EPIDEMIOLOGY OF SHARP INJURIES AND HEPATITIS B VACCINATION AMONG SUDANESE DENTAL HOUSE OFFICERS

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Abstract

Occupational sharps injuries have been investigated among dental healthcare personnel; however, data about their prevalence and about hepatitis B vaccination is scanty among dental practitioners in Sudan. The aim of the survey was to describe the epidemiology of sharps injuries and hepatitis B vaccination among dental house officers. A cross-sectional survey using an anonymous questionnaire was used to collect data from 161 dental house officers at a tertiary dental care facility in Khartoum.

The response rate was 95%. Sharps injuries were experienced by 37.3% of house officers. Most injuries were caused by hollow bore needles (73.3%). The one hand scoop technique was practiced by 87.6%; 60.2% used sharps disposal containers. The Surgery Department was the major source of reported incidents (65.5%). Most of the injured house officers did not report their injury (90%). Only 32.9% were aware of the existence of a post-exposure prophylaxis protocol at the hospital. Full vaccination against hepatitis B was reported by 43.5% of respondents and 6.7% received prophylaxis for hepatitis B.

Adequate education and training, provision of hepatitis B vaccination and up-scaling of dental facilities to meet safer dental practices will help to reduce the incidents of sharps injuries and reduce hepatitis B infection.

Keywords: Sharps injuries – hepatitis B vaccination – occupational injuries – blood borne pathogens.

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ÉPIDÉMIOLOGIE DES BLESSURES À INSTRUMENTS TRANCHANTS ET LA VACCINATION CONTRE L'HÉPATITE B CHEZ DES ÉTUDIANTS SOUDANAIS

Résumé

Les blessures par objets tranchants ont été étudiées chez le personnel de santé dentaire, mais les données sur leur prévalence et sur la vaccination contre l'hépatite B sont rares parmi les dentistes au Soudan.

Le but de la présente étude était de décrire l'épidémiologie des blessures par objets tranchants et la vaccination contre l'hépatite B chez des dentistes exerçant en milieu hospitalier. Une enquête transversale a été menée pour collecter les informations auprès de 161 dentistes dans un hôpital de soins dentaires à Khartoum.

Le taux de réponse était de 95%. 37,3% des participants ont été piqués par des objets tranchants. La plupart des blessures ont été causées par des piqures d'aiguilles (73,3%).

Le département de chirurgie était la principale source d'accidents signalés (65,5%). La plupart des participants n'ont pas déclaré leurs blessures (90%). Seulement 32,9% étaient au courant de l'existence d'un protocole hospitalier de prophylaxie à la suite d'une blessure accidentelle.

La vaccination complète contre l'hépatite B a été signalée par 43,5% des répondants.

Une éducation et une formation adéquates du personnel de santé, la vaccination contre l'hépatite B et l'amélioration des installations de soins dentaires aideront à réduire les blessures par objets tranchants et le risque d'infection par VHB.

Mots-clés: blessure par objets tranchants – blessure professionnelle - pathogènes à diffusion hématogène.

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Introduction

Dental practitioners like other healthcare workers face a recognized risk of occupational exposure to blood borne pathogens such as the human immunodeficiency virus (HIV), the hepatitis B virus (HBV), and the hepatitis C virus (HCV).

The World Health Organization estimates that 2.5% of HIV and 40% of HBV and HCV cases among healthcare workers worldwide are the result of occupational exposures [1]. The transmission risk is influenced by the type and number of microorganisms present in the blood, the presence of visible blood on the needle, the depth of the injury and the size and type of needle used [2]. These infections can be transmitted from infected staff to patients, from infected patients to staff, or from patient to patient via contaminated instruments [3]. Hence, occupational injuries are an important medical and public health problem.

Most exposures are accidental and can be avoided by using safe work practices and following infection control guidelines [4]. However, not all practicing dentists follow guidelines for preventing injuries [5]. It has been reported that inadequate staff, lack of experience, insufficient training, duty overload and fatigue may lead to occupational sharp injuries [6]. The likelihood of being infected by a blood borne virus is low after a single exposure, but the exposure could potentially result in detrimental effects on the personal and professional lives of dentists [3].

The prevalence and circumstances of sharp instruments injuries have been investigated in both developed and under-developed world [3, 5-18]. However no data exists about their prevalence among dentists in Sudan.

The aim of the present survey was to describe the epidemiology of sharp instruments injuries among practicing dental house-officers, the reporting of injuries, the hepatitis B vaccination, the immunization status and the post-exposure prophylaxis (PEP) protocol following sharp instruments injuries.

Materials and methods

The cross-sectional survey was conducted in February 2014 at Khartoum Dental Teaching Hospital (KDTH). KDTH is the main tertiary dental hospital in Sudan and provides internship training for house officers, registrars and specialist assessment. The study population consisted of 170 dental house officers working in the various dental departments. All were eligible to participate in the survey.

WINPEPI software was used to calculate the sample size using formula for prevalence studies. With a 95% confidence level, a population size of 170, an expected prevalence of 50% (P = 0.5) and a desired precision of 5% (d = 0.05), the sample size was 119 house officers. To safe-guard against non-response bias an additional 20% was added giving a sample size of 143 house officers. However, we decided to include all 170 house officers to allow meaningful analysis.

A structured, self-administered, anonymous questionnaire was constructed to collect data on socio-demographic characteristics, exposure to sharps instruments, frequency of exposure to sharps instruments injury, tools causing injury, department where injury occurred, mechanism leading to injury, reporting of injuries, reasons for not reporting injuries, testing for blood borne viruses (BBV), hepatitis B immunization status and PEP.

The prevalence of sharp injuries was measured using the definition provided by Hussain et al. [19]. A sharp injury was defined as "the introduction into the body of a healthcare worker, during the performance of his/her duties, of blood or potentially infectious material by a hollow-bore needle or sharp instrument, including but not limited to needles, lancets, scalpels and contaminated broken glass" [19].

The prevalence of needle stick injury was measured using the definition used by Khader et al. [5]: "A percutaneous injury of any depth caused by a small, medium or large bore hollow syringe needle which did or did not involve visible blood at the time of injury". A recall period of twelve months was used to measure the prevalence of sharp instrument and needle stick injuries.

Clearance to conduct the survey was granted from the Ethics Committee at the Graduate College of the University of Medical Sciences and Technology and Medical Director of KDTH. All dental house officers were visited in KDTH and were informed that participation in the research is voluntary. Verbal informed consent from the participants was obtained. The respondents were assured about confidentiality. Questionnaires were collected on the same day.

Data was checked for consistency, completeness and range-checked before data analysis. Analysis was performed using IBM SPSS version 20 (Chicago, Illinois, USA.). Descriptive frequency analysis was conducted for all variables.

Results

Of 170 house officers working in KDTH, 161 house officers participated in the survey with a response rate of 95%. The reasons for the remaining house officers not participating in the survey were either refusal to participate or being absent at the time of the distribution of the questionnaire. One questionnaire was excluded because of missing data. There were more females (123; 76.4%) than males (38; 23.6%) and the mean age was 24.5 ± 2.1 years.

Sharps injuries were reported by 60 (37.3%) house officers (Table 1). Of those injured, 33 (55%) reported that they were injured once, 11 (18.3%) were injured twice, 8 (13.3%) were injured three times and 8 (13.3%) were injured more than five times.

	Frequency	Percentage
Prevalence of sharps instruments injury		
Yes	60	37.3
No	101	62.7
Prevalence of needle sticks injury		
Yes	44	27.3
No	117	72.7
Number of injuries		
1 injury	33	55
2 injuries	11	18.3
3 injuries	8	13.3
5 or more injuries	8	13.3
Department of reported injury		
Surgery	39	65
Outpatient	18	30
Periodontics	15	25
Conservative dentistry	9	15
Pedodontics	6	10
Prosthodontics	0	0
Instrument causing injury		
Needle	44	73.3
Scaler	10	16.7
Suture needle	8	13.3
Endodontic file	6	10
Explorer	6	10
Fixation wire	3	5
Scalpel	2	3.3
Scissors	1	1.7
Bur	1	1.7
Ampoule	0	0
Orthodontic band	0	0
Denture clasp	0	0
Mechanism of needle stick injury		
During block anesthesia	10	22.7
During infiltration	8	18.2
During needle disposal	6	13.6
During needle recapping	5	11.4
Needle exchange	4	9.1
Collision with needle	4	9.1
Multiple mechanisms	7	15.9

Table 1: Prevalence and characteristics of sharp instruments injury.

	Frequency	Percentage
Reporting of injury		
Yes	16	10
No	145	90
Reasons for not reporting injury		
Injury by an unused sharp instrument	16	29.6
Not knowing how or to whom to report injury	10	18.5
Injury was minor	10	18.5
Being busy	7	13
Fear of consequences of cross infection	3	5.6
Dissatisfaction with follow-up procedures after reporting	2	3.7
Embarrassment of reporting	1	1.9
Multiple reasons	5	9.3

Table 2: Reporting of sharps injuries.

	Frequency	Percentage
Needle-recapping		
I use both hands	16	9.9
I use one scoop technique	141	87.6
I do not recap needles	4	2.5
Disposal of sharps and needles		
I place them in sharp container	97	60.2
I leave it on the tray	47	29.2
I throw it in garbage	17	10.6

Table 3: Needle re-capping and disposal.

The Surgery Department was the major source of reported incidents (39; 65.5%). Other reported incidents occurred in the Outpatient (30%), Periodontics (25%), Conservative Dentistry (15%) and Pedodontics Departments (10%). No injury was reported in the Prosthodontics Department. The majority of injuries (73.3%) were caused by hollow bore needles.

Injuries were also caused by scalers (16.7%), suture needle (13.3%), explorer (10%), endodontic file (10%), fixation wire (5%) scalpel (3.3%), scissors (1.7%) and drill (1.7%). The orthodontic band, ampoule and denture clasps were not reported as tools causing injuries.

With regards to mechanism of needle injury, 10 (22.7%) were injured during block anesthesia, 8 (18.2%) during infiltration anesthesia, 6 (13.6%) during needle disposal, 5 (11.4%) during needle recapping, 4 (9.1%) during needle exchange and 4 (9.1%) during collision with needle on table. Seven house officers (15.9%) reported multiple mechanisms of needle injury.

More than half (90%) did not report their injury (Table 2). The reasons provided for not reporting injury were the item being unused (29.6%), not knowing how or to whom to report (18.5%), perception of risk was minor (18.5%), being busy (13%), fearing the consequences of cross infection (5.6%), dissatisfaction with follow-up procedures after reporting (3.7%), and embarrassment to report injury (1.9%). Five (9.3%) house officers reported for multiple reasons for not reporting injury.

Sixteen (9.9%) house officers practiced needle recapping with both hands, 141 (87.6%) recapped needles using the one scoop technique and 4 (2.5%) reported not recapping needles (Table 3). Sharps containers were used by 97 (60.2%) of house officers. Other mechanisms of sharps disposal

	Frequency	Percentage
Hepatitis B vaccination status		
Full vaccination	70	43.5
Incomplete vaccination	63	39.1
Not vaccinated	22	13.7
Not sure	6	3.7
HBsAg titer testing after completing vaccination		
Yes	14	20.0
No	56	80.0
Level of HBV antibody titer status		
100 IU/ml or below	1	7.1
I don't know/ I can't recall	13	92.9

Table 4: Hepatitis B vaccination and immunity status.

were placement on tray (29.2%) and throwing sharps in trash bin (10.6%). Regarding the use of hand retraction during different dental procedures, 110 (68.3%) use their hands for retraction.

Seventy (43.5%) reported being fully vaccinated against hepatitis B vaccination (Table 4), 63 (39.1%) didn't complete their vaccination, 22 (13.7%) were not vaccinated and 6 (3.7%) were not sure if they completed their vaccination.

Of the seventy who were fully vaccinated, only 14 (20%) checked their antibody titer. Of these only 1 (7.1%) house-officer reported a level of 100 IU/ml or below.

Regarding the presence of PEP protocol at the hospital, 53 (32.9%) were aware that there is a PEP protocol at the hospital (Table 5), while 12 (7.5 %) reported that there is no PEP protocol at the hospital and 96 (59.6%) didn't know about the existence of a PEP protocol at the hospital.

Seven (11.7%) tested themselves for HBV following injury and 4 (6.7%) received PEP. The majority of house officers (149/92%) were in agreement that they needed improvement in knowledge and awareness of safe dental procedures. When questioned about the risk of transmission of HBV from a single percutaneous injury, most house officers (75.8%) failed to acknowledge the estimated actual risk of transmission of HBV.

Discussion

This is the first survey on the prevalence of sharp instruments injuries among dental house officers in Sudan. It is distinct from other studies which reported results on needle stick injuries only in healthcare personnel in general.

Findings of the present survey were compared to studies conducted among dental students and dental healthcare personnel. Differences in prevalence rates could be attributed to adopting different definitions for the recall period.

The reported prevalence of sharp instruments injuries was 37%. The most common cause of injuries results from hollow bore needle sticks. Studies conducted among dental students and dental healthcare personnel reported variable prevalence rates of needle stick injuries ranging from 23% to 75.4% [3, 5, 6, 10, 14, 16, 19, 20-26].

In dentistry, sharps injuries are likely to occur due to a small operating field, frequent patient movement and the variety of sharp dental instruments used in everyday practice [27].

In the United States, syringe use is the major cause of percutaneous injuries among dental professionals [2]. Syringe needles are hollow bore and blood contaminated; they may thus carry significant risks of transmitting blood borne pathogens [12, 19].

The most serious form of needle injury occurs during injection or recapping as this has the potential to transmit serious blood borne viruses [6]. Between 25% and 30% of injuries are caused by needle recapping alone [28]. Needle recapping is prohibited by the Occupational Safety and Health Administration (OSCHA) to prevent transmission of blood borne pathogens [19]. The majority of house officers (87.6%) used the single scoop for needle recapping. The one handed scoop technique for recapping has been promoted widely and it is highly effective, even for non-experienced users [3].

In the United States, intravenous (IV) delivery systems that do not require the use of needles are used in approximately 70% of the hospitals [17, 29].

In the present study, most injuries were reported to occur in the Surgery (65%) and Outpatient (30%) departments. At KDTH, more patients are managed by house officers at the

	Frequency	Percentage
Awareness of PEP protocol at dental hospital		
Yes	53	32.9
No	12	7.5
I don't know	96	59.6
Testing for HBV after injury		
Yes	7	11.7
No	53	88.3
Received PEP for hepatitis B		
Yes	4	6.7
No	56	93.3
Risk of transmission of HBV from percutaneous injury		
Correct	39	24.2
Incorrect	122	75.8
Need for improvement in knowledge and awareness on safe dental practice		
Yes	149	92.5
No	12	7.5

Table 5: Awareness of post exposure prophylaxis protocols.

Outpatient and Surgery Departments than any other dental department. These factors may explain why these departments have the highest reported incidents.

Under-reporting of injuries remains a topic of concern in dental practice. Studies have revealed high rates of under-reporting ranging from 60% to 90.6% [1, 3, 6, 7, 13, 25, 26, 30]. Reasons indicated in the literature for not reporting injuries were: not knowing to whom or where to report, believing that reporting would not influence outcome, injury happened before needle was used, perception of little or no risk, fear of stigmatization and discrimination, fear of consequences, being busy and dissatisfaction with the follow-up procedures [1, 3, 5, 19]. In our study, the majority of house officers (90%) did not report their injuries.

The implementation of a PEP protocol is crucial especially among healthcare providers. Among dental students in the UAE, 47.8% knew about the existence of a post-exposure prophylaxis protocol [3]. In our study, 67.1% of house officers were unaware of the existence of a PEP protocol at the hospital. This could be a factor for under-reporting injuries.

Prompt reporting of injuries should be encouraged as it enables early counseling and initiation of the treatment when necessary [19]. It is essential to acknowledge the existence of PEP protocols as prophylaxis is reported to be effective in 75% to 90% of the cases for HBV; in cases of HIV, PEP can reduce risk of infection by 79% if given within 2 hours of exposure [1, 4, 9]. In Sudan, not all health care personal are provided with PEP against HBV and HIV at the hospitals where they work and have, therefore, to seek PEP independently.

Studies indicated that there is a higher prevalence of HBV among dentists compared to the general population [26]. In developing countries, hepatitis B vaccination rates remain low [1]. Dentists who received hepatitis B vaccine and have developed immunity to the virus are at virtually no risk for infection [7]. For unvaccinated individuals, the risk of acquiring HBV infection through infected blood varies from 6% to 40% [1, 3, 6, 7, 31]. The reasons reported in the literature for sub-optimal vaccination rates are lack of motivation, lack of opportunity, lack of information, non-availability, fear of side-effects, lack of awareness, fear of being recognized as hepatitis B carrier, high cost of vaccine, being busy, forgetting to complete vaccination, lack of perceived need for the vaccine and erroneous belief of non-susceptibility [1, 3-4, 6, 9, 12, 19, 24, 26, 32-35]. Vaccination against hepatitis B is sub-optimal among the house officers in our study. Only 43.5% were fully vaccinated. This level of immunization puts house officers at greater risk of acquiring hepatitis B. The rates of vaccination in similar studies varied from 20% to 100% [1, 3, 6, 8, 14-16, 20, 24, 26, 33, 36-40].

When asked about ways to increase vaccination rates, Nigerian dental surgeons suggested making vaccination available at no cost, educating dentists on the merits of vaccination, using

evidence of vaccination as a requirement for annual practicing license and employment, and using reminders [1].

The limitations of this study are associated with the potential recall bias and the reporting bias. The survey relied on self-reporting of injuries and what dentists report may be different from what they practice. Another limitation concerns the validity of the study since its findings are only valid to KDTH and not to other dental healthcare settings.

Conclusion

Sudan is a country with sub-optimal healthcare and infection control standards. There is a need to provide better education and training on safe injection practices as well as handling and disposal of sharp instruments. Dental facilities need to be up-scaled to meet the requirements of safe dental practice standards. These measures can significantly reduce exposure to sharp instruments injuries. However, their implementation requires legislation to enforce them.

In Sudan, the prevalence of hepatitis B was estimated at 20% among the general population [33]. HBV virus was the commonest cause of chronic liver disease and hepatocellular carcinoma and was the second commonest cause of acute liver failure [34]. Therefore, hepatitis B vaccination, routine serological testing for confirmation of immunity status and PEP protocols should be administered during clinical training in universities and among healthcare providers.

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References

1. Hashemipour H, Sadeghi A. Needlestick injuries among medical and dental students at the University of Kerman. A Questionnaire Study. Journal of Dentistry, Tehran University of Medical Sciences. 2008;2(5):71-6.
2. Cleveland JL, Barker L, Gooch BF, Beltrami EM, Cardo D. National surveillance system for healthcare workers group of the Centers for Disease. Use of HIV post-exposure prophylaxis by dental health care personnel: an overview and updated recommendations. JADA 2002 Dec;133(12):1619-26.
3. Jaber MA. A survey of needle sticks and other sharp injuries among dental undergraduate students. Int J Infect Control 2011;7(13):1-10.
4. McCarthy GM, Britton JE. A survey of final-year dental, medical and nursing students: Occupational injuries and infection control. J Can Dent Assoc 2000 Nov;66(10):561.
5. Khader Y, Burgan S, Amarin Z. Self-reported needle-stick injuries among dentists in North Jordan. Eastern Mediterranean Health Journal 2009 Jan-Feb;15(1):185-9.
6. Askarian M, Malekmakan L, Memish ZA, Assadian O. Prevalence of needle stick injuries among dental, nursing and midwifery students in Shiraz, Iran. GMS Krankenhaus Interdiscip 2012;7(1):Doc05.
7. Gupta N, Tak J. Needlestick injuries in dentistry. KUMJ. 2011;35(3):208-12.
8. Al-Sarheed M. Occupational exposures and hepatitis B vaccination statues in dental students in Central Saudi Arabia. Saudi med J 2004 Dec;25(12):1943-6.
9. Askarian M, Malekmakan L. The prevalence of needle stick injuries in medical, dental, nursing and midwifery students at the university teaching hospitals of Shiraz, Iran. Indian J Med Sci 2006 Jun;60(6):227-32.
10. Bokhari K, Shariff M, Wahab MA, Togoo RA, Hady Y, Hassan Y. Accidental occupational exposures among dental healthcare workers in Asir region, Saudi Arabia. J Orofac Res 2012;2(1):5-8.
11. Callan RS, Caughman F, Budd ML. Injury reports in a dental school: a two-year overview. J Dent Educ 2006 Oct;70(10):1089-97.
12. Gaballah K, Warbuton D, Sihmbly K, Renton T. Needle stick injuries among dental students: Risk factors and recommendations for prevention. Libyan J Med. 2012;7:1-4.
13. Smith WA, Al-Bayaty HF, Matthews RW. Percutaneous injuries of dental personnel at the University of the West Indies, School of Dentistry. Int Dent J 2006 Aug;56(4):209-14.
14. Shah SM, Merchant AT, Dosman JA. Percutaneous injuries among dental professionals in Washington State. BMC Public Health 2006;6:269.
15. Rimkuviene J, Puriene A, Peciuliene V, Zaleckas L. Percutaneous injuries and hepatitis B vaccination among Lithuanian dentists. Stomatologija 2011;13(1):2-7.
16. Paul T. Self-reported needlestick injuries in dental health care workers at Armed Forces Hospital Riyadh, Saudi Arabia. Mil Med 2000 Mar;165(3):208-10.
17. Panlilio AL, Orelien JG, Srivastava PU, Jagger J, Cohn RD, Cardo DM, et al. Estimate of the annual number of percutaneous injuries among hospital-based healthcare workers in the United States, 1997-1998. Infect Control Hosp Epidemiol 2004 Jul;25(7):556-62.

18. Okeke EN, Ladep NG, Agaba EI, Malu AO. Hepatitis B vaccination status and needle stick injuries among medical students in a Nigerian university. Nigerian Journal of Medicine 2008 Jul-Aug;17(3):330-2.

19. Hussain JSA, Ram SM, Galinde J, Jingade RRK. Occupational exposure among dental, medical and nursing students in Mahatma Ghandi Mission's Campus, Navi Mumbai, India. J Contemp Dent 2012;2(2).

20. Vargas-Ferreira F, Palma Santana B, Beatriz Chaves Tarquino S, Fernanado Demarco F. Prevalence of percutaneous injuries and associated factors among dental surgeon. Rev Odonto Cienc 2012;27(3):196-201.

21. Teixeira C, Pasternak-Júnior B, Silva-Sousa Y, Correa-Silva S. Pre and post-exposure preventive measures to injuries caused by percutaneous instruments during dental practice. Rev Odonto Ciênc 2008;23:10-4.

22. Martins A, Barreto S, Rezende V. Occupational accidents with sharp instruments of dental surgeons. Rev Bras Med Trab 2004;2:267-74.

23. Garcia LP, Blank VL. Prevalence of occupational exposures to potentially infectious materials among dentists and dental assistants. Cadernos de saude publica 2006 Jan;22(1):97-108.

24. Ashfaq M, Chatha MR, Sohail A. Awareness of needlestick injuries among the dental health professionals at Lahore medical & dental college. PODJ 2011;31(2).

25. Malik A, Shaukat M, Qureshi A. Needlestick Injury: A rising biohazard. J Ayub Med Coll Abbottabad 2012;24.

26. Mungure EK, Gakonyo JM, Mamdani Z, Butt F. Awareness and experience of needle stick injuries among dental students at the University of Nairobi, Dental Hospital. East African medical journal 2010 May;87(5):211-4.

27. Porter KM, Scully C, Porter S, Theyer Y. Needlestick injuries to dental personnel. J Dent 1990;18:258–62.

28. Anil S, Jafer M, Preethnath R. Transmission and post-exposure management of blood-borne virsus infections in dental practise. Saudi Dent J. 2008;20(2):56-66.

29. Trape-Cardoso M, Schenck P. Reducing percutaneous injuries at an academic health center: a 5-year review. American Journal of Infection Control 2004 Aug;32(5):301-5.

30. Kotelchuck D, Murphy D, Younai F. Impact of underreporting on the management of occupational bloodborne exposures in a dental teaching environment. J Dent Educ 2004 Jun;68(6):614-22.

31. Goniewicz M, Wloszczak-Szubzda A, Niemcewicz M, Witt M, Marciniak-Niemcewicz A, Jarosz M. Injuries caused by sharp instruments among healthcare workers--International and Polish perspectives. Ann Agric Environ Med 2012;19(3).

32. Elduma AH, Saeed NS. Hepatitis B virus infection among staff in three hospitals in Khartoum, Sudan, 2006-07. Eastern Mediterranean Health Journal 2011 Jun;17(6):474-8.

33. Mudawi HM. Epidemiology of viral hepatitis in Sudan. Clinical and experimental gastroenterology. 2008;1:9-13.

34. Israsena S, Kamolratanakul P, Sakulramrung R. Factors influencing acceptance of hepatitis B vaccination by hospital personnel in an area hyperendemic for hepatitis B. Am J Gastroenterol 1992 Dec;87(12):1807-9.

35. Duffy RE, Cleveland JL, Hutin YJ, Cardo D. Evaluating infection control practices among dentists in Valcea, Romania, in 1998. Infection control and hospital epidemiology 2004 Jul;25(7):570-5.

36. Song KB, Choi KS, Lang WP, Jacobson JJ. Hepatitis B prevalence and infection control among dental health care workers in a community in South Korea. J Public Health Dent 1999;59(1):39-43.

37. Utomi IL. Attitudes of Nigerian dentists towards hepatitis B vaccination and use of barrier techniques. West Afr J Med 2005 Jul-Sep;24(3):223-6.

38. Di Giuseppe G, Nobile CG, Marinelli P, Angelillo IF. A survey of knowledge, attitudes, and behavior of Italian dentists toward immunization. Vaccine 2007 Feb 19;25(9):1669-75.

39. Resende VL, Abreu MH, Paiva SM, Teixeira R, Pordeus IA. Concerns regarding hepatitis B vaccination and post-vaccination test among Brazilian dentists. Virol J 2010;7:154.