



Contents lists available at ScienceDirect

## American Journal of Infection Control

journal homepage: [www.ajicjournal.org](http://www.ajicjournal.org)

## Major Article

## Retrospective investigation of 9 years of data on needlestick and sharps injuries: Effect of a hospital infection control committee

Gönül Çiçek-Şentürk MD<sup>a\*</sup>, Asiye Tekin NP<sup>b</sup>, Yunus Gürbüz MD<sup>a</sup>, E. Ediz Tütüncü MD<sup>a</sup>, Ganime Sevinç NP<sup>b</sup>, Semanur Kuzi MD<sup>c</sup>, F. Aybala Altay MD<sup>a</sup>, Nilgün Altın MD<sup>a</sup>, İrfan Şencan MD<sup>a</sup><sup>a</sup> Department of Infectious Disease and Clinical Microbiology, Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey<sup>b</sup> Hospital Infection Control Committee Nursing, Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey<sup>c</sup> Infection Clinic, Artvin State Hospital, Artvin, Turkey

## Key Words:

Hospital infection control committee  
Bloodborne pathogen  
Education**Background:** The risk of occupational transmission of bloodborne pathogens to health care workers is primarily associated with needlestick and sharps injuries (NSIs). However, most NSIs are not reported, and most health care workers are not aware of postexposure procedures.**Methods:** Data for NSIs reported in our hospital between 2008 and 2016 were reviewed retrospectively.**Results:** A total of 546 staff members reported NSIs. Of these, 376 (68.9%) were women. NSIs were more commonly reported by trainee nurses (243 [44.5%]), followed by nurses (121 [22.2%]), cleaning staff (108 [19.8%]), and doctors (49 [9%]). The rate of postexposure interventions was 13% in 2008 and 92.6% in 2016 ( $P < .0001$ ;  $\chi^2 = 82.866$ ). NSI rates also show that the number of applications with NSIs increased over the years. When occupational blood exposure was examined, the number of bloodborne pathogens was 50 (9.3%) cases of hepatitis B virus, 30 (5.6%) cases of hepatitis C virus, 3 cases of Crimean-Congo hemorrhagic fever, 1 case of HIV, and 2 cases of hepatitis B virus and hepatitis C virus coinfection.**Discussion:** Over the years, the increase in both the appropriate intervention rate and the number of reports to the hospital infection control committee after NSIs shows that regular training regarding NSIs is effective.**Conclusions:** Hospital infection control committees may play a more active role in raising awareness in this regard and thus reducing the rate of unreported NSIs.

© 2018 Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. All rights reserved.

Occupational exposure to bloodborne pathogens with needlestick or other sharp tool injuries is a serious but preventable problem. Needlestick and sharps injuries (NSIs) in health care workers (HCWs) are primarily associated with occupational transmission of hepatitis B virus (HBV), hepatitis C virus (HCV), and HIV, but the number of pathogens transmitted by this pathway is  $>20$ .<sup>1</sup> In Turkey, Crimean-Congo hemorrhagic fever (CCHF) is one of the most important occupational exposure risks.<sup>2,3</sup> In a cross-sectional study by Leblebicioğlu et al,<sup>2</sup> 25 (49%) of 51 occupational exposures to CCHF were reported to develop into infection, of which 4 resulted in death. Although NSIs can result in severe infections, they are reported less when they occur, and most HCWs do not know what to do after exposure.<sup>4</sup> Burke and Maden<sup>5</sup> showed that only 9% of doctors reported NSIs. One of the

best ways to increase the rate of NSI reporting by health care staff is to provide educational activities and thus increase awareness. Previously published articles also reported on the positive effects of infection control activities and education on this subject.<sup>6-9</sup> In this study, the NSI data of the employee health subcommittee of the hospital infection control committee (HICC) were examined retrospectively; both the present situation and the effects of education provided by the HICC over the years were investigated. Previously, many studies on NSIs have been published.<sup>10-12</sup> However, most of these publications are survey studies. This study is the first from Turkey to provide long-term data of the HICC.

## METHODS

This study was conducted in a tertiary care education and research hospital with a capacity of 657 beds in Ankara. In 2016, the total number of HCWs including doctors, nurses, trainee nurses, and cleaning personnel at our institution was 2,315. Our hospital, which had previously served in the Social Insurance Institution, was transferred to the

\* Address correspondence to Gönül Çiçek-Şentürk, MD, Department of Infectious Disease and Clinical Microbiology, Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ziraat Mahallesi, Şehit Ömer Halisdemir Cad, 06110 Dışkapı, Ankara, Turkey.

E-mail address: [drgonulcicek@hotmail.com](mailto:drgonulcicek@hotmail.com) (G. Çiçek-Şentürk).

Conflicts of interest: None to report.

Ministry of Health in 2005. In the same year, the HICC was established in accordance with the regulation, which has authority over both hospital management and employees. Since 2008, the HICC has established the Employee Health Subcommittee. This subcommittee has started to register HCWs applying with NSIs by creating a form. In addition, this subcommittee has been training on NSIs under the heading “Precautions to Be Taken in NSIs” in their annual training plan for all employees and each newly started employee orientation training. No further training was given for this study. In addition, the shortcomings identified in the routine inspections conducted by the HICC have been reported to both management and the related department, and an attempt has been made to provide a solution jointly.

Appropriate management after the NSI is defined as washing the area with soap and water without applying pressure and leaving it to itself, and to report to the HICC during working hours or to the nearest infection control clinic as soon as possible outside of working hours. This study was designed as a retrospective study. The Clinical Research Ethics Committee of our institution approved this study.

## STATISTICAL ANALYSIS

Data analyses were made using SPSS Statistics V23.0, Open Epi, and Excel programs. In addition, graphics were drawn using the Excel program. Numerical variables and percentage distributions, rates of injuries, changes of rates with years, 95% confidence intervals with a 5% margin of error, and relative risk calculations were used for evaluating the data. A *P* value <.05 was considered statistically significant. The percentage of appropriate management and sharps instrument injury rates according to years were evaluated by the linear regression method:

Annual injury rate = number of injury cases / number of staff in the relevant year × 1,000

Rate of injuries attributed to duties and injuries specified = number of injuries resulting from injury as specified in the specified personnel / number of staff specified × 1,000 (the injury rate per 1,000 staff)

Rate of injury dependent on duty and specified equipment = number of injuries attributed to specified equipment in specified staff / number of specified staff × 1,000 (rate of injuries by 1,000 staff in the relevant department).

## RESULTS

During the 9-year period, a total of 546 employees reported NSIs to the HICC. Of these employees, 376 (69%) were women and girls. The average age of these personnel was 27.0 ± 11.5 years (range, 14–64 years). Some features of the 546 reported NSIs are shown in Table 1.

Among the cleaning staff, 55.6% of the injuries occurred during garbage collection, and 30.6% occurred during disposal of sharp instruments. Among trainee nurses, most of the NSIs occurred during invasive procedures (34.2%), during blood glucose measurement (23.9%), or while recapping the injector needle (15.9%). Overall, the instrument causing the injury was needlestick in >70% of cases. In addition, 417 of 546 NSI cases (76.4%) occurred during work hours (8 AM and 4 PM), 15.4% (n = 84) occurred between 4 PM and 12 AM, and 8.2% (n = 45) occurred between 12 AM and 8 AM.

NSIs were most reported in 2016. The rates and risk of injury are shown in Table 2. Compared with 2011, the rate of injury was highest in 2016, followed by 2012 and 2015, respectively. The lowest risk was found to be among doctors; by comparison, it was determined that the rate was 9.3 times for trainee nurses, 4.1 times for cleaning staff members, and 3 times for nurses.

**Table 1**

Some features of needlestick and sharp instrument injuries among health care workers in the hospital (2008–2016)

Feature	Number (n)	%
Sex		
Female	376	68.9
Male	170	31.1
Age group at event		
17 y	63	11.6
17–24 y	213	39.1
25–34 y	132	24.2
≥35 y	137	25.1
Mean ± SD, y	27.0 ± 11.5	
Median (min-max), y	24 (14–64)	
Profession		
Trainee nurse	243	44.6
Nurse	121	22.2
Cleaning staff member	108	19.8
Doctor	49	9.0
Other	24	4.4
Form of injury		
During invasive procedure	176	32.2
While disposing sharp instruments	100	18.3
While handling trash	64	11.7
During blood withdrawal	64	11.7
During serum glucose measurement	63	11.5
While recapping injector needle	61	11.2
Other	18	3.3
Event scene		
Inpatient clinic	245	44.9
Intensive care unit	99	18.1
Emergency department	79	14.5
Operating room	46	8.4
Blood drawing station	24	4.4
Outpatient clinic	21	3.8
Laboratory	8	1.5
Other	24	4.4
Tool that caused injury		
Needlestick	432	79.1
Lancet	57	10.4
Scalpel	27	5.0
Catheter	21	3.9
Other	9	1.6
Intervention appropriateness		
Appropriate	409	74.9
Not appropriate	137	25.1
Total	546	100

Contamination of the instruments was investigated: 526 of 546 (96.5%) injury cases were contaminated with body material, 11 (2%) had no contamination, and 8 (1.5%) were not identified. In blood-borne illness in the body material that caused any contamination, 50 (9.3%) were contaminated with HBV, 30 (5.6%) with HCV, 3 with CCHF virus, 1 with HIV, and 2 with concomitant HBV and HCV.

**Table 2**

Injury rates and injury risks according to professions and years (2011–2016)

	Injury rate (per 100 staff)	Risk ratio (95% confidence interval)
Year		
2011	2.1	1 (ref)
2012	3.5	1.6 (1.1–2.4)
2013	3.8	1.8 (1.2–2.6)
2014	3.2	1.5 (1.1–2.2)
2015	3.7	1.7 (1.5–2.5)
2016	4.5	2.1 (1.5–3.0)
Profession		
Trainee nurse	10.5	9.3 (6.9–12.6)
Cleaning staff member	4.7	4.1 (3.0–5.8)
Nurse	3.4	3.0 (2.2–4.2)
Doctor	1.1	1 (reference)

Of the 546 injured personnel, 452 (82.9%) were immunized against HBV. Two (0.4%) of the HCWs were also positive for hepatitis B surface antigen (HBsAg). The HBV test results of the HCWs with NSIs and the prophylactic applications for it are shown in Table 3. One person was given postexposure prophylaxis for HIV, and 3 staff members injured with a CCHF-contaminated instrument were given ribavirin prophylaxis.

The instrument causing injury was contaminated with 1 of the agents (HBV, HCV, HIV, or CCHF) in 29 (59%) doctors, 29 (23.9%) nurses, 4 (3%) members of the cleaning staff, and 8% of the trainee nurses admitted with NSIs. During the NSIs, 433 (79.3%) staff members were using personal protective equipment.

HCWs injured with instruments contaminated with any blood-borne disease were followed up for a maximum of 6 months according to the type of contaminant agent. None of the employees injured with an instrument contaminated with HBV, HCV, HIV, or NSIs developed the relevant infection, with the exception of a resident doctor who developed CCHF disease.

The appropriateness of management after injury and the changes over the years are shown in Figure 1 (appropriate management was 13% in 2008, whereas it increased to 92.6% in 2016;  $\chi^2 = 82.866$ ,  $P < .0001$ ). Over the years, the appropriateness of management in cases of NSI has increased to >90%. In the same chart, the rate of injury according to years is also seen, in which reported NSIs increased over the years. The rate of NSI cases that occurred among the cleaning staff members while collecting garbage ( $P < .001$ ); among nurses ( $P < .001$ ), trainee nurses ( $P < .001$ ), and doctors while recapping the injector needle; and among all HCWs during disposal of sharp instruments to relevant sharps disposal containers is presented in Figure 2.

## DISCUSSION

Of the 546 personnel who reported to the HICC for NSI-related reasons, 68.9% were women and girls, and 31.1% were men and boys. The high female ratio in NSI admissions was believed to be owing to the fact that the female ratio is higher among nurses, trainee nurses, and cleaning staff members. Most of the NSI cases were trainee nurses (44.6%). Trainee nurses were also the group of HCWs most exposed to NSIs in previous publications. This may be owing to the inexperience of the trainee nurses. In the study by Yang et al,<sup>9</sup> trainee nurses were exposed to NSIs about 2–4 times more frequently than

other nurses. Similarly, these data are compatible with those in previous publications.<sup>13</sup> The fact that NSIs were detected at lower rates among doctors may have been owing to less reporting of the injury in this group.

It is a general opinion that not all NSI cases are reported. It is also known that the awareness of the identity of the source and whether it does not have any bloodborne infections causes a false sense of trust after exposure and reduces the frequency of reports to relevant units.<sup>14</sup> The percentage of unreported NSIs in the literature ranges from 22%–82%, and several studies have been published about this issue.<sup>15–17</sup> Voide et al<sup>15</sup> conducted a questionnaire survey about NSIs among health care professionals. They found that although the most frequent injuries occurred among doctors (49.2%), the group that least reported NSIs was also doctors. The rate of nonreporting NSIs in this study was 67.1%.<sup>15</sup> We also believe that the unreported NSI rate is very high in our institution, especially among doctors, one of the reasons possibly being that anti-HIV, HBsAg, and anti-HCV tests are routinely performed before patients undergo any invasive procedure in our hospital. Our HICC proposes that it is sufficient to take standard precautions before invasive procedures, and therefore routine conduction of these tests before invasive procedures is unnecessary. In addition, despite the fact that there is an institutional decision not to request these tests routinely in terms of cost effectiveness, surgeons insist on these tests before each operation. We believe that when an injury occurs, doctors check the test results of the source and report NSIs to protect themselves if infectious disease is present. Indeed, the fact that the materials that caused injury to 59% of doctors, 23.9% of nurses, 3% of cleaning staff members, and 8% of trainee nurses reporting NSIs were found to be contaminated with HBV, HCV, HIV, or CCHF partially clarifies this situation.

NSIs were found to occur most frequently during invasive procedures (32.2%), followed by disposal of sharp instruments into relevant medical waste sharps containers (18.3%), recapping the injector needle (11.2%), and garbage collection (11.7%). Sharps disposal containers are boxes designed to prevent NSIs and should prevent such injuries when used in accordance with procedure.<sup>18</sup> The Occupational Safety and Health Administration recommends that injectors should be disposed of into sharps disposal containers without recapping. Several publications have emphasized that most NSIs occur while recapping the injector needle and that recapping should be avoided before disposal.<sup>18</sup> Nevertheless, many recent publications report that the rate of NSIs during recapping the needle is still high.<sup>19,20</sup> In a study by Salzer et al,<sup>21</sup> among medical school students in Austria, Germany, and England, the overall rate of NSIs occurring during recapping the injector needle was found to be 13%. In a recently published review, the rate of NSIs that occurred in this manner was 11.1%.<sup>1</sup> Unver et al<sup>10</sup> reported the rate of NSIs during recapping the needle as 20.3% among nursing students. In a study by Kepenek and Sahin-Eker,<sup>22</sup> the NSI rate while recapping needles was 41%. We as the HICC are most concerned that we as HCWs should be educated about disposing of used injectors without recapping the needle into the relevant sharps disposal containers. As a matter of fact, in the nurse and trainee nurse groups, a statistically significant decrease was observed in injuries that occurred during needle recapping, because this precaution had begun to be implemented. No such NSIs have been reported among nurses in the past 2 years (Fig 2). There was also a marked decrease in NSIs that occurred in this way in the trainee nurse group. Additionally, it was noted that NSIs that occurred among cleaning staff members during garbage collection in the first years were high, and the education program was extended to include this group. The fact that some of the NSIs that took place during garbage collection of needles and sharp tools that were being thrown into medical waste bags was determined to be the result of accidental exposure of the garbage collector. Regarding this situation, strict controls have been

**Table 3**  
HBV test results and prophylactic applications in the first submission to the hospital infection control committee of health care workers with needlestick and sharps injuries

HBV test results	N	%
Hepatitis B surface antigen		
Positive	2	0.4
Negative	544	99.6
Total	546	100.0
Anti-hepatitis B surface antigen		
Positive	453	82.9
Negative	93	17.1
Total	546	100.0
Application of HBV prophylaxis		
HBV immunoglobulin application		
Applied	10	1.8
Not applied	536	98.2
Total	546	100.0
HBV vaccination program		
Receipt	111	20.4
Not receipt	435	79.6
Total	546	100.0

HBV, hepatitis B virus.

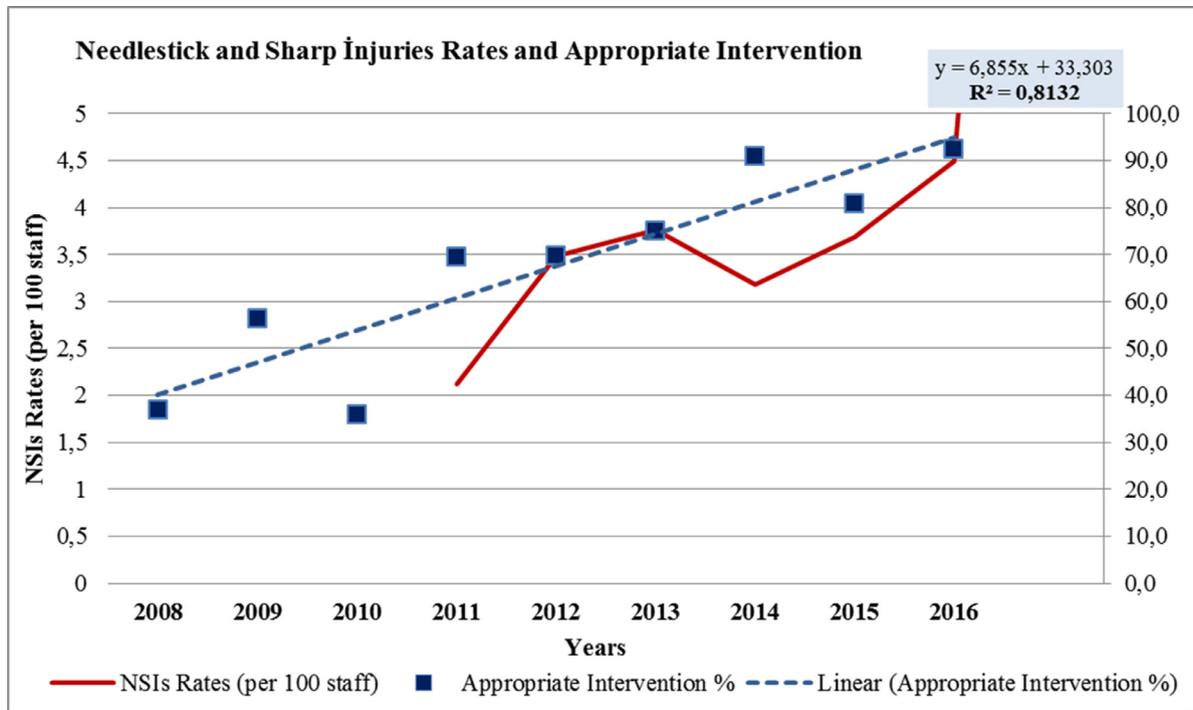


Fig 1. Needlestick and sharps injury (NSI) rates and appropriate intervention percentages over the years.

implemented to properly dispose of garbage. As a result, the NSIs that occurred in cleaning staff members while handling trash have significantly decreased, especially in the past 3 years. The same successful outcome could not be achieved in NSIs that occur during disposal of sharp instruments into relevant sharps containers.

The most frequently encountered scene for NSIs was at in-patient clinics (44.9%). After the clinics, NSIs occurred, in decreasing order, in intensive care units (18.1%), emergency services (14.5%), operating rooms (8.4%), blood drawing stations (4.4%), and outpatient clinics (9.3%). In our study, the incidence of NSIs, especially in the operating

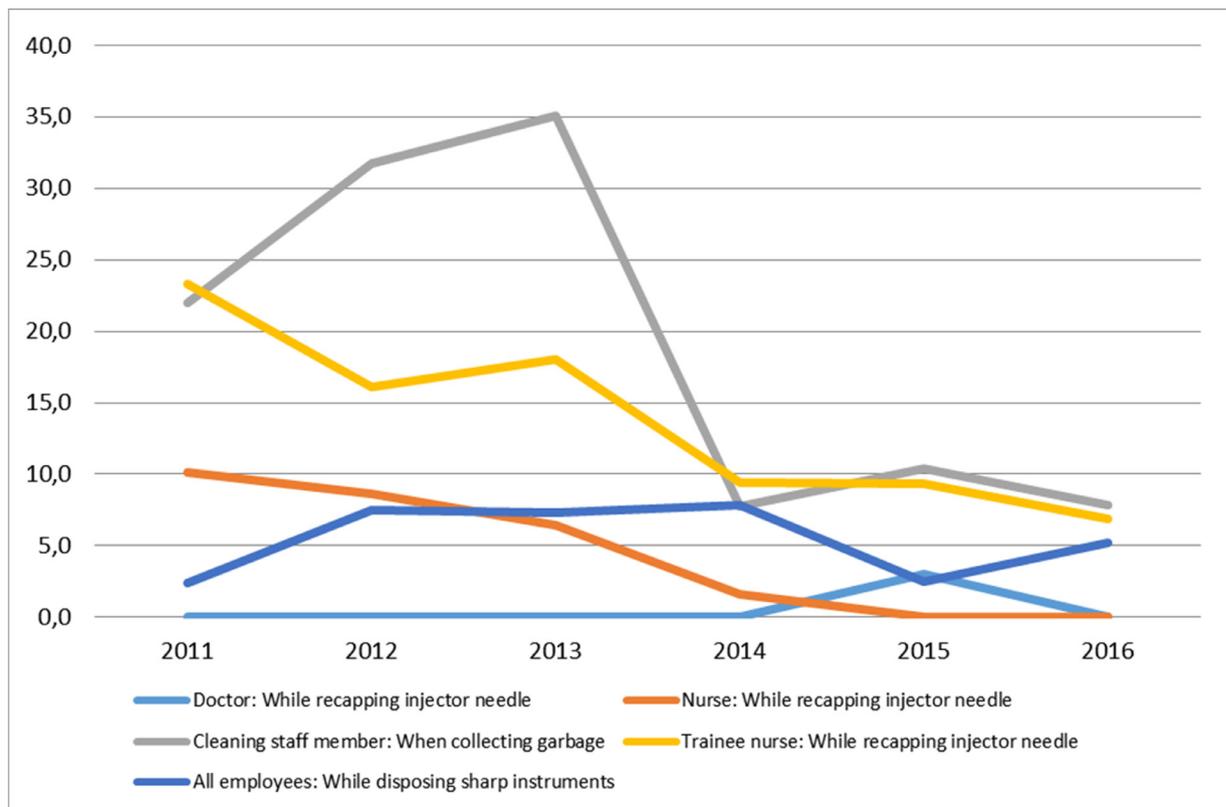


Fig 2. Changes in the rate of injury according to injury forms and professions (per 1,000 persons) (n = 435).

room, was not consistent with that reported in the literature. In many studies, operating rooms have been reported as one of the places where NSIs most frequently occur.<sup>23,24</sup> However, in the studies conducted in Turkey, the operating room was found to be one of the places where NSIs were relatively rare.<sup>7,11,25</sup> The most plausible explanation for this situation is that, as mentioned earlier, all surgeons request HBV, HCV, and HIV serology before surgery so that if the serology result is negative, NSIs are not likely to be reported. The number of HIV tests conducted in 2015 in our hospital was 77,191, which supports our prediction (unpublished data). In a survey conducted by Au et al,<sup>17</sup> surgeons noted that they reported only 19 (2.26%) of 840 NSIs. In this study, surgeons attributed the lack of NSI reports to the scarcity of their time and the excessive amount of paperwork.

The most common contaminating bloodborne agents after NSIs are HBV, HCV, and HIV. In our study, we found that 50 (9.3%) of the sharp instruments that caused NSIs were contaminated with HBV, 30 (5.6%) with HCV, 3 with CCHF virus, 1 with HIV, and 2 with concomitant HBV and HCV. In a study by Azap et al<sup>11</sup> conducted in Turkey, 17% of the source patients were HBsAg positive, 7% were anti-HCV antibody positive, and 3% were both HBV and HCV positive. In a study by Kuruuzum et al,<sup>12</sup> again from Turkey, seropositivity of the source patients for HCV, HBV, and HIV was reported as 7%, 4.7%, and 0.8%, respectively.

After the NSIs with HBV-, HCV-, or HIV-positive sources, no infection was transmitted to any HCW, and only 1 HCW developed CCHF infection who survived with a subclinical disease. In fact, the most serious problem in Turkey with NSIs is CCHF. In a study conducted by Celikbas et al,<sup>3</sup> 6 of 9 CCHF cases in HCWs were attributed to NSIs. In a multicenter study by Leblebicioglu et al,<sup>2</sup> it was found that 32 (62.7%) of 51 HCWs with CCHF were infected because of NSIs, of which 4 resulted in death.

In a study by Fritzsche et al,<sup>16</sup> it was thought that the rate of unreported NSIs was high, and the authors attempted to increase the reported rate of NSIs. In some studies, several initiatives have been made to reduce rates of unreported NSIs. These initiatives included the safe use of tools, the provision of education, and the introduction of several national and institutional rules, and their reflection on outcomes and behaviors has been researched.<sup>1,16</sup> In the article by Fritzsche et al,<sup>16</sup> a new regulation was made at a university hospital to report to an infection clinic for postexposure prophylaxis while personnel with NSIs also went to their accident insurance doctors, resulting in a statistically significant increase in the rate of reporting NSIs. Similarly, in previous studies, positive effects of infection control activities and education have been shown on NSIs.<sup>8,26,27</sup> Our goal as an HICC team is to increase both the compliance of post-NSI interventions in general and the reporting rate of NSIs. We also focus on issues that lead to NSIs and can be corrected by taking simple precautions, such as avoiding recapping needles, proper disposal of medical waste, and avoiding injuries while handling trash. As noted previously, there was statistically significant success in other matters except for the NSIs that occurred during the use of medical sharps disposal containers (Fig 2).

The most important limitation of our study is that it was retrospective, so the intervention is not in the framework of a program. However, we assessed the natural impact of the HICC process.

## CONCLUSIONS

As a result of NSIs, HCWs can be infected with chronic diseases such as HBV, HCV, and HIV, as well as with acute mortal infections such as CCHF and Ebola. Despite the seriousness of the situation, most HCWs do not report these incidents because of job intensity or because procedures take too long when NSIs are reported, and many HCWs do not know what to do in such situations. Infection control committees in hospitals may play a more active role in raising awareness in this regard and reducing the number of unreported NSIs. From this point of view, it may be more effective to provide training

for the development of behavioral changes that are done as a process rather than over a period of time.

## ACKNOWLEDGMENTS

The authors wish to thank the epidemiologist Dr. Fehminaz Temel for his contribution to statistical analysis.

## References

- Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. *Med Devices (Auckl)* 2017;10:225-35.
- Leblebicioglu H, Sunbul M, Guner R, Bodur H, Bulut C, Duygu F, et al. Healthcare-associated Crimean-Congo haemorrhagic fever in Turkey, 2002-2014: a multi-centre retrospective cross-sectional study. *Clin Microbiol Infect* 2016;22:387.e1-4.
- Celikbas AK, Dokuzoguz B, Baykam N, Gok SE, Eroglu MN, Midilli K, et al. Crimean-Congo hemorrhagic fever among health care workers. *Turkey. Emerg Infect Dis* 2014;20:477-9.
- Riddell A, Kennedy I, Tong C. Management of sharps injuries in the healthcare setting. *BMJ* 2015;351:h3733.
- Burke S, Madan I. Contamination incidents among doctors and midwives: reasons for non-reporting and knowledge of risks. *Occup Med* 1997;47:357-60.
- Richard V, Kenneth J, Ramaprabha P, Kirupakaran H, Chandu GM. Impact of introduction of sharps containers and of education programmes on the pattern of needle stick injuries in a tertiary care centre in India. *J Hosp Infect* 2001;47:163-5.
- Karabay O, Gulsume K, Ogutlu A. The effect of training on the notification of sharp instrument injuries. *Mediterr J Infect Microb Antimicrob* 2014;3:21.
- Zafar A, Habib F, Hadwani R, Ejaz M, Khowaja K, Khowaja R, et al. Impact of infection control activities on the rate of needle stick injuries at a tertiary care hospital of Pakistan over a period of six years: an observational study. *BMC Infect Dis* 2009;9:78.
- Yang Y-H, Liou S-H, Chen C-J, Yang CY, Wang CL, Chen CY, et al. The effectiveness of a training program on reducing needlestick injuries/sharp object injuries among soon graduate vocational nursing school students in southern Taiwan. *J Occup Health* 2007;49:424-9.
- Unver V, Tastan S, Coskun H. The frequency and causes of occupational injuries among nursing students in Turkey. *Arch Environ Occup Health* 2012;67:72-7.
- Azap A, Ergonul O, Memikoglu KO, Yesilkaya A, Altunsoy A, Bozkurt GY, et al. Occupational exposure to blood and body fluids among health care workers in Ankara, Turkey. *Am J Infect Control* 2005;33:48-52.
- Kuruuzum Z, Elmali Z, Gunay S, et al. Occupational exposures to blood and body fluids among health care workers: a questionnaire survey. *Mikrobiyol Bul* 2008;42:61-9.
- Shen C, Jagger J, Pearson RD. Risk of needle stick and sharp object injuries among medical students. *Am J Infect Control* 1999;27:435-7.
- Jeffe DB, Mutha S, L'Ecuyer PB, Kim LE, Singal RB, Evanoff BA, et al. Healthcare workers' attitudes and compliance with universal precautions gender, occupation, and specialty differences. *Infect Control Hosp Epidemiol* 1997;18:710-2.
- Voide C, Darling KE, Kenfak-Foguena A, Erard V, Cavassini M, Lazor-Blanchet C. Underreporting of needlestick and sharps injuries among healthcare workers in a Swiss University Hospital. *Swiss Med Wkly* 2012;142:w13523.
- Fritzsche C, Heine M, Loebermann M, Klammt S, Podbielski A, Mittlmeier T, et al. Reducing the underreporting of percutaneous exposure incidents: a single-center experience. *Am J Infect Control* 2016;44:941-3.
- Au E, Gossage J, Bailey S. The reporting of needlestick injuries sustained in theatre by surgeons: are we under-reporting? *J Hosp Infect* 2008;70:66-70.
- Jackson MM, Mulherin S, Rickman LS. Dumpster diving in sharps disposal containers: what's really inside? *Infect Control Hosp Epidemiol* 1996;17:570-1.
- Afridi AAK, Kumar A, Sayani R. Needle stick injuries—risk and preventive factors: a study among health care workers in tertiary care hospitals in Pakistan. *Glob J Health Sci* 2013;5:85-92.
- Goel V, Kumar D, Lingaiah R, Singh S. Occurrence of needlestick and injuries among health-care workers of a tertiary care teaching hospital in North India. *J Lab Physicians* 2017;9:20-5.
- Salzer HJ, Hoenigl M, Kessler HH, Stigler FL, Raggam RB, Rippel KE, et al. Lack of risk-awareness and reporting behavior towards HIV infection through needlestick injury among European medical students. *Int J Hyg Environ Health* 2011;214:407-10.
- Kepenek E, Sahin-Eker HB. An assessment of sharp injuries to workers in a state hospital. *Klimik Dergisi* 2017;30:78-82.
- Lakbala P, Sobhani G, Lakbala M, Inaloo KD, Mahmoodi H. Sharps injuries in the operating room. *Environ Health Prev Med* 2014;19:348-53.
- Makary MA, Al-Attar A, Holzmueller CG, Sexton JB, Syn D, Gilson MM, et al. Needlestick injuries among surgeons in training. *N Engl J Med* 2007;356:2693-9.
- Guliz E, Meral U, Safak K, et al. Evaluation of sharp object injuries in healthcare personnel working in Diyarbakir Gazi Yasargil Training and Research Hospital. *Mediterranean J Infect Microbes Antimicrob* 2015;4:9.
- El Beltagy K, El-Saed A, Sallah M, Balkhy HH. Impact of infection control educational activities on rates and frequencies of percutaneous injuries (PIs) at a tertiary care hospital in Saudi Arabia. *J Infect Public Health* 2012;5:297-303.
- Brusaferrro S, Calligaris L, Farneti F, Gubian F, Londero C, Baldo V. Educational programmes and sharps injuries in health care workers. *Occup Med (Lond)* 2009;59:512-4.