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Injuries from Vascular Access Devices: High Risk and Preventable

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IN MAY 1996 THE CENTERS FOR DISEASE CONTROL and Prevention (CDC) published a landmark report showing that occupational exposures to human immunodeficiency virus (HIV) varied in the level of transmission risk they posed to health care workers.¹ The report identified a list of characteristics that increase HIV transmission risk, including exposures that involved: (1) a deep percutaneous injury; (2) a needle that was used for vascular access; (3) visible blood on the device causing injury, and/or (4) a

source patient with either end-stage AIDS or in the acute phase of retroviral illness (when HIV concentration in the blood is highest). These factors all suggest that HIV transmission risk increases as the amount of virus the health care worker is exposed to increases. An additional unexpected finding was that the HIV transmission risk among health care workers receiving postexposure prophylactic zidovudine (ZDV) was reduced by an es-

timated 79%. Therefore, the absence of postexposure ZDV (and possibly other anti-HIV drugs) may also be considered a risk factor for HIV transmission.

In this publication, the CDC provided an important confirmation of transmission patterns that were inferred by CDC surveillance data on health care workers with documented and possible occupational HIV

infection. As of June 1997, 166 cases had been reported in the United States by the CDC.² Although there are likely to



be many more such cases than have been identified officially by the CDC, the identified cases provide useful information. It is to be expected that nurses are the professional group most often occupationally infected by HIV because there are more nurses in the health care workplace than any other professional group (approximately 2 million), and nurses often perform procedures requiring needles.

Clinical laboratory technicians are the

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Injuries from Vascular Access Devices

professional group with the second highest number of occupational HIV infections, which requires an explanation. In the United States, phlebotomists usually are classified as laboratory technicians, and in this case, most of the injuries leading to HIV infections were associated with blood-drawing procedures. When a phlebotomist is stuck by a needle, it is most likely to be a blood-filled needle that was used for vascular access (i.e., a high-risk injury). Phlebotomists contracted about two-thirds as many HIV infections as nurses, even though there are only about one-twentieth the number of phlebotomists in the work force as nurses.³

The CDC data do not identify HIV-infected nurses who specialize in intravenous (IV) catheter placement as a separate professional group. Like phlebotomists, these nurses' occupational risk of contracting HIV, or other bloodborne pathogens, is likely to be higher than that of other nurses, because when they sustain a needlestick, it usually is caused by a blood-filled IV catheter stylet, a high-risk injury. Therefore, available epidemiologic data on occupational HIV transmission reinforce the need to identify and implement effective measures to reduce needlestick injury rates from vascular access needles. The following analysis focuses on injuries from IV catheter stylets.

EPINet Data

Nationwide data on occupational needlesticks and blood exposures in the U.S. are available for 1993, 1994, and 1995 from a network of 77 U.S. hospitals (the number of hospitals varies slightly from year to year) using a standard exposure tracking system, the Exposure Prevention Information Network (EPINet), in collaboration with researchers at the University of Vir-

Figure 1. Items Most Frequently Causing Sharp-Object Injuries, EPINet 1995

63 healthcare facilities, injuries = 3,003

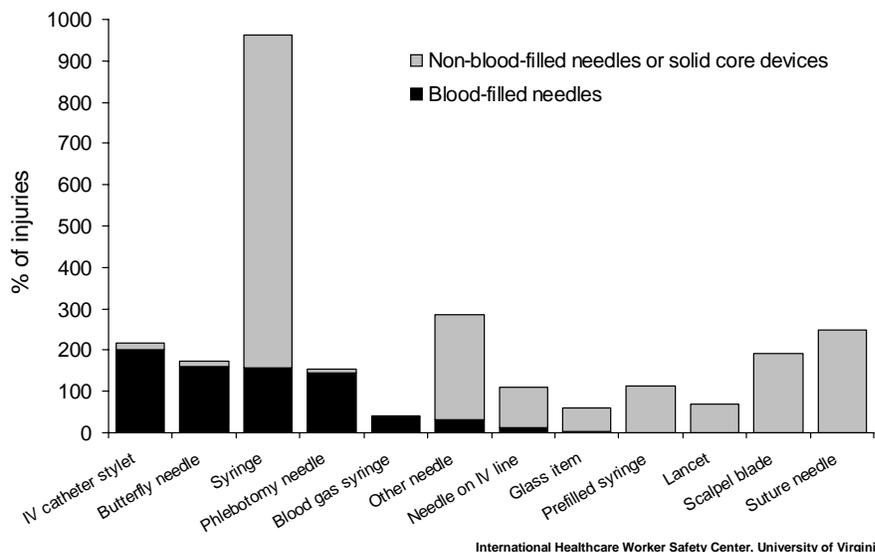
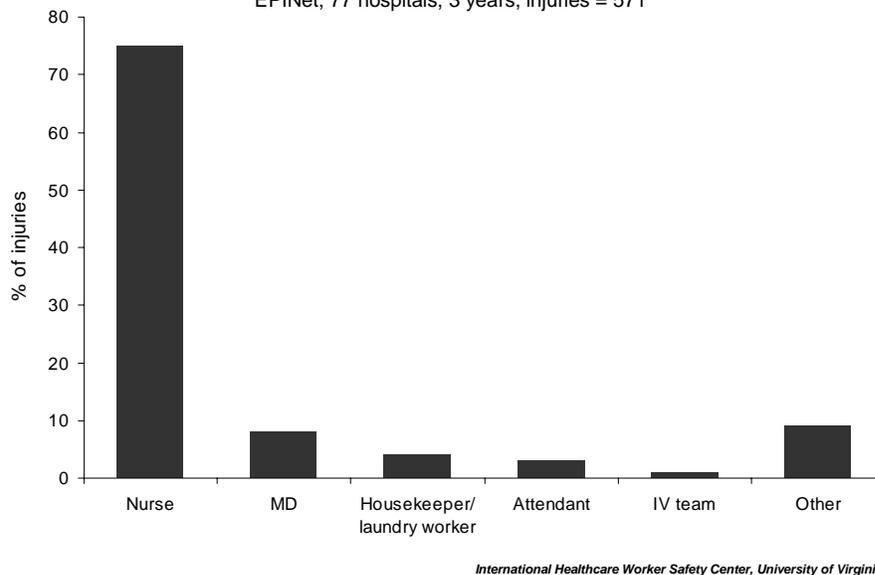


Figure 2. Injuries from Conventional IV Catheters By Job Category

EPINet, 77 hospitals, 3 years, injuries = 571



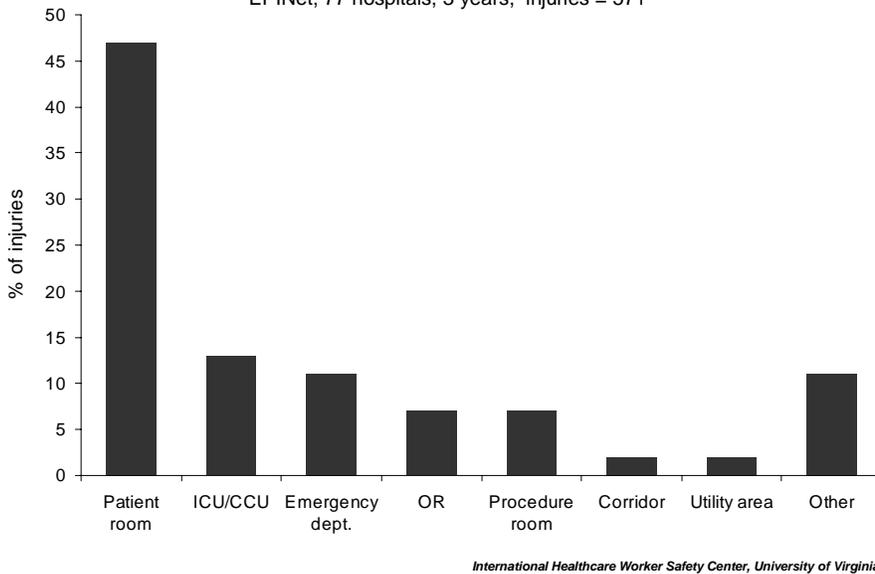
ginia. EPINet is designed to identify medical products associated with either causation or prevention of occupational blood exposures. The three-year database contains a total of more than 10,000 percutaneous injuries, including descriptions of devices causing injuries, procedures the devices were used for, and how the injuries occurred.

Figure 1 shows the distribution of items most frequently causing per-

cutaneous injuries in 63 participating hospitals in 1995. The shaded areas indicate high-risk injuries involving blood-filled needles. It can be seen that the hierarchy of high-risk injuries does not follow the overall frequency of injuries. For example, the disposable syringe causes more injuries than any other device, but ranks third among high-risk injuries. Ranking first among blood-filled needles causing in-

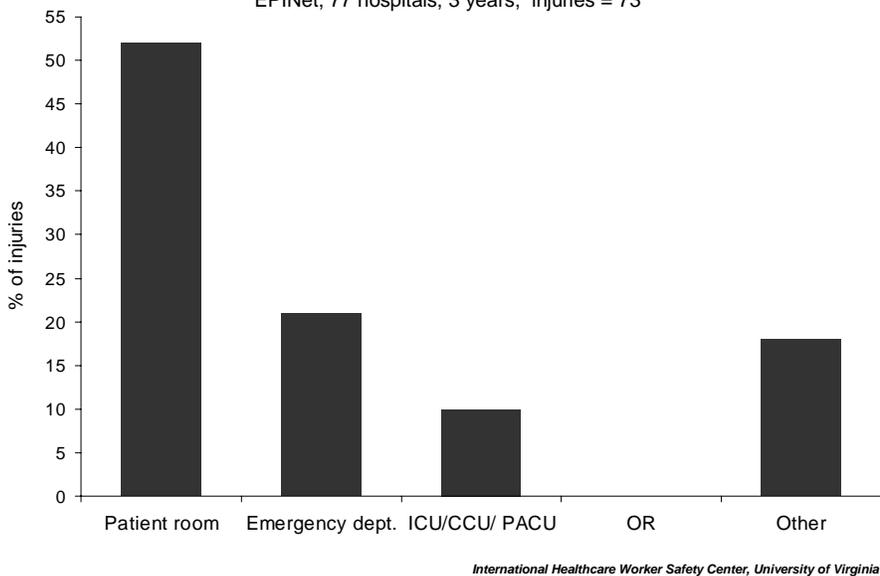
**Figure 3. Injuries from Conventional IV Catheters
By Place of Occurrence**

EPINet, 77 hospitals, 3 years, injuries = 571



**Figure 4. Injuries from Safety IV Catheters
By Place of Occurrence**

EPINet, 77 hospitals, 3 years, injuries = 73



jury is the IV catheter stylet. The remaining injuries from blood-filled needles were associated with blood-drawing procedures, including butterfly-type needles, needles on syringes, vacuum tube phlebotomy needles, and blood gas syringe needles.

The three-year EPINet database includes 77 hospitals and contains a total of 571 injuries from conventional IV catheter stylets and 73 injuries from safety IV catheter stylets.

Figure 2 shows the job categories most frequently sustaining injuries from conventional (non-safety) IV catheter stylets. Seventy-five percent of injuries were sustained by nurses, which is notable because across all devices, nurses accounted for 50% of injuries sustained.⁴ One percent of injuries were sustained by members of IV teams; however, because there are few IV teams represented in the 77-hospital network, it cannot be determined based on these

data whether the 1% figure suggests that members of IV teams have a lower injury risk, or whether it simply reflects few individuals in this professional category. Physicians and attendants sustained a total of 11% of injuries. Housekeepers and laundry workers sustained 4% of injuries, all of which were caused by others who mishandled or inappropriately disposed of used stylets.

The locations of injuries from conventional IV catheter stylets are shown in **Figure 3**. Forty-seven percent of injuries occurred in patient rooms. Fewer injuries occurred in clinical areas including intensive care units (13%), emergency departments (11%), operating rooms (7%), and procedure rooms (7%). Four percent of injuries occurred in nonclinical areas such as corridors and utility areas. These data are useful for assessing the potential impact of selectively introducing safety IV catheters into limited areas of the hospital. In particular, some hospitals have introduced safety IV catheters selectively into emergency departments in the belief that there is a higher risk of IV catheter stylet injuries in the emergency setting. These data support widespread rather than selective implementation, showing that only 11% of injuries hospital-wide would be addressed by this selective implementation in the emergency department.

Figure 4 shows the locations of injuries from safety IV catheter stylets. There were only a small number of injuries from safety IV catheters (73) in comparison to conventional IV catheters (571); **it should be kept in mind that a safety device can be very effective and still cause a small number of injuries** (as further discussed in relation to Figure 5, next page). The main differences in comparison to locations for conventional devices shown in Figure 3 were a higher percentage of injuries occurring in the emergency department and no injuries occurring in the operating room.

Injuries from Vascular Access Devices

This distribution does not indicate that the risk of injury is higher for safety devices in certain locations, but instead shows where the safety devices are in use in the hospital. Anesthesiologists are the professional group that is most likely to use IV catheters in the operating room, but safety IV catheters have not yet been widely accepted by anesthesiologists owing to special design requirements that are unique to anesthesia practice. The absence of injuries from safety IV catheter stylets in the operating room reflects that the devices were not used there at the time of data collection.

Conventional vs. Safety IV Catheters

An opportunity occurred that permitted the direct comparison of injury rates from conventional versus safety IV catheters. Safety IV catheters were introduced in three different network hospitals simultaneously in September 1992. The safety device differed from the conventional device in that the stylet of the safety catheter retracted into a cylindrical protective shield as the stylet was removed from the catheter. With the conventional catheter, the sharp stylet remained exposed until it was placed in a disposal container. All three institutions used the same brand of conventional catheter and introduced the same brand of safety IV catheter at the same time. In specific areas (pediatrics, anesthesiology) of the three hospitals, the conventional IV catheter continued to be used concurrently with the safety catheter. This allowed the direct comparison of needlestick rates for the conventional device versus the safety device across the three hospitals. All hospitals provided records of the number of conventional and safety catheters purchased during the interval under

Figure 5. IV Catheter Stylet Injury Rates

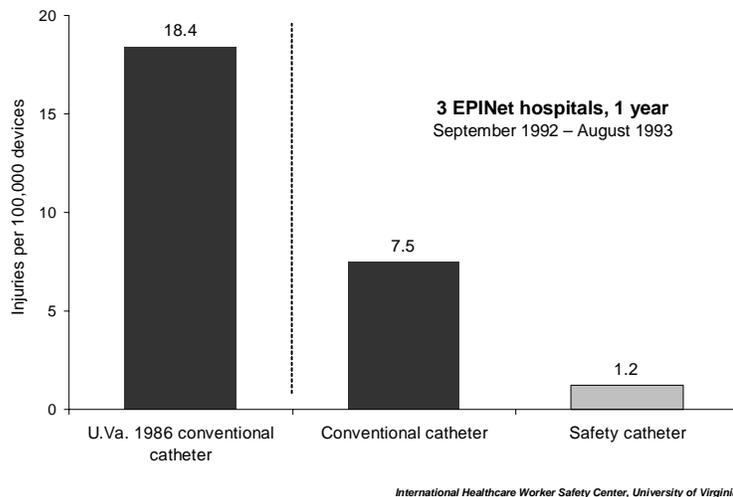
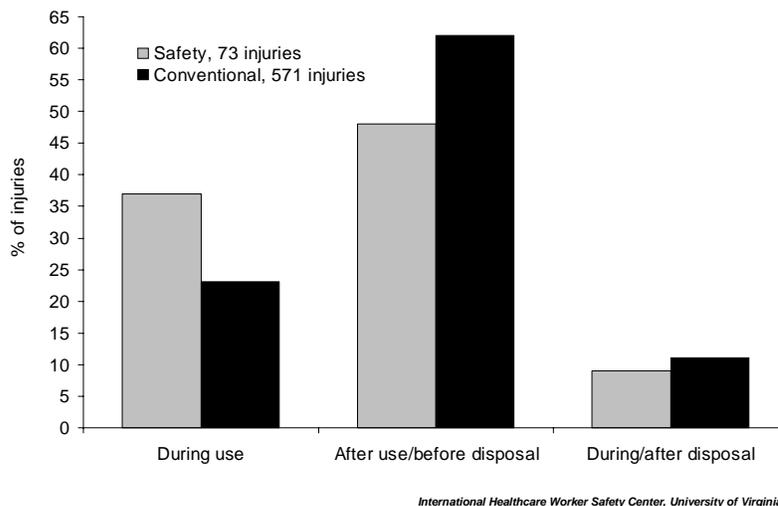


Figure 6. Safety vs. Conventional IV Catheter Injuries

77 hospitals, 3 years, injuries = 644



study. These numbers provided an approximation of the number of devices used in calculating device-specific needlestick rates per 100,000 devices used.

Figure 5 shows that in three hospitals in 1992 and 1993, the needlestick rate for the conventional IV catheter was 7.5 injuries per 100,000 conventional catheters used. This compared to an injury rate of 1.2 injuries per 100,000 safety catheters used, which was an 84% lower rate than for the conventional catheter. Although historic data were not available from all three hospitals,

comparable data were available from one of the three hospitals for 1986 and had been previously published.⁵ In 1986, University of Virginia Hospital reported an injury rate from conventional IV catheters (same brand as above) of 18.4 per 100,000 devices used. The higher rate, which is more than twice that of the same conventional IV catheter in 1992 and 1993, reflects the circumstances that were prevalent before the implementation of the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard.⁶ The changes that took place after

Injuries from Vascular Access Devices

1987 included educational safety programs for hospital staff, placement of disposal containers closer to the point of use, and significant improvements in the design of disposal containers.

These data suggest that safety education and improved disposal systems can result in substantial declines in injury risk (59%) and are important measures. However, after the implementation of good disposal systems and safety education, even greater reductions in injury risk can be achieved by the introduction of an effective safety device (84%). All safety measures together (education, improved disposal systems, safety device) resulted in a 94% reduction in injury risk as compared to 1986, before the implementation of these measures.

The mechanism of injury from safety IV catheters differs somewhat from that of conventional catheters. The percentage distribution of injury mechanism for both types of catheters is shown in **Figure 6**. Because safety IV catheters provide a shield for the sharp stylet when it is withdrawn from the patient, it is to be expected that injuries occurring after use of the stylet and during and after disposal of the stylet would be prevented. Injuries occurring during the placement of the catheter might not be

affected since the differences between the two devices are minimal during placement. Figure 6 shows that injuries from safety IV catheters are more likely to occur during use (during catheter placement) and less likely to occur after use in comparison to conventional IV catheters. Safety IV catheters did not eliminate injuries occurring after removal of the stylet, but did decrease the proportion of injuries occurring after use. In most instances in which injuries occurred after removal of the stylet, the user did not completely retract the stylet into locked position in its sheath.

Conclusion

Nationwide EPINet data show that among all devices causing percutaneous injuries, the IV catheter stylet is the number one device causing high-risk needlesticks, that is, needlesticks involving a blood-filled, large-bore needle. This occupational risk is concentrated among nurses whose duties include frequent placement of peripheral IV catheters. The demonstrated potential for preventing injuries from conventional IV catheter stylets is great. Our data show that educational safety programs and improved disposal systems that were introduced when the OSHA Bloodborne Pathogens Standard was implemented were associated with a 59% decrease in device-specific injury rates from IV catheter stylets in one EPINet

hospital. An additional 84% reduction in IV catheter injury rates was achieved in three EPINet hospitals after the introduction of a safety IV catheter designed to prevent needlesticks. The prevention of high-risk needlesticks from IV catheter stylets will not only prevent the occupational transmission of HIV but of all bloodborne pathogens. Because of the high risk involved in IV catheter stylet injuries and the seriousness of occupational infection from bloodborne pathogens, IV catheters incorporating needlestick prevention features should be implemented in all health care settings, to the maximum extent clinically feasible, without delay. □

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