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Incidence of needlestick injuries among medical students after implementation of preventive training

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INTRODUCTION Structured training for the prevention of needlestick injuries (NSIs) among medical students was implemented in Singapore in 1998. In this study, we determined the incidence of NSIs and the knowledge and practice of managing and reporting NSIs among first-year clinical students in a medical school in Singapore, as well as the adequacy of the training provided for these students, 14 years after preventive training was instituted.

METHODS All third-year medical students (n = 257) from the Yong Loo Lin School of Medicine, National University of Singapore, Singapore, who had completed their first clinical year posting were enrolled in this cross-sectional study. A self-administered questionnaire was answered by the students one month after completion of their last clinical posting. Students who repeated their first clinical year were excluded from the study.

RESULTS 237 students completed the questionnaire. However, 9 of these students were excluded because they repeated their first clinical year. The response rate was 91.9%. Although 8 (3.5%) students reported one NSI each, only 2 (25.0%) of these 8 students reported the incident to the relevant authority. Among the students surveyed, 65.8% reported using gloves at all times during venepuncture procedures, 48.7% felt that improvements could be made to the current reporting system and procedures, and 53.2% felt that the training provided before commencement of clinical posting could be enhanced.

CONCLUSION There was a decrease in the incidence of NSIs among medical undergraduates in their first clinical year when compared to the incidences reported in earlier studies conducted in the same centre (35.1% in 1993 and 5.3% in 2004). The current reporting system could use a more user-friendly platform, and training on NSIs could be improved to focus more on real-life procedures and incident reporting.

Keywords: incident reporting, medical students, needlestick injuries

INTRODUCTION

Needlestick injuries (NSIs) are defined as puncture wounds resulting from the usage of hypodermic needles, suture needles, blood collection needles, intravenous (IV) cannulas, winged needle IV sets, IV stylets and needle components of the IV delivery systems.[1-4] As medical students lack knowledge, experience and skill, they are vulnerable to accidental exposure to blood and other body fluids when performing clinical activities. This places medical students at the potential risk of blood-borne diseases such as hepatitis B virus (HBV), hepatitis C virus and human immunodeficiency virus (HIV). Even if there are timely and effective postexposure prophylaxes, such as for HBV and HIV, there can be serious psychological and economic consequences following NSIs.[5-7] Also, unsafe practices such as not wearing gloves and the resheathing of needles predispose medical students to NSIs.

There are various approaches and differences in the programme curricula of various medical schools to prevent NSIs among medical students. One preventive strategy is to enhance training programmes on infection control, including the prevention of NSIs, while another is to improve medical students' knowledge of the management and reporting procedures following an NSI. An effective and multifocused training programme is essential, as its implementation can decrease the overall rate of NSIs in hospitals.[8] The Clinical Skills and Foundations Course (CSFC) was introduced in the Yong Loo Lin School of Medicine, National University of Singapore (NUS), Singapore, in 1998 to help medical students gain essential clinical skills prior to their clinical postings. Medical students are given simulation-based training, clinical experience and knowledge about infection control during the course as part of the measures taken to reduce the incidence of NSIs among medical students.[9,10] There are also existing guidelines on the prevention of blood-borne diseases and injury notification available in Singapore from the Singapore Ministry of Health,[11] NUS[12] and various restructured hospitals.

Although earlier studies on NSIs at the Yong Loo Lin School of Medicine showed a declining trend for the incidence of NSIs, the last such study was performed in 2004.[13,14] As medical education has since evolved, this study was conducted to determine the incidence of NSIs among third-year medical students, so as to: (a) study their knowledge of NSI prevention practices; (b) examine their management of NSI incidents and incident-reporting behaviour; and (c) establish areas of the training programme that might require further refinement.

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METHODS

The study population of this cross-sectional study comprised all third-year medical students attending the Yong Loo Lin School of Medicine in 2011 who had completed their first clinical year posting (n = 257). This group of students were selected because they should have been educated about the prevention of NSIs during CSFC before they began their clinical year, and because they would have been exposed to the risk of NSIs by the end of their third-year postings. Students who repeated their first clinical year were excluded from the study.

A self-administered questionnaire on hepatitis B vaccination status, training on venepuncture, NSI incidence, NSI incidence reporting, knowledge of NSI prevention and suggested areas of improvement in the current training system was completed by students one month after the completion of their last clinical posting. By this time, all students were expected to have completed one month of CSFC and ten months of clinical rotation. CSFC included two weeks of general medicine postings, two weeks of general surgery postings and basic procedural trainings such as venepuncture, while clinical rotation consisted of five two-month long postings in general medicine, general surgery, orthopaedics, family medicine and paediatrics. The number of venepunctures performed by students during the various postings was not specifically quantified in the questionnaire. However, students generally performed the most number of venepunctures during their general surgery posting, followed by postings in general medicine, family medicine and orthopaedics. Students were not required to perform venepunctures during their paediatrics posting.

All statistical analyses were performed using the Statistical Package for the Social Sciences for Windows version 19 (SPSS Inc, Chicago, IL, USA). Descriptive analysis was performed by calculating absolute frequencies for categorical variables. Fisher's exact test was used to compare the proportions of binary variables between respondents with NSI and those without during their first clinical year in medical school. Logistic regression would be used to assess the relationship between the students' knowledge of the universal precaution guidelines and reporting protocols, and their reporting behaviour, if initial results were significant. A p-value of < 0.05 was considered statistically significant.

RESULTS

Out of the 257 students, 237 completed the questionnaire. However, 9 of these 237 students were excluded because they had repeated their third year, leaving a total of 228 students in the study. Therefore, a response rate of 91.9% (228/248 eligible students) was obtained in our study cohort. The mean age of the respondents was 21.7 years, and the majority of them were male (50.4%) and of Chinese ethnicity (87.2%). All students were vaccinated against hepatitis B.

The 8 (3.5%) students who had sustained NSIs during their clinical posting had one episode of NSI each. The highest incidence occurred during the general surgery posting (7/8 students); only one incident occurred during the general medicine posting. No NSI was reported during the other postings. Three of these eight NSIs occurred during clinical ward work, three during on-call time (after 5 pm) and two in the operating theatre. Five NSIs occurred when the student was disassembling a syringe, one when the student was transferring a needle to a coworker and one while the student was suturing. The remaining incident was not described. Only two out of the eight students who had sustained an NSI reported the incident to the relevant authority.

Five of the eight students who reported an NSI used gloves during all venepuncture procedures. Among all the respondents, most (65.8%) used gloves each time they took blood, while 28.9% of students used gloves most of the time and only 5.3% of students never or rarely used gloves during blood-taking procedures. In the event that an NSI is sustained, more than 50% of the respondents indicated that they would immediately employ first aid (wash the wound with water and disinfectant), notify the infection control officer at the hospital, or look up the case notes of the source patient for past medical history of blood-borne diseases. Approximately one-third of the respondents indicated that they would immediately proceed to the staff clinic or emergency department for blood tests, make a full report of the incident to the infection control officer in the hospital, or notify the Office of Safety, Health and Environment (OSHE) in the university via the online accident and incident reporting system.

In terms of the students' knowledge on preventing and reporting NSIs, three guidelines and protocols were explored in the questionnaire – the universal precaution guidelines and the NSI reporting protocols of the respective teaching hospital and university. We found that students had more knowledge of the reporting protocols of their respective teaching hospitals, with 68.0% reporting that they knew some details about it. Only 40%–60% of the students knew some details of the universal precaution guidelines and NSI reporting protocols of the university. Students reported having the least knowledge about universal precaution guidelines, with 15.3% having never heard of it. Less than 9% of students knew all the details, and 20%–40% of students had not heard of or did not know any details about the universal precaution guidelines and the NSI reporting protocols of the teaching hospital and university (Table I).

Most (95.1%) students indicated that they would report the incident if they had sustained an NSI, with the main reason for reporting being the concern of contracting certain blood-borne diseases (54.7%). Other reasons for reporting NSI included knowing the importance of making a report (25.2%), to obtain early treatment (18.2%) and knowing the proper reporting procedures (1.9%). Only 4.9% of students indicated that

Table I. Knowledge of the universal precaution guidelines and needlestick injury reporting protocols of the hospitals and university among students (n = 222).

Parameter	Know all details	Know some details	Heard about it, but do not know the details	Have not heard about it
Universal precaution guidelines	16 (7.2)	110 (49.5)	62 (27.9)	34 (15.3)
NSI reporting protocol in your teaching hospital	19 (8.6)	151 (68.0)	51 (23.0)	1 (0.5)
NSI reporting protocol of the university	16 (7.2)	127 (57.2)	67 (30.2)	12 (5.4)

Data is presented as no. (%). Six respondents were excluded due to missing data in this question section. NSI: needlestick injury

Table II. Relationship between knowledge of students and their incident-reporting behaviour (n = 222).

Parameter	Will report (n = 212)	Will not report (n = 10)	Risk ratio	p-value
Universal precaution guidelines			1.9	0.105
Knows all or some details	123/126 (97.6)	3/126 (2.4)		
Does not know any details or have not heard about it	89/96 (92.7)	7/96 (7.3)		
NSI reporting protocol in your teaching hospital			1.3	0.249
Knows all or some details	164/170 (96.5)	6/170 (3.5)		
Does not know any details or have not heard about it	48/52 (92.3)	4/52 (7.7)		
NSI reporting protocol of the university			1.3	0.332
Knows all or some details	138/143 (96.5)	5/143 (3.5)		
Does not know any details or have not heard about it	74/79 (93.7)	5/79 (6.3)		

Data is presented as proportion of students (%). Six respondents were excluded due to missing data in this question section. NSI: needlestick injury

they would choose not to report the incident if they had sustained an NSI. Most students would not report the NSI if they thought the injury was due to a clean needle (27.3%), if they perceived a low risk of any disease transmission to themselves (27.3%), or if they did not know the proper reporting procedure (18.2%). Other reasons quoted for not reporting were having no time to report, concerns about confidentiality and not thinking it was important to report.

Almost half (48.7%) of the students thought that improvements could be made to the current reporting system and procedures. Of these students, 85.3% hoped to have a more user-friendly reporting system, 54.1% wanted to have more accessible authorised personnel (e.g. infection control nursing officers) to report to, and 45.0% requested for a 24-hour reporting hotline. More than half (53.2%) of the students felt that the training provided during CSFC regarding prevention of NSI and the reporting procedures after sustaining an injury was inadequate. Most students wanted supervised practice on real patients (61.4%), and on the reporting procedures and guidelines (50.4%). Other suggestions made by the students included having simulations on NSI reporting procedures (43.9%), having more venepuncture practice via the use of simulators (34.2%), and reinforcement of prevention measures (26.3%) and infection control (18.9%). Table II shows the relationship between the students' knowledge of universal precaution guidelines and reporting protocols of their teaching hospital and university, and their reporting behaviour.

The percentage of students who knew all or some details of the universal precaution guidelines and would report the NSI incidence was 97.6%. However, 92.7% of students who did not know any details or had not heard of the universal precaution guidelines would still report NSIs. The difference between these two groups was not statistically significant. The percentage of students who knew all or some details of the NSI reporting protocols of their teaching hospital and university and would report the NSI was 96.5% in both instances. In contrast, 92.3% and 93.7% of students who did not know or had not heard of the reporting protocols of their teaching hospital and university, respectively, indicated that they would report NSI occurrences. The differences between these two groups were also not statistically significant. Logistic regression analysis to assess the relationship between the students' knowledge about universal precaution guidelines and NSI reporting protocols, and the students' reporting behaviour was not done as the initial results were not statistically significant.

DISCUSSION

In this study, 3.5% of the students surveyed reported at least one NSI in their first clinical year. There has been a decline in the one-year incidence of NSI among first clinical year students at the medical school from the 1990s to the early 2000s, as well as to the present time, with the rate being 35.1% in 1993,[13] 5.3% in 2004[14] and 3.5% in 2011 (data from present study). This one-year incidence of NSI is comparable to the rates reported for third-year medical students from overseas centres, such as the New York-Presbyterian Hospital/Weill Cornell Medical Center (10.7%)[15] and the University of Florida (9.3%) in the United States.[16]

Of the 8 students who had an NSI in our study, 7 sustained the injury during their general surgery posting and 1 during their internal medicine posting. This finding might be related to the larger pool of inpatients within the surgical and medical departments of hospitals, leading to heavier

workloads during these postings and the need for more procedures to be performed by students. Importantly, six of the eight students who sustained an NSI did not report the incident to their supervisors or via the university online reporting system. Underreporting of injuries is a concern that needs to be addressed. Possible reasons cited by students who would not report the incident if they experienced an NSI included busy schedules, lack of familiarity with reporting procedures for NSI, concerns about confidentiality and inadequacy of the reporting platform. It is thus important that students be properly educated regarding NSI during preventive training. As the cohort of students enrolled in this study only included medical students in their first clinical year, our findings cannot be accurately extrapolated to second and final clinical year students.

This study also found that 34.2% of students did not always wear gloves when they drew blood from patients. Gloving is known to protect against injury from needles,[17] as well as reduce the risk of blood-borne infections to healthcare workers due to the 'wiping effect' of the glove material.[18] Gloving reduces the risk of blood-borne infections because it can reduce the volume of contaminated blood being introduced by injury due to hollow-bore needles.[18-20] However, due to constraints of sample size and questionnaire length, we were unable to further investigate the reasons for not wearing gloves during venepunctures. Instructors need to keep in mind the importance of inculcating in students the practice of wearing gloves during all venepunctures procedures, as it is part of universal precautions to protect both healthcare workers and patients.

The first published Singapore study on the incidence of NSI among medical students in 1993 showed a high number (35.1%) of first clinical year students with at least one NSI.[13] Some of the recommendations made following that study have been implemented (e.g. formal training, adequate equipment, reporting and counselling systems and hepatitis B vaccination for medical students). The incidence of NSI has since declined at this medical school, with the one-year NSI incidence among first clinical year students being 5.3% in 2004.[14] This could be attributed to the implementation of instituted formal training courses at the school, such as the CSFC, prior to students starting their clinical training from 1998 onwards. Notably, none of the students in our study sustained an NSI due to the resheathing of used needles. Also, all the medical students in our study had been vaccinated against hepatitis B. Evidence of hepatitis B immunity is mandatory before students are allowed to enrol into medical schools in Singapore. It has also been made compulsory for medical students to have sufficient hepatitis B antibody titres before they enter the clinical year.

Venepuncture training during CSFC is generally only done on medical simulation mannequins. When students start their clinical postings, additional training on venepuncture is left to the discretion of the clinical tutors at the various hospitals. The CSFC teaching for venepuncture could be extended to the wards, where clinical tutors could supervise the medical students' first few attempts at performing venepuncture on patients. Students can also be evaluated using formal assessment tools such as the mini-clinical evaluation exercise (mini-CEX) during the course of CSFC.[21] This would ensure that mistakes are picked up and corrected early, instead of allowing students to make a habit of incorrect venepuncture techniques.

There might be a need to revisit the reporting systems in place for NSI, as our study showed that only two of the eight (25%) students who had NSI actually reported the incidents. Furthermore, most students were unaware of the proper reporting procedures should they sustain an NSI. It is important that students who have sustained an NSI report the incident to a well-established system, so that they can receive timely postexposure prophylaxis, if needed. A direct link could be placed on the homepage of the university's and hospital's websites for easy access, and reporting should be made possible with minimal input components, in which less critical information can be filled in at a later time. Hotline telephone numbers and/or dedicated infection control personnel would also significantly increase reporting compliance among students.[8] Clear policies and guidelines are also important to increase the reporting of NSI incidents.[22,23] Although knowledge can transform attitudes and change behaviour, we did not observe a statistically significant relationship between the students' knowledge of universal precaution guidelines and NSI reporting protocols of the teaching hospital and university, and their reporting behaviour.

In conclusion, the incidence of NSI among first clinical year medical undergraduates at our medical school declined ten-fold in the last two decades. This decrease can be attributed to the implementation of instituted formal training courses, such as the CSFC, for medical students prior to the commencement of their clinical postings. Training enhancements that could be considered include supervised practice venepuncture on real patients and practise of incident reporting. Assessments could be carried out using mini-CEX. The reporting system could be further publicised and the platform made more user-friendly to encourage reporting after NSI incidents. It might also be worthwhile to consider setting up a hotline for students who have sustained NSIs to report the NSI, as well as receive assistance and guidance on the incident, especially if the NSI was sustained when they were on-call or after office hours.

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