Preventing Needlesticks in Emergency Medical System Workers

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Emergency medical system (EMS) workers frequently use sharp devices in injury-prone circumstances that involve limited visibility, confined spaces, rapidly moving vehicles, and uncooperative victims. This study examined the efficacy of an automatic self-retracting lancet in reducing needlestick injuries and related direct and indirect costs. Subjects were 477 active-duty EMS workers. Counseling, laboratory testing (hepatitis B and C, hepatic function enzymes, and human immunodeficiency virus), antiviral prophylaxis, and immunizations were provided according to US Public Health Service guidelines. Baseline and biennial laboratory testing for hepatitis B and C and liver function enzymes were conducted. After the introduction of a spring-loaded automatic-retracting type glucometer lancet device, needlestick injuries decreased from 16 per 954 EMS worker-years to 2 per 477 EMS worker-years. The annualized cost of treatment declined from $8276 to $2068. The change to a self-retracting device decreased the number of needlestick injuries and was cost-effective with a minimal increase in device cost (annualized $366 per year). (J Occup Environ Med. *2001;43:554–557*)

Emergency medical system (EMS) workers such as paramedics and firefighters are exposed to a host of risk factors in the course of their duties, including infectious diseases (hepatitis B and C, human immunodeficiency virus [HIV], meningococcal meningitis, and tuberculosis), musculoskeletal disorders, and chemical and physical hazards. Infectious diseases may be caused by exposure to blood and blood products and by other potentially infectious material, such as vaginal secretions and cerebrospinal, synovial, peritoneal, pericardial, and amniotic fluids. Preventing blood exposures is an important means of preventing occupationally acquired infections.

Although education and barrier-type methods can prevent bloodborne pathogen exposures, gloves are easily compromised[1] and are not conveniently replaced by EMS workers, who are frequently involved in time-critical rescue situations. In addition, EMS workers frequently conduct in-the-field testing (eg, random glucose measurements with a glucometer lancet) using sharp devices in injury-prone circumstances that may involve limited visibility, cramped spaces, rapidly moving vehicles, and thrashing victims.

Needlestick injuries (NSI) are a recognized source of exposure to bloodborne pathogens for workers in EMS and other work. Each year over 800,000 occupational NSI occur[2] that can lead to serious or fatal infections from HIV, hepatitis B virus (HBV), and hepatitis C virus (HCV). As of last year in the United States,

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the number of individuals with HIV was approximately 900,000[3]; 1.25 million with HBV; and 3.9 million with HCV, of whom 2.7 have chronic HCV.[4] The risk of a bloodborne infection may not be immediately recognized, symptoms may not become apparent until weeks or months after the needlestick, and multiple infections may be transmitted.[5]

The Occupational Safety and Health Administration (OSHA) estimates that approximately 8 million health personnel in the United States are at risk for exposure to bloodborne pathogens and that 80% of work-related exposures to HIV occur through needlesticks.[2] The pathogen transmission risk from a needlestick injury is estimated at 6% to 30% for HBV, 0.5% to 2% for HCV, and 0.3% for HIV.[6] Substantial underreporting occurs. A Centers for Disease Control and Prevention survey indicated that only 54% of NSI are reported, and that only 68% of nurses, 35% of medical students, and 31% of resident physicians admitted to reporting a needlestick injury.[7]

The incidence of NSI may be higher in certain occupations than others because of concerns about possible work limits if the employee contracted an infectious disease and such information became publicly known. Those who are HBV-, HCV-, or HIV-positive should follow strict aseptic techniques and standard universal precautions, including the use of such protective barriers as disposable latex gloves, hand washing, and careful use and disposal of sharp instruments.

The importance of NSI in the transmission of bloodborne pathogens has led to the evaluation of interventions to reduce such injuries. Strategies include education; barriers such as gloves, aprons, and face shields; and engineering interventions.[7]

Engineering strategies include self-sheathing devices, needle guards or covers, blunt needles, disposable protective syringes, and needleless intravenous systems. For example, the O'Connor study reviewed a self-capping intravenous catheter and determined a marked reduction in NSI over 10 months.[8] Wright et al investigated the efficacy of a needle cover in nurses and found a decline from 32 NSI/539 nurse-years to 11 NSI/449 nurse-years.[9] A three-center study used a shield device that slipped over the needle and noted a decline in NSI from 27 to 3 over a 2-month period for 3-cc syringes.[10]

Most studies have examined operating room or hospital settings in contrast to the non-surgical, non-inpatient work encountered in the EMS.[11] Linda Rosenstock, Director of the National Institute of Occupational Safety and Health (NIOSH), suggests that further inquiry is necessary to determine "which interventions effective in reducing needlestick injuries in surgical settings will be effective in non-surgical settings."[12] The potential for NSI in the non-surgical workplace is considerable—the EMS workers we evaluated use 30,000 glucometer lancets for blood glucose monitoring each year.

Evaluating such interventions to reduce or eliminate NSI can be informative for organizations that make decisions to implement injury prevention strategies, particularly when the change is associated with an inconvenience factor, training time, and increased expense. Cost-effectiveness evaluations that incorporate the cost of evaluating and treating a needlestick injury can be useful when management considers alternative approaches. The dual purposes of this study were to determine if needlesticks in EMS work from random glucose determinations would decrease after a change to a self-retracting device, and if such an intervention was cost-effective.

Administrative interest in such analyses will be heightened by the new OSHA directive that updates an earlier standard issued in 1992,[13] aims to further decrease the risk of exposure to blood and other potentially infectious material for workers such as EMS personnel, and reflects better postexposure regimens[14] and the availability of improved devices[15]—the subject of this study.

The revised directive emphasizes the importance of an annual review and update of each organization's bloodborne pathogens program *and* the use of safer devices to help reduce NSI and other injuries due to sharps. OSHA does not recommend the use of a particular device. Furthermore, NIOSH, in collaboration with the Centers for Disease Control and Prevention and outside reviewers from academia, industry, labor, and public health organizations, offers detailed guidance for work-related NSI in a new bulletin, "NIOSH Alert: Preventing Needlestick Injuries in Health Care Settings."[15]

In absolute numbers, most NSI occur in nurses,[16] but EMS workers, laboratory technicians, doctors, housekeepers, and others are at risk. NIOSH recommends that needles be eliminated among these work groups whenever possible. Hollow-bore and larger-gauge needles present the greatest risk for transmission of infectious materials, though the potential for NSI exists with any sharp device. If effective needleless alternatives are unavailable, NIOSH suggests self-retracting devices such as the one evaluated in this study, shields and sheaths that cover needles, or fail-safe measures such as an automatic locking mechanism or a visual or auditory confirmation that the needle is covered. Devices should be chosen, used, and evaluated as part of a comprehensive written program in which safe work practices, such as prohibiting recapping and frequent disposal of sharps containers, are followed and workers are adequately trained in those practices.

Methods

Subjects

Data were obtained from a population of 477 active-duty EMS workers for a municipal fire department. Ages ranged from 20 to 61 years; 9% were female, and 81% were male. Lancet-related NSI were chosen for analysis because they represented the majority of needlestick injuries in this population.

Procedure

Subjects were instructed to report all NSI due to glucometer lancets and other exposures, as directed by the OSHA Bloodborne Pathogens Standard, to a designated fire department medical officer; subsequent follow-up was done by a board-certified occupational medicine physician who was available 24 hours a day, 7 days a week, for consultation. Laboratory testing (hepatitis B surface antibody and antigen, hepatitis C antibody, liver function enzymes, and HIV) was conducted for all exposures at time zero, 6 weeks, 3 months, and 6 months. If antiviral prophylaxis was prescribed, a complete blood count and renal and hepatic panels were added at time zero, 2 weeks, and 4 weeks to monitor drug-related side effects, concurrent with a physician evaluation. All firefighters completed biannual laboratory testing for hepatitis B and C.

Universal precautions and bloodborne pathogens training, as mandated by the Bloodborne Pathogens Standard, have been provided on a routine basis to all department EMS workers since 1992. In 1998, to encourage reporting and to offer guidance, an orange, highly visible laminated card with instructions regarding the above procedure, along with telephone numbers for regular and after-hours contact, was provided to all EMS workers to be carried on their person and department vehicles. EMS workers wore gloves during the use of the glucometer lancet and followed universal precautions.

All subjects completed baseline screening for HCV antibody and HBV surface antigen and antibody in 1998 and repeat testing at the conclusion of the study. For those who were positive for the HCV antibody, the test was confirmed using a supplementary, second-generation recombinant immunoblot assay, and the viral load was quantified for levels of HCV RNA using the polymerase chain reaction (PCR) method. Those who were confirmed positive were referred to a hepatologist for further evaluation.

Ninety-nine percent of the firefighters had previously received the complete immunization series for hepatitis B. Those with negative results for the HBV surface antibody during postexposure testing, at baseline, or during biennial testing were offered a hepatitis B booster after giving their informed consent.

In October 2000, six EMS workers sustained a needlestick injury with a straight stick non-retracting lancet-type device. Approximately 2500 such lancets were used each month. The fire department, in consultation with a board-certified occupational medicine physician, changed to a self-retracting glucometer lancet. The former device was removed from all facilities and vehicles. All active-duty personnel were trained in the use of the new device, specifically to hold the point against the skin, press the plunger until the sharp was released and lanced the skin, confirm visually that the lancet had automatically retracted into its protective housing, and then dispose the lancet into a sharps container.

In winter 1999 to spring 2000, the subjects were retested for HCV antibody and HBV antibody and antigen. Supplementary testing for HCV was provided for all positive HCV antibody cases.

Results

In 1998, the prevalence rate of EMS workers (before the change to a self-retracting glucometer) who were positive for HCV antibody was 9 of 477 (1.9%).[4] Two of the nine tested negative for HCV using second-generation recombinant immunoblot assay and qualitative PCR. Seven had a viral load count, by the PCR method, of greater than 100,000 copies per milliliter. This is equivalent to the background rate of 1.8% reported by the Centers of Disease Control and Prevention.

Two workers were positive for HBV surface antigen before the introduction of the new device. After the change to the new device, no additional HCV- or HBV-positive cases were detected. The clearance rate for HBV and HCV was zero. No subjects converted to HIV-positive.

For the 2 years preceding, up to the substitution of a new self-retracting lancet glucometer, 16 lancet sticks with a straight stick–type lancet device occurred, or 16 per 954 worker-years. During the 12 months after the device change, NSI from the glucometer procedure decreased to 2 per 477 EMS worker-years, a statistically significant change at the 0.05 alpha level using the Z Test of Proportions ($z = 2.071787$).

Cost-Effectiveness

An analysis of cost-effectiveness should incorporate a comparison of both direct and indirect costs for alternative strategies.[17] The direct and indirect costs of NSI were substantial. Direct costs included the cost of medical care and equipment, including the increased expense for the self-retracting device (annualized increase, $366). The average medical expense for each NSI in the study was $1034.60. Costs included physician evaluation and counseling, antiviral medication, laboratory tests, and hepatitis boosters as recommended by US Public Health Service protocols. The total for the 16 cases pre-intervention was $16,553.60, and for the two cases post-intervention, $2068. Additional costs included laboratory testing of the source patients—when consent was obtained—for hepatitis B and C and HIV.

TABLE 1
Direct Cost Summary

Pre-device change	
Annualized cost for medical care	8,277
Annual expense for lancets	6,570
Total	14,847
Post-device change	
Annualized cost for medical care	2,751
Annual expense for lancets	6,936
Total	9,687
Annual savings	5,160

Indirect costs included lost time from active duty while completing paperwork, visiting the clinic and laboratory, and decreased efficiency due to frequently encountered antiviral medication side effects (primarily nausea and fatigue) and stress reactions.[18] Training time involved reading a department-wide guide and individual instruction, both of which occurred during slow times so as not to incur overtime expense. A summary of direct costs is provided in Table 1.

Discussion

Many approaches can decrease NSI, including education and the use of gloves. Because of the uncontrollable nature of EMS work, the integrity of gloves is readily compromised, and automatic measures to protect preoccupied workers from sharps are warranted. As seen in this study, engineering controls using a device alteration can decrease NSI, medical expenses, indirect costs such as lost time for medical evaluations and blood draws, and the possibility of a serious or fatal illness.

Limitations

Self-reporting rather than observational design poses a bias in that certain participants in the study might not have noted subtle needlesticks or may have chosen not to report them. The confirmed-positive results for HBV and HCV cannot be conclusively attributed to glucometer lancet NSI. Although such injuries comprised the major part of department needlesticks (only two nonlancet injuries were reported during the study period), other exposures were possible, including mucus membranes and compromised skin and non-occupational exposures. Confounding factors such as EMS worker turnover were minimal during the study period.

Conclusion

Many interventions (education and barriers such as gloves) have been studied to decrease NSI, particularly in the surgical setting. As seen in this study, engineering controls are a cost-effective strategy in a nonsurgical environment involving EMS workers. Now that transcutaneous glucose monitoring is available, lancet glucometers may become obsolete if these relatively expensive devices ever become affordable. Because one NSI occurred when the self-retracting lancet came out of the housing when the plunger was pushed again, the department is switching to a similar device with the addition of a locking feature to prevent such an occurrence.

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