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Prevalence of Needlestick Injuries (NSIs) among Laboratory Personnel at The National Center of Public Health Laboratory in Aden, Yemen

Adel Jumaan Awadh Binsaad
Faculty of Medicine and Health Science || University of Aden || Yemen

Abstract: Background: Needlestick injuries (NSIs) are one of the most common health hazards facing healthcare workers (HCWs) worldwide.

Objectives: The aims of this study were to determine the prevalence of occupational exposure to NSIs among laboratory personnel working at the national center of public health laboratory in Aden, Yemen. Also, to identify the risk factors associated with NSIs and HBV vaccination status.

Method: A descriptive cross-sectional study was conducted among laboratory personnel in the national center of public health laboratory in Aden. Data collection was done using a pretested administered questionnaire.

Results: A total of 33 (34.4%) participants had been exposed to needlestick injuries during their work in the laboratory. Only 33.3% of needlestick injuries were reported to administrator in the laboratory. The prevalence rate of needlestick injury was significantly higher (65.6%) among those who had an experience of less than 5 years (P< 0.05) and those who had not (41.9%) received training course on biosafety (P< 0.05). About one-third (32.3%) of participants reported that they had been vaccinated against HBV. The vaccination coverage rate against HBV was significantly higher among laboratory personnel who had received a bachelor's degree (P< 0.05), and those who received biosafety training course (P< 0.05).

Conclusions and Recommendations: This study showed relatively higher prevalence rate of NSIs among the laboratory personnel. The rate of non-reported NSIs is also high among laboratory personnel who had needlestick injuries. Low rate of receiving biosafety training courses and low vaccination coverage among laboratory personnel. Therefore, laboratory personnel should be trained on safety measures for handling and disposing of needles and should be encouraged to report NSIs to get the right treatment and counseling. Also, the laboratory should be provided with protective equipment in sufficient quantities to reduce the incidence of NSIs and HBV vaccination should be achieved for laboratory personnel working at the national center of public health laboratory in Aden.

Keywords: Healthcare workers; Needlestick injury; Laboratory personnel; Vaccination; Aden

معدل انتشار إصابات الوخز بالإبر بين طاقم المختبر الوطني المركزي للصحة العامة في مدينة عدن، اليمن

عادل جمعان عوض بن سعد
كلية الطب والعلوم الصحية || جامعة عدن || اليمن

المستخلص: الخلفية: تعتبر اصابات الوخز بالإبر أحد المخاطر الصحية المهنية الخطيرة وأكثرها شيوعا بين عمال الرعاية الصحية حول العالم.

اهداف الدراسة: هدفت هذه الدراسة لتحديد معدل انتشار التعرض المهني للوخز بالإبر بين العاملين في المركز الوطني لمختبر الصحة العامة في مدينة عدن، اليمن. وكذلك لتحديد عوامل الخطورة المرتبطة بالوخز بالإبر وكذلك حالة التطعيم ضد فيروس الكبد البائي.
الطريقة: أجريت دراسة مقطعية وصفية بين العاملين في المركز الوطني لمختبر الصحة العامة في مدينة عدن، اليمن .وتم استخدام استبيان الذي تم اختباره مسبقًا لجمع البيانات.
النتائج: تبين ان 33 (34.4٪) من المشاركين كانوا قد تعرضوا لإصابات الوخز بالإبر أثناء عملهم في المختبر. وقد تم الإبلاغ فقط عن 33.3 ٪ من هذه الإصابات لإدارة المختبر. وقد كانت نسبة الإصابات كبيرة (65.6٪) وذو دلالة إحصائية بين العاملين الذين تقل خبرتهم عن 5 سنوات وبين أولئك الذين لم يتلقوا تدريبات على السلامة الحيوية (41.9٪). وقد أفاد تقريبا ثلث المشاركين (32.3٪) بأنهم قد تلقوا تطعيمًا ضد فيروس التهاب الكبد البائي. وقد كانت نسبة تغطية التطعيم ضد فيروس التهاب الكبد الوبائي عالية وذات دلالة احصائية بين العاملين الذين يحملون شهادة البكالوريوس وكذلك العاملين الذين تلقوا تدريبات على السلامة الحيوية.
الاستنتاجات والتوصيات: اظهرت الدراسة بأن معدل انتشار الإصابات بوخز الإبر عالي نسبيا بين طاقم المختبر كما ان نسبة الإصابات التي لم يتم الإبلاغ عنها ايضا عالية. وكانت نسبة كلاً من التدريب على السلامة الحيوية ونسبة التلقيح ضد فيروس التهاب الكبد البائي منخفضة. لذلك، يجب تدريب عمال المختبر على اجراءات السلامة المتبعة للتعامل والتخلص من الإبر الملوثة كما يجب تشجيعهم على الإبلاغ عن الإصابات الناتجة عن الوخز بالإبر حتى يتمكنوا من الحصول على العلاج والاستشارة الطبية الصحيحة. كما يجب ترويد المختبر بمعدات الوقاية والسلامة بكميات كافية كما يجب توفير اللقاحات ضد فيروس التهاب الكبد البائي لعمال المختبر المركزي الوطني للصحة العامة في مدينة عدن.

الكلمات المفتاحية: عمال الرعاية الصحية، إصابات الوخز بالإبر، طاقم المختبر، التلقيح، عدن.

Introduction

Needlestick injuries (NSIs) are defined as injuries caused by blood collection needles, hypodermic needles, cannula and needles used to connect parts of intravenous delivery systems contaminated with blood or body secretions (Himmelreich *et al.*, 2013). Needlestick injuries are serious occupational hazards facing healthcare workers (HCWs) throughout the world. Healthcare workers are exposed to contaminated needlestick injuries during their daily activities in the healthcare settings, and they are at higher risk of acquiring infection with blood-borne pathogens(Isara & Ofili, 2012). There are more than 20 blood-borne pathogens that could be transmitted through contaminated NSIs with patient's blood or body fluids to healthcare workers, and the most common are hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV)(Cui, Zhu, Zhang, Wang, & Li, 2018; Marusic, Markovic-Denic, Djuric, Protic, & Dubljanin-Raspopovic, 2017). Worldwide, about three million HCWs are exposed to blood-borne viruses per year. Out of this, 2.5% and 40% of cases are owing to exposure to HIV and HBV and HCV respectively, and more than 90% of these cases occur in the developing countries (Cui *et al.*, 2018; Shaghaghian, Golkari, Pardis, & Rezayi, 2015).It was estimated that the risk of transmission following a percutaneous injury for HBV, HCV, and HIV infection to be 40%, 3% to 10%, and 0.2% to 0.5 % respectively(Goel, Kumar, Lingaiah, & Singh, 2017).

The prevalence of NSIs differs from country to county even it can be vary within a country. However, in developing countries, the prevalence of needlestick injuries is higher due to high poor health settings, lack of training, adopting of safer working practices, awareness about HBV prevalence, and unavailability of occupational protective measures such as vaccination against HBV(Cui *et al.*, 2018;

Shaghaghian, Golkari, Pardis, & Rezayi, 2015). Also, in developing countries, the incidence of NSIs is high and underestimated due to the absence of surveillance and reporting systems in the healthcare institutions(Chalya *et al.*, 2015).

Conducting a study regarding the prevalence of NSIs is very important for intervention and policy to decrease bloodborne infection transmission among laboratory personnel. In Yemen, a few studies conducted to assess the prevalence of needlestick injuries among laboratory personnel reported prevalence rates of14.6% and 54.8% in Sana'a city(Al-Abhar, Moghram, Al-Gunaid, Al Serouri, & Khader, 2020; Al Eryani *et al.*, 2019).Therefore, the aim of this study was to determine the prevalence of NSIs among laboratory personnel working at the national center of public health laboratory in Aden. Also, to identify the risk factors associated with NSIs and HBV vaccination status.

Methodology

Study design and study area:

This is a descriptive cross-sectional study conducted in the national center of public health laboratory in Aden over three months (October - December 2021).Aden is the second important city in the Republic of Yemen holding a population of around 590,413.Aden is a seaport city, located by the eastern approach to the Red Sea (the Gulf of Aden), some 170 kilometers (110 mi) east of Bab-El-Mandeb southern Yemen within longitude 45°02′12″ E and latitude12°46′45″ N(Saleh, Amer, & Al-Alawi, 2018).

Study population:

The study included laboratory personnel working in the national center of public health laboratory in Aden.

Inclusion and exclusion criteria:

The laboratory personnel who were involved in handling and processing clinical samples were included, while laboratory personnel who were not involved such as administrative staff, were excluded.

Sample size:

All the laboratory personnel who were present and who gave verbal consent were considered as the sample size for the study.

Data collection:

Administered structured questionnaire was used to collect data. The questionnaire was developed based on previously reviewed similar literatures (Al-Abhar, Moghram, Al-Gunaid, Al Serouri, & Khader, 2020; Al Eryani et al., 2019; Goel, Kumar, Lingaiah, & Singh, 2017; Nagi et al., 2017), as well as it was modified by experts from the Department of Community Medicine, Faculty of Medicine and Health

Science, University of Aden. The questionnaire was pretested, and a pilot testing was conducted with a random sample of 10 laboratory personnel to check its reliability, clarity, time required, acceptability, and missing data. Required changes were made and laboratory personnel who participated in pilot study were excluded from the study. The questionnaire included three parts. The first part contained information on sociodemographic characteristics of participants, and the second part included information on the usage and availability of the personal protective equipments (PPE). In the third part, the participants were asked if they had a history of exposure to needlestick injury during their work in the laboratory, and if they were vaccinated against HBV.

Ethical consideration:

Permission for conducting this research was granted by the administrators of the national center of public health laboratory in Aden before the study initiation and verbal consent was obtained from each participant after providing a clear explanation about the study's purpose before participation, and the anonymity of participants was maintained.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) software version 20 was used to enter, clean and analyze the data. Descriptive statistics like frequencies and proportions were used to summarize the data. Chi-square test was used to determine the associations between categorical variables. A p-value of ≤0.05 was regarded as statistically significant.

Results

Table 1 shows the participants' sociodemographic characteristics.

A total of 96 laboratory personnel have participated in this study. The majority (59.4%; 57/96) of them were female and forty (41.7%) of the participants were among the age group of 20 to 29 years. More than half (56.2%; 54/96) of the participants had received a diploma degree, and 36 (37.5%) had more than 10 years of work experience. Only 34 (35.4%) and 31 (32.3%) of laboratory personnel received biosafety training course and vaccination against the hepatitis B virus respectively.

Table 1. Sociodemographic characteristics of laboratory personnel at the national center of public health laboratory in Aden(n=96).

Variable	Laboratory personnel	
	Frequency	(%)
Gender		
Male	39	40.6
Female	57	59.4
Age group (year)		
20-29	40	41.7

Variable	Laboratory personnel	
	Frequency	(%)
30-39	18	18.8
40-49	16	16.7
50-59	18	18.8
>59	4	4.2
Education		
Diploma	54	56.2
Bachelor	24	25.0
Master	18	18.8
Work experience (years)		
<5	32	33.3
5-10	28	29.2
>10	36	37.5
Received biosafety training		
Yes	34	35.4
No	62	64.6
HBV vaccine		
Yes	31	32.3
No	65	67.7

Table 2 shows the prevalence of NSIs according to sociodemographic characteristics.

Out of 96 laboratory personnel, thirty-three of them had been exposed to needlestick injury during their work in the laboratory. Thus, the prevalence of NSIs was 34.4%. On the other hand,only 11 (33.3%) of those exposed to needlestick injury reported the incidence while majority (22/33; 66.7%) of participants did not.

The prevalence of NSIs was slightly higher in males (35.9% vs. 33.3%) than in females. A similar NSIs prevalence rate of 50% was found among laboratory personnel in the age group 30 to 39 and those with more than 59 years. According to educational level, the highest prevalence rate of 35.2% was in laboratory personnel who had received a diploma degree. Significant higher NSI prevalence rates of 65.6% and 41.9% were found in those who had less than 5 years of work experience ($P< 0.05$), and those who had not received a biosafety training course ($P< 0.05$), respectively.

Table 2. Prevalence of needlestick injury among laboratory personnel according to sociodemographic characteristics (n=96).

Variables	Total	Injured		Not injured		*P*value
	Number	N	(%)	N	(%)	
Gender						
Male	39	14	35.9	25	64.1	P=0.79503
Female	57	19	33.3	38	66.7	$\chi 2$=0.0675

Variables	Total	Injured		Not injured		*P*value
	Number	N	(%)	N	(%)	
Age (year)						
20-29	40	12	30	28	70	P=0.500676 χ^2=3.3524
30-39	18	9	50	9	50	
40-49	16	4	25	12	75	
50-59	18	6	33.3	12	66.7	
>59	4	2	50	2	50	
Education						
Diploma	54	19	35.2	35	64.8	P=0.982203 χ^2=0.0359
Bachelor	24	8	33.3	16	66.7	
Master	18	6	33.3	12	66.7	
Work experience (years)						
<5	32	21	65.6	11	34.4	P=000011* χ^2=22.9077
5-10	28	8	28.6	20	71.4	
>10	36	4	11.1	32	88.9	
Received biosafety training						
Yes	34	7	20.6	27	79.4	P=0.035193* χ^2=4.4358
No	62	26	41.9	36	58.1	

* Significant.

Table 3 shows the availability and the use of personal protective equipments by laboratory personnel. A total of 93.8% (90/96), 95.8% (92/96) and 94.8% (91/96) of laboratory personnel were found to wear gloves, laboratory coats, and masks respectively. Eye goggles, eye washers and safety cabinets were less available and used only by 3.13% (3/96), 1.04% (1/96), and 7.3% (7/96) of laboratory personnel, respectively.

Table 3. Availability and usage of personal protective equipment in the national center of public health laboratory in Aden

Personal protective equipment (PPE)	Total	
	N	(%)
Gloves	90	93.8
Lab coats	92	95.8
Masks	91	94.8
Eye Goggles	3	3.13
Eye washer	1	1.04
Safety cabinet	7	7.3

In regard to vaccination status, only 32.3% (31/96) of participants reported that they had been vaccinated against HBV. The vaccination coverage rate against HBV was significantly higher among laboratory personnel who had received a bachelor's degree (48.4%), and those who received the biosafety training (74.2%,)(Table 4).

Table 4. Hepatitis B virus vaccination according to some sociodemographic characteristics (n=96).

Variables	Vaccinated		Not Vaccinated		*P*value
	N	(%)	N	(%)	
Education					
Diploma	7	22.6	47	72.3	P=0.000018* χ^2=21.8256
Bachelor	15	48.4	9	13.8	
Master	9	29.0	9	13.8	
Work experience (years)					
<5	7	22.6	25	38.5	P=0.122635 χ^2=4.1971
5-10	8	25.8	20	30.8	
>10	16	51.6	20	30.8	
Received biosafety training course					
Yes	23	74.2	11	16.9	P=0.00001* χ^2=30.098
No	8	25.8	54	83.1	

* Significant.

Discussion

Worldwide, about three million HCWs are exposed to blood-borne viruses per year. Out of this, 2.5% and 40% of cases are owing to exposure to HIV, HBV and HCV respectively, and more than 90% of these cases occur in the developing countries(Cui, Zhu, Zhang, Wang, & Li, 2018; Goel, Kumar, Lingaiah, & Singh, 2017).

In the current study, 34.4% (33/96) of laboratory personnel suffered from needlestick injury during their work in the laboratory. This result was in line with previous studies from India (34%) (Nagi *et al.*, 2017), Ghana (33.6%)(Kumah *et al.*, 2020), and Yemen (37.5%)(Alwabr, 2018).However, higher prevalence rates were reported from Yemen (54.8%)(Al Eryani *et al.*, 2019), Iran (76%) (Jahangiri, Rostamabadi, Hoboubi, Tadayon, & Soleimani, 2016), and India (68.3%) (Archana Lakshmi, Raja, Meriton Stanly, Paul, & Gladius Jennifer, 2018). On the other hand, lower results were reported from Yemen(14.6%)(Al-Abhar, Moghram, Al-Gunaid, Al Serouri, & Khader, 2020) and Ethiopia (13.2%)(Dilie, Amare, & Gualu, 2017).This relatively high prevalence rate of NSI found in the current study could be explained by less work experience, lack of training on occupational health and infection prevention and lack of adequate and/or proper personal protective devices(Al-Abhar, Moghram, Al-Gunaid, Al Serouri, &

Khader, 2020; Alwabr, 2018; Kebede & Gerensea, 2018). In addition, in developing countries, the prevalence of NSIs is higher and underestimated, and it varies between countries and even can vary within a country. The possible reasons for these variations could be due to differences in awareness, degree of exposure to needles, and methodological differences among studies. Moreover, the prevalence can vary from facility to facility depending on standards, workload overload, overcrowding, type of profession, level of skills, and accessibility and use of resources(Kebede & Gerensea, 2018; Kumah et al., 2020).

In this study, a significant high NSIs prevalence rates of 65.6% and 41.9% were found among those who had less than 5 years of work experience($P<.000011$), and those who had not received training courses on biosafety($P<.035193$). These findings were in agreement with previous studies(Al-Abhar, Moghram, Al-Gunaid, Al Serouri, & Khader, 2020; Al Eryani *et al.*, 2019), and disagreed with other studies (Kebede & Gerensea, 2018).However, this finding could be explained by the long duration of services and experience and training on biosafety are important and helpful in enhancing awareness and improving attitudes and protective practices of laboratory personnel towards NSI(Khabour, Al Ali, & Mahallawi, 2018; Zhang, Gu, Cui, Stallones, & Xiang, 2015).Therefore, the implementation of universal infection prevention measures and biosafety training of laboratory personnel is crucial in reducing the exposure to NSIs(Al-Abhar, Moghram, Al-Gunaid, Al Serouri, & Khader, 2020; Kebede & Gerensea, 2018; Rajpal, Garg, Bano, & Singh, 2021; Zhang, Gu, Cui, Stallones, & Xiang, 2015).

In many previous studies, syringe needles were identified as the major source of NSIs(Kumah *et al.*, 2020; Zhang, Gu, Cui, Stallones, & Xiang, 2015), and the reasons which may be accounted for NSIs were recapping of used needles, improper handling, and poor disposal of needles by HCWs(Kumah *et al.*, 2020; Rajpal, Garg, Bano, & Singh, 2021). Therefore, in order to decrease the incidence of NSIs, sharp devices with safety engineering controls such as auto-disposable syringes, needle-free devices, and blunt immediately after use needles were introduced. These devices are help in reduce the risk of NSIs and are widely used in North America and Europe and they are required by law in some countries such as the USA(Alfulayw, Al-Otaibi, & Alqahtani, 2021).Implementation and the use of sharp devices with safety engineering controls should be considered, and laboratory personnel should be properly trained on how to use these devices, how safely handle sharp equipment, and dispose of used sharp, and needle recapping should be avoided(Alfulayw, Al-Otaibi, & Alqahtani, 2021).

In this study majority (66.7%; 22/33) of laboratory personnel who were exposed to needlestick injury during their work did not report the incidence of NSIs, while only one-third (33.3%; 11/33) were reported the incidence of NSIs. In the current study, the reason for not reporting might be because laboratory personnel did not know who and where to report needlestick injuries due to lack of reporting system. Consequently, in developing countries, the prevalence of NSIs is high and underreported(Goel, Kumar, Lingaiah, & Singh, 2017; Kumah *et al.*, 2020).In addition, this finding indicates the lack of

knowledge of the benefit of post-exposure prophylaxis (PEP)(Chalya *et al.*, 2015). Also, this result reflects the wrong belief that there is very low risk of infection transmission following needlestick injury(Alfulayw, Al-Otaibi, & Alqahtani, 2021; Chalya *et al.*, 2015; Kumah *et al.*, 2020).However, this result was in line with other developing countries(AlDakhil, Yenugadhati, Al-Seraihi, & Al-Zoughool, 2019; Kumah *et al.*, 2020; Rajpal, Garg, Bano, & Singh, 2021), and disagreed with another study which reported high (68.1%)reporting rate(Kumah *et al.*, 2020). However, it is important for all laboratory personnel to report all work-related needlestick injuries in order to get the treatment, prophylaxis, and advice (Alfulayw, Al-Otaibi, & Alqahtani, 2021; Rajpal, Garg, Bano, & Singh, 2021)Reporting system is very important for policies and interventions on occupational health exposure of healthcare workers. Therefore, reporting systems should be achieved, and healthcare organizations should motivate reporting(Mursy & Mohamed, 2019).

In this study more than ninety percent of laboratory personnel were found to wear gloves, laboratory coats, and masks. These findings were in accordance with a previous study(Afridi, Kumar, & Sayani, 2013; Al Eryani *et al.*, 2019; Alfulayw, Al-Otaibi, & Alqahtani, 2021; Kebede & Gerensea, 2018) and differ from other studies in which a low proportion of laboratory personnel used such personal protective devices (PPE)(Afridi, Kumar, & Sayani, 2013; Alfulayw *et al.*, 2021).The reasons for did not wear PPE could be attributed to the unavailability of the safety devices, overcrowding in health institution, and overlook to wear the protective devices(Alwabr, 2018).

It was estimated that healthcare workers who don't use PPE during their work are at higher risk of acquiring needlestick injury and subsequent infection with blood-borne pathogens in comparison with those who use personal protective equipment(Beyene & Yirsaw, 2014; Kebede & Gerensea, 2018; Velvzhi, Senthil, Sucilathangam, & Revathy, 2016). Thus, laboratory personnel should adhere to standard precautions such as wearing gloves and other protective equipment(Alfulayw, Al-Otaibi, & Alqahtani, 2021). Similar to other studies, other protective equipments such as safety cabinets, goggles, and eye washers were less available(Al-Abhar, Moghram, Al-Gunaid, Al Serouri, & Khader, 2020; Al Eryani *et al.*, 2019).Therefore, laboratories should be provided with protective equipment in sufficient quantities in order to reduce the incidence of NSIs(Alfulayw, Al-Otaibi, & Alqahtani, 2021; Arafa, Mohamed, & Anwar, 2016).

For pre-exposure prophylaxis to HBV, the commercially available throughout the world, since 1982 HBsAg vaccine (HBV vaccine) is currently recommended for all susceptible, at-risk groups, while, the specific hepatitis B immune globulin (HBIG) is recommended for post-exposure prophylaxis(Zhao, Zhou, & Zhou, 2020).HBV vaccine is up to 95% effective against hepatitis B if all the doses in the vaccination series is received (3 or 4 shots given at different times) and it provides protection for at least 20 years (Overturf, 2000; Schillie *et al.*, 2013).Persons exposed to HBV percutaneously or by contamination of mucosal surfaces should immediately receive both HBV vaccine and HBIG administered simultaneously at

different sites to provide passively acquired immunity and active acquired immunity(Arafa, Mohamed, & Anwar, 2016; Overturf, 2000). However, in developing countries, although HBV is endemic most HCWs are not vaccinated(Tatsilong *et al.*, 2016). In this study, only 32.3% (31/96) of the participants had been vaccinated against HBV at the time of the study, while 67.7%(65/96) had never been vaccinated. Similar finding was reported in a previous study conducted among healthcare workers by Al Eryani *et al* from Yemen(Al Eryani *et al.*, 2019) and by Mursy *et al* from Sudan(Mursy & Mohamed, 2019) and differ from a study finding in Yemen reported by Al-Abhar *et al*(Al-Abhar, Moghram, Al-Gunaid, Al Serouri, & Khader, 2020) and in Ethiopia by Kebede*et al*(Kebede & Gerensea, 2018) in which higher vaccination rate of 76.5% and 74,4% were reported respectively**.** However, this lower HBV vaccination rate reported in this study could be explained by the lack of awareness about occupational safety measures such as vaccination against HBV and post-exposure prophylaxis(Badawi, Atif, & Mustafa, 2018; Chalya *et al.*, 2015). In addition, this could be due to that HBV vaccination is not routinely provided to HCWs in Yemen. Therefore, HBV vaccination should be achieved for laboratory personnel working at national center of public health laboratory in Aden. However, this study showed significant HBV vaccination rate among those who had received a bachelor's degree (P<0.000018), and those who received biosafety training(P<.0.00001). Similar result was reported by Al-Abhar *et al* in Yemen(Al-Abhar *et al.*, 2020).This could reflect that knowledge and training courses on biosafety are helpful in increasing awareness as well as improving attitudes towards vaccination(Barbieri, Feitosa, Ramos, & Teixeira, 2019).

Conclusions and Recommendations

This study showed relatively higher NSIs prevalence rate among the laboratory personnel. The rate of underreporting of NSIs is also high among laboratory personnel whohad suffered from needlestick injuries. Moreover, low rate of receiving biosafety training course in laboratory and low vaccination coverage rate. Therefore, laboratory personnel should be trained on safety measures for handling and disposing of needles and sharp devices with safety engineering controls should be considered. In addition, laboratory personnel should be encouraged to report NSIs in order to get the treatment and consultation and laboratory should be provided with protective equipment in sufficient quantities in order to reduce the incidence of NSIs, and HBV vaccination should be achieved for laboratory personnel at the national center of public health laboratory in Aden.

Limitation

One of the of study's limitations; the sample was small and the participants were recruited from only one laboratory in Aden. Thus, the results cannot be generalized to all laboratories in Aden city.

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