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EPINet™ Report:

Suture Needle and Scalpel Blade Injuries

Frequent but Underreported

by Janine Jagger, M.P.H., Ph.D. and Melanie Balon, B.S.

MOST REPORTS ON PERCUTANEOUS INJURIES among health care workers focus on hollow-bore needle devices such as syringes, blood-drawing devices, and vascular access devices. One reason is that the majority of reported percutaneous injuries in health care settings are caused by hollow-bore needles. In 58 U.S. hospitals participating in an EPINet data-sharing group from September 1992 through August 1993, hollow-bore needles accounted for 67% (2,565/3,829) of all reported percutaneous injuries.[1] Furthermore, hollow-bore needles have been most often associated with occupational transmission of bloodborne pathogens, especially HIV.[2] However, injuries that occur predominantly in the surgical setting are far less likely to be reported to a hospital authority than those that occur elsewhere in the hospital. In one prospective study, as few as 4% of percutaneous injuries or blood exposures to mucous membranes or non-intact skin that were observed in the operating room were subsequently reported to the employee health department of the hospital.[3] This finding highlights the fact that sharp instruments used in surgery are a frequent cause of percutaneous injuries but are not as well documented as other devices because data describing these injuries have been less accessible.

Suture needles and scalpel blades are the two most common non-hollow-bore devices causing percutaneous injuries in hospitals, together accounting for 17% of all reported injuries in one 58-hospital study.[1] Since most of these injuries occurred in the operating room, where only a fraction of injuries are reported, their true frequency is much higher. Despite the high number of injuries, few instances of occupational infection have been directly linked to suture needles and scalpel blades. This may be because the high frequency of undocumented injuries makes it difficult to link an infection to a specific exposure. Additionally, pathogen transmission rates may be related to the viral titer in the blood of the source patient and the amount of inoculum introduced into the wound. The quantity of blood inoculum introduced by a suture (solid) needle has been shown to be significantly less than that introduced by a blood-filled hollow-bore needle.[4]

One case of HIV transmission following a scalpel blade injury has been documented in Italy [personal communication, Dr.

Suture Needles and Scalpel Blades (cont.)

G. Ippolito]. There are at least four cases of possible occupational HIV transmission in the literature, in which multiple percutaneous injuries and blood exposures were recalled while working in surgical settings in high HIV-prevalence areas.[5] The four cases do not provide evidence of HIV transmission by suture needles or scalpel blades, but the possibility that they may have been transmission vehicles or caused a wound that permitted viral penetration in one or more of these cases must be considered.

The localized transmission of tuberculosis to the hands of pathologists who sustained scalpel injuries during the performance of autopsies was common enough early in this century to be referred to as "prosector's finger."[6] The problem has not been eliminated and can be compounded by the potentially grave consequences of infection with a resistant strain of tuberculosis.[7]

A further concern is that suture needles and scalpels come into contact with the open wounds of patients, creating the additional potential risk of health-care-worker-to-patient pathogen transmission when a percutaneous injury occurs. To date, no cases of HIV transmission from operating room personnel to patients have been reported, despite large-scale look-back studies testing the serology of patients whose surgeons were HIV positive.[8] On the other hand, numerous reports document the transmission of HBV from operating room personnel to patients.[9] The specific exposure mechanisms in these cases were not determined, although inadequate barrier precautions were cited as a contributing factor in several cases.

In order for a patient to be exposed to the blood of a health care worker, the worker must first sustain an injury from a sharp instrument, and then the contaminated instrument must recontact the patient, or the worker must bleed directly into the patient's wound. It is necessary to determine

Figure 1. Job Categories of Workers Reporting Injuries with Suture Needles and Scalpel Blades

EPINet, 9 hospitals, 2 years, cases = 660

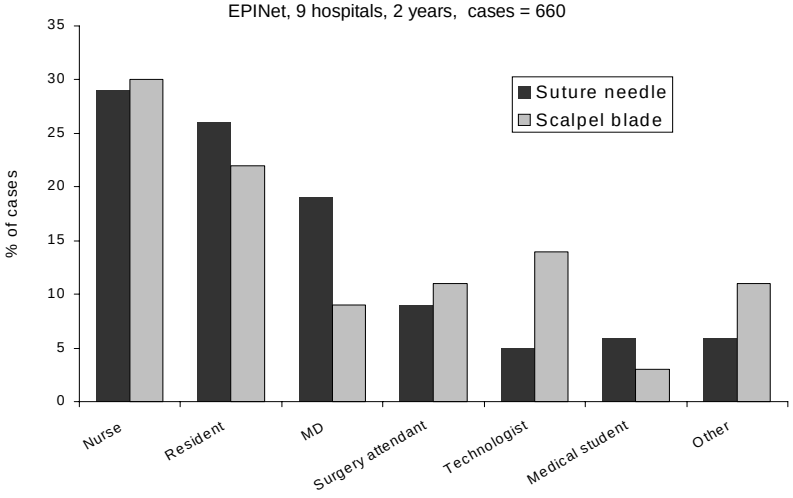

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Figure 2. Location of Workers Reporting Injuries with Suture Needles and Scalpel Blades

EPINet, 9 hospitals, 2 years, cases = 660

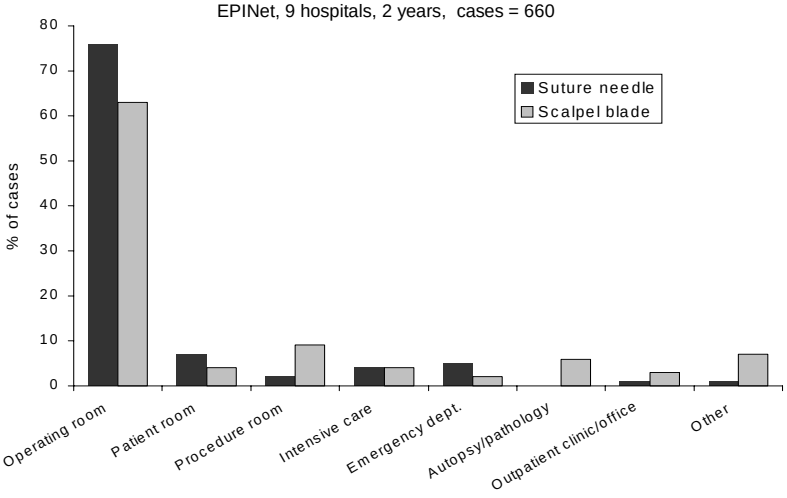

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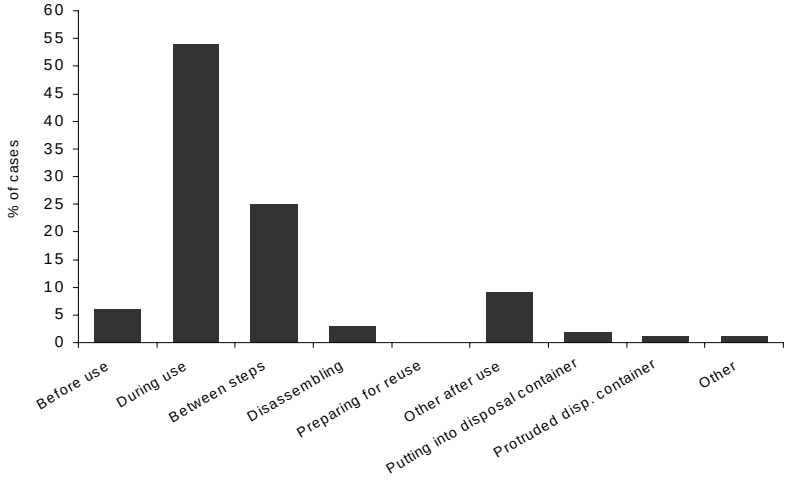
Figure 3. Mechanism of Suture Needle Injuries

EPINet, 9 hospitals, 2 years, cases = 389



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the probability of this sequence of events in order to estimate the risk of bloodborne pathogen transmission from health care worker to patient. Two observational studies reported the proportion of percutaneous injuries to surgical personnel in which an instrument contaminated with the worker's blood recontacted a patient. The studies found that patient recontact with the sharp instrument occurred after 20% and 24% of injuries respectively.[10,11]

Although the mechanism of injuries from suture needles and scalpel blades is similar whether the injuries occur in the operating room, emergency department, pathology, or elsewhere in the hospital, published reports based on observational methods primarily describe injuries in the operating room, and the number of recorded events in these studies is too small to evaluate device-specific patterns of occurrence.[10-12] This report will analyze the patterns of occurrence of a large number of suture needle and scalpel blade injuries reported in a nine-hospital data-sharing network in order to enhance understanding of health care worker risk when handling these sharp instruments, and to identify the most promising opportunities for minimizing the risk of pathogen transmission to health care workers and to patients.

Findings

Nine hospitals which voluntarily participate in a data-sharing network contributed data for this report [*see list at end of article*]. They are located in six states in the eastern half of the U.S. All the hospitals use the Exposure Prevention Information Network (EPINet) system for tracking both percutaneous injuries and blood and body fluid exposures in their institutions, and they report their data quarterly to the University of Virginia. The cumulative average daily census for the nine hospitals is 4,886 occupied beds. Data in this report include sharp object injuries only and were collected during a two-year period from September 1992 through August 1994. A total of 3,666 percutaneous injuries were reported in the nine hospitals during two years, including 389 (10.6%) suture needle injuries and 271 (7.4%) scalpel blade injuries. The following results will be restricted to these 660 cases.

Job categories and location of injuries

Suture needles and scalpel blades have similar injury profiles with regards to job categories of injured workers and location in which injuries occurred. In contrast to patterns noted with most other devices, physicians (including attending physicians and residents) outnumber nurses in frequency of injuries. Forty-five percent of injuries from suture needles were to attending or resident physicians, and 29% were to nurses (**Figure 1**). For scalpel blades, 31% of injuries were to physicians, and 30% were to nurses. Technologists (mainly surgical) sustained 14% of scalpel blade injuries while surgery attendants sustained 11% of scalpel injuries.

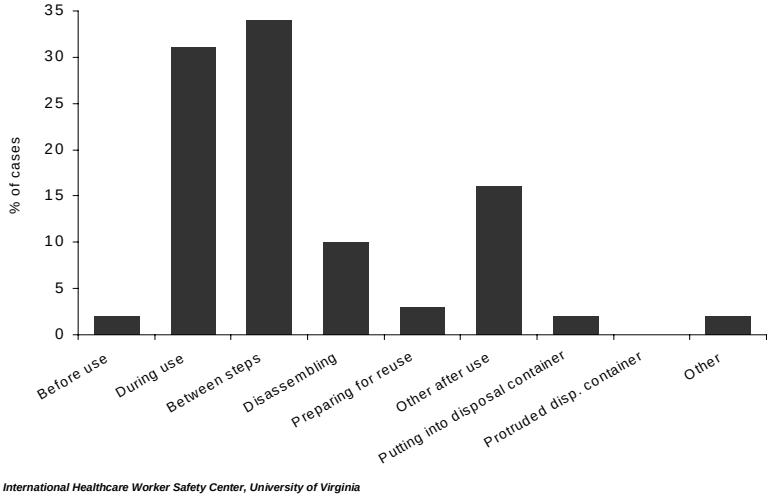
The majority of injuries occurred in the operating room: 76% of suture needle injuries and 63% of scalpel blade injuries (**Figure 2**). Outside the operating room, scalpel blade injuries occurred mainly in pathology/autopsy and in procedure rooms such as angiography and cardiac catheterization labs. Suture needle injuries outside the operating room occurred in patient rooms and emergency departments; however, despite the frequency of wound-suturing in the emergency department, only 5% of the injuries occurred there.

Mechanism of injuries

More than half (54%) of reported suture needle injuries occurred while the device was in use, that is, during suturing (**Figure 3**). This profile is in direct contrast to that of most hollowbore devices; injuries from these devices are incurred primarily after use and during disposal. Of interest was the comparison between users and non-users of suture needles. Of 213 injuries to original users of the needles, 68% of injuries were self-inflicted during suturing. Of 172 injuries to non-users of the needles (scrub nurses or assistants), 36% of injuries occurred during suturing and were inflicted by the person using the needle. This indicates that the hands of assistants are often close to needles during suturing, and are therefore highly vulnerable to injury. Twenty-five percent of all suture needle injuries occurred between steps, mainly while passing suture needles. Only 12% occurred after use or in disposal. These findings highlight the special need for needle protection not only after use of the device but during suturing and passing.

Figure 4. Mechanism of Scalpel Blade Injuries

EPINet, 9 hospitals, 2 years, cases = 271



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Suture Needles and Scalpel Blades (cont.)

A smaller proportion of injuries (34%) occurred during the use of (that is, while cutting with) scalpel blades, closer to the usual profile of injuries from hollow-bore needles (**Figure 4**, previous page). Unique to scalpel blades, however, was that more injuries occurred between steps of a procedure, such as during passing, than during any other phase of use. Scalpel blade injuries were also unique in that the injured party was less often the user (39%) than the non-user assistant (61%). Of 105 users, 45% of injuries were self-inflicted during the use of scalpels. Of 164 non-users, 22% of injuries were inflicted by users during cutting. Ten percent of all scalpel blade injuries occurred during disassembly of scalpel blades from reusable handles.

A comparison of mechanism of injury for physicians versus nurses **(Figure 5)** reflects a pattern of interaction between the two groups. Sixty-nine percent of physicians sustained injuries while cutting or suturing. Only 21% of nurses sustained injuries during cutting or suturing, and many of these injuries were inflicted by another person using the device. Only 22% of injuries to physicians occurred during passing or disassembling, while 50% of nurses sustained injuries during passing and disassembling.

If an injured worker was not the original user of the device causing the injury, and the injury occurred during cutting, suturing, or between steps such as when passing, the injury was determined to be inflicted by another worker. **Table 1** compares the percentage of injuries to nurses, resident physicians, and attending physicians that were inflicted by another worker.

The difference between attending and resident physicians in percentage of incidents inflicted by others was not statistically significant ($\chi 2=.8$, $p=.37$). The difference between all physicians and nurses, however, was statistically significant ($\chi 2=31$, $p<.0001$), with 44% of injuries to nurses related to the actions of others. This finding demonstrates the crucial role of physician-assistant interaction in injuries from suture needles and scalpel blades, and highlights the need to involve all professional groups in efforts to reduce risk of injury.

Figure 5. Mechanism of Suture Needles and Scalpel Blades Injuries: Nurses vs. Physicians

EPINet, 9 hospitals, 2 years, cases = 449

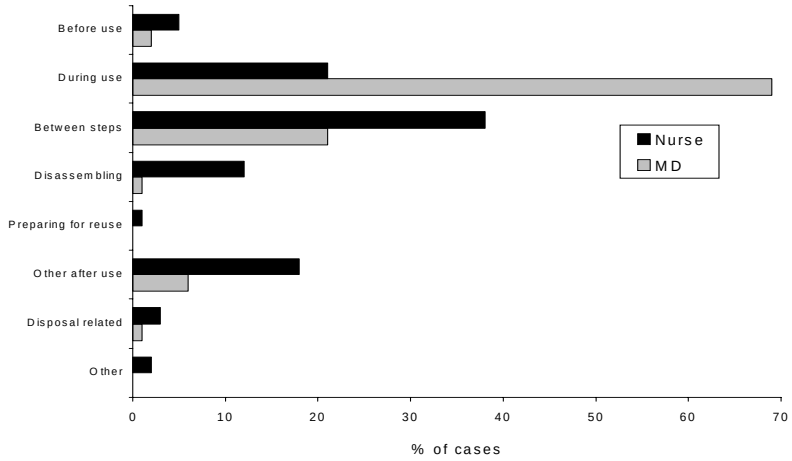

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Table 1. Percentage of Injuries From Suture Needles and Scalpel Blades Inflicted By Another Worker, By Job Category

	# in group	# injuries inflicted by other worker	% injuries inflicted by other worker
Nurses	193	85	44%
Resident MD's	160	34	21%
Attending MD's	96	16	17%

Table 2. Comparative Severity of Injuries From Suture Needles and Scalpel Blades

	suture needles # (%)	scalpel blades # (%)
superficial	202 (52%)	79 (29%)
moderate	177 (46%)	156 (58%)
severe	6 (2%)	35 (13%)

The distribution of injuries to the hands is shown in **Figures 6 and 7** (next page). For both devices together, 39% of injuries were to the right hand, and 53% were to the left hand. Although handedness was not reported in this study, the finding is consistent with a pattern previously reported in which the non-dominant hand sustained the majority of injuries from surgical instruments.[10] However, factors other than handedness also play a role in the distribution of these injuries. In particular, when the injuries occurred during the use of the instrument, while cutting or suturing, the left hand was most frequently injured. But when injuries occurred during passing, disassembly, or disposal, the discrepancy in injury frequency between the two hands was reduced; in the case of scalpel blades the pattern was reversed, with a higher frequency of injuries to the right hand. This reversed pattern may be related to hand-to-hand passing, in which the dominant hand is used for receiving instruments.

Nineteen scalpel blade injuries were not to the hands. Most of these injuries were to forearms and upper arms, and often occurred when workers inadvertently rested arms on or brushed against the instrument stand where scalpels were placed.

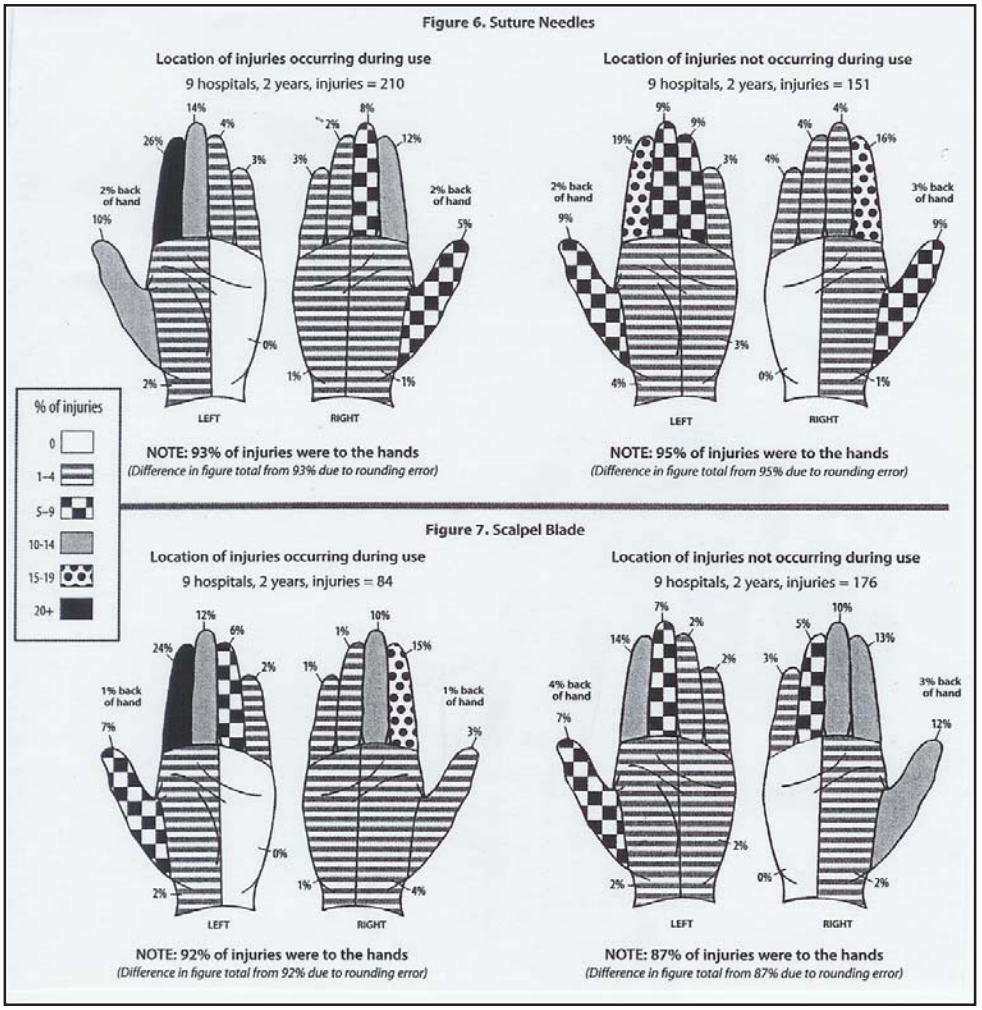
On average, scalpel blades are likely to cause more severe injuries than suture needles (**Table 2**). Fifty-two percent of suture needle injuries were classified as superficial (little or no bleeding), while only 29% of scalpel blade injuries were superficial, the remaining 71% being moderate (skin punctured, some bleeding) or severe (profuse bleeding). The difference in injury severity between the

two devices is statistically significant ($\chi 2=57.25$, $p<.0001$).

When an injury results in bleeding and the health care worker's hands are in or near the surgical site—which is the case when injuries occur during use of suture needles or scalpel blades—there is a potential risk of health care worker-to-patient pathogen transmission. Scalpel blades quences of possible infection, including post-exposure follow-up, emotional stress, and, if the source patient is the carrier of a bloodborne pathogen, changes in personal behavior until transmission can be ruled out. These injuries also have financial consequences for the institutions where they occur, which are further compounded if an infection results from an exposure.

There are many opportunities for changes in devices, procedures, and barrier equipment for reducing injury risk from suture needles and scalpel blades. One approach is to reduce the use of these sharp devices by utilizing them only when necessary. For example, using stapling devices or adhesive products for wound closure whenever possible would reduce the use of suture needles.

The integration of safety features into the designs of suture needles and scalpels is another approach. Scalpels with blade shields that can be placed in protective position during passing and after use are available. If these designs perform as they are intended to, the proportion of injuries that might potentially be prevented is large (as high as 69%), since so many scalpel blade injuries occur at times when the blade shield could be in protected position, such as when passing or during disposal. However, it is important to document actual compliance in activating the safety feature and prevention efficacy. Devices that allow the non-manual release of scalpel blades from reusable handles provide a method for reducing injury risk during disassembly of scalpels, potentially addressing 10% of scalpel blade injuries; such devices include specially designed scalpel handles that release scalpel blades, and accessory devices that mechanically remove blades from reusable handles. The use of disposable scalpels, which do not require blade removal, also have the potential to prevent disassembly-related injuries.



Blunt suture needles have recently become available that are sharp enough to penetrate internal tissues such as muscle and fascia but are not sharp enough, under normal conditions, to cause percutaneous injuries to health care workers. The potential for injury prevention depends on the proportion of tissue-suturing that can be performed with blunt needles. In response to a survey, general surgeons at the University of Virginia estimated that 33% of sutures were placed in muscle or fascia, while resident surgeons estimated 37%.[15] Although blunt suture needles cannot be used for all suturing, their potential applicability is nevertheless substantial, at least in the surgical setting, since suture needles cause more injuries in the operating room than any other device.

Changes in procedures, in particular techniques for passing instruments, have been implemented in many institutions in an effort to reduce surgical instrument injuries. Twenty-five percent of suture needle injuries and 34% of scalpel blade injuries in this study occurred between steps of a procedure, which includes passing, although the percent associated with hand-to-hand passing cannot be determined. Hands-free transfer is a technique that is applicable to the operating room and is intended to minimize collisions of hands with sharp instruments by designating a neutral zone where instruments can be placed and picked up. The neutral zone may be a small basin or other appropriate re-

Suture Needles and Scalpel Blades (cont.)

ceptacle, or a specially designed surgical drape with a recessed area for instrument placement. This technique is becoming more widespread, although controlled studies are needed to fully validate it as an effective injury-reduction method. The high proportion of injuries that occur during interaction of device users and assistants indicates the importance of cooperation among different personnel categories when implementing new procedures or techniques, such as hands-free instrument transfer.

Barrier products for the prevention of punctures and cuts to the hands are now available, such as cut-resistant gloves and puncture-resistant adhesive pads. Since these products are intended for hand protection, the issues of flexibility and touch sensitivity are of importance to users. The products are often recommended for use on hand locations where instruments are most likely to cause injuries; for example, since percutaneous injuries are most likely to be incurred by the non-dominant hand, cut-resistant gloves worn on non-dominant hands would likely have a higher efficacy than gloves worn only on dominant hands, where they might interfere with touch sensitivity or dexterity. Selective use of puncture- and cut-resistant hand protection should be carefully considered, however, because the distribution of injury locations on hands is markedly different for device users as opposed to those who are assisting users. The inappropriate placement of such barriers can greatly compromise their potential efficacy.

Finally, widespread, standardized surveillance systems are needed that document device and product involvement in blood exposures, and which also incorporate follow-up serology of exposed health care workers, so that device- and mechanism-specific transmission rates can be ascertained, not only for HIV but for HBV and HCV as well. Comprehensive surveillance systems incorporating these elements have been implemented recently in Italy, Canada, and Australia. Such systems will result in a more specific understanding of pathogen transmission as it relates to different classes of medical devices, and in the selective promotion of the most effective prevention measures for minimizing the occupational transmission of bloodborne pathogens.

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