Research Article

Effectiveness of safety cannula in reducing needle stick injuries

KT Abeywardana[1], WABN Wijesinghe[1], GK Iresha[1], PCLS Buddhadasa[1], SK Jayatilleke[1]

Sri Lankan Journal of Infectious Diseases 2020 Vol.10 (1):65-71

DOI: http://dx.doi.org/10.4038/sljid.v10i1.8272

Abstract

Introduction: The decision to support the implementation of safety cannulae in a health care institution requires analysis of its cost-effectiveness. The aim of our study was to evaluate the effectiveness of safety cannulae over conventional cannulae in reducing needle stick injury (NSI) incidence in Sri Jayewardenepura General Hospital (SJGH), Sri Lanka.

Methods: Hospital device utilization data, NSI data, and total expenditure data including the cost of management of NSIs for conventional and safety cannulae were collected from the period 01/01/2016 to 30/06/2019. The NSI incidence (annual rates per 100,000 devices) for conventional and safety cannulae were calculated and compared to determine the existence of a statistical difference between them. The cost per device inclusive of the management of associated NSIs was also calculated.

Results: The total number of conventional and safety cannulae utilized during the study period was 86,412 and 284,686 respectively. In total, there were 12 NSIs associated with conventional cannula insertion and 5 NSIs associated with safety cannula insertion. The annual NSI incidence per 100,000 devices for conventional and safety cannulae was 13.89 (95% CI 7.18-24.26) and 1.76 (95% CI 0.57-4.099) respectively. There was a significant reduction of NSI incidence with the use of safety cannulae ($p< 0.0001$). The cost per device inclusive of management of associated NSIs for conventional and safety cannulae was Lankan Rupee (LKR) 73.18 and LKR 83.17 respectively.

Conclusion: There was a substantial reduction of NSI incidence with safety cannulae and we recommend its use in the prevention of occupational risk to health care workers.

Keywords: Needle stick injuries, Health care workers, Safety devices, Safety cannula, Patient safety, Occupational health

Introduction

Needle stick injuries (NSIs) are perceived by most healthcare workers as one of the most anxiety-provoking occupation-related hazards. (NSIs in the healthcare setting is a serious occupational health hazard, mainly due to its potential for the transmission of blood borne

[1] *Sri Jayewardenepura General Hospital (SJGH), Sri Lanka*

Address for correspondence: Dr KDST Abeywardana, Sri Jayewardenepura General Hospital (SJGH), Sri Lanka. Telephone: + 00940716367437 Email: thejaniwardana@gmail.com

https://orcid.org/0000-0002-1303-3114

Received 10 November 2019 and revised version accepted 17 April 2020

pathogens. WHO estimates that approximately 2 million such exposures occur annually worldwide in occupation related health incidents.[1] According to a national surveillance study carried out in Japanese hospitals, the mean annual incidence per 100 occupied beds was 6.2 with a 95% confidence interval of 5.7-6.7.[2] A descriptive cross-sectional study conducted in 2014 found a 43% prevalence of a history of needle stick injuries in healthcare workers in three District General hospitals in Sri Lanka.[3] The same study showed intravenous cannulation as the most hazardous procedure, as 51% of NSIs occured during cannulation.

The estimated prevalence of the main blood borne viruses in Sri Lanka are reported as 0.29-2.5% for hepatitis B virus (HBV), 0.56-0.97% for hepatitis C virus (HCV) and 0.56-0.97% for HIV.[3] Following a percutaneous injury, the risk of transmission is 35%, 3-10%, 0.2-0.5% for hepatitis B virus, hepatitis C virus infection and HIV infection respectively.[1] According to a WHO report, needle stick injuries account for 40% each of hepatitis B and hepatitis C infections and 4.4% of HIV infections acquired by health care workers.[1] In addition, there is a substantial psychological impact of NSIs, primarily emotional distress and anxiety.[4] A comparative study using data from European countries and the United States emphasize the economic burden of NSIs.[5]

It is therefore essential to have strategies at an organizational level to prevent needle stick injuries with appropriate use of modern technology. Minimising invasive procedures, education and training on prevention of NSIs, vaccination against preventable disease, usage of safety devices, and timely introduction of post-exposure prophylaxis to susceptible individuals are the key approaches identified in various studies.[3]

Safety devices like safety peripheral intravascular cannulae, intravenous cannulae having blunt needles and needle-free intravenous access systems are designed with built-in safety controls and manufactures claim they have the potential to prevent needle stick injuries. The efficacy of safety devices has been evaluated by several published studies.[6] There was a needle stick injury reduction of 22% to 100% with a safety device use according to a review of 17 studies on the effectiveness of safety devices by Tuma and Sepkowitz.[7]

In 2016, the administration of SJGH had decided to utilize safety cannulas in addition to the conventional cannulas. The safeguard mechanism of the safety cannula used in our hospital is by encapsulation of the needle by a sheath as soon as the stylet is removed from the cannula, thereby preventing pricks after the procedure.

The decision to support the implementation of safety cannulae in a health care institution requires analysis of its cost-effectiveness. A prospective study published in 2006 indicated that NSIs were significantly prevented by safety device usage.[8] However, there is no published data on the efficacy of such devices in the prevention of needle stick injuries in the Sri Lankan setting. Therefore, our study aimed to evaluate the cost effectiveness of safety cannulae over conventional cannulae on needle stick injury (NSI) incidence.

Methods

Study design: A descriptive retrospective was conducted to evaluate the cost effectiveness of safety cannulae over the conventional cannulae.

Study setting: Sri Jayewardenepura General Hospital (SJGH), Sri Lanka

Study period: 1st January 2016 to 30th June 2019

Data collection

Device utilization data for conventional cannulae and safety cannulae were collected during the study period. Details of needle stick injuries related to intravenous cannulae were collected during the study period. The device used, occupation of the injured worker, the stage of procedure when the incident occurred and the awareness and adherence to guidelines were systemically collected. Data on clinical experience and place where the injury was sustained were not available from janitorial workers.

Total expenditure on purchasing of conventional and safety cannulaa and direct costs associated with needle stick injuries were collected. Costs for testing for blood borne infections after an NSI and cost of post-exposure prophylaxis were used in calculating the direct costs of NSIs.

Data analysis

Data was entered in Microsoft Excel® and analysed using SPSS 17.0® software. Descriptive statistics were reported as mean with the confidence interval and as frequency (percentage) for categorical variables. Characteristics of the injured person and the stage of procedure when the incident occurred were described.

Quantitative variables were compared using the independent t-test and qualitative variables were compared using Chi-square analysis. The statistical significance was set at a p-value < 0.05.

The annual needle stick injury incidence (per 100,000 devices) was determined with a 95% confidence interval (CI) for both conventional and safety cannula. Incidence rate ratio with 95% CI was calculated using the "Exact Poisson method" and the difference between the two rates and its 95% CI was calculated by "Test based method" . The existence of statistical difference between them was determined by chi-square analysis. The statistical significance was set at a p-value < 0.05. The cost per device inclusive of cost associated with management of needle stick injuries in respect to testing blood borne infections after an NSI and cost of post-exposure prophylaxis was calculated for conventional cannula and safety cannula separately using the below formula.

$$\text{Total cost per device} = \frac{(A*B) + C(D+E) + F(G+H)}{A}$$

A- Total number of devices utilized
B- Cost per device
C- Number of needle stick injury to clinical staff
D- Cost of screening for Human Immunodeficiency Virus (HIV), Hepatitis B (HBV) and Hepatitis C (HCV) infection of the patient
E- Cost of lab investigation of for HIV and Hepatitis C infection and hepatitis B antibody status of the clinical staff)
F- Number of needle stick injury to janitorial workers
G- Cost of screening for HIV, Hepatitis B and Hepatitis C infection of janitorial workers
H- Cost of hepatitis B vaccination

Results

The total number of conventional and safety cannulae utilized were 86,412 and 284,686 respectively. In total there were 12 needle stick injuries for conventional cannulae and 5 needle stick injuries for safety cannulae. Table 1 shows the characteristics of needle stick injuries

Table 1: characteristics of needle stick injuries

Variable	Safety cannula n-5	Conventional cannula n-12	P value
Occupation of injured health care worker			
Medical officer	01	01	0.94
Nursing officer	04	05	0.92
Student nurse	00	01	0.95
Janitorial workers	00	05	0.88
Place of injury occurrence			
Emergency treatment unit	01	00	0.90
Ward	01	06	0.88
Operation theatre	01	01	0.98
Labor room	01	00	0.90
radiology	01	00	0.90
Timing of injury			
During use of device	05	06	0.90
After the procedure but before disposal	00	01	0.95
During the disposal of sharps	00	05	0.88
Adherence to guidelines			
Aware on guidelines and followed them appropriately	03	01	0.84
Aware on guidelines but not adhered	02	08	0.95
Not aware of guidelines	00	03	0.91
Clinical experience of injured health care workers			
<1 year	00	01 years	0.89
1-10years	03 years	04 years	0.99
>10 years	02 years	02 years	0.97
Mean clinical experience CI- confidence interval	12.4 years (95%CI=1.2-23.60 years)	8.28 years (CI=1.28-15.2 years)	0.155

There was no statistical significance between 2 groups on the tested variables as shown in Table 1. Therefore, there were no identified confounding factors between the two groups. The mean clinical experience of health care workers injured with safety cannula was 12.4 years with a 95%CI =1.2-23.60, while the mean value for health care workers injured with conventional cannula was 8.28 years with a 95% CI of 1.28-15.2. There was no difference in the clinical experience between the two subgroups (p: 0.155).

The annual needle stick injury rate per 100,000 conventional cannulae use was 13.89 (95% CI 7.18-24.26) while annual NSI incidence was 1.756 (95% CI 0.57-4.099) for 100,000 safety cannulae use. Reduction of needle stick injuries with the safety device was 12.13/ 100,000

devices per year (95% C.I 6.98-17.28) with the incidence rate ratio of 0.1265 (95% C.I 0.034-0.385). When the two incidence rates were compared statistically, there was a remarkable reduction in NSI incidence with use of safety cannulae giving a p-value less than 0.0001.

From the total needle stick injury irrespective of the device, 64.7% occurred during the cannulation procedure while 29.4% occurred during disposal. All injuries associated with safety cannula occurred during the cannulation procedure. Twenty nine percent (29.41%) of needle stick injuries occurred in janitorial workers. Among five who were injured, two were aware of guidelines, but only one had adhered to them. Fifty two percent (52.9%) NSI occurred among nursing officers and all of them were aware of guidelines but had not followed them. Seventy five percent (75%) of NSI experienced by health care workers had less than 10year experience. 58% of NSI occurred in the wards.

There were no needle stick injuries resulting from safety cannula to janitorial workers, of whom only 40% were aware of guidelines. In addition, 41.6% of injuries occurred in this group from conventional cannulas during disposal of the cannulae.

The cost per device inclusive of management of associated NSIs for conventional and safety cannulae was LKR 73.18 and LKR 83.17 LKR respectively.

Discussion

The study showed the annual NSI incidence of 13.89 (95% CI 7.18-24.26) and 1.756 (95% CI 0.57-4.099) per 100,000 devices for conventional and safety cannulae respectively. A Japanese multicenter study has shown the NSI incidence of 6.39 per 100,000 conventional cannulas and 0.95 per 100,000 safety cannulas.[7] Reduction of needle stick injuries with use of the safety device was 12.13/ 100,000 devices per year (95% C.I 6.98-17.28) with an incidence rate ratio of 0.12. A similar Japanese study demonstrated a reduction of 5.44 NSI incidence with a safety cannula with a ratio of 0.15.[9]

Our study showed that no needle stick injury resulted from safety cannulas to janitorial workers, whilst 41.6% of injuries were due to conventional cannulae, which occurred during disposal. The janitorial workers are not immunized against hepatitis B and their immune status is also not known, as janitorial services are outsourced to a company. Therefore, needle stick injury among them results in higher cost due to direct cost associated with testing for blood borne infections and post-exposure prophylaxis. Furthermore, injuries to janitorial workers occurred during disposal, hence putting them at high risk due to the inability to identify the source. Janitorial staff should therefore have ideally received prophylaxis with hepatitis B immunoglobulin which was not offered as it was costly. The implementation of the use of safety cannulae will eliminate the risk of exposure of janitorial workers to blood borne viral infections and dramatically reduce the cost associated with testing for blood borne infections and post-exposure prophylaxis.

More than 50 % of needle stick injuries occurred in nursing officers. This may be because they are on average four times more nurses than medical officers within our institution and a greater number of cannulation procedures were performed by nursing officers. Since denominator data were lacking (i.e. the number of persons in each category engaged in cannulation during the study period), precise calculations were not possible.

More than 50% of NSI incidents of health care workers occurred in wards. It may be because a greater number of cannulation procedures are performed in wards. This was also shown by a similar study showing 45.1% of NSI incidence in medical wards and 13.3% incidence in surgical wards.[3]

This study simultaneously evaluated the difference in NSI incidence rates for the safety cannulae and conventional cannulae over the same study period in the same hospital, while the majority of previous studies done internationally compared data received from different locations and different periods.

Since needle stick injuries are usually self-reported by the injured person, under-reporting of injuries might have resulted in an underestimation of true NSI incidence. A 17- 97% under-reporting of blood and body fluid exposures was shown in a review performed by Kessler et al.[10] The incidence rates in the current study might therefore be an underestimate. However, it will not affect our conclusions significantly, since this level of under-reporting can be assumed to be similar for injuries related to both conventional and safety cannulae.

When analyzing costs associated with needle stick injuries, we were unable to get direct costs such as additional cost of staffing and administration due to NSI, and indirect costs such as cost of counseling and staff absence. Consequently, we were not able to demonstrate the effectiveness of introducing safety cannulae in terms of cost. We recommend a detailed cost analysis of conventional and safety cannulae use.

According to the present study, although most health care workers were aware of the guidelines, adherence was poor. We recommend conducting further studies on the reasons for non-adherence.

Conclusion

Safety devices have substantially reduced the incidence of needle stick injuries and we highly recommend the implementation of safety cannulae use to prevent occupation-related health hazards and to improve health care safety.

Acknowledgement: Prof Nalika Gunawardena for her opinion on the necessity of statistical analysis between the needle stick injuries caused by conventional cannulae and safety cannulae.

Conflict of interests: There are no conflicts of interest

Ethical approval: Ethical clearance was obtained from Ethics Review Committee of Sri Jayewardenepura General Hospital (SJGH), Sri Lanka

References

1. Ballout RA, Diab B, Harb AC, et al. Use of safety-engineered devices by healthcare workers for intravenous and/or phlebotomy procedures in healthcare settings: a systematic review and meta-analysis. *BMC Health Serv Res* 2016; 16:458. *doi: http://dx.doi.org/10.1186/s12913-016-1705-y.*
2. Yoshikawa T, Wada K, Lee JJ, et al. Incidence rate of needle stick and sharps injuries in 67 Japanese hospitals: an national surveillance study. *PLoS ONE* 2013; 8(10):77524. *https://doi.org/10.1371/journal.pone.0077524*

3. Yapa MMP, Gamaralalage SK, Sridharan S. Factors associated and response to needle stick injuries among nursing officers in district general hospitals of Sri Lanka. *Global Journal of Health Science* 2017; 9(8):107-118. *doi:10.5539/gjhs.v9n8p107*
4. Wicker S, Jung J, Allwin R, et al. Prevalence and prevention of needle stick injuries among health care workers in a German University hospital. *Int Arch Occup Environ Health* 2008; 81:347. *doi: https://doi.org/10.1007/s00420-007-0219-7.*
5. Saia M, Hofmann F, Sharman J, et al. Needle stick injuries: incidence and cost in the United States, United Kingdom, Germany, France, Italy and Spain. *Biomedicine International* 2010; 1:41-49. *No doi.*
6. Adams D, Elliott TSJ. Needle protective devices; where are we now? *Journal of Hospital Infection* 2008; 70(2):197–198. *doi: http://dx.doi.org/10.1016/j.jhin.2008.06.016.*
7. Tuma S, Sepkowitz KA. Efficacy of safety-engineered device implementation in the prevention of percutaneous injuries: a review of published studies. *Clin Infect Dis* 2006; 42:1159-1170. *doi: http://dx.doi.org/10.1086/501456.*
8. Cullen BL, Genasi F, Simington I. Potential for reported needle stick injury prevention among healthcare workers through safety device usage and improvement of guideline adherence: expert panel assessment. *Journal of Hospital Infection* 2006; 63:445-451. *doi: http://dx.doi.org/10.1016/j.jhin.2006.04.008*
9. Fukuda H, Yamanaka N. Reducing needle stick injuries through safety engineered devices: results of a Japanese multi-centre study. *Journal of Hospital Infection* 2016; 92:147-153. *doi: http://dx.doi.org/10.1016/j.jhin.2015.09.019*
10. Kessler CS, McGuinn M, Spec A, et al. Underreporting of blood and body fluid exposures among health care students and trainees in the acute care setting: a 2007 survey. *Am J Infect Control* 2011; 39:129-134. *doi: http://dx.doi.org/10.1016/j.ajic.2010.06.02.*