

THE NATIONAL SURVEILLANCE SYSTEM FOR HEALTHCARE WORKERS (NaSH)



Summary Report for Blood and Body Fluid Exposure
Data Collected from Participating Healthcare Facilities
(June 1995 through December 2007)



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

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SECTION 1: GLOSSARY AND KEY DEFINITIONS

BBF: blood and body fluid

Exposures: a specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood, visibly bloody fluids, as well as tissues, and laboratory specimens that contain concentrated HBV, HCV, or HIV.

Routes of exposure include:

1. Percutaneous injuries: Penetration of skin by a needle or other sharp object that was in contact with blood, tissue, or other body fluid prior to the exposure.
2. Mucous membrane exposures: Fluid contact to the external oral, ocular, or nasal membranes with blood and/or fluids, tissues or specimens listed above.
3. Non-intact skin exposures: Contact of wounds, previously opened/abraded skin with the fluids, tissues, or specimens listed above.
4. Bite exposures: Penetrating skin or mucosal injuries received from the mouth or teeth from patients or co-workers.

HBV: hepatitis B virus

HCP: healthcare personnel (plural form): All persons (e.g., employees, students, contractors, attending clinicians, public safety workers, or volunteers) whose activities involve contact with patients or with blood or other body fluids from patients in a healthcare, laboratory, or public safety setting

HCV: hepatitis C virus

HIV: human immunodeficiency virus

HCW: healthcare worker (singular form)

NaSH: the National Surveillance System for Healthcare Workers

NHSN: the National Healthcare Safety Network

NSI: needle-stick injury: a wound from a needle piercing or puncturing intact skin

PEP: post-exposure prophylaxis

SECTION 2: BACKGROUND AND METHODS

BACKGROUND

The National Surveillance System for Healthcare Workers (NaSH) was a voluntary surveillance system developed by the Centers for Disease Control and Prevention (CDC) to systematically collect information important to the prevention of occupational exposures and infections among healthcare personnel (HCP). NaSH was established in 1995 by the Hospital Infections Program, National Center for Infectious Disease, in consultation with other divisions and institutes within CDC. NaSH collected surveillance data through 2007.

Both before and during this period, there were several major events that pertain to the prevention of occupational blood and body fluid exposures. This includes the publication of the Occupational Safety and Health Administration's (OSHA) Bloodborne Pathogen Standard (29 CFR 1910.1030) in 1991 that required employers to implement an exposure control plan with details on HCP protection measures including engineering and work practice controls. Over the ensuing 10 years, awareness that, despite ongoing technologic advances in medical devices engineered to reduce risk, there continued to be an unacceptably large annual number of percutaneous injuries involving contaminated sharps. This led Congress to pass the Needlestick Safety and Prevention Act. This legislation directed OSHA to revise the Bloodborne Pathogens Standard to explicitly state the requirements that employers identify and use effective and safer medical devices. The revision was published and became effective in 2001.

Participation in NaSH grew from 5 hospitals in 1995 to 64 facilities in 2000, decreasing to 18 in 2007, and information was gathered from nearly 130,000 HCP adverse events. There was at least one NaSH facility in 28 states and the District of Columbia. Most sites were located in the eastern United States (Figure 1).

NaSH consisted of data collection modules for monitoring and managing immunization and tuberculin skin-testing programs; recording exposures to blood and body fluids, vaccine-preventable diseases, and tuberculosis; and determining levels of under-reporting of percutaneous injuries. Each NaSH facility decided on its extent of involvement in the surveillance program and the specific modules that it used. NaSH became a legacy system to the web-based National Healthcare Safety Network (NHSN) Healthcare Personnel Safety component which was launched in August 2009 (<http://www.cdc.gov/nhsn/hps.html>).

NaSH enabled CDC to monitor trends, identify emerging hazards for HCP and evaluate prevention strategies. Among NaSH facilities, information on the types, frequency, and circumstances of exposure among HCP was used to describe or detect problems, determine ways to prevent exposures, assess priorities for prevention, and measure the impact of prevention programs.

The purpose of this report is to describe to the public health, the occupational health and safety, and infection control communities, the variety of occupational exposures to blood and body fluids that occur among HCP. This report provides no inferential analysis regarding the differences noted between and within healthcare facilities.

METHODS

The population under surveillance was HCP working in US healthcare facilities participating in NaSH. The surveillance period was June 1995 through December 2007.

- Reportable incidents were exposures (see Glossary and Key Definitions for substances and modes of exposure) to BBFs occurring during the performance of a healthcare worker's (HCW's) job duties.
- BBF exposure surveillance through NaSH also included information on the source patient's HBV, HCV, and HIV status; a HCW's HIV baseline status, use of post-exposure prophylaxis (PEP) and the timing of such PEP; and side effects of PEP.
- Exposures involving more than one route (3% of all exposures) were counted as one exposure according to the route with the highest risk of bloodborne virus transmission (e.g., an exposure involving both a percutaneous injury and mucocutaneous exposure (such as a cut with a broken blood collection tube) was counted as a percutaneous injury with a solid sharp.
- Exclusion Criteria: Exposures involving non-visibly bloody solutions, and non-visibly BBFs (such as tears, urine, sputum, and feces) were considered to have a negligible risk of infection transmission, in addition to exposures involving intact skin or clean needles.
- Because standardized denominators were not collected to conduct rate based analyses, only numerator-based analyses were conducted for this report.

PREVENTABILITY INDICATORS

To assess the preventability of percutaneous injuries from hollow-bore needles, we used a hierarchical algorithm to determine if a needlestick reported to NaSH was preventable through use of safer routine work practices or technologies. Preventability was assessed only for percutaneous injuries caused by hollow-bore needles—and not for suture needle injuries or injuries with other solid sharps.

Variables assessed within the algorithm included: device type, purpose of use, injury circumstances (i.e., how did injury occur?), time between use and injury (before, during, after use, disposal), safety needle device information, type of safety device, the timing of an injury in relation to the activation of its safety feature.

Injuries were classified as potentially preventable if: a needle was unnecessarily used, a device's safety feature was not activated or was used improperly, a conventional device was used instead of a market-available safety device, a safer work practice might have prevented the injury, or a sharp was disposed of improperly.

If none of the above conditions applied, injuries were classified as patient care-related and therefore less amenable to promotion of safer routine work practices and technologies. Examples of such injuries include needlestick injuries resulting from a patient moving during a procedure or injuries during the insertion or removal of a needle from a patient, despite compliance with safe work practices and properly employing the correct safety technology, the HCW injures himself/herself during the insertion or removal of a needle from a patient.

Table 1. Number of Participating Facilities and Reported BBF Exposures, 1995-2007

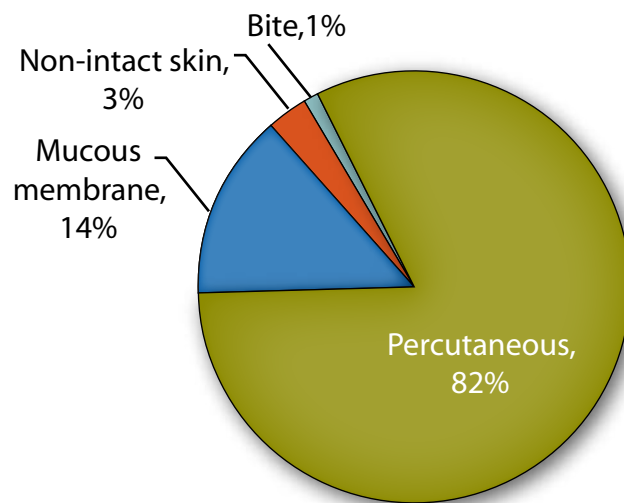
Year	Number of Facilities	Number of Exposures
1995	5	378
1996	6	574
1997	11	927
1998	23	2,616
1999	45	3,288
2000	64	4,334
2001	63	3,972
2002	51	3,242
2003	42	3,178
2004	34	3,034
2005	31	2,476
2006	24	1,726
2007	18	1,200
Total		30,945

The highest number of exposure reports occurred in 2000, the same year that NaSH enrollment peaked with 64 hospitals participating.

SECTION 3: CHARACTERISTICS OF EXPOSURES TO BLOOD AND BODY FLUIDS

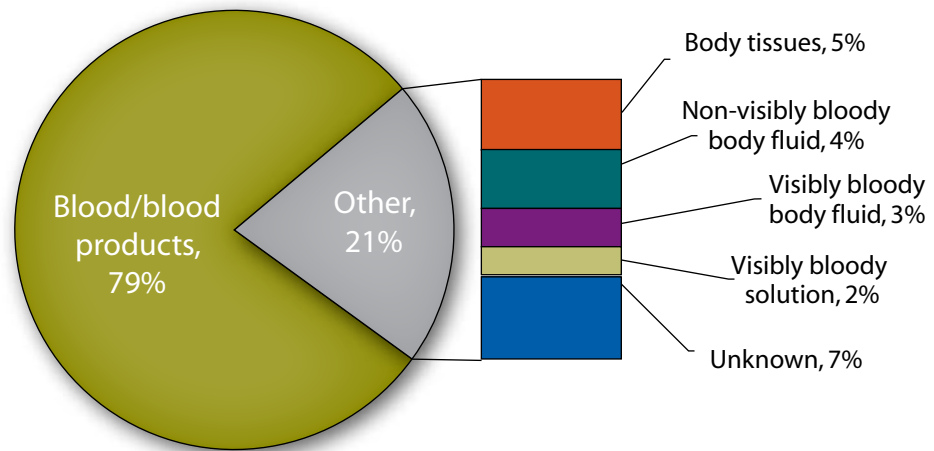
Figures 2-5 describe the routes and types of exposures and work locations and occupational groups of exposed HCP for the total 30,945 BBF exposures reported to NaSH.

Figure 2. Routes of Reported BBF Exposures (n=30,945)



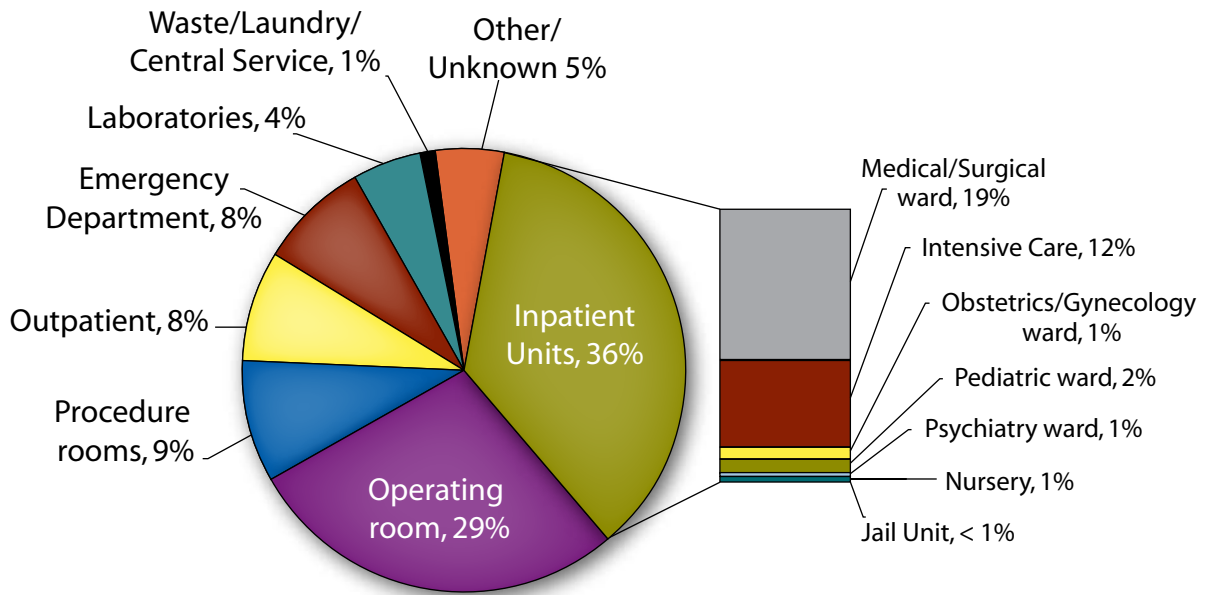
- Percutaneous injuries (82%) were the most commonly reported route of blood and body fluid exposures, followed by mucous membrane (14%) and non-intact skin exposures (3%).

Figure 3. Types of Fluid/Tissue Involved in Reported BBF Exposures (n=30,867; 78 missing)



- Blood and blood products were involved in almost four-fifths of all reported exposures.

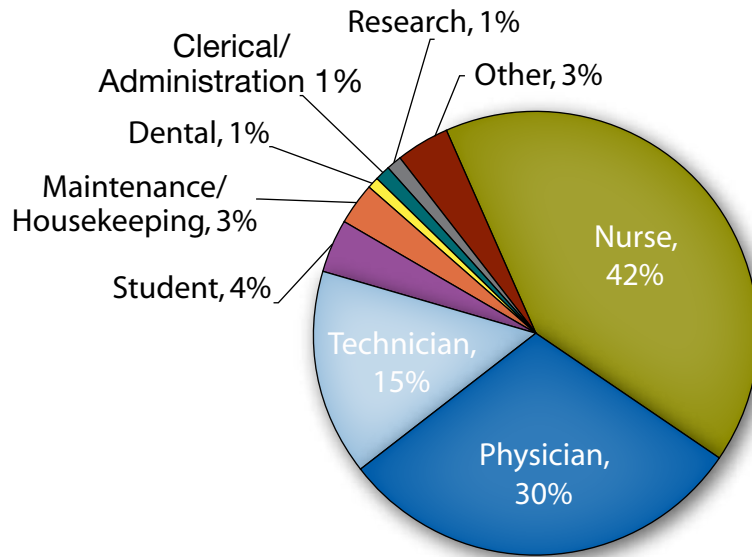
Figure 4. Work Locations Where Reported BBF Exposures Occurred (n=30,881, 64 missing)



The distribution of work locations where reported exposures occurred reflects areas of healthcare facilities where sharps devices are most frequently used or handled by HCP.

- Inpatient areas accounted for the largest proportion of hospital-based BBF exposures, closely followed by operating rooms which reported almost a third of all reported BBF exposures.
- Within the inpatient area, the medical/surgical units and the ICU reported the largest proportion of exposures, likely from the numerous interventions and devices used in these specialized settings.

Figure 5. HCP Groups Exposed to BBFs (n=30,927; 18 missing)



- Blood and body fluid exposures were reported by a wide variety of occupational groups.
- Most (72%) reported exposures involved direct-care providers (e.g., nurses, physicians).
- While the vast majority of reported exposures occurred among HCP with clinical responsibilities (e.g., nurses and physicians), a small percentage (4%) of reported injuries was sustained by HCP whose jobs do not require the routine use or handling of sharps (e.g., maintenance, housekeeping, clerical/administrative personnel).

Figures 6-10 describe the characteristics for the subset of 25,324 BBF exposures (i.e., 82% of all exposures in Figure 2) that were percutaneous injuries.

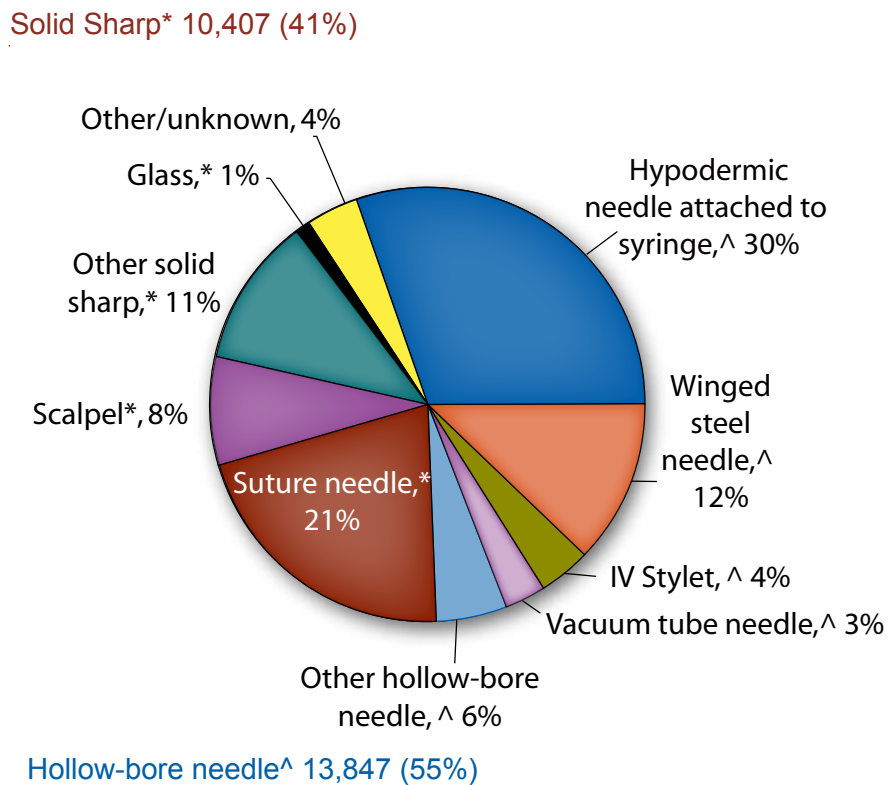
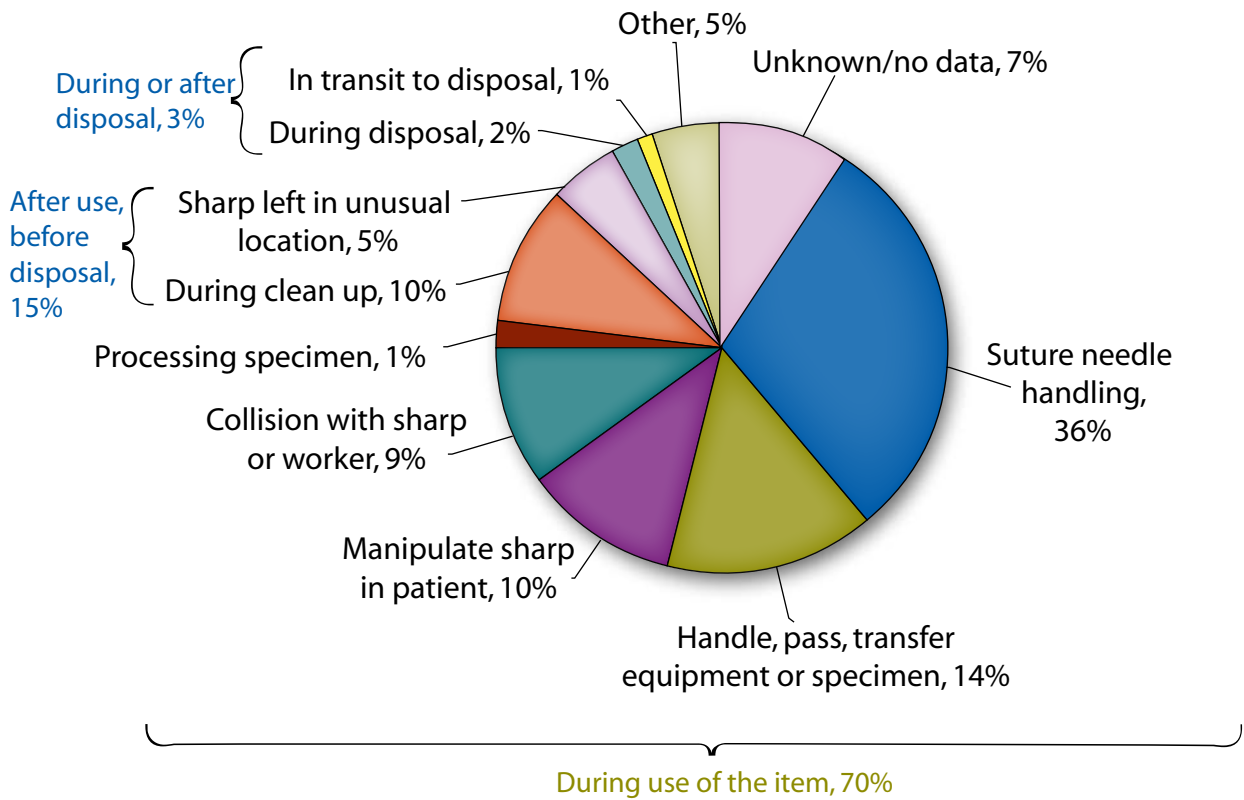


Figure 6. Types of Devices Involved in Percutaneous Injuries (n=25,324)

- Hollow-bore needles were involved in the majority (55%) of all reported percutaneous injuries. Hollow-bore needles carry a higher risk of transmission of bloodborne viruses to HCP than other devices.
- Hypodermic needles attached to syringes were the most common type of hollow-bore needle involved in percutaneous injuries and accounted for 30% of all percutaneous injuries. Suture needles, a solid sharp device, were the next most frequently involved in percutaneous injuries.

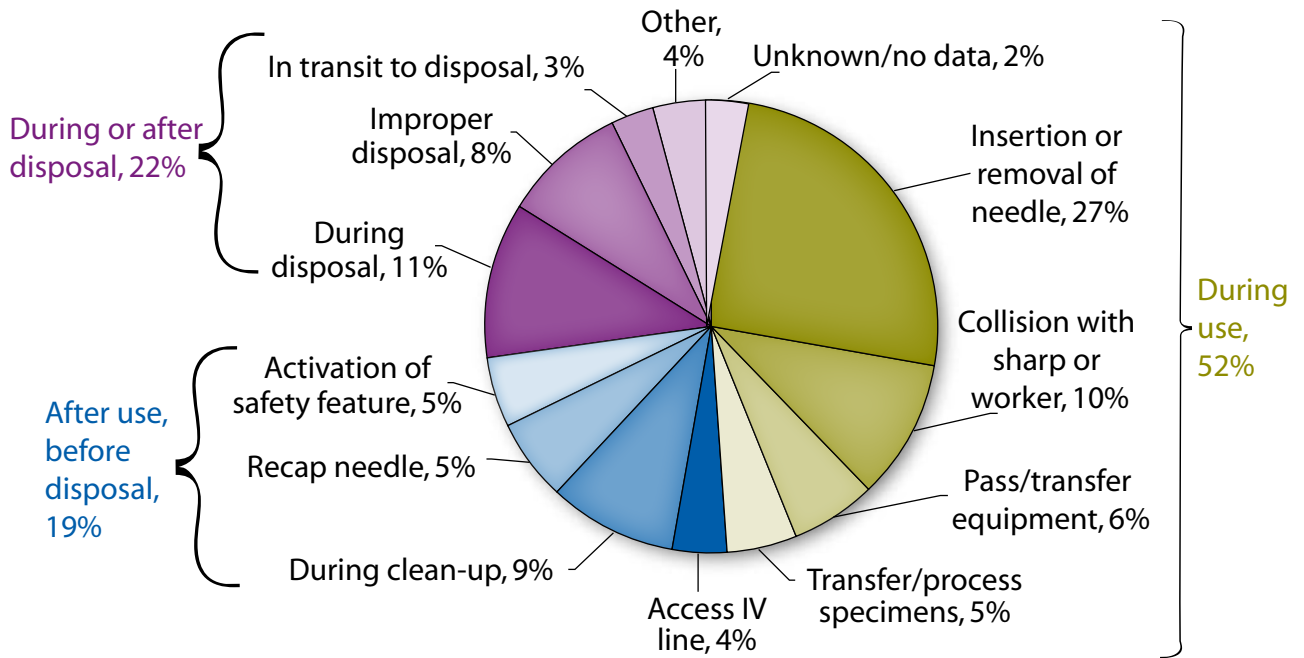
Injuries involving solid sharps and hollow-bore needles are examined in more detail in Figures 7 and 8 respectively.

Figure 7. Circumstances and Timing of Percutaneous Injuries Involving Solid Sharps (n=10,407)



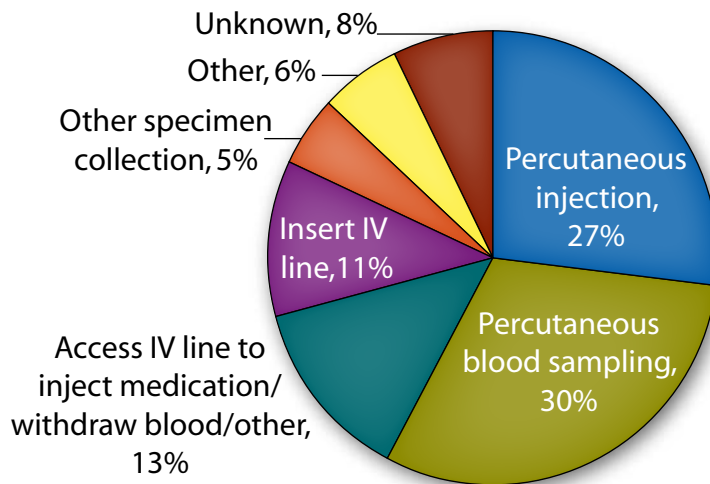
- The largest proportion of solid sharps injuries (36%) occurred during the handling of suture needles.
- Most injuries occurred during use of the device (70%), followed by 15% after use but before disposal, and 3% during or after disposal.

Figure 8. Circumstances and Timing of Percutaneous Injuries Involving Hollow-Bore Needles (n=13,847)



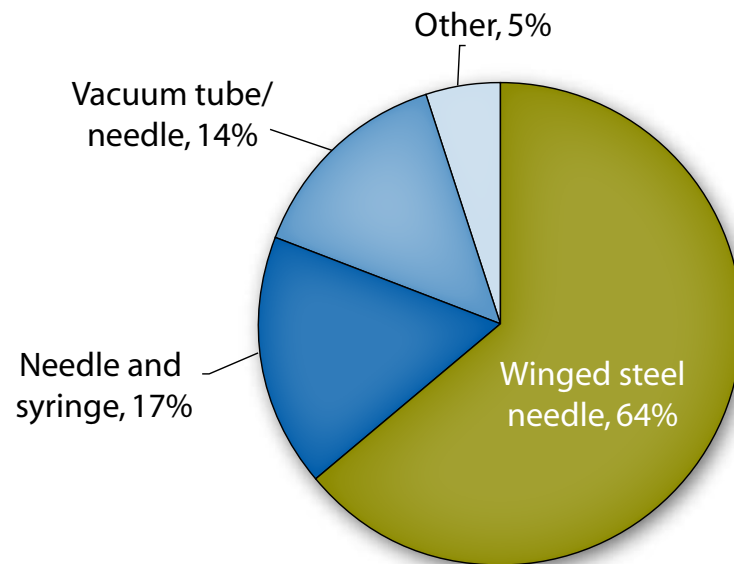
- Percutaneous injuries occurring during sharps use accounted for 52% of all hollow-bore needle injuries, followed by during or after disposal (22%) and after use but before disposal (19%)
- Over one-fourth (27%) of hollow-bore needle percutaneous injuries occurred when the needle was being inserted, moved, or removed from the patient.
- Recapping, a practice prohibited by OSHA regulations, accounted for 6% of injuries involving hollow-bore devices.

Figure 9. Intended Use of Hollow-Bore Needles Involved in Percutaneous Injuries (n=13,847)



- The most common intended use of hollow-bore needles involved in percutaneous injuries was percutaneous blood sampling (30%), followed by percutaneous injection (27%), accessing an existing intravenous line to inject medication or withdraw blood (13%), and inserting an intravenous catheter (11%).
- For the subset of injuries associated with percutaneous blood sampling, most occurred during venipuncture (27%), followed by arterial puncture (3%), connecting the patient during dialysis (<1%), and a during fingerstick or heelstick (<1%) (data not shown graphically).
- The types of devices associated with injuries during blood collection are shown in the next figure (Figure 10).

Figure 10. Types of Devices Involved in Injuries During Percutaneous Blood Sampling (n=4,078)

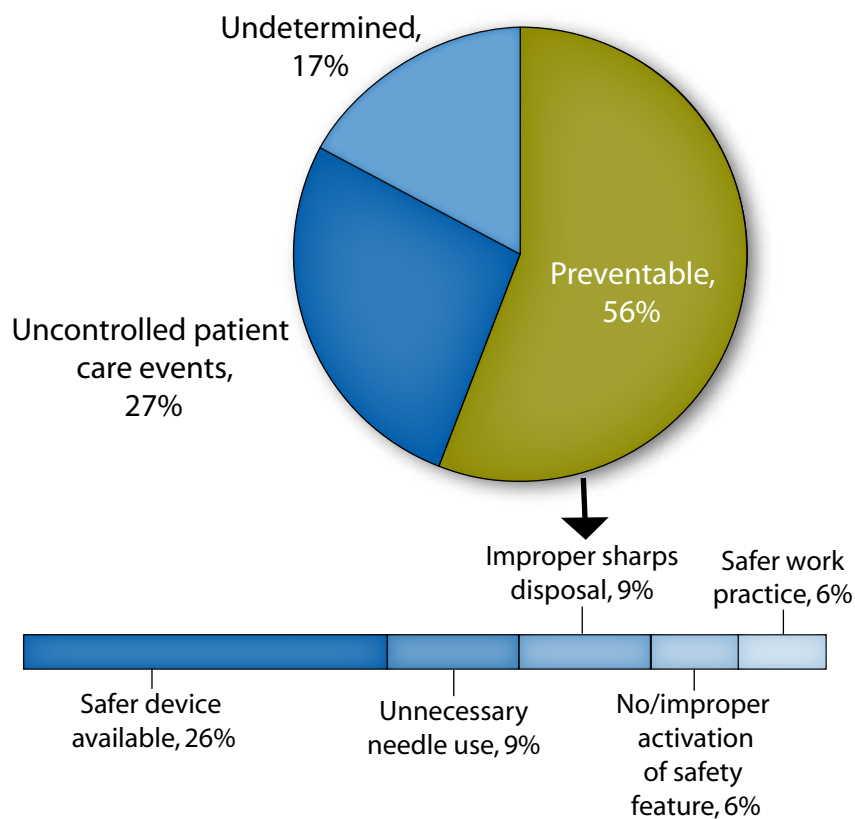


- Winged steel needles (64%), hypodermic needles and syringe combinations (17%), and vacuum tube needles (14%) accounted for 95% of injuries associated with blood collection.

SECTION 4: PREVENTABILITY OF HOLLOW-BORE NEEDLE INJURIES AND USE OF SAFER DEVICES

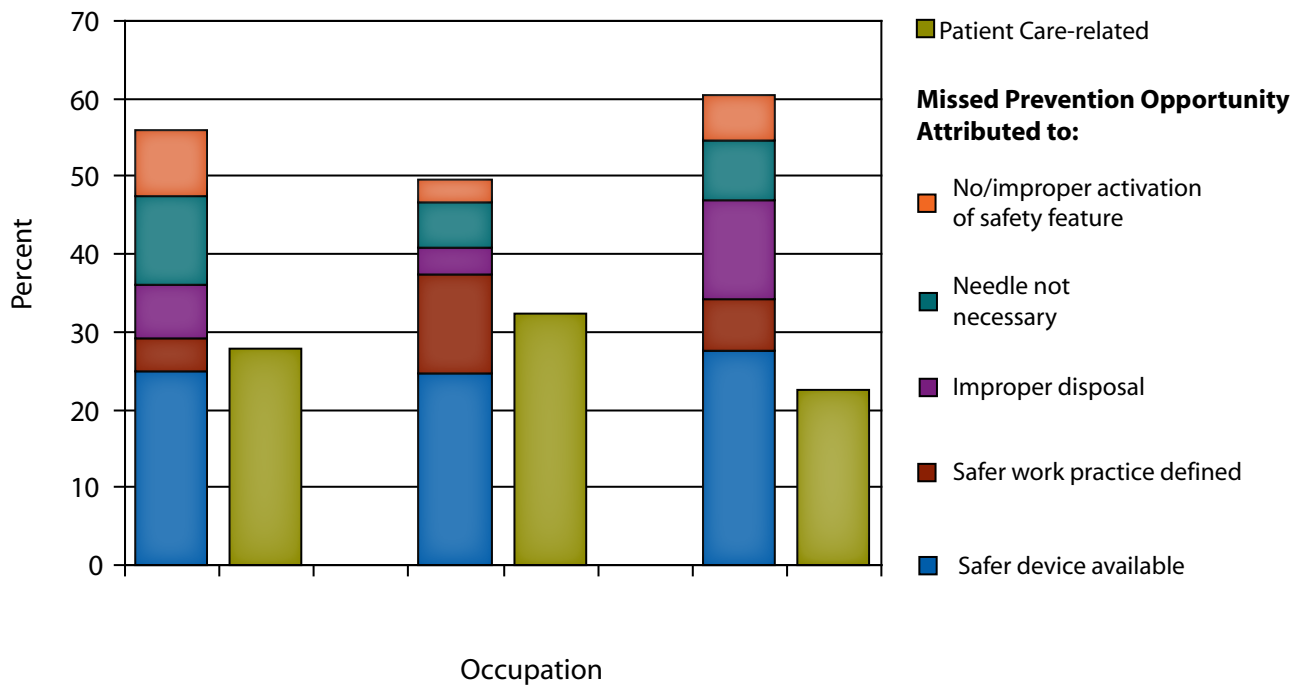
The following section (Figures 11-12) describes NaSH findings related to the preventability of percutaneous injuries involving hollow-bore needles.

Figure 11. Estimated Preventability of Percutaneous Injuries Involving Hollow-bore Needles (n=13,847)



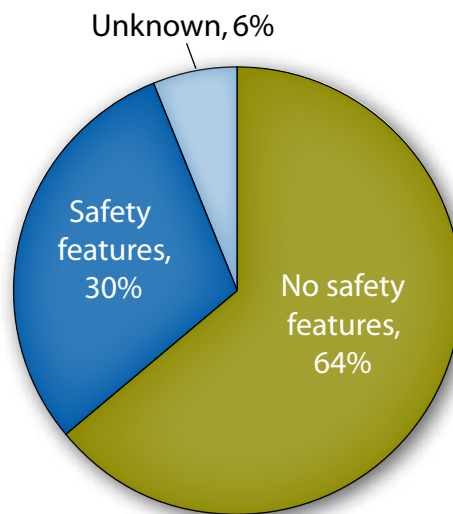
- Most (56%) percutaneous injuries with hollow-bore needles were considered potentially preventable by using safer work practices or technology. A sub-categorization of these missed opportunities for prevention is shown above. Nearly one-quarter of hollow-bore needle injuries were considered patient care-related and therefore may be classified as less preventable despite safer work practices or technology.
- In approximately one out of every six hollow-bore needle injuries, preventability could not be assessed from the available information.

Figure 12. Estimated Preventability of Percutaneous Injuries Involving Hollow-bore Needles, by Occupation (n=11,508)



- Among all occupational categories, the largest proportion of preventable injuries was associated with activities for which a safer device was available (25% among nurses, 25% among physicians, and 28% among others).
- Among nurses, an additional 11% of injuries may have been prevented by using non-needle devices or methods.
- Among physicians, an additional 13% of injuries may have been prevented through safer work practices.
- Among other occupational groups, an additional 13% of injuries may have been prevented through proper disposal of sharps.

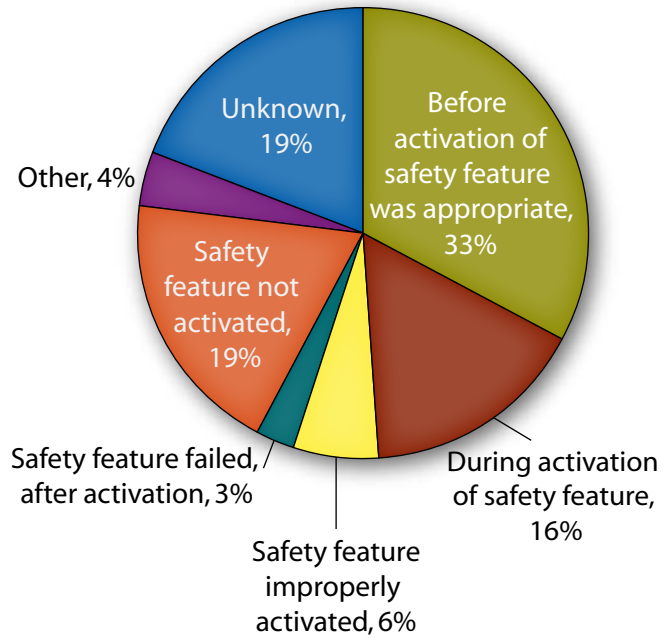
Figure 13: Presence of Safety Features Among Hollow-bore Needles Involved in Percutaneous Injuries (n=13,847)



- Of all percutaneous injuries caused by hollow-bore needles, 4,103 (30%) involved hollow-bore needles with safety features; 64% of hollow-bore needle injuries involved devices without safety features.
- Estimating any change in proportions among hollow-bore needle injuries with and without safety features since the implementation of the Needlestick Safety and Prevention Act in 2000 was not feasible.

The timing of injuries in relation to activation of the safety features is shown in Figure 14.

Figure 14. Timing of Percutaneous Injuries Involving Hollow-bore Needles in Relation to Activation of Safety Features (n=4,103)



- The largest proportion of percutaneous injuries with hollow-bore safety needles occurred when the device was being used, before activation was appropriate (33%).
- 19% of injuries may have been prevented had the safety feature been activated and another 6% had it been activated properly.
- A safety feature failed in 3% of percutaneous injuries involving hollow-bore needles.

SECTION 5: REPORTING OF PERCUTANEOUS INJURIES BY HEALTHCARE PERSONNEL

The following section presents survey information regarding the number of percutaneous injuries that were actually reported to the appropriate occupational health departments by HCP in participating facilities.

- Data were collected from 53,000 surveys periodically-distributed to HCP in 30 hospitals between 1996 and 2007
- HCP responded that an average of 46% of all percutaneous injuries was reported to infection control, emergency rooms, or employee health programs during this time period. This proportion varied by occupation:
 - Technicians, 66%
 - Nurses, 53%
 - Non-surgical medical staff, 53%, and
 - Surgeons, 30%

SECTION 6: MANAGEMENT OF EXPOSURES

The following section presents information regarding the management of exposures, including source patient information and details on HIV post-exposure prophylaxis (PEP). Recommendations for the follow up of HCP exposed to HIV were first published in 1990 at which time post-exposure prophylaxis with zidovudine was not yet recommended for routine use. By 1996, sufficient clinical experience with anti-retroviral drugs had accumulated, including evidence from observational case-control studies suggesting reduced transmission with PEP, such that firm recommendations for PEP with anti-retroviral drugs were put forth. These recommendations were stratified based upon the degree of BBF exposure and consisted of initiating, as soon as possible after exposure, a two (i.e., zidovudine plus lamivudine) to three (i.e., addition of indinavir) drug regimen and continuing this for four weeks. Based upon the availability of newer agents and other information, updated guidelines were published in 1998, 2001, and 2006. Throughout this era, recommendations included testing the source patient if their HIV status was unknown and discontinuing PEP if they were found to be HIV negative. The advent and increased availability of rapid HIV testing in the late 1990s greatly facilitated ability to make an informed decision to discontinue PEP. Meanwhile, the recommendation to continue PEP for 4 weeks remained unchanged and the increased availability of more tolerable regimens may have improved compliance.

EXPOSURES TO BLOODBORNE VIRUSES

- The source patient was identified in 92% of reported blood and body fluid exposures.
- 12% of all exposures involved a source patient testing positive for one or more bloodborne viruses.
 - 4.5% HIV-positive patients
 - 8.4% HCV-positive patients
 - 1.4% HBV-positive patients
- Among all known source patients, 1.7% were co-infected with HIV and HCV, representing 38% of HIV-infected sources and 20% of HCV-infected sources.

HIV POSTEXPOSURE PROPHYLAXIS (PEP)

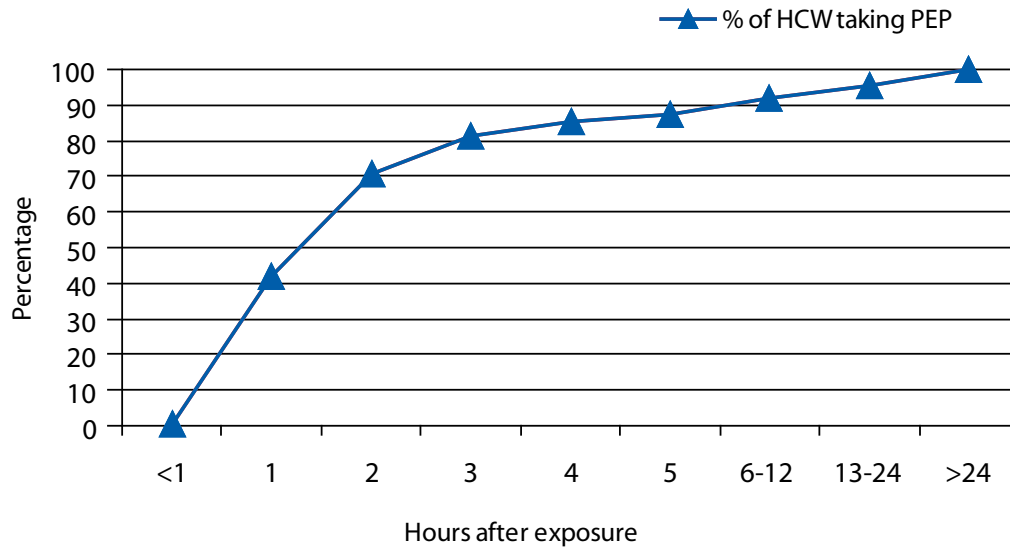
- Of 1,465 HCP with a BBF exposure to an HIV-positive source, only 63% took PEP.
- Among HCP who took PEP, the average duration of adherence was 25 days.

Table 2. Duration of HIV PEP After Occupational BBF Exposures Among HCP, 1995-2007 (n=2,205)

	Median Duration after Exposures to HIV-Positive Source (days)	Median Duration after Exposures to HIV-Negative Source (days)
1995	9	7.5
1996	16.5	15
1997	13	4
1998	25	3
1999	27.7	2
2000	27	1
2001	26	1
2002	27	1
2003	15.5	1
2004	25	1
2005	21	0
2006	27	1
2007	28	0
Overall	25	2

- Median duration of PEP after an occupational exposure to an HIV positive source increased during the late 1990s and has generally remained stable.
- Median duration of taking PEP after exposure to an HIV negative source decreased during the late 1990s and has remained stable.
- In 2007, the median duration of taking PEP was 28 days after exposure to an HIV positive source and zero days after exposure to an HIV negative source, consistent with U.S. Public Health Service Guidelines.

Figure 15. Number of Hours After Occupational BBF Exposure to Initiation of HIV PEP, 1995-2007 (n=2,942)



- This graph represents the timing of the initiation of PEP; it is based on available data among all HCP who were reported as having started PEP after exposure to an HIV-positive, an HIV-negative source or an unknown source.
- Overall, 80% of those taking HIV PEP initiated prophylaxis within 3 hours after occupational exposure.
- Caution is advised when interpreting these data, as occupational HIV exposure management protocols, including PEP regimens and source patient testing practices (e.g., the use of rapid HIV tests), were revised during the surveillance period.

Table 3. Adverse Signs and Symptoms in HCP Taking HIV PEP After Occupational BBF Exposures, 1995-2007 (n=1,114)

535 (48.9%) HCP reported any adverse signs and symptoms while taking PEP*. 561 (50.4%) reported having no symptoms upon follow-up.

Adverse Sign or Symptom	HCP on HIV PEP Reporting Symptom / Sign (%)
Nausea	28.6
Malaise / Fatigue	24.1
Headache	11.3
Emotional distress	9.7
Diarrhea	9.2
Vomiting	7.3
Loss of appetite	6.3
Other	33.0

*HCP may report multiple symptoms. Only symptoms reported by > 4% HCP listed.

- Adverse signs and symptoms were reported by almost half of HCP taking HIV PEP
- The most frequently reported symptoms were nausea and malaise/fatigue
- Emotional distress was reported by a proportion of HCP, but the direct contribution of PEP toxicity is unknown.

SECTION 7: SUMMARY AND CONCLUSIONS

Over the 12 ½ years NaSH was in use, 30,945 BBF exposures were reported, more than three quarters (82%) of which were percutaneous injuries. Despite this being a large number of percutaneous injuries, results from HCP questionnaires during this period suggest these reports represent less than half the total number of injuries that actually occurred during this period owing to under-reporting. Questionnaire results further suggest that surgeons may be particularly prone to under-report and may be one reason why more BBF exposures were reported by nurses (42%) than any other occupational group. The intensity of sharps usage per patient-day or per HCP hours worked may have much to do with the proportion of BBF exposure reports from different settings. Although most exposures occurred on inpatient units, a relatively large proportion of exposures (29%) occurred in operating rooms and, within inpatient units, approximately one-third of exposures occurred in ICUs. The majority of reported percutaneous injuries involved hollow-bore needles (55%), with 30% of all percutaneous injuries involving hypodermic needles attached to syringes.

Overall, almost two-thirds of injuries with hollow-bore needles involved devices lacking integral safety features. More than half (56%) of percutaneous injuries involving hollow-bore needles were potentially preventable through safer work practices or technologies and 25% of injuries that occurred in both nurses and physicians were potentially preventable by use of a device with safety features. Among the hollow-bore injuries that occurred despite use of a safety needle, 45% occurred during use of a safety winged steel needle. Most injuries that occurred despite the presence of a safety feature occurred before activation of the safety feature was appropriate (41%), but many (25%) involved failure to properly activate the feature.

The identity and infection status of source patients were known for the majority (92%) of BBF exposures. Nonetheless, less than two-thirds (63%) of HCP with BBF exposures to an HIV-positive source patient took HIV PEP. Although adverse signs and symptoms were frequently reported among HCP who took HIV PEP, the median number of days that exposed HCP took PEP appears consistent with current guidelines. Meanwhile, HCP exposed to source patients who turned out upon testing to be HIV-negative appear to have discontinued their PEP in a timely fashion.

LIMITATIONS

Exposure to BBF represents an important and frequently preventable occupational hazard for HCP that requires a comprehensive approach to prevention and management (www.cdc.gov/Sharpssafety). There are significant limitations of the data from NaSH including the absence of denominator data preventing reliable estimates of risk, and the variable number of reporting hospitals preventing meaningful trend analysis. Analyses of trends, particularly to identify reductions in injuries after the implementation of key OSHA regulations, were not feasible due to changes in healthcare facility participation in NaSH from year to year. Additionally, some data were not collected in NaSH such as the proportions of conventional devices versus safety devices that were in use each year, nor the mechanism of a safety features, or device manufacturers/models. While assessment of a preventable fraction of hollow-bore needle injuries based on an algorithm may be an oversimplification of a complex, multi-factorial process that may also depend on unmeasured characteristics like user skill level, patient compliance, workplace culture, fatigue, staffing,

and local healthcare facility policies, it may represent an important step toward identifying better prevention strategies. Finally, additional limitations include a lack of representativeness of NaSH participants due to an overrepresentation of facilities from the eastern half of the US, over-representation of larger teaching hospitals, incomplete follow up after occupational exposures, and a small sample size of US facilities.

Despite these limitations the surveillance of BBF exposures and their management provides useful information to gauge HCP safety and the effectiveness of prevention strategies. For example, overall sharps safety training should especially be focused on areas such as operating rooms and ICUs where a disproportionate number of BBF exposures appear to occur. Even with increasing availability of safety devices, these data suggest these features are still not being used to the degree necessary, although it was difficult to assess whether the proportion of injuries involving safety devices changes since the OSHA regulatory mandate in 2000. This is certainly one area where the ability to conduct a trend analysis would be beneficial. As important as it is to provide HCP with safety devices, it is necessary to train them in their proper use. Still there are a significant proportion of injuries caused by hollow-bore needles that occur because of uncontrolled “patient care related” events or behavior. Events such as these require better characterization and understanding so that new generation of prevention strategies and technologies can be developed and evaluated. As NHSN assumes the role of collecting data on BBF exposures in HCP it will be important to promote reporting not only for the improvement in safe environments of care within individual healthcare facilities but also to support a national prevention monitoring and research strategy. Such a strategy will require innovation both in the prevention of BBF exposures and in their surveillance. Despite the limitations of NaSH, the data from this system provides useful information to gauge HCP safety and the effectiveness of prevention strategies and serve to outline the type of data that will be required for the future elimination of BBF exposures in HCP.