injury Prevention Program ([CDC, 2004](#)) along with the NIOSH Best Practices web site ([NIOSH, 2004](#)) are valuable resources for assisting nurses and institutions in preventing needlestick injuries, and complying with the OSHA Bloodborne Pathogens Standard.

Working While Infected with HIV or Hepatitis

...there should be no discrimination against health care workers on the basis of real or perceived HIV status or hepatitis infection.

Just as the Code of Ethics for Nurses ([ANA, 2001a](#)) calls for nurses to provide care to patients without discrimination on the basis of diagnosis, there should be no discrimination against health care workers on the basis of real or perceived HIV status or hepatitis infection. The International Labor Organization (ILO) states that HIV infection is not a cause of termination of employment indicating that persons with HIV-related illnesses should be able to work for as long as medically fit ([ILO, 2001](#)). The ILO further states that screening for HIV/AIDS should not be required of job applicants or employed persons (ILO). CDC guidelines call for a case-by-case analysis of duty fitness and recommend restriction of HIV positive health care workers only from practicing in "invasive exposure prone procedures."

Nurses who are infected with HIV or hepatitis whether from occupational exposure or not, are able to work in the health care workplace as long as their health allows. There is no undue risk to patients from infected workers. Nurses are safe to practice in all areas with the exception of exposure-prone procedures performed in the surgical setting such as when scrubbing in to an abdominal surgery case as first surgical assistant ([CDC, 2001](#)).

Conclusion

Needlestick and sharps injuries continue to be a serious hazard exposing health care workers to deadly viruses and other bloodborne pathogens despite significant progress in policy, practice, and products. Over the past 20 years, progress has included the implementation of Universal Precautions, and has culminated with implementation of needleless systems and safer needle devices as required by the U.S. Needlestick Safety and Prevention Act of 2000. Preventable needlestick injuries, while still common in the United States, occurs most commonly in Africa and Southeast Asia. These are the settings where health care workers are at greatest risk for infection because of the prevalence of infections among the patients and where hepatitis B immunization is not the standard. More attention and resources are needed to extend protection to health care workers worldwide.

The risk of infection with HIV/AIDS has stimulated a focus on health care worker health and safety, and has galvanized efforts towards the prevention of occupational injury and illness to push the hierarchy of controls to the utmost level, eliminating the hazards. The elimination of unnecessary injections and unnecessary sharps is the first step to preventing infection with bloodborne pathogens. Other occupational hazards can be eliminated with similar attention to prevention by eliminating toxic chemical exposures causing occupational asthma and eliminating unsafe lifting causing disabling back injuries. Focusing policy on health care worker health and safety has the additional benefit of improving quality of patient care and reducing risks to patients who are cared for in and suffer from the same environmental contaminants. Protecting health care workers by providing appropriate staffing as well as demonstrating commitment to prevention through the implementation of a comprehensive health and safety program will improve worker safety and patient safety.

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Susan Wilburn, MPH, RN, has worked on behalf of nurses and nursing for the past 15 years at the local, state, national, and international levels as a shop steward, union organizer, lobbyist, political activist, and labor educator. She is currently the occupational and environmental health specialist for the American Nurses Association (ANA) and the International Council of Nurses. Susan is co-chair of the nurses work group of Health Care Without Harm, project director of ANA's RN No Harm project whose goal is to develop nurses as environmental health advocates, project director of the WHO/ICN Needlestick Prevention project, and holds an elected position on the Washington State Nurses Association policy and legislative council. Susan is a graduate of Kent State University School of Nursing and the University of Washington School of Public Health.

Under Susan's leadership, the ANA, prioritized occupational health as one of the top five core issues for the organization, passed the 2000 U.S. Needlestick Safety and Prevention Act, and adopted a precautionary approach as a principle for occupational and environmental health policy.

Susan speaks and writes extensively on occupational and environmental health issues including a regular column in the American Journal of Nursing. She has written testimony and testified before Congress, the European Union, and the World Health Organization. She has spoken on the subject of environmental health, occupational health, latex allergy, needlestick injury prevention, and chemical hazards.

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