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Occupational blood-borne pathogen exposures among community workers

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Exposures to blood and other body fluids occur across a wide variety of occupations and raise a myriad of complex medical, legal, and regulatory issues. Most research and prevention recommendations regarding such exposures have focused on healthcare workers, the occupational group at highest risk for exposure [1,2]. Workers in other at-risk occupations largely have been ignored. Whether in healthcare or community settings, occupational exposures to blood or body fluids have the potential for transmitting disease [3].

There are no national surveillance systems in place to provide accurate incidence rates for occupational exposures to blood or body fluids outside of the healthcare setting. Workers in other occupations are at increased risk because of their use of sharp instruments, and their potential risk for encountering discarded sharp instruments or materials that are contaminated with blood or body fluids. The pathogens of primary concern, HIV, hepatitis B virus (HBV), and hepatitis C virus (HCV), are discussed (Box 1). The same principles of exposure management applied to healthcare workers should be applied to workers in community settings [4].

This article aims to raise awareness among public health officials, medical care providers, workers, and employers about the risks associated with occupational exposure to blood and body fluids among workers in non-healthcare settings. In this article, these workers are referred to as "community workers." A partial listing of community occupations is given (Table 1). A medical literature

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Box 1. Pathogens of concern

HBV

The probability of HBV transmission after an occupational exposure is dependent on the degree of contact with blood and the status of the hepatitis B e antigen (HbeAg)—a marker for how infectious an affected person is likely to be—in the source person. The risk for transmission after a needlestick exposure (if the exposed person is not immune) is about 37% to 62% if the source person is positive for HbeAg, whereas the risk for transmission after a needlestick exposure is 23% to 37% if the source patient is negative for HbeAg [5]. HBV is resistant to drying, simple detergents and alcohol and has been found to be stable on environmental surfaces for at least 7 days [3,6,7]. Indirect inoculation can occur by way of inanimate objects (eg, contaminated medical equipment or environmental surfaces).

HCV

The average incidence of HCV infection after needlestick injury or exposure to sharp instruments from a patient who tests positive for HCV ranges from 0% to 7% [8–12]. No transmission to healthcare workers has been documented from intact or nonintact skin exposures to blood [9]. The risk for transmission after exposure to fluids or tissues other than blood has not been quantified, but is expected to be low [4]. Data are limited on survival of HCV in the environment [13].

HIV

The risk for occupational infection with HIV varies with the type of exposure and factors such as the amount of blood involved in the exposure, the amount of virus in the blood or body fluid, and whether treatment was given after the exposure [4]. In studies of healthcare workers, the average risk for transmission of HIV after a percutaneous exposure to HIV-infected blood has been estimated to be approximately 0.3% (1 in 300), and after a mucous membrane exposure, approximately 0.09% (1 in 1000) [14]. Although cases of HIV transmission after nonintact skin exposure have been documented, the average risk for transmission by this route is estimated to be less than the risk for mucous membrane exposures [15,16]. There have been no documented cases of HIV transmission caused by an exposure involving a small amount of blood on intact skin. The risk for transmission after exposure to HIV-infected tissues or fluids other than blood also has not been quantified, but seems to be lower than for blood exposures [17]. There is no evidence of HIV transmission from environmental surfaces [4].

Table 1
Occupations with potential exposure to blood and body fluids

Potential exposure	Occupation
Needles and sharp instruments	Acupuncturists
	Body piercers
	Tattoo artists
Materials contaminated with blood or body fluids	Biorecovery workers
	Custodial staff, including janitors and maintenance staff
	Day care workers and teachers
	Funeral service workers
	Hospitality workers, including food servers
	Housekeepers, maids
	Laundry and dry cleaners
	Plumber
	Public safety workers, including police officers
	Recycling workers
	Waste haulers and handlers
	Waste water workers

review and legal case review were conducted to discern available information related to this issue. This article discusses these reviews.

Medical literature review

A review of the medical literature was conducted to identify published research on exposure to blood and body fluids among community workers. The discussion of each at-risk occupation includes background information, a brief discussion of published research, and prevention strategies specific to that occupation. Prevention strategies that are common to a number of the occupations are summarized (Box 2).

Box 2. Prevention strategies for workers with potential for exposure to blood-borne pathogens

It is recommended that all workers who may be exposed to blood-borne pathogens in occupational settings receive prophylactic HBV vaccinations, use personal protective equipment (PPE), report any exposure, and receive prompt medical follow-up for exposure. Workers at risk for occupational blood-borne pathogen exposure should receive routine education, and the employer should institute a spill response plan. The use of engineering controls to prevent exposure, including approved safety devices (when made available), strongly is recommended.

Community workers who use sharp instruments

Acupuncturists

There are roughly 10,500 licensed acupuncturists in the United States, providing about 9 to 12 million treatment visits annually. Some visits occur in traditional healthcare settings, such as hospitals or clinics, whereas many visits occur at other sites. Acupuncture involves the insertion of very fine needles (28–38 gauge) into the skin. Another practice often used in conjunction with acupuncture is cupping, in which a lancet is used to puncture the skin, after which a small glass jar is heated and placed over the punctured area, creating a vacuum that draws out approximately 3 to 5 mL of blood [18]. Transfer of viral infections can occur between patients, or between patients and practitioners, if needles are not sterilized properly between uses, or if a needlestick injury occurs [19–22]. Sterile, single-use needles are used almost universally in the United States and are regulated by the Food and Drug Administration (FDA) as approved medical devices [23]. These needles are surrounded by a protective plastic sheath, or guide tube, that prevents the needle from being inserted too deeply into the skin and helps prevent inadvertent needlestick injuries to the practitioner.

In 2000, investigators from the National Institute for Occupational Safety and Health (NIOSH) observed procedures at an acupuncture clinic in Texas to determine if employees were at risk for exposure to blood-borne pathogens [24]. They found that acupuncture and cupping procedures can expose employees to blood-borne pathogens. Nakashima and colleagues reported on the prevalence of HCV infection among hospital staff and acupuncturists in Japan and found that the prevalence of anti-C100 seropositivity in acupuncturists was 2.2%, a value that did not differ significantly from that for the comparison group [25].

Acupuncture practitioners should use the most protective needles, such as those surrounded by a protective plastic sheath. After use, these needles should be disposed safely in approved containers for sharp instruments [24].

Body piercers

Body piercing is a relatively quick procedure that is done without local anesthesia. The first step in performing a piercing involves cleaning the area with a topical antiseptic. Entrance and exit sites are marked with a pen to provide a guide for the needle. The skin is held taut by forceps, while the piercing is made with a large (12- to 16-gauge) hollow-bore needle (Fig. 1). Some body piercers prefer to place a cork at the exit site to catch the needle. Other piercers report that the cork can break, resulting in the potential for a needlestick injury. For certain penile and nose piercings, a receiving tube is used to guide the needle, which helps prevent injury to the client. For nose piercings, the receiving tube is placed in the client's nostril. Jewelry is attached to the needle and guided through the hole in a needle-and-thread–type fashion. A bead, metal ball, or disk is screwed onto the exiting side of the jewelry. Because some bleeding usually occurs, manual pressure is applied to the pierced area with sterile gauze.

Fig. 1. A common body-piercing procedure. The position of the piercer's hands in relation to the piercing needles is shown.

There is relatively little information available on the occupational risks posed to body piercers. The number of body piercers in the United States has not been documented. There are no published data regarding the number of body piercers who have sustained needlestick injuries or who may have contracted an infection caused by a blood-borne pathogen. Many body piercers have received piercings themselves, making studying this group of employees more difficult.

In 1999, investigators from NIOSH observed piercing activities and decontamination procedures at two piercing studios in Florida where there was concern about potential occupational exposures to blood-borne pathogens [26]. NIOSH investigators concluded that the body piercers at both facilities were at an increased risk for exposure to blood-borne pathogens because of the potential for needlestick injuries, which reportedly were most likely to occur when the unprotected needle exited the piercing site. Inconvenient location of the sharp-instrument containers resulted in multiple contacts with contaminated needles and forced the body piercer to make unnecessary movements while holding the needle. Other risks included the potential for cross-contamination of instruments and surfaces, lack of HBV vaccination, and lack of exposure-control programs [27].

Prevention strategies noted in the NIOSH evaluation that can be applied to all body piercers include: (1) prompt disposal of needles in sharp-instrument containers that are within reach of the body piercer, (2) use of solid needles instead of hollow-bore needles, (3) postexposure medical management with an attempt to determine the infectious status of the source individual, and (4) installation of wrist-action or foot-pedal–operated sinks to prevent cross-contamination of hands.

Tattoo artists

There are two types of tattoo artists: traditional tattoo artists and tattoo artists who apply permanent cosmetics, such as mascara and lipstick. Tattooing involves

the insertion of pigment into the dermis by using an electric tattoo gun, drawing on the skin and inserting the ink with a needle, or cutting or burning the skin followed by rubbing the ink into the wounds [28]. Most tattoo artists use an electric gun that causes a solid-bore (10- to 14-gauge) needle to penetrate the skin several hundred times per minute. Ink can be applied by placing it on the skin and driving it through or by repeatedly dipping the needle in ink as the tattoo is made. As ink and blood surface to the top of the skin, they are wiped away. Needles are disposed of after use on an individual.

Few publications are available concerning tattoo artists' risks for infection with blood-borne pathogens. Thompson and co-workers conducted anonymous testing of 41 samples of sera for markers of HIV, HBV, and HCV antibodies [29]. Nineteen sera samples tested positive for the presence of HBV antibodies, none were positive for HIV antibodies, and 2 were positive for HCV antibodies. The authors concluded that exposure to HBV was an occupational or lifestyle hazard for tattoo artists, whereas HCV exposure did not seem to be a great risk. In 1995, Tope reviewed existing tattoo-related statutes and their contents from the 50 United States, the District of Columbia, and six US territories [30]. At the time, 27 states had no statutory regulations, 11 had minimal legislation in place, and 12 had more complete statutes, including infection-control procedures and training requirements. In seven states, tattooing was forbidden.

Tattoo artists should be educated about how blood-borne pathogens are transmitted and should take precautions to prevent their transmission. Universal precautions should be followed as recommended by the Centers for Disease Control and Prevention (CDC) [2] and as required by the Occupational Safety and Health Administration (OSHA) [27]. Surgical gloves should be used during procedures. Single-use materials and disposable needles should be disposed of appropriately, and reusable instruments should be autoclaved. Postexposure medical management should include the collection of contact information and infection status from the client, as permitted under state law.

Community workers who encounter sharp instruments

Medical waste workers

The Environmental Protection Agency defines medical waste as "any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals" [31]. In 1999, Leese et al estimated that more than 10,000 workers in the United States work in the medical waste stream and also studied exposure to blood-borne pathogens from blood splashes among employees at three commercial medical waste treatment facilities [32]. They examined the potential for blood splashes among workers who manually dump small containers of medical waste onto conveyors or into larger vessels for treatment and final disposal. Six pads each were placed on the upper torsos of 18 workers, and the number and sizes of splashes were recorded after each worker's shift. The authors estimated that across the three facilities, about 8% of the pads tested positive for hemoglobin (11 positive pads of 128 total pads). Blood splashes to personal eye protectors also were assessed. Of the 18 workers who were monitored at the three sites, four (22%) of the workers' eye protectors tested positive for blood. Adjacent work surfaces were monitored for blood splashes; 61 of 96 (64%) surfaces tested positive for blood.

In a NIOSH study, workers at a medical waste treatment facility were found to be at risk for needlestick injuries and exposure to blood and body fluids [33]. Medical interviews revealed that some employees failed to report needlestick injuries, other sharp-instrument injuries, and splashes to the eyes, nose, mouth, or skin. Most needlestick injuries reportedly occurred while unclogging the waste processing system by hand, and most splashes happened while stacking waste bins on hand trucks during the unloading of incoming trailers; on occasion, the snap-on lids of the bins were not secure during shipping. There was also insufficient employee training regarding infection-control principles, the potential hazards associated with the processed infectious waste, task-specific procedures, the use of PPE and clothing, disposal of soiled Tyvek suits (Dupont Tyvek® Protective Apparel, Wilmington, DE), and spill control and cleanup. There was no medical follow-up with the employees to ensure that they received all three required doses of the HBV vaccine, and a review of the company's OSHA log and summary of occupational injuries and illnesses (Form 200) showed differences in the number of needlestick injuries listed and the number reported in the medical records. This difference indicated that some needlestick injuries were not documented and that not all injuries were followed-up with medical care.

When handling any medical waste, employees should avoid direct contact at all times, and all containers (eg, red bag waste) should remain closed. Medical waste treatment facilities that perform grinding or compaction of untreated waste should require their client laboratory facilities to decontaminate infectious materials at the generation site before disposal. This recommendation is consistent with the meeting report of the State and Territorial Association on Alternative Treatment Technologies [34].

Municipal waste workers

Municipal solid waste consists of everyday items and may include syringes and other medical sharps that are used in the home. In the United States, the number of medical sharp devices that are used and discarded in the municipal waste stream each year outside of the healthcare setting is unknown. Needles commonly are used by individuals who self-administer medical injections and by intravenous drug users. Approximately 1 billion injections of insulin are given each year [35]. There is an unknown number of injections for other legally prescribed medications, including heparin. Lurie and colleagues estimated that drug users administer between 920 million and 1.7 billion injections each year in the United States [36]. There is no universal guidance on how needles used outside of healthcare settings should be discarded, and syringes used outside of healthcare settings that end up in municipal solid waste sites may result in injury

to waste workers. The management of community solid waste, such as handpicking to retrieve recyclables to reduce the volume of landfills, can result in needlestick injuries to municipal waste workers.

In response to heightened public concern about medical waste and the fear of AIDS, Congress directed the Agency for Toxic Substances and Disease Registry (ATSDR) to collect data on the amount, types, and public health implications of medical waste generated in the United States. In a 1990 report to Congress [37], ATSDR identified refuse work as an occupation in which workers were at risk for exposure to medical waste, and the agency estimated that the annual medical waste-related injury rate from sharp instruments for refuse workers was 2.7 to 36.3 per 1000 employees. They also estimated that between 500 to 7300 sharp-instrument injuries occurred to refuse workers every year.

Turnberg and Frost examined occupational exposures to blood-contaminated waste and discarded needles in the municipal waste stream [38]. In 1989, they surveyed 940 municipal waste collection and disposal workers in Washington State (representing 70% of the state's waste-industry workforce). Of the respondents (response rate of 47%), 69% reported receiving job safety training, of which 26% indicated that this included training on medical waste safety practices. Thirty-two percent of the respondents reported getting blood on their clothing or shoes, 13% on their skin, and 5% on their face or in their eyes. Exposure to a discarded syringe that resulted in a needlestick injury or scratch was reported by 21% of the respondents.

In 1975, Cimino reported that approximately 50 to 100 percutaneous injuries occur each year to New York City sanitation workers [39]. He reviewed medical records for a two-year period and did not identify any seroconversions to HBV. He believed this finding resulted from each of the exposed workers having received postexposure prophylaxis with gamma globulin.

Primary consideration should be given to eliminating used syringes and other sharp instruments from the municipal waste stream and using engineering controls to isolate contaminated material. Training, education, and the use of PPE might help prevent exposures. Individuals need clear guidance and alternatives for disposal of used syringes and other medical sharp instruments. Employers must expect and plan for sharp instruments to be in the municipal waste stream. Communities may want to consider strategies for properly disposing of used syringes and other medical waste that is used outside of the healthcare setting. Rhode Island has implemented a statewide disposal system for needles used at home [40]. Another option is to initiate syringe-exchange programs.

Police officers

Potential blood-borne pathogen exposures among police officers can occur during a variety of police activities, including performing searches, restraining suspects, handling evidence, and administering first aid. Researchers have noted the potential for high rates of infection with blood-borne pathogens among individuals in the criminal justice system [41].

Hoffman et al conducted a prospective study of 1333 Denver police officers to examine the risk for exposure to blood-borne pathogens [42]. The police officers self-reported 137 potential exposures to blood, 42 of which were identified by the researchers as documented occupational exposures. Of these exposures, 24 involved blood contact with nonintact skin, 6 involved blood exposures to mucous membranes, 6 were human bites, 4 were needlestick injuries, and 2 exposures were lacerations. Most of the exposures (64%) occurred during restraint and subduing situations, 24% occurred while the officers were administering first aid, and 10% occurred during searches or evidence gathering. In response to a questionnaire administered at the end of the study, only 57% of respondents stated that they had followed instructions to self-report all potential exposures that had occurred during the study.

Lorentz and colleagues studied potential blood-borne pathogen exposures by using a voluntary anonymous questionnaire survey of active-duty San Diego police officers [43]. Thirty percent of respondents reported at least one occupational needlestick injury; of those respondents, only 39% sought medical evaluation at the time of the injury. Searches were the most commonly involved work activity: 36% occurred during pat-down searches, 25% occurred during arrest-related searches, and 10% occurred during vehicle or property searches. Among respondents, 73% reported frequent use of PPE (ie, gloves). Seventy-four percent rated their concern regarding needlestick injuries as the same or greater than for a gunshot or knife wound.

Pagane and co-workers conducted a retrospective study of self-reported transcutaneous exposures (limited to human bites and needlestick injuries) among New York City police officers. One hundred six human bites and 15 needlestick injuries were reported by the police officers [41].

Clark-Burton and Boudreau investigated the potential for blood-borne pathogen exposure from handling criminal evidence in a sheriff's office [44]. They found that the evidence room contained blood- and body fluid-soaked articles of clothing, objects found in sewers, and items used to cover decedents (such as blankets or sleeping bags). They concluded that there were potential risks for employee exposure to blood-borne pathogens, especially when gathering evidence in the field at the site of a crime.

In developing prevention strategies for police officers, the unique problems associated with police work must be considered. Officers often do not have sufficient time to don PPE, and available PPE might be ineffective in certain public safety situations. Lorentz et al noted a unique preventive measure—installing plastic (rather than padded) rear seats in patrol cars to discourage suspects from attempting to dispose of needles in the seat padding [43]. The study also mentioned the possible usefulness of unique PPE for police officers, such as puncture-resistant, flexible gloves.

Postal workers

In 1992, the US Postal Service (USPS) published a final rule to protect its employees and customers from biologic hazards and injuries related to the

mailing of infectious waste through the USPS system [45]. The ruling requires packages containing sharp instruments or other medical devices to be mailed as registered priority or first-class mail and to meet specific USPS packaging requirements. By requiring a return receipt, a tracking system had been established, resulting in greater accountability on the part of the sender [46]. Although these regulations are in place, USPS employees are still at risk for exposures to sharp instruments, blood, and body fluids.

The National Institute for Occupational Safety and Health (NIOSH) conducted an investigation at a USPS mail facility located near New York City to evaluate procedures for preventing worker exposures to medical specimens and waste [47]. Investigators found that, although written blood-borne pathogen and emergency response plans were compliant with OSHA standards, employees were still at risk for sharp-instrument injuries and exposure to blood and body fluids. Torn and damaged packages containing blood samples and needles were observed, and several biohazard-labeled packages were pulled out of the bulk-mail conveyor stream. The incident log identified risks associated with loose needles and sharps containers. Four exposure incidents that occurred during a 3-year period were related to medical specimens and waste, three of which involved needlestick injuries to fingers. The fourth incident occurred when the contents of a damaged package containing biologic waste dripped onto the skin of an employee. Employees reported that approximately 10 to 30 packages containing biohazards were pulled from the stream on a daily basis, 50% of which did not have a return address.

Packages containing sharp instruments and other medical devices need to be shipped using priority or first-class mail. Failure to do so results in these packages being sent through bulk-mail sorting systems. These large, automated systems occasionally damage packages that can cause the contents to break open or leak. Individuals must follow the USPS packaging requirements, including appropriate labeling for identification purposes.

School workers

School workers, including school nurses, custodians, teachers, coaches, and other staff, have the potential for exposure to blood or body fluids by way of needlestick injuries or while attending to injured students or staff.

The limited information related to potential exposures among school workers includes a survey of school employees in one urban school district to assess compliance with universal precautions and exposures to blood and body fluids [48]. Among respondents, 50% reported that they had responded to bleeding injuries and cleaned spills of blood or other body fluids (eg, vomit, urine) during the previous school year. School custodians, teachers, and teacher aides also reported direct contact with blood or body fluids without using universal precautions.

The American Academy of Pediatrics has published recommendations regarding prevention of transmission of blood-borne pathogens in schools and childcare facilities [49]. These recommendations include educating healthcare workers, teachers, administrators, maintenance workers, and other school employees. This training includes (1) the use of universal precautions; (2) use of PPE, including gloves; and (3) proper disinfection of soiled surfaces.

Other workers

There are a few articles related to several other occupations in which blood-borne pathogen exposures can occur. These jobs include corrections officers [50], sewer workers [51], funeral service practitioners [52], clothing industry workers [53], housekeeping and janitorial service workers [54], and casino workers [55].

Legal case review

A legal case review was conducted to identify reported cases of litigation involving occupational blood exposures among community workers (Box 3).

Box 3. Examples of occupational injuries in non-healthcare settings that have resulted in litigation

A ferry worker reported being stuck by a needle while cleaning ferry seats and filed a negligence claim for her HCV infection [56].

A funeral director reported being stuck by a needle while removing an intravenous line from the body of an HIV-positive individual and filed claims of negligence and infliction of emotional distress against the individual's doctor, home healthcare provider, pharmacy, and treating hospital [57].

A janitorial worker of an office building reported being stuck by a needle in a trash can and filed a claim against the building's owners for fear of developing AIDS [58].

A janitorial worker who claimed she had been stuck by needles in garbage bags, and who was disciplined for her subsequent refusal to handle garbage bags, filed a personnel action and a claim of retaliatory employment practices and negligent infliction of emotional distress against her employer [59].

A janitorial worker with HCV infection, who worked at a manufacturing facility where she claimed to have encountered several needles and had sustained one needlestick injury while cleaning restrooms, filed an intentional tort claim against her employer [60].

A medical waste handler, who claimed to have frequent exposures to blood and frequent needlestick exposures, sought workers' compensation coverage for HCV infection [61].

A refuse collector filed a workers' compensation claim for HBV infection [62].

A sanitation worker stuck by a dental instrument unlawfully discarded with regular (rather than medical) waste sued the dentist for payment for treatment of his injury and for negligent infliction of emotional distress [63].

A wastewater treatment worker (instrument repair technician) filed a workers' compensation claim for HBV infection and claimed that he had frequent occupational exposures to raw sewage and often had nicks or cuts on his hands [64].

A sewage-plant maintenance mechanic, "whose employment required him to work in raw sewage at a wastewater treatment plant where [he] sustained cuts from needles and other sharp objects flushed into the sewer system," filed a workers' compensation claim for chronic HBV infection [65].

A welder working on a railroad reported being stuck by a discarded needle and filed a claim against the railroad for negligent infliction of emotional distress [66].

A corrections officer, who was bitten by an HIV-positive inmate, filed a workers' compensation claim for his postexposure evaluation and treatment; the employer contested that it should not be forced to pay for the evaluation and treatment [67].

A prison corrections officer reported being exposed on his face and in his mouth to an inmate's visibly bloody spit and sought workers' compensation for HCV infection [68].

A police officer, who was bitten by an HIV-positive patient while trying to restrain him in a hospital emergency department, filed a claim against the hospital for negligent infliction of emotional distress [69].

A police officer who reported being exposed to blood while assisting crime victims and apprehending a suspect sought workers' compensation payment for his emergency department blood testing [70].

An evidence room technician, who reported that she had been stuck on several occasions while logging in used needles that were collected as police evidence, filed a workers' compensation claim for her HCV infection [71].

A postal worker who was stuck by a needle sticking out of an envelope filed a claim against the nurse who had obtained and packaged the specimen and against the company to which it was being mailed [72].

A transporter, who claimed that she was exposed to bloody specimen samples while transporting them from a medical center to a laboratory, filed a claim against the medical center for negligent infliction of emotional distress [73].

A hotel busboy who reported being stuck by a sharp device wrapped in a napkin by a diabetic customer (who had used the device to check his blood sugar) filed a claim for emotional distress based on his fear of contracting AIDS [74].

Airplane baggage handlers, who reported being exposed to blood from an HIV-positive individual while unloading a bag containing the individual's blood specimen, sought compensation for negligent infliction of emotional distress [75].

A quality assurance engineer, who examined Foley (urinary) catheters that had been used in patients, contracted HCV infection and sought workers' compensation coverage for the infection [76].

A store employee, who was exposed to blood and bloody feces from an HIV-infected store shopper, sought workers' compensation payment for her postexposure medical evaluation and treatment [77].

A worker at a state mental facility reported having workplace exposures to the blood of facility residents and filed a workers' compensation claim for his HBV infection [78].

An attendant at a state school who cared for children with HBV infection developed this infection and filed a workers' compensation claim [79].

A school teacher, who was bitten by an 8-year-old, HIV-positive student while trying to restrain the student, brought a claim for infliction of emotional distress against the school board and several school administrators [80].

This list of cases is not all inclusive, but it provides additional indicators of situations for such exposures. The legal cases often point to common problem areas in prevention, educational needs, and medical management of exposures among community workers.

Regulatory issues

A number of regulations at the federal, state, and local levels are potentially applicable to blood-borne pathogen exposures in community workers. These regulations include the OSHA Bloodborne Pathogen Standard [27], state OSHA plan regulations, state workers' compensation laws, state health and safety regulations, transportation laws for medical waste, and state and local medical and municipal waste laws. Employers must ascertain which of these regulations are applicable to them. The OSHA Bloodborne Pathogen Standard is relevant to most of the occupations addressed in this article.

OSHA Bloodborne Pathogen Standard

The OSHA Bloodborne Pathogen Standard, promulgated in 1991, requires that: (1) HBV vaccine be made available to all workers who are at risk for occupational HBV exposure; (2) written exposure-control plans be developed by covered employers; (3) engineering and work practice exposure controls be implemented by covered employers; and (4) exposed workers receive annual training in prevention of blood-borne pathogen exposure [27]. On November 6, 2000, the Needlestick Safety and Prevention Act was signed into public law [81]. This legislation mandated specific revisions to OSHA Bloodborne Pathogen Standard, including a requirement that, in workplaces with a risk for percutaneous exposures to blood or other body fluids, a sharp-instrument injury log be kept in addition to the OSHA Log and Summary of Occupational Injuries and Illnesses (Form 200). This sharp-instrument injury log must include detailed information on the injury, including the type and brand of device involved in the incident, the department or work area where the exposure incident occurred, and an explanation of how the incident occurred.

Many employers mistakenly believe that the OSHA Bloodborne Pathogen Standard is limited to healthcare settings. The standard applies to all covered workplace settings where occupational exposures to blood and other potentially infectious material may be anticipated. OSHA has issued citations for Bloodborne Pathogen Standard violations in non-healthcare settings, including hotel, motel, retail, and waste disposal industries (A. Hogan, personal communication, 2002). The most frequent violations cited in these community settings were failure to have a written exposure plan, failure to provide employee training or PPE, or failure to implement a HBV vaccination program.

Exposure management

Managing exposures to contaminated blood and body fluids requires a concerted effort among the employer, employee, and medical provider. The employer must be aware of and comply with applicable laws and regulations. Employers of community workers who have the potential for blood-borne pathogen exposure must deal proactively with this requirement. Community workers at risk should take advantage of training, vaccination programs, and PPE provided by their employer. Employees should report all exposure incidents to their employer.

Medical providers should be aware that occupational exposures to blood and body fluids occur outside the healthcare setting and should be knowledgeable about how to manage such exposures. The medical evaluation and treatment of community workers who are exposed to blood-borne pathogens are the same as is recommended for healthcare workers [4]. There are a number of unique issues for community workers, however, such as difficulties in implementing a medical management program to provide timely and appropriate postexposure assessment and medical management and difficulties in assessing the magnitude of risk from an exposure, because assessment typically involves an unknown source and a question of viability of the pathogen.

Exposure prevention

Innovative approaches and techniques may be required to prevent blood-borne pathogen exposures in community settings. Further information related to the number and nature of such exposures and related to the potential for exposures is needed to assist in the development of such approaches and techniques.

The necessity for meeting the educational needs of workers and management is indicated by failures to provide and use appropriate PPE and to promptly report and assess potential exposures. Some organizations have developed educational tools and sample exposure-control plans. The National Education Association developed a sample exposure-control plan and educational materials for school workers. Other professional associations and labor unions should consider developing similar information.

Communities may want to tackle the issue of proper disposal of syringes that are used for legitimate medical reasons outside of healthcare settings and by drug users. Options may include initiating syringe-exchange programs or providing syringe-disposal containers in locations that are frequented by drug users.

The following CDC recommendations for healthcare settings can be applied to community settings: (1) Organizations should make available to their employees a system that includes written protocols for prompt reporting, evaluation, counseling, treatment, and follow-up of occupational exposures that might pose a risk for infection with a blood-borne pathogen; (2) personnel should be educated about the risk for and prevention of blood-borne infections, including the need to be vaccinated against HBV; and (3) any person who performs tasks involving contact with blood, blood-contaminated body fluids, other body fluids, or sharp instruments should be vaccinated against HBV [4].

Available information indicates that workers in a variety of community settings are at risk for occupational exposure to blood-borne pathogens. Further research is needed to define the scope of the problem and to develop effective preventive strategies and educational programs. Lessons learned from exposure of healthcare workers may provide guidance in the community setting. Interventions in the community setting may include increasing rates of HBV vaccination, improving reporting of exposures, and implementing more effective engineering and work practice controls.

Needle-exchange programs

Creating safe disposal options for syringes and other sharp instruments used in community settings is the primary means of preventing disease transmission

through incidental needlestick injuries. Although the problem includes the disposal of syringes used in home-care settings, controversy surrounds syringes that are used by drug users. Syringe-exchange programs, in which used needles are exchanged for new sterile needles in retail pharmacies or in the community, may offer a solution. Not all community leaders and members of the general public are convinced that this option is acceptable, however.

Individuals who support syringe-exchange programs argue that the programs provide a mechanism for drug users to safely dispose of used syringes [82]. Injection drug users account for one fourth of the AIDS cases and half of the HCV cases in the United States [83,84]. Syringe-exchange programs can reduce sharing and reuse of needles and do not increase the number of people who inject drugs, the number of injections, or the number of syringes discarded on the street [85–87]. These programs often offer a range of prevention and care services, such as HIV and AIDS counseling and education, referrals to drug treatment programs, onsite HIV testing, and screening for tuberculosis, HBV, and HCV [82,88]. Obtaining sterile syringes from retail pharmacies has several benefits: Privacy is ensured for injection drug users who do not want to be identified as drug users, and purchasers must pay for their own syringes instead of using public funds [89].

Individuals who are against syringe-exchange programs often fear and have negative attitudes about drug use and injection drug users [84]. Many believe that these programs encourage drug use and drug traffic and increase the number of discarded syringes, especially on the street [82,85]. The public health goal of drug treatment and access to sterile syringes is often at odds with the law enforcement goals of preventing and punishing the distribution and sale of illicit drugs [90]. Some injection drug users do not want to be identified as drug users and may not participate in the programs [84]. Retail pharmacies are reluctant (and often are forbidden by a variety of laws, regulations, and pharmacy practice policies) to accept used syringes because of concern that the number of used syringes that are discarded in public places will increase, that drug-related crime will increase, and that their personal or customer safety will be compromised [82,89,90]. Syringe-exchange programs do not resolve the underlying problem of drug abuse [87].

The complex issue of using syringe-exchange programs to increase disposal options for drug users should be addressed in community settings. The public health benefit of comprehensive drug treatment programs should be weighed against the community and law enforcement concerns about the use of illicit drugs.

References

[1] Centers for Disease Control and Prevention. Recommendations for prevention of HIV transmission in healthcare settings. MMWR Morb Mortal Wkly Rep CDC Surveill Summ 1987;36:1–18.

[2] Centers for Disease Control and Prevention. Update: universal precautions for prevention of transmission of HIV, HBV & other bloodborne pathogens in health-care settings. MMWR Morb Mortal Wkly Rep CDC Surveill Summ 1988;37:377–88.
[3] Bond WW, Favero MS, Peterson NJ. Survival of hepatitis B virus after drying and storage for one week [letter]. Lancet 1981;1:550–1.
[4] Centers for Disease Control and Prevention. Updated Public Health Service guidelines for the management of occupational exposures to HBV, HCV and HIV and recommendations for post-exposure prophylaxis (PEP). MMWR Mor Mortal Wkly Rep CDC Surveill Summ 2001;50:1–52.
[5] Werner BG, Grady GF. Accidental hepatitis B surface antigen positive inoculations: use of e antigen to estimate infectivity. Ann Intern Med 1982;97:367–9.
[6] Favero MS. Sterilization, disinfection and antisepsis in the hospital. In: Lennette EH, Balows A, Hausler WJ, Shadomy HJ, editors. Manual of clinical microbiology. 4th edition. Washington, DC: American Society for Microbiology; 1985. p. 129–37.
[7] Pattison CP, Boyer KM, Maynard JE, Kelly PC. Epidemic hepatitis in a clinical laboratory: possible association with computer card handling. JAMA 1974;230:854–7.
[8] Alter MJ. The epidemiology of acute and chronic hepatitis C. Clin Liver Dis 1997;1:559–68.
[9] Davis GL, Lau JYN. Hepatitis C. In: Haubrich WS, Schaffner F, Berk JE, editors. Gastroenterology. 5th edition. Philadelphia: WB Saunders; 1995. p. 2082–114.
[10] Lanphear BP, Linnemann Jr CC, Cannon CG. Hepatitis C virus infection in healthcare workers: risk of exposure and infection. Infect Control Hosp Epidemiol 1994;15:745–50.
[11] Mitsui T, Iwano K, Masuko K. Hepatitis C virus infection in medical personnel after needlestick accident. Hepatology 1992;16:1109–14.
[12] Puro V, Petrosillo N, Ippolito G. Italian study group on occupational risk of HIV and other bloodborne infections: risk of hepatitis C seroconversion after occupational exposure in healthcare workers. Am J Infect Control 1995;23:273–7.
[13] Davis GL, Lau JY-N, Urdea MS. Quantitative detection of hepatitis C virus RNA with a solid-phase signal amplification method: definitely of optimal conditions for specimen collection and clinical application in interferon-treated patients. Hepatology 1994;19:1337–41.
[14] Bell DM. Occupational risk of human immunodeficiency virus infection in healthcare workers: an overview. Am J Med 1997;102(suppl):9–14.
[15] Centers for Disease Control and Prevention. Update: human immunodeficiency virus infections in health-care workers exposed to blood of infected patients. MMWR Morb Mortal Wkly Rep CDC Surveill Summ 1987;36:285–9.
[16] Fahey BJ, Koziol DE, Banks SM, Henderson DK. Frequency of nonparenteral occupational exposures to blood and body fluids before and after universal precautions training. Am J Med 1991;90:145–53.
[17] Henderson DK, Fahey BJ, Willy M. Risk for occupational transmission of human immunodeficiency virus type 1 (HIV-1) associated with clinical exposures: a prospective evaluation. Ann Intern Med 1990;113:740–6.
[18] Chirali IZ. Cupping therapy: traditional chinese medicine. London: Churchill Livingstone; 1999.
[19] Kent GP, Brondum J, Keenlyside RA, LaFazia LM, Scott HD. A large outbreak of acupuncture-associated hepatitis B. Am J Epidemiol 1988;127:591–8.
[20] Stryker WS, Gunn RA, Francis DP. Outbreak of hepatitis B associated with acupuncture. J Fam Pract 1986;22:155–8.
[21] Sun CA, Chen HC, Lu CF. Transmission of hepatitis C virus in Taiwan: prevalence and risk factors based on a nationwide survey. J Med Virol 1999;59:290–6.
[22] Vittecoq D, Mettetal JF. Acute HIV infection after acupuncture treatments. N Engl J Med 1989;320:250–1.
[23] Department of Health and Human Services, Food and Drug Administration. Medical devices: reclassification of acupuncture needles for the practice of acupuncture, final rule. Federal Register 1996;61:64616–7.
[24] National Institute for Occupational Safety and Health (NIOSH). Hazard evaluation and technical

assistance report: Dallas Institute of Acupuncture and Oriental Medicine, Dallas, TX. Cincinnati, OH: US Department of Health and Human Services, US Public Health Service, CDC; 2001. p. 1–16. NIOSH HETA report no. 2000–0341–2839.
[25] Nakashima K, Kashiwagi S, Hayashi J, Noguchi A, Hirata M, Ikeda S, et al. Low prevalence of hepatitis C virus infection among hospital staff and acupuncturists in Kyushu, Japan. J Infect 1993;26:17–25.
[26] Weber AM. Evaluation of potential bloodborne pathogen exposures among body piercers. Appl Occup Environ Hyg 2001;16:925–35.
[27] U.S. Department of Labor, Occupational Safety and Health Administration (OSHA). Occupational exposure to bloodborne pathogens: final rule. Federal Register 1991;56:64004–182.
[28] Long GE, Rickman LS. Infectious complications of tattooing. Clin Infect Dis 1994;18:610–9.
[29] Thompson SC, Goudey RE, Breschkin AM, Carnie J, Catton M. Exposure to hepatitis B and C of tattooists in Victoria in 1984. J Viral Hepat 1997;4:135–8.
[30] Tope WD. State and territorial regulation of tattooing in the United States. J Am Acad Dermatol 1995;32:791–9.
[31] Environmental Protection Agency (EPA). Medical waste. Available at: http://www.epa.gov/epaoswer/other/medical/. Accessed April 5, 2002.
[32] Leese KE, Cole EC, Jensen PA. Assessment of blood-splash exposures of medical waste treatment workers. J Environ Health 1999;61:8–11.
[33] Weber AM, Boudreau Y, Mortimer VD. A tuberculosis outbreak among medical waste workers. J Am Biological Safety Assoc 2000;5:70–88.
[34] State and Territorial Association on Alternative Treatment Technologies (STAATT). Technical assistance manual: state regulatory oversight of medical waste treatment technologies. a report of the state and territorial association on alternative treatment technologies. Palo Alto, CA: EPRI; 1998.
[35] Centers for Disease Control and Prevention. Syringe disposal. Available at: http://www.cdc.gov/idu/facts/aed_idu_dis.htm. Accessed April 18, 2002.
[36] Lurie P, Jones TS, Foley J. A sterile syringe for every drug user injection: how many injections take place annually, and how might pharmacists contribute to syringe distribution? J Acquir Immune Defic Syndr 1998;18(suppl):S45–51.
[37] Agency for Toxic Substances and Disease Registry (ATSDR). The public health implications of medical waste: a report to Congress. Atlanta: US Department of Health and Human Services, Public Health Service, ATSDR; 1990.
[38] Turnberg WL, Frost F. Survey of occupational exposure of waste industry workers to infectious waste in Washington State. Am J Public Health 1990;80:1262–4.
[39] Cimino JA. Health and safety in the solid waste industry. Am J Public Health 1975;65:38–46.
[40] Freyer FJ. Group ponders safe disposal of needles. The Providence Journal-Bulletin 2001; May 14.
[41] Pagane J, Chanmugam A, Kirsch T, Kelen GD. New York City police officers incidence of transcutaneous exposures. Occup Med (Lond) August 1996;46:285–8.
[42] Hoffman RE, Henderson N, O'Keefe K, Wood RC. Occupational exposure to human immunodeficiency virus (HIV) infected blood in Denver, Colorado police officers. Am J Epidemiol 1994;139:910–7.
[43] Lorentz J, Hill L, Samimi B. Occupational needlestick injuries in a metropolitan police force. Am J Prev Med 2000;18:146–50.
[44] Clark-Burton N, Boudreau Y. Assessment of a sheriff's office evidence drying room. Appl Occup Environ Hyg 2000;15:321–3.
[45] US Postal Service. Domestic mail manual section C042: hazardous materials—section 8.0: etiologic agent preparation, clinical specimens and biological products. 1993;46.
[46] Turnberg WL. United States Postal Service: mailability of sharps and other used medical devices. Med Waste Anal 1994;2:1–6.
[47] National Institute for Occupational Safety and Health (NIOSH). Hazard evaluation and technical assistance report: US Postal Service, New Jersey international and bulk mail center, Jersey City, NJ. Cincinnati, OH: US Department of Health and Human Services, US Public Health Service, CDC; 1994. p. 1–13. NIOSH HETA report no. 93–1041–2439.
[48] Blake SM. Factors associated with occupational exposure and compliance with universal precautions in an urban school district. Health Educ Behav 1999;26:734–50.
[49] American Academy of Pediatrics. Issues related to human immunodeficiency virus transmission in schools, child care, medical settings, the home, and community. Pediatrics 1999;104: 318–24.
[50] Hessl SM. Police and corrections. Occup Med 2001;16:39–49.
[51] Brautbar N, Navizadeh N. Sewer workers: occupational risk for hepatitis C—report of two cases and review of literature. Arch Environ Health 1999;54:328–30.
[52] Gershon RR. Occupational risk of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus infections among funeral service practitioners in Maryland. Infect Control Hosp Epidemiol 1995;16:194–7.
[53] Ind JE, Jeffries DJ. Needlestick injury in clothing industry workers and the risks of blood-borne infection. Occup Med 1999;49:47–9.
[54] Williams NR. Needlestick and sharps injuries in hygiene service engineers. Occup Med 1993;43:132–4.
[55] Keith MM. Identifying and prioritizing gaming workers' health and safety concerns using mapping for data collection. Am J Ind Med 2001;39:42–51.
[56] Crane v State of Washington, 13 P.3d 642 (Wash Ct App 2000).
[57] Dunlap v Levine, No. 0479B (NY App Div 2000).
[58] Castro v New York Life Insurance Company, 588 NYS2d 695 (NY Sup Ct 1991).
[59] Sanders v State of Washington, Wash App LEXIS 150 (1997).
[60] Doe v Hi-Stat Manufacturing Company, Lexis 1743 (Ohio App 2001).
[61] Lowhorn v Carle Foundation Hospital, 95 WC 02674 (Ill Ind Comm 2000).
[62] Browning-Ferris Industry of PA, Inc. v WC Appeal Board, 617 A.2d 846 (PA 1992).
[63] DiMilio v Schrager, 666 A2d 627 (NJ 1995).
[64] Rosas v WC Appeal Board, 20 Cal Rptr 2d 778 (1993).
[65] Sprague v City of Lafayette, 635 So 2d 603 La App 3rd Cir (1994).
[66] Marchica v Long Island Railway Company, 31 F 3d 1197 2nd Cir (1994).
[67] Arkansas Dept. of Corrections v Holybee, 878 SW2d 420 (Ark 1994).
[68] SCI Waymart v Workers' Compensation Appeal Board, PA. Commonw LEXIS 707 (2000).
[69] Johnson v West Virginia Univ. Hosp., 413 SE2d 889 (W Va 1991).
[70] Williams v City of Rawlins, 2 P.3d 543 Wyoming (2000).
[71] Sparks v Delray Beach Police Dept. Fla (1997).
[72] Kaufman v Physical Measurements, Inc., 615 NYS2d 508 (1994).
[73] Madrid v Lincoln City Medical Center, 909 P 2d 14 (NM 1995).
[74] Heilman v Microsoft Corp., No 98–3202 (ED La 1999).
[75] Roes v FHP, Inc., 985 P 2d 661, 91 Haw 470 (1999).
[76] Muir v C.R. Bard, Inc., 519 SE2d 583, 336 SC 266 (1999).
[77] K-Mart v Evenson, 1P.3d 477 (2000).
[78] Neier v State of Illinois, Dept. of Mental Health, Howe Development Center (Ill Ind Comm 1996).
[79] Enid State School v Mitchell, 590 P2d 1179 (Ok 1978).
[80] Colona v Accomack County School Board, 52 Va Cir 421 (2000).
[81] U.S. Congress. Needlestick Safety and Prevention Act; 2000. Public Law 106–430. HR5178.
[82] Centers for Disease Control and Prevention. A comprehensive approach: preventing blood-borne infections among injection drug users: appendix A. Available at: http://www.cdc.gov/idu/pubs/ca/appendixA.htm. Accessed April 17, 2002.
[83] Centers for Disease Control and Prevention. HIV/AIDS Surveillance Report. 2001;13:12.
[84] Centers for Disease Control and Prevention. Access to sterile syringes. Available at: http://www.cdc.gov/idu/facts/aed_idu_acc.htm. Accessed April 18, 2002.
[85] Doherty MC, Garfein RS, Vlahov D, Junge B, Rathouz PJ, Galai N, et al. Discarded needles do

not increase soon after the opening of a needle exchange program. Am J Epidemiol 1997;145: 730–7.
[86] Heimer R, Khoshnood K, Bigg D, Guydish J, Junge B. Syringe use and reuse: effects of syringe exchange programs in four cities. J Acquir Immune Defic Syndr 1998;18(suppl):S37–44.
[87] Normand J, Vlahov D, Moses LE. Preventing HIV transmission: the role of sterile needles and bleach. Washington, DC: National Academy Press; 1995.
[88] Centers for Disease Control and Prevention. Syringe exchange programs. Available at: http://www.cdc.gov/idu/facts/aed_idu_syr.htm. Accessed April 18, 2002.
[89] Centers for Disease Control and Prevention. Pharmacy sales of sterile syringes. Available at: http://www.cdc.gov/idu/facts/aed_idu_phar.htm. Accessed April 18, 2002.
[90] Centers for Disease Control and Prevention. Policy efforts to increase IDU's access to sterile syringes. Available at: http://www.cdc.gov/idu/facts/aed_idu_pol.htm. Accessed April 18, 2002.

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