Editorial

Building Better Programs to Prevent Transmission of Blood-Borne Pathogens to Healthcare Personnel: Progress in the Workplace, But Still No End in Sight

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In 2001, there were an estimated 9.2 million individuals working in healthcare in the United States.[1] Despite the use of standard precautions and the introduction of safety-engineered devices, healthcare workers remain at substantial risk of occupational exposure to blood-borne pathogens, including hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV). Estimates of the annual number of percutaneous injuries among U.S. healthcare personnel vary widely but represent a substantial occupational risk. Using national occupational health surveillance data from 1997 and 1998, Panlilio et al. estimated that in the United States there were approximately 384,000 percutaneous injuries annually among hospital-based healthcare workers.[2]

Despite effective pre-exposure and postexposure prophylaxis for HBV and recent revised recommendations for postexposure prophylaxis after HIV exposure, the best approach to prevent occupational blood-borne infection is the prevention of percutaneous injuries associated with medical devices contaminated with blood. In September 1998, California became the first U.S. state to implement a safe needle device act to decrease the risk of occupational percutaneous injuries. Currently, more than 17 other states have passed similar legislation. In November 2000, the federal Bloodborne Pathogen Safety Act was signed into law, and as of April 30, 2002, the Joint Commission on Accreditation of Healthcare Organizations required full compliance with this act.

If properly used, safety devices can be an effective means of reducing the number of percutaneous injuries. In a large study conducted by investigators from the Centers for Disease Control and Prevention and 10 U.S. teaching hospitals during 1993 to 1995, use of phlebotomy devices with safety features significantly reduced phlebotomy-associated percutaneous injuries and was associated with minimal adverse events.[3] Activation rates of the safety feature varied according to ease of use, healthcare worker preference, perceived patient adverse events (such as hematoma formation and need for repeat phlebotomy), and device-specific training. Despite a study demonstrating that use of blunt suture needles decreased the risk of percutaneous exposure during gynecologic surgical procedures, acceptance of these devices in surgical practice remains poor.[4]

Healthcare facilities can use many types of safety-engineered devices to reduce the number of percutaneous injuries, but these devices have limitations and obstacles to full implementation remain. There is a growing and bewildering assortment of safety devices currently being marketed, some of which require user activation and others with automatically activated safety features. They vary considerably in their ease of use and effectiveness in reducing injury rates, and are not available for certain situations, such as dentistry and arterial line placement. Training and education are necessary to ensure proper use. The increased direct cost of safety devices is another potential obstacle to implementation. The added cost of a needle with a safety feature ranges from pennies for a blood collection needle or syringe with a needle attached to more than $0.70 for an intravenous catheter. The annual cost to a healthcare facility to comply with the federal Safe Needle Device Act is not trivial. Following implementation of the California Safe Needle Device Act in 2000, we estimated that the added cost for safety features for our hospital increased the annual expenditure for needle-containing devices 50%, from $412,000 in 1999 to $825,000 in 2000.[5]

The benefits of needles with safety features appear to

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exceed their costs in most clinical situations. The cost of postexposure treatment ranges from $500 to $3,000 per injury and includes the cost of the occupational health evaluation, serologic testing of the healthcare worker and source, postexposure treatment, and management of toxicity if postexposure prophylaxis is given.[6] The cost of a liver transplant and the first year of treatment averages more than $300,000, and the lifetime cost for medical care for HIV exceeds $195,000.[7] Use of needles with safety features likely will reduce these costs as well as other indirect costs, such as workers' compensation, worker replacement, and liability claims. Although the safety features add incremental cost to the cost of medical devices, the U.S. General Accounting Office estimated that eliminating 69,000 needlesticks per year could decrease the overall cost of postexposure prophylaxis for healthcare workers in hospitals between $37 and $173 million per year and prevent at least 25 cases of HBV and at least 16 HCV infections per year.[6]

In 2000, the U.S. General Accounting Office estimated that 30% of the annual needlesticks in U.S. hospitals were preventable by using needles with safety features, and that an additional 109,000 injuries could be prevented by eliminating the unnecessary use of needles.[6] However, the use of devices with safety features alone is insufficient. Up to one-quarter of percutaneous injuries occur during use of a device in a patient when the patient moves suddenly and thus cannot be prevented with safety features. Approximately 50% of percutaneous injuries occur after the procedure is completed and can occur before or during activation of the safety feature, especially when the device requires user activation, or during disposal. Measures to modify workplace practices, including increasing the availability of puncture-resistant disposal containers in all patient care areas, not allowing disposal containers to overfill, and avoiding needle recapping, can further reduce the risk of percutaneous injuries. In addition, use of safety devices must be combined with comprehensive occupational health programs. These programs must include immunization of healthcare workers against HBV, training in the use of safety devices and modification of work practices, postexposure management, and systematic evaluation of the effectiveness of these measures.

In 2001, the U.S. Public Health Service published updated guidelines for the management of occupational HIV exposure that assist healthcare providers in determining whether healthcare personnel should receive postexposure prophylaxis and in choosing appropriate postexposure prophylaxis regimens.[8] Although seroconversion is infrequent following occupational exposure to HIV, as of December 2001, 57 U.S. healthcare workers had confirmed occupational transmission of HIV.[9] At least 21 instances of failure of postexposure prophylaxis to prevent occupational transmission of HIV have been reported, including instances of failure of combination postexposure prophylaxis regimens associated with HIV source virus resistant to each of the antiviral agents used.[10,11] Occupational transmission of multidrug-resistant HIV is a growing concern. In this issue of *Infection Control and Hospital Epidemiology,* there are two articles that examine current challenges to the prevention of occupational exposure to blood-borne pathogens.[12,13]

As detailed knowledge about the antiviral susceptibility phenotype of the source HIV strain often is not available at the time of occupational exposure, the study by Beltrami et al. provides important clinical guidance to healthcare providers faced with the growing challenge of selecting appropriate empiric postexposure prophylaxis.[12] In this study, the prevalence of HIV source virus resistant to antiretroviral drugs was assessed during a 2-year period at seven tertiary-care medical centers in five U.S. cities, including three New York City centers. There were 91 eligible HIV exposures, and no HIV transmission occurred. Sixty-four HIV-infected source patients consented to participate. Virus strains from the 50 patients with detectable viral loads had genotypic antiviral drug resistances determined by sequencing the entire viral protease gene and partially sequencing the reverse transcriptase gene. Phenotypic resistance to 11 antiretroviral agents was determined using a commercial antiviral susceptibility assay.

Overall, a substantial proportion of source patients (19 [38%] of 50) had HIV strains with gene mutations associated with resistance to one or more antiretroviral agents, including to reverse transcriptase inhibitors (17 [34%]), protease inhibitors (10 [20%]), and non-nucleoside reverse transcriptase inhibitors (9 [18%]). In all but a few instances, genotypic resistance mutations correlated with in vitro phenotypic antiretroviral resistance and with current or recent (within 3 months) therapy with that class of antiretroviral agent(s). Although many questions remain about the impact of targeting postexposure prophylaxis based on the source patient's known or estimated risk of infection with resistant HIV, these results support the use of recent (within 3 months) antiretroviral resistance genotype or phenotype data or recent treatment history to guide postexposure prophylaxis. On the basis of these findings, the authors recommend that in situations where antiretroviral resistance is a concern, healthcare providers should include one or more drugs or drug classes with which the source patient has never been treated or, if not achievable, has not been treated within the prior 3 months. As the authors emphasize, interpretation of these data requires expert consultation with healthcare providers knowledgeable about HIV treatment and antiretroviral resistance.

Most published reports of rates of occupational needlestick injuries are based on data from single institutions that primarily are large, urban, acute care teaching hospitals. In the second article of this issue, Babcock and Fraser expand our knowledge about the epidemiology of occupational percutaneous injuries in an acute care hospital by systematically reviewing 5 years of standardized percutaneous injury data from the nine hospitals in their large, integrated healthcare system.[13] Rates of percutaneous injuries for selected exposure characteristics were compared between hospitals grouped by bed size, setting (urban vs rural), teaching affiliation, and patient mix (adult

vs pediatric). Although attending physicians reported to a separate occupational health system and were not included in this analysis, resident physicians, nurses, and other high-risk healthcare personnel were captured in their database.

Encouragingly, the reported annual percutaneous injury rate declined 21% for all nine hospitals combined during the study period, likely reflecting the impact of increased acceptance and appropriate use of safety devices and ongoing education efforts. The average annual rate of percutaneous injuries varied more than fourfold among the nine hospitals (range, 5.8 to 25.3 per 100 hospital beds). There were significant differences among the different hospital settings in percutaneous injury rates by patient care location, activity, and medical device, and in the seroprevalence of HCV and HIV but not of HBV among source patients. Of note, percutaneous injuries were significantly more common in the emergency departments and operating rooms of small hospitals (250 or fewer beds) and in the wards of larger hospitals. These findings support the importance of the systematic collection and analysis of healthcare facility–specific percutaneous injury data to more effectively target interventions to high-risk locations and job categories.

With the increasing prevalence of blood-borne pathogens and drug-resistant HIV among source patients, building a comprehensive program to prevent occupational transmission requires greater resources and state-of-the-art clinical expertise. Occupational exposure to blood or body fluids harboring or potentially harboring blood-borne pathogens is a medical emergency, but as many as 70% of percutaneous injuries have gone unreported.[14] All healthcare organizations should not only periodically train all healthcare personnel in standard precautions and the proper and consistent use of safety devices, but also reemphasize the critical importance of reporting occupational exposures. Administrative barriers that delay postexposure management must be minimized.

Improving and standardizing electronic percutaneous injury registries, such as that used by the occupational health clinics in the study by Babcock and Fraser, can increase the reliability and timeliness of reported percutaneous injury rates. Use of an appropriate denominator (eg, 100 patient beds or 1,000 patient days) can assist healthcare facilities to trend and to benchmark percutaneous injury rates and to better assess the impact of safety devices and training and education programs.[15] Although more than half of U.S. healthcare personnel work in nonhospital settings, there are only limited, published data on percutaneous injuries in these settings. More data also are needed on the safety, tolerability, and effectiveness of postexposure prophylaxis regimens, especially for the management of exposures to source patients with antiretroviral-resistant HIV. As resistance testing of the source virus at the time of an exposure remains impractical, additional epidemiologic studies should help to refine clinical markers for source HIV drug resistance. Despite substantial progress, the recent challenge by the Centers for Disease Control and Prevention to eliminate occupational needlestick injuries among healthcare workers remains to be met.

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