SHARPS INJURIES AMONG MEDICAL TRAINEES

MASSACHUSETTS SHARPS INJURY SURVEILLANCE SYSTEM DATA, 2002-2009

Occupational Health Surveillance Program, Massachusetts Department of Public Health
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DATA HIGHLIGHTS

- A total of 8,268 sharps injuries among physicians working in Massachusetts hospitals were reported for the surveillance period Jan 1, 2002 to Dec 31, 2009 (an average of 1,034 injuries per year).
- Medical trainees accounted for more than half of all sharps injuries to physicians (60%, 4,972).
- There was a declining trend over the academic year in the frequency of injuries to trainees. The greatest frequency was observed during the first quarter of the academic year (July – September).
- Most medical trainees were injured by suture needles (44%), followed by hypodermic needles & syringes (22%), scalpel blades (10%) and other hollow bore needles (9%).
- Suturing procedures accounted for the greatest percentage of injuries to medical trainees (43%). Injection accounted for 16% of the injuries to medical trainees.
- In comparison to attending physicians, medical trainees sustained proportionately:
  - Fewer sharps injuries in the operating and procedure rooms (57% vs. 69%).
  - More sharps injuries in the intensive care unit (11% vs. 4%) and inpatient units (11% vs. 6%).
  - More sharps injuries associated with blood procedures that occurred after use and before disposal of the device (42% vs. 27%).
  - More sharps injuries associated with recapping the needles after injections (14% vs. 12%).
- After excluding injuries due to suture needles, devices for which few alternatives with sharps injury protection features are available, 65% of the remaining injuries to medical trainees involved devices lacking sharps injury prevention features, predominantly hypodermic needles/syringes (609).
- Sharps injury rate was higher among medical trainees (84 injuries per 1,000 trainees FTEs) than that of attending physicians (65 injuries per 1,000 attending FTEs).

INTRODUCTION

One of the most serious occupational health hazards that medical trainees face during their clinical training is the risk of exposure to bloodborne pathogens, particularly as a result of sharps injuries. Sharps injuries have been associated with occupational transmission of hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV) and over 20 other pathogens.[1] A number of studies have documented the high prevalence of sharps injuries in this group.[2-8] Medical trainees are also at higher risk than more experienced physicians.[9] In this report, data from the Massachusetts Sharps Injury Surveillance System are used to describe sharps injuries to medical trainees in Massachusetts hospitals during 2002-2009.

BACKGROUND

Epidemiology of Sharps Injuries among Medical Trainees

Several epidemiological studies reveal that 35-74% of physicians-in-training and medical students reported one or more sharps injuries during the course of their training.[2-4,7,10-11] In 2009, a study found that 59% of the 699 recent medical school graduates reported at least one needlestick injury during medical school. Moreover, graduates who sustained a needlestick injury during medical school were 2.6 times more likely to have a needlestick injury during residency than did those who had not sustained such an injury during medical school.

Across the spectrum of clinical clerkships throughout medical education, surgical rotations may present the greatest risk.[4,6-7] In surveys of medical students, surgery rotations and surgical electives accounted for 38-53% of needlestick injuries.[4,6,10] A study conducted at the University of Southern California Medical Center illustrated that surgical residents had a six-fold increased risk of sharps injuries in comparison to their internal medicine counterparts.[7] Sharma et al., also reported that 83% of medical school graduates reported that they incurred a needlestick injury at some point during their surgical training.[11]

Inexperience may play a role in explaining the high risk of sharps injuries during medical training.[5,12-13] A study conducted of third-year medical students during their surgical rotation found a significant decrease in the exposure rates from the first quarter to the final quarter of the academic year (3.4 vs. 1 exposure per student), as they presumably had a better knowledge of universal precautions and were more comfortable performing procedures by the end of the academic year.[5]

Another factor that has been investigated as a potential explanation is that of fatigue and the disruption of circadian rhythms. A recent case-crossover study revealed that fatigue among medical trainees, often the result of long work hours and sleep deprivation, was associated with 3-fold increase in sharps injury risk.[8] Another study also reported that medical residents had a 1.5 times greater risk of sustaining a bloodborne pathogen exposure working nights in comparison to working days.[14]

Underreporting of Sharps Injuries

Several studies have addressed the issue of underreporting of sharps injuries among physicians.[15-17] In one UK study, only 9% of the physicians reported their needlestick injuries, whereas 46% of the midwives reported injuries sustained.[16] Research investigating reporting behaviors among medical trainees also indicates that underreporting is a common practice. Studies reveal that 41-81% of sharps injuries sustained by medical students go unreported.[2,4,11,18-20] A recent study found that 47% of medical residents who sustained a needlestick injury during medical school did not report their injury.[11]

The most common reasons of underreporting given by medical trainees include lack of time, perception of incidents as "low-risk," fear of stigmatization and embarrassment, and not knowing the reporting procedure.[11,16,21] In 2009, Sharma et al., found that a needlestick injury was 22 times more likely to be unreported if no one but the injured worker knew about the injury.[11]

The Massachusetts Sharps Injury Surveillance System

In 2001, Massachusetts enacted legislation regarding needlestick injury surveillance and prevention (MGL Chapter 111 §53D). Licensed hospitals are required to use devices with sharps injury prevention technology, develop exposure control plans, maintain logs of worker injuries with contaminated sharps and report data from these logs annually to the Massachusetts Department of Public Health (MDPH). Data reported to the MDPH Sharps Injury Surveillance System are compiled and published annually to guide state efforts to prevent sharps injuries and promote action at the local level. The surveillance system provides information about occupations at risk and devices, procedures and departments associated with sharps injuries that need to be addressed. It also serves as a vehicle for hospitals and health care workers in Massachusetts to share information about prevention strategies.

METHODS

All health care workers in acute and non-acute care hospitals licensed by MDPH, as well as any satellite units (e.g., community health centers, ambulatory care centers) operating under a hospital license, are included in the population under surveillance. Reportable incidents are exposures to blood or other potentially infectious materials as a result of events that pierce the skin or mucous membranes during the performance of an employee's duties. For more detailed description of the surveillance system and methods, refer to *Sharps Injuries among Hospital Workers in Massachusetts, 2004: Findings from the Massachusetts Sharps Injury Surveillance System* (www.mass.gov/Eeohhs2/docs/dph/occupational_health/injuries_hospital_2004.pdf).

This special topic report is based on data from 2002-2009, the first 8 years for which surveillance data are available. All licensed hospitals (~99) submitted an Annual Summary of Sharps Injuries between 2002 and 2009 to MDPH. A total of 25,500 injuries among all hospital workers were reported. Of these, 8, 268 (32%) were sustained by physicians. Physicians were further divided into two groups: 1) *medical trainees*, which included medical students, interns, residents and fellows, and 2) *attending physicians*, which included all other physicians, such as surgeons, anesthesiologists and radiologists. Injury rates using the numbers of full-time employees (FTE) as denominator for a subsample for which employment data are available are also presented. Injuries among medical trainees were compared to those among attending physicians.

LIMITATIONS

This report provides descriptive statistics (injury frequency and rates) of sharps injuries among physicians, especially medical trainees, in Massachusetts. However, a number of limitations need to be taken into account when interpreting the data. As previously noted, underreporting of sharps injuries, particularly among medical trainees, has been well documented. Also, small numbers of injuries in some categories highlighted in this report make results less stable and make interpretation somewhat challenging. Finally, this report updates our previous report *Sharps Injuries among Medical Trainees, 2002,* and includes data from 2002 to 2009. The 2002 report represents data collected early in the surveillance system, and reflects the distribution of sharps injuries among medical trainees in the period immediately following changes to federal and state laws. In contrast to the 2002 report, this new multi-year report excludes physician assistants from the attending physician category. Therefore, caution should be used when comparing injury distributions published in these two reports.

FINDINGS

FIGURE 1. SHARPS INJURIES AMONG PHYSICIANS N=8,268

Medical trainees accounted for 60% (4,972) of all reported sharps injuries among physicians. Of the medical trainees, the highest number of reported injuries were to interns and residents, and 92% of injuries occurred in teaching hospitals*, compared to 66% of attending physicians. Of the 6,736 injuries occurring among all physicians in teaching hospitals, 4,555 (68%) occurred to medical trainees.

* According to the Medicare Payment Advisory Commission, a major teaching hospital is defined as at least 25 full-time equivalent medical school residents per 100 inpatient beds.

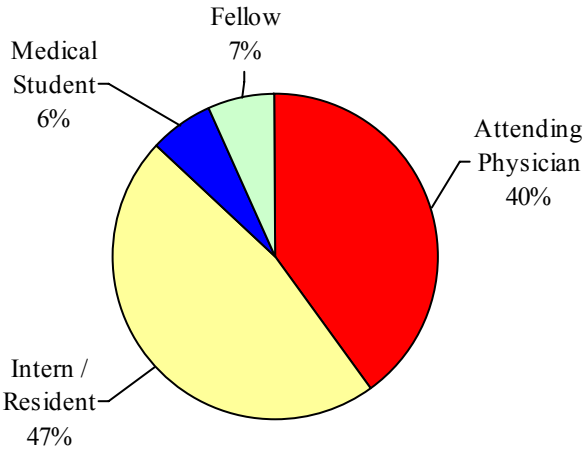


FIGURE 2. SHARPS INJURIES BY ACADEMIC YEAR QUARTERS MEDICAL TRAINEES VS. ATTENDING PHYSICIANS N=7,215*

Medical trainees showed a steady decline in the number of reported sharps injuries as they progressed through the academic year.

In contrast, attending physicians had a fairly constant number of injuries throughout the year.

* Seven complete academic years were presented in this figure. The first two quarters of 2002 and the last two quarters of 2009 were dropped due to incomplete academic years.

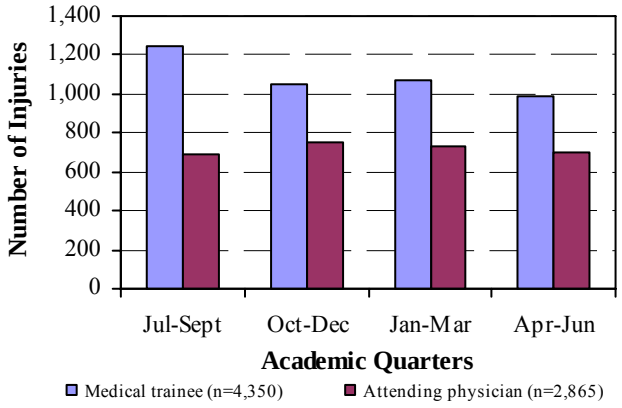


FIGURE 3. SHARPS INJURIES AMONG MEDICAL TRAINEES BY DEVICE N=4,972

Most medical trainee injuries (44%) involved suture needles, followed by hypodermic needles & syringes (22%). This distribution of devices involved in injuries was similar to that of attending physicians (data not shown), where suture needles and hypodermic needles & syringes accounted for 38% and 23% of the injuries respectively.

Hollow bore needles as a group accounted for 34% of injuries to medical trainees.

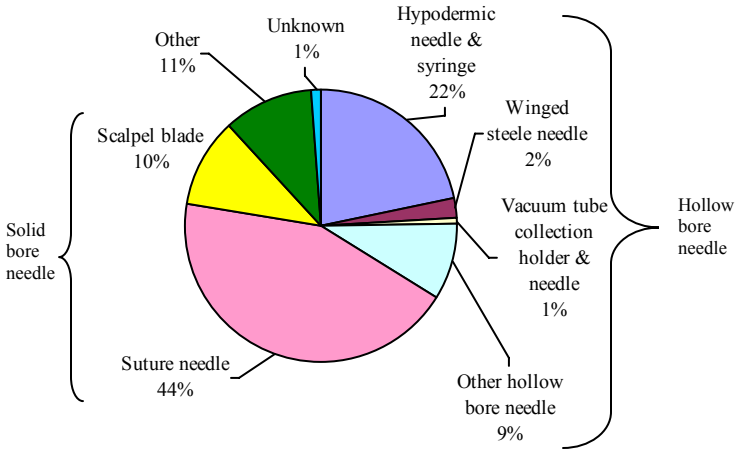


FIGURE 4. SHARPS INJURIES BY DEPARTMENT MEDICAL TRAINEES VS. ATTENDING PHYSICIANS **N=8.268**

The majority of injuries among medical trainees occurred in operating and procedure rooms (57%), followed by intensive care units (11%) and inpatient areas (11%).

This is similar to the distribution of injuries among attending physicians that more than half (69%) of injuries among them occurred in operating and procedure rooms. However, 8% of the injuries among them occurred in emergency departments and 6% in inpatient units.

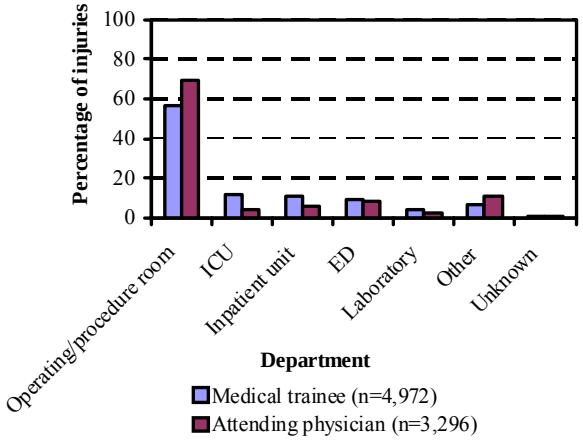


FIGURE 5. PROCEDURE OR PURPOSE FOR WHICH SHARP WAS USED **N=4,972**

Medical trainees were most often injured with devices associated with suturing, followed by those used for injection procedures.

The distribution of procedures involved in injuries among trainees was similar to that of attending physicians (data not shown) for whom suturing accounted for 38% and injection 19% of injuries.

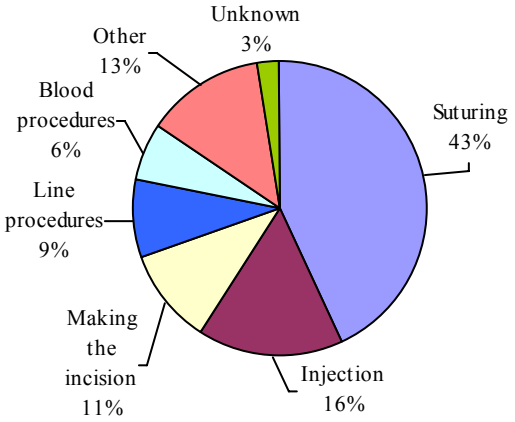


FIGURE 6. SHARPS INJURIES AMONG MEDICAL TRAINEES BY PROCEDURE AND WHEN INJURY OCCURRED **N=4,972**

Forty percent of the injuries among medical trainees associated with injections and 29% associated with line procedures occurred "after use, before disposal", when the presence of sharps injury protection feature on the device is important. Such distributions of procedures involved in injuries were similar to those of attending physicians (data not shown).

For blood procedures, 42% of the injuries to trainees occurred "after use, before disposal," compared to only 27% for attending physicians (data not shown).

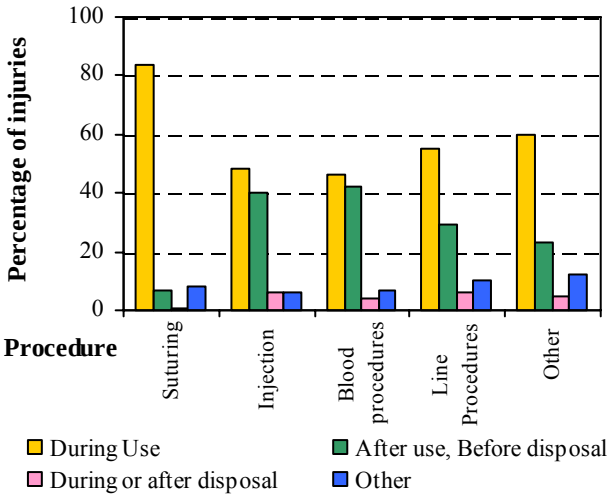


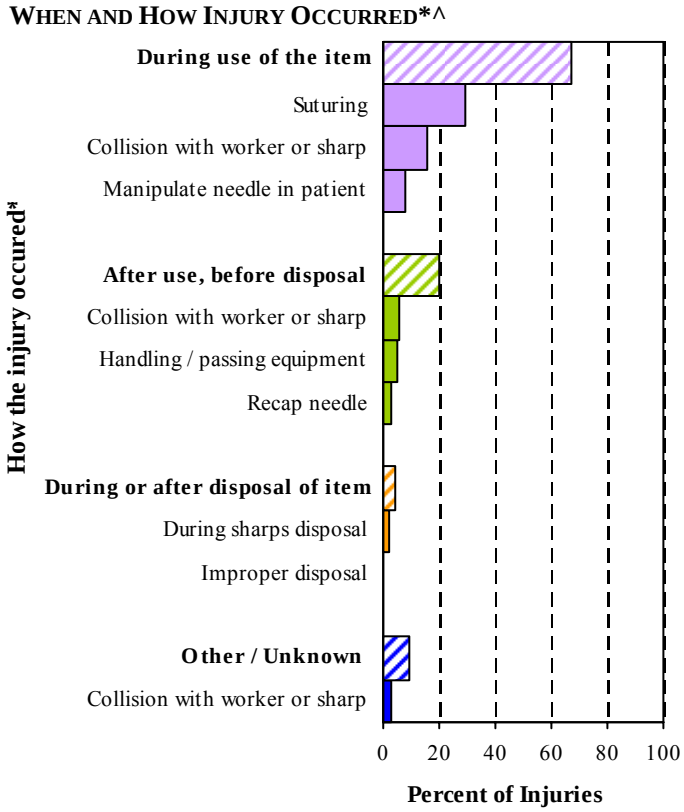
FIGURE 7. SHARPS INJURIES AMONG MEDICAL TRAINEES BY WHEN AND HOW INJURY OCCURRED N=4,972

A majority of injuries among medical trainees occurred during use of the sharp item (67%). One out of 5 sharps injuries to medical trainees occurred "after use, before disposal" of the sharp.

Of injuries among medical trainees occurring during use of the item, most occurred while suturing (29%), followed by "collision with a worker or sharp" (16%).

"Collision with a worker or sharp" and "Handling / passing equipment" accounted for 6% and 5% of the injuries occurring "after use, before disposal" respectively.

The distribution of these variables was similar to that of attending physicians (data not shown).



* Striped bars represent percentages of injuries by When injury occurred.
^ Where fleasible, top 3 expanations of How injury occurred by When injury occurred are listed.

FIGURE 8. SHARPS INJURIES TO MEDICAL TRAINEES DURING INJECTION PROCEDURES BY HOW THE INJURY OCCURRED N=785

When performing injection procedures, collision with worker or sharp accounted for 27% of injuries among medical trainees.

Manipulating needle in patient and recapping needle accounted for 18% and 14% of injuries associated with injection procedures respectively.

Three percent of all injuries associated with injection procedures occurred while activating sharps injury prevention feature.

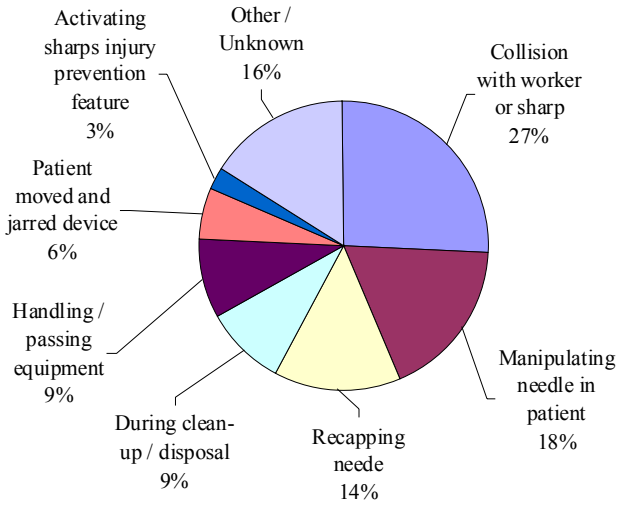
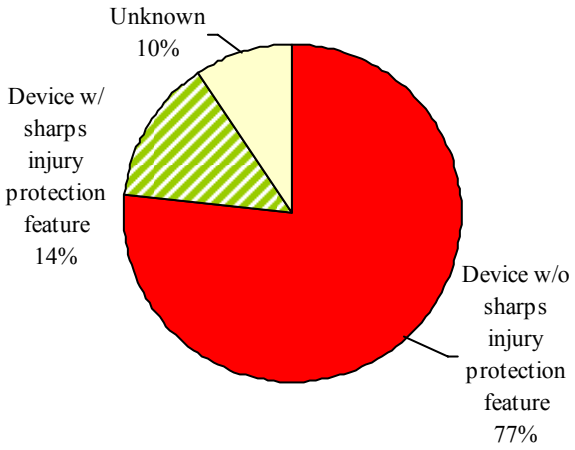
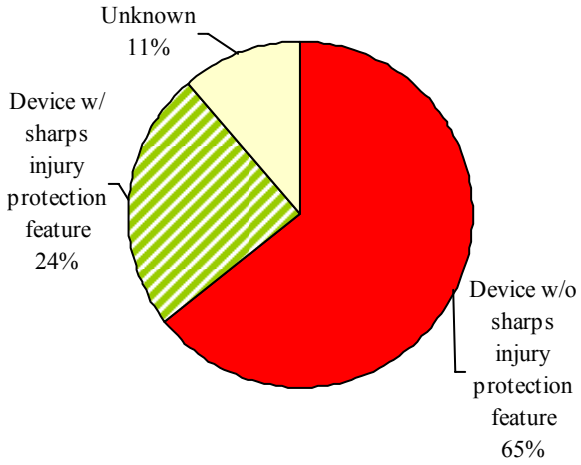


FIGURE 9. SHARPS INJURIES BY PRESENCE OF SHARPS INJURY PROTECTION FEATURE

Sharps Injuries Among Medical Trainees (N=4,972)



Sharps Injuries Among Medical Trainees - Excluding Sutures (N=2,803)



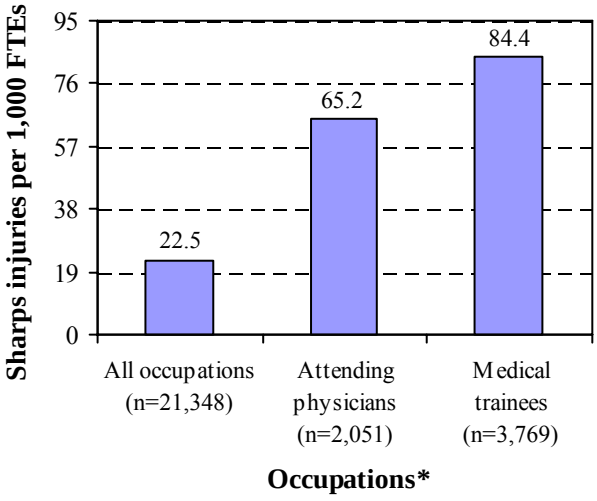
The majority of injuries (77%) among medical trainees involved devices without sharps injury protection features, similar to that of attending physicians (78%). Among medical trainees, 52% of these devices were suture needles, compared to 44% among attending physicians.

After excluding suture needles, devices for which few safety alternatives are available, devices without sharps injury protection features still accounted for 65% of the injuries to medical trainees, About 34% (609) of these devices were hypodermic needles / syringes, *devices for which safer alternatives are widely available*. Among attending physicians, 70% of injuries involved devices without sharps injury protection features, and 32% of them were hypodermic needles / syringes (data not shown).

FIGURE 10. SHARPS INJURY RATES BY OCCUPATION

Overall, medical trainees have the highest sharps injury rate (84 injuries per 1,000 trainee FTEs) in MA acute care hospitals, compared to other occupations (data not shown), and this is consistent with studies previously published.[22-23] Attending physicians have the second highest sharps injury rate (65 injuries per 1,000 attending FTEs).

*Rate analysis was restricted to sharps injuries among hospital employees in 77 acute care hospitals for which hospital employment data was available.



DISCUSSION

Sharps injuries are a common preventable hazard faced by medical trainees during the course of their training. The consequences of such injuries include the potential transmission of bloodborne pathogens and associated detrimental effects on their health, personal and professional lives. Preventing such injuries requires a concerted effort on the part of medical schools, hospitals, government agencies, equipment manufacturers and the trainees themselves. The findings of this report highlight specifics that need to be addressed to protect medical trainees and ensure a safe workplace.

Injury patterns of concern

Timing of injuries varied by the type of procedure being performed. For instance, suture-related injuries occurred most often during the procedure, whereas injuries relating to blood procedures occurred often after use and before disposal. Prevention measures regarding suturing should focus on the elimination of the hazard and substitution of devices by using alternative methods of closure (e.g., glues) and blunt suture needles where appropriate. For injuries relating to blood procedures, use of appropriate devices, training in the use of sharps injury prevention features and identification of barriers to the proper use of these features are feasible prevention methods.

Twenty percent of reported sharps injuries among medical trainees occurred "after use, and before disposal", indicating a delay or difficulty in prompt, efficient disposal of used sharps. Availability and placement of sharps containers may be a factor. Prevention strategies should also target sharps disposal containers (both fixed and portable), ensuring that they are available in adequate numbers and placed in appropriate locations, with protocols for replacing the containers when full.

Recapping needles

As outlined in the OSHA Bloodborne Pathogen Standard, recapping of needles should not be performed, unless it is done with the one-handed method. However, "recapping the needle" accounted for 14% of injection-related sharps injuries among medical trainees, stressing the importance of correct education in medical school regarding sharps handling. This finding also added to another recent study that reported that 27% of sharps injuries among healthcare workers involved recapping needles.[24] That study found that two-thirds of the healthcare workers had the misconception that needles should be recapped after use.[25] Since medical trainees imitate their instructors, these results emphasize the importance of continuous education on prohibiting and discouraging needle recapping among the entire healthcare workforce.

Devices without sharps injury protection features

The majority of reported sharps injuries (77%) among medical trainees involved devices lacking sharps injury protection features. This unacceptably high percentage underscores the urgent need to replace these devices with devices with engineered sharps injury protection features, and provide training in their proper use and disposal. The development of an inventory of devices as well as continuous evaluation of devices used within a facility is a key step in the process of converting to devices with engineered sharps injury prevention features. Conducting a review in a systematic fashion, on at least an annual basis, will aid in compliance with state as well as federal OSHA Bloodborne Pathogens regulations (29 CFR 1910.1030). For details on the process for maintaining an inventory of devices and evaluating devices, refer to *Sharps Injuries among Hospital Workers in Massachusetts, 2009: Findings from the Massachusetts Sharps*

Injury Surveillance System
(www.mass.gov/Eeohhs2/docs/dph/occupational_health/injuries_hospital_2009.pdf).

Inexperience
Medical trainees reported more sharps injuries during the first quarter of the academic year compared to the subsequent quarters. The frequency of sharps injuries declined throughout the academic year, approaching that of attending physicians. This may be explained by increased proficiency with various procedures, changes in job tasks or decreased reporting by medical trainees over the course of the year. Prevention strategies include targeted training seminars for medical trainees to increase their experience in handling sharps during various procedures, such as manipulating the needle in the patient during injection procedures, which was often associated with high number of sharps injuries. These should be mandatory and repeated throughout training at regularly scheduled intervals.

Fatigue
While not addressed in this study, as noted earlier, fatigue is a possible modifier of the risk of sharps injury among trainees. The Accreditation Council for Graduate Medical Education (ACGME) has standards limiting residents to an 80 hour work week averaged over 4 weeks.[26] In early September 2010, a petition, seeking a limit of 80 work hours per week for medical residents and other rest and hours limits, was also submitted to the Occupational Safety and Health Administration (OSHA) by Public Citizen and others.[27] In response to this petition, OSHA announced it will consider the need for federal regulations that would limit the work hours of resident physicians.[28] Hospitals are encouraged to collect data on work hours during medical training and document such information on incident reports to further evaluate this issue.

Underreporting
Literature indicates that medical students and physicians in training vastly underreport sharps injuries. The most common reasons center on aspects of self risk assessment and an under-appreciation of the value of following devised protocols. Lack of experience and judgment performing potentially high risk procedures may place them at increased risk for exposure. This lack of experience and judgment may also contribute to improper risk assessment and a failure to report the exposure incident. Underreporting of exposure incident prevents timely and appropriate post exposure management. The importance of reporting and follow-up must be emphasized in training and education seminars geared towards medical trainees, and should also be included in medical school curriculum as well as during hospital specific orientations.

CONCLUSION
The high proportion of sharps injuries among medical trainees within the physician group underscores the need to implement prevention measures targeted at these workers. The decrease in the number of injuries reported over the academic year raises questions about underreporting and proficiency with various procedures. Additional training during medical school and clinical rotations, as well as during residency and internships, on the use of devices with sharps injury prevention features will help to prevent sharps injuries. In addition, hospitals should continue to convert devices to those with sharps injury prevention features, paying particular attention to those devices used by physicians in training. MDPH will continue to monitor sharps injuries among medical trainees over time, with possible changes in the data collection process to allow for more detailed analysis in the future.

REFERENCES:

1. U.S. Occupational Safety and Health Administration (OSHA). Occupational Exposure to Bloodborne Pathogens; Needlestick and Other Sharps Injuries; Final Rule. *Fed Regist*. 2001;66:5317-5325.
2. Heald A and Ransohoff D. Needlestick Injuries among Resident Physicians. J of Gen Int Med. 1990; 5:389-393.
3. Lee C, Carter W, Chiang W, Williams C, Asimos A, and Goldfrank L. Occupational Exposures to Blood among Emergency Medicine Residents. Emergency Medicine. 1999;6(10):1036-1043.
4. Koenig S and Chu J. Medical student exposure to blood and infectious body fluids. Am J Infect Control 1995;23:40-43.
5. Vergilio J, Roberts R, and Davis J. The Risk of Exposure of Third-Year Surgical Clerks to Human Immunodeficiency Virus in the Operating Room. Arch Surg. 1993;128:36-39.
6. Birenbaum D, Wohl A, Runyon M, Stearns B, and Willett M. Medical students' occupational exposures to potentially infectious agents. Acad Med 2002;77(2):185-189.
7. O'Neill T, Abbott A, and Radecki S. Risk of Needlesticks and Occupational Exposures among Residents and Medical Students. Arch of Int Med. 1992;152:1451-1456.
8. Fisman D, Harris A, Rubin M, Sorock G and Mittleman M. Fatigue Increases the Risk of Injury From Sharp Devices in Medical Trainees: Results From a Case-Crossover Study. Infect Control Hosp Epidemiol 2007; 28:10-17.
9. Fisman D, Harris A, Sorock G and Mittleman M. Sharps-related injuries in health care workers: a case-crossover study. Am J Med 2003; 114:688-694.
10. Cervini P and Bell C. Brief report: Needlestick injury and inadequate post-exposure practice in medical students. J Gen Intern Med 2005; 20:419-421.
11. Sharma GK, Gilson MM, Nathan H and Makary MA. Needlestick injuries among medical students: incidence and implications. Acad Med. 2009; 84:1815–1821.
12. Sharma GK, Gilson MM, Nathan H, Makary MA. Needlesticks and Surgical Residents: Who Is Most at Risk? Acad Med. 2009 Dec;84(12):1815-21.
13. Guimet M, Mendicino S and Rockett M. Percutaneous injuries in a high-volume podiatric surgical residency program. The Journal of Foot and Ankle Surgery 2001 January-February: 40(1):15-20.
14. Parks D, Yetman R, McNeese M, Burau K, and Smolensky M. Day-Night Pattern in Accidental Exposures to Blood-Borne Pathogens among Medical Students and Residents. Chronobiology International 2000:17(1):61-70.
15. Tanberg D, Stewart K, and Doezema D. Underreporting of Contaminated Needlestick Injuries in Emergency Health Care Workers. Ann of Emerg Med. 1991:66-70.
16. Burke S and Madan I. Contamination incidents among doctors and midwives: reasons for non-reporting and knowledge of risks. Occup Med (Lond). 1997 Aug; 47(6):357-60.
17. Rattner S, Norman S, and Berlin J. Percutaneous Injuries on the "Front Line": A Survey of Housestaff and Nurses. Amer J of Prev Med. 1994; 10(6):372-377.
18. Patterson JMM, Novak CB, Mackinnon SE, Ellis RA. Needlestick injuries among medical students. Am J Infect Control. 2003; 31:226 –230.
19. Rosenthal E, Pradier C, Keita-Perse O, Altare J, Dellamonica P, and Cassuto JP. Needlestick injuries among French medical students. JAMA 1999; 281(17):1660.
20. Schmid K, Schwager C, Drexler H. Needlestick injuries and other occupational exposures to body fluids amongst employees and medical students of a German university: incidence and follow-up. Journal of Hospital Infection. 2007; 65, 124e130.

21. Shen C, Jagger J, Pearson R. Risk of needle stick and sharp object injuries among medical students. AJIC Am J Infect Control 1999; 27:435-7.
22. Naghavi SH, Sanati KA. Accidental blood and body fluid exposure among doctors. Occup Med (Lond). 2009 Mar;59(2):101-6
23. Ng LN, Lim HL, Chan YH, Bin Bachok D. Analysis of sharps injury occurrences at a hospital in Singapore. Int J Nurs Pract. 2002 Oct;8(5):274-81
24. Rampal L, Zakaria R, Sook LW and Zain AM. Needle stick and sharps injuries and factors associated among health care workers in a Malaysian hospital. European Journal of Social Sciences 2010; 13(3):354-362.
25. Lymer UB, Schutz AA and Isaksson B. A descriptive study of blood exposure incidents among healthcare workers in a university hospital in Sweden. Journal of Hospital Infection 1997; 35(3):223-235.
26. The Accreditation Council for Graduate Medical Education (ACGME). ACGME Duty Hour Standards Fact Sheet. http://www.acgme.org/acWebsite/newsRoom/ ACGMEdutyHoursfactsheet.pdf. Accessed March 30, 2011
27. Preston CM, Wolfe SM, Czeisler CA, et al. A Petition to Occupational Safety and Health Administration (OSHA) regarding resident work hours. 2010. http://www.wakeupdoctor.org/images/stories/OSHA.pdf. Accessed September 8, 2010
28. U.S. Department of Labor. Statement by US Department of Labor's OSHA Assistant Secretary Dr. David Michaels on long work hours, fatigue and worker safety. 2010. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=NEWS_RELEASES&p_id=18285. Accessed September 8, 2010