Bacterial and viral contamination of reusable sharps containers in a community hospital setting

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Background: Proper disposal of sharps in the clinical setting is a key factor in infection control. Previous research studies suggest that reprocessed, reusable medical devices and infectious waste containers are potential sources of microorganisms capable of causing infection in immunocompromised patients. This pilot study was a single-center, prospective, hospital-based, microbiologic evaluation of reusable sharps disposal containers returned to the hospital from a reprocessing company.

Methods: A New England area, 130-bed community hospital performed the evaluation. Following delivery to the hospital's shipping/receiving area, 30 newly processed, reusable sharps disposal containers were swabbed for the presence of bacteria and viruses.

Results: Twenty-seven containers (90%) tested positive for bacteria, and 10% of the recovered isolates were gram-negative rods. Nine out of 30 (30%) cultures were positive for viruses: HIV (10%), hepatitis A (6.7%), hepatitis B (6.7%), and hepatitis C (13.3%), and several containers tested positive for multiple viruses and bacteria.

Conclusion: Reusable sharps containers were returned to this medical facility with bacterial and viral contamination. Further testing is warranted to determine the scope of the problem and potential clinical implications. (Am J Infect Control 2007;35:527-30.)

Health care-associated infections (HAIs) are infections acquired by patients during the course of receiving treatment for medical conditions, or infections acquired by health care workers while performing their duties in a health care setting.[1] Occupational exposure to bloodborne pathogens such as Human Immunodeficiency Virus (HIV), hepatitis A virus (HAV), hepatitis B virus (HBV), hepatitis C virus (HCV), and bacteria poses a significant risk to health care workers who suffer substantial morbidity, mortality, and increased health care costs from occupationally acquired infections.[2] In the United States, HAIs affect approximately 2 million people, result in 90,000 deaths, and cost $4.5 billion in excess health care costs annually.[1] Proper disposal of sharps (needles, syringes, and others) in the clinical setting is a critical component of occupational and patient safety.

Choices for sharps disposal include single-use sharps containers and reusable sharps containers. Under a single-use policy, health care facilities dispose of full sharps containers and replace them with new containers. An alternative to the single-use approach is offered by companies that provide reusable sharps containers. These companies supply the health care facility with reusable containers that are routinely exchanged with reprocessed containers obtained from various health care facilities. The success of this type of program depends primarily on the reliability of the sharps disposal company and the quality of its service.[3] If not properly disinfected before reintroduction into the medical facility, reusable sharps containers represent a potential risk for bacterial and viral contamination.

Previous research has shown the potential for contamination of reprocessed waste containers. In the *Association for Professionals in Infection Control and Epidemiology's* article "Investigation of Single-Use Versus Reusable Infectious Waste Containers as Potential Sources of Microbial Contamination," a systematic study of the microbes present on reusable infectious waste containers versus single-use containers was undertaken.[4] Upon delivery, 10% of single-use infectious waste containers were contaminated with bacteria or fungi as compared with greater than 99% of reusable infectious waste containers. Most of the bacteria and fungi present on the reusable containers were normal environmental or skin flora, but some of the cultures showed microorganisms that pose potential harm to patients with compromised immunity. Infection rates in the burn patients in this study decreased significantly from 5.8 to 3.2 infections per 100 patients

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after instituting changes to decrease the microbial transfer to patients from reusable infectious waste containers.[4]

For an infection to occur, microorganisms must be transferred from a reservoir to a susceptible host. In the hospital setting, the reservoir may include patients themselves, health care workers, tap water, soap dispensers, waste containers, and other environmental factors. Indirect transmission is the most common method of transfer of HAI and involves a mechanical transfer of the agent on the hands of a health care worker to a susceptible patient. Alternatively, contaminated inanimate objects such as work surfaces or shared medical devices may act as fomites for the spread of infection.[5]

Universal precautions are a systematic approach applied by health care workers to reduce the spread of infection from reservoir to host and minimize the risk of occupationally acquired infections.[2] Universal precautions may involve barrier protection (eye protection, gowns, gloves, shoe covers, and/or patient barriers) in conjunction with handwashing to prevent exposure to potentially infectious mediums. Unfortunately, numerous studies reveal that compliance with universal precautions has not been achieved.[2,6,7] A study by Kelen et al found only a 44% compliance rate with a comprehensive barrier protection approach by health care workers caring for critically ill and emergency department patients.[7]

Low compliance with universal precautions suggests a need for constant vigilance and education of the health care worker, combined with a comprehensive approach to identifying sources of infection. The clinical microbiology laboratory plays a pivotal role in the identification and control of HAI.[5] By identifying pathogens and their susceptibility, microbiology provides the tools needed to localize the source and control the spread of infection. In this way, the clinical microbiology laboratory partners with the infection control professional who performs surveillance, provides education, and revises protocols in an effort to minimize the incidence of costly HAI. The purpose of the study was to determine whether reusable sharps containers returned to the hospital from a reprocessing company were returned ''post-cleaning'' with HIV, HAV, HBV, HCV, and/or bacteria.

METHODS

Design

This study was a single-center, prospective, hospital-based, microbiologic evaluation of reusable sharps disposal containers returned to the hospital from a reprocessing company.

Setting

The study was conducted at a New England area, 130-bed community hospital (hospital name withheld at facility's request). All cultures for this study were collected on June 23, 2005, by an infection control nurse employed at the hospital.

Materials

The site was provided with 30 bacterial culture swabs, 30 polymerase chain reaction (PCR) swabs, preprinted requisitions for submission of specimens to the central laboratory, and an overnight air shipping container to deliver the specimens to the central laboratory.

Culture collection

The infection control nurse swabbed containers that were recently reprocessed and delivered to the loading dock at the facility. All containers present on the day of culture collection were swabbed. Sterile technique (including the use of hemostats to swab inside the containers) was used to ensure that contamination was not introduced during collection of the samples. Bacterial and PCR swabs were collected on each container.

Bacterial swab. The bacterial swab was removed from its packaging and the tip was moistened with a drop of sterile, nonbacteriostatic saline. The infection control nurse swabbed the lid, inside surface area, and outside surface area. The swab was then inserted into its transport tube, labeled, and prepared for shipment.

PCR swab. The swab was removed from its sample container with a hemostat and moistened with DNA/RNA free water. After ringing the entire lid, inside surface area, and outside surface area of each container, the swab was returned to its holding tube, labeled, and secured for shipment.

This process was repeated for all 30 reusable sharps disposal containers. The details of the types of containers cultured are listed in Table 1. Specimens and requisitions were packaged in International Air Transport Association compliant shipping containers for overnight delivery to the accredited, independent microbiology laboratory for analysis (North Coast Clinical Laboratory, Inc., Sandusky, OH).

Aerobic and anaerobic bacterial cultures were performed on bacterial swabs obtained from each reusable sharps container. PCR analysis for viruses was performed by Research Think Tank, Inc. (Atlanta, GA), a privately owned, diagnostic, clinical trial, basic research facility. The PCR detection for HIV, HAV, HBV,

Table 1. Details of containers cultured

Description of container	Number of containers cultured
0.5-Gallon reusable sharps container	1
1-Gallon reusable sharps container	7
3.5-Gallon reusable sharps container	17
8-Gallon reusable sharps container	4
Reusable lids and caps	1

and HCV was performed on swabs obtained from each reusable sharps container.

RESULTS

Bacterial data

Of the 30 cultures collected, 27 (90%) tested positive for the presence of bacteria. Table 2 details the presence of bacteria recovered from these containers. Enterobacter and Escherichia (gram-negative rods) were isolated from 10% of the containers. Three containers (10%) showed no growth at 5 days.

Viral data

The PCR analysis for HIV, HAV, HBV, and HCV revealed that 9 of the 30 cultures collected (30%) tested positive for the presence of viruses. All viruses targeted in this investigation were recovered. Table 3 reports the viruses isolated from the containers.

Qualitative data

Several observations were made during collection of the cultures. Soiled gauze, dried blood, and used gloves were found adhered to the sides of several cleaned containers. A biohazard bag filled with used syringes was found inside an 8-gallon container. The infection control nurse stated that these were not the type of syringes used at the hospital and therefore could not have been placed in the container after delivery. Trash was found inside one of the containers (labels containing the name of another hospital, napkins, and papers). The inside and outside of the reusable sharps containers were soiled.

DISCUSSION

The fact that 90% of the cultures tested positive for bacteria is not unexpected. Normal skin and environmental flora are abundant in the environment, and complete sterility is not the goal or claim of reprocessing companies. In fact, the sharps containers (pre- and postreprocessing) are transported in trucks without sealed outer coverings and are stored in loading docks and other nonsterile, uncontrolled areas.

Table 2. Bacteria isolated from reprocessed sharps containers

Isolate	Number of containers positive for isolate	Percentage of containers positive for isolate
Bacillus species	24	80%
Acinetobacter lwoffi	2	6.6%
Enterobacter agglomerans	2	6.6%
Acinetobacter baumannii	1	3.3%
Escherichia vulneris	1	3.3%
Staphylococcus epidermidis	1	3.3%
Staphylococcus hominis	1	3.3%

Table 3. Viruses isolated from reprocessed sharps containers

Virus	Number of containers positive for virus	Percentage of containers positive for virus
HCV	4	13.3%
HIV	3	10%
HAV	2	6.7%
HBV	2	6.7%

Five of the 7 isolates found on the containers can be considered normal environmental flora. However, concern develops around the 3 containers with isolates of Enterobacter and Escherichia. These gram-negative rods present a risk of infection to immunocompromised patients and/or health care workers with exposed nonintact skin. A thorough decontamination process would be expected to eradicate these organisms and prevent their reentry into the hospital.

Of further concern is the 30% positivity rate for known bloodborne pathogens (HIV, HAV, HBV, and HCV). There is opportunity for the reusable sharps container to function as a fomite to aid the transmission of these viruses from the surfaces of the container to an immunocompromised patient and/or patient and health care worker with an exposed break in the skin. The most unexpected findings were the multiple containers filled with used sharps, contaminated waste, paper, trash, and general dirt and grime. These findings call into question the efficiency of the emptying process prior to decontamination, as well as the decontamination process itself. Although the infection control professional at this hospital was concerned with these findings, the response of the reprocessing company to the complaint is not known.

As demonstrated in the study of infectious waste containers conducted by Neely et al, contaminated containers may result in serious infections in patients who are immunocompromised.[4] The fact that infection rates in their facility dropped from 5.8 to 3.2 per

100 burn patients after procedures were put in place to decrease the possibility of microbial transfer suggests that health care facilities utilizing reusable sharps containers should consider added precautions in areas that house immunocompromised patients.

HAIs are by far the most common complication affecting hospitalized patients.[8] One means of reducing the risk of HAI is to identify risk factors and provide some measure of infection control to mitigate them. The results of this study support cause for concern that reusable sharps containers may transmit infections in medical facilities. Risk factors that help determine the risk of exposure to such agents include the following: inoculum concentration, quantity of inoculum, duration of exposure, portal of entry, loss of infectivity during transfer, and immunologic status of both the exposed health care worker and the patient coming in contact with the exposed health care worker.[2] Although this study was not designed to investigate the clinical effect of contamination, if microorganisms are not properly eliminated from the reusable sharps disposal container, the health care provider may become a vector of transmission between the contaminated sharps container and the susceptible patient. Given the pressure on health care facilities to reduce cost and switch to reusable services, careful surveillance of infection rates may be warranted to determine the effect of implementing reusable sharps container services.

Although single-use containers are the most prevalent method of sharps disposal worldwide, the increasing presence of reprocessing companies in the United States suggests that reusable containers may become more popular in the international community as countries develop reprocessing facilities. Reusable sharps containers are already widely used in Australia and New Zealand where they are more popular than single-use containers (personal communication, Travis Stephenson of Tyco Healthcare Australia, September 26, 2006). Although this study took place in the United States, the international community may wish to conduct similar studies. Given the potential variability in quality of service, ongoing surveillance of the condition of containers as they return from reprocessing companies may be a critical component of hospital infection control.

Because it was designed as a pilot study, this trial has several shortcomings. The study was conducted at a single facility and therefore relies on the reprocessing company in this geographic area. Also, 1 swab was collected per container, making it impossible to determine the exact location of the bacteria/virus on the container. Despite this potential limitation, the exact location of the contaminant provides minimal value because the rinse water covers the inside and outside of the container. Additionally, containers are often transported and stored stacked one inside the other, thereby contaminating the outside surface of one container with the inside surface of the other. Because no matching control group of single-use containers was tested, the effect of the environment on the results cannot be elucidated. The cultures and PCR samples in this study were not intended to provide quantitative measures of organism bioburden. Future studies could assess the extent of bioburden on the incoming containers. This pilot study supports the need for larger, controlled, multicenter studies of bacterial and viral contaminants on reusable sharps containers compared with single-use containers.

In summary, bloodborne pathogens (HIV, HAV, HBV, HCV) and bacteria were present on incoming, reprocessed reusable sharps disposal containers. This pilot study validates the need to determine the risk of exposure to infectious agents for health care workers and patients in health care facilities that utilize reusable sharps disposal containers. Ongoing research will determine the scope of the problem and potential clinical implications.

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