

Analysis of 10 years of accidents with biological material among the nursing staff*

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ABSTRACT

The objectives of the present study were: to identify the profile of accidents with biological material among nursing professionals treated in a reference service; to characterize pre-exposure conducts and to analyze factors associated with percutaneous exposure. An epidemiological, retrospective and analytical study was conducted in records of accidents involving biological material from 2000 to 2010. The number of accidents with the nursing staff was 2,569, representing 44.6% of the total records. There was a prevalence of percutaneous exposure cases involving needles with lumen and blood in upper limbs among female nursing technicians. Being female and working outside the city where the service is located increased about twice the chances of suffering percutaneous accidents. The data found strengthen the importance of biological risk in the nursing practice and point to the fact that workers have to move between cities to be treated when the accident is considered serious, such as the case of percutaneous accidents.

Descriptors: Occupational Exposure; Accidents, Occupational; Occupational Risks; Occupational Accidents Registry; Nursing, Team.

INTRODUCTION

Sharps are devices often involved in occupational accidents among nursing professionals in the work practice⁽¹⁻²⁾. The human immunodeficiency virus (HIV), and the hepatitis B (HBV) and hepatitis C (HCV)⁽³⁾ viruses stand out among the most relevant epidemiological microorganisms associated with occupational exposure. For HIV, the occupational acquisition risk is of one case in every 300 percutaneous

exposure events to contaminated blood; for hepatitis B, the risk ranges from 6% to 30%; and for hepatitis C it is 1.8%⁽³⁻⁴⁾.

Several studies indicate that professionals of the nursing staff are the most commonly exposed to biological material and sharp devices are the objects that are most often involved in accidents⁽¹⁻²⁾. Therefore, the nursing staff is the one who acquires more infections⁽⁵⁾. In Brazil, all five published cases of HIV seroconversion after occupational exposure occurred with members of the nursing staff⁽⁶⁻⁷⁾, which reinforces the interface of biological risk and the nursing staff.

To minimize the risk of contamination by infectious microorganisms, there is agreement among national and international recommendations on safety measures that must be implemented before and after exposure. Among the pre-exposure measures, vaccination against hepatitis B and the correct use of personal protective equipment (PPE) stand out. Attention with the accident site, use of immunoprophylaxis and chemoprophylaxis when indicated, notification and clinical and laboratory follow-up⁽³⁾ are considered post-exposure measures.

Given the relevance of the matter, occupational accidents involving biological material cannot be considered daily events of professional practice and must be permanently studied to promote preventive measures based on the epidemiological knowledge of this grievance. Considering differences of work conditions of each context, there are no consolidated data among the nursing staff in the study period.

The objectives of this study were to identify the profile of accidents with biological material among nursing professionals treated in a reference service, characterize pre-exposure conducts in the records of victims of accidents with biological material in this category and analyze sociodemographic and work factors associated with occupational exposure by sharps.

METHOD

An epidemiological, retrospective and analytical study was conducted in records of accidents with biological material among the nursing staff who sought care at a reference hospital in infectious diseases in a state of the center-west of Brazil. Data were collected by means of record survey of nursing staff professionals, who were victims of accidents with biological material, after previous consent of the local study institution and approval by its research ethics committee under protocol no. 33/10, meeting the Brazilian standards for human research.

Data were collected from January to July 2011, with the use of a semi-structured form, previously evaluated and tested. Records of accidents with nursing professionals were included, from 2000 until clinical and laboratory follow-up was concluded in December 2010, and records that did not present information regarding the "type of exposure" and the "year of the accident" were excluded. The percutaneous accident was established as an outcome variable and the independent variables were sociodemographic (gender, age and education level) and work factors (professional category, victims' origin and vaccine status for hepatitis B).

The data were analyzed by means of the Statistical Package for the Social Sciences 15 (SPSS) software and descriptive statistics was used to characterize the accidents' profile and pre-exposure conducts, in addition to univariate analysis to estimate the chance (odds ratio) of percutaneous accidents occurrence, with a 95% confidence interval. The independent variables that obtained $p < 0.10$ in the univariate analysis were tested by means of the forward likelihood ratio multivariate logistic regression model.

RESULTS

Between 2000 and 2010, the number of accidents with the nursing staff was 2,568, representing 44.6% of the total records. Of these, 10.1% regarded victims who suffered more than one accident, ranging from two to six records for the same professional. Regarding gender, 91.6% were women and 8.4% were men. Median age was 33 years, with minimum of 18 and maximum of 69. Nursing technicians had more accidents (77.0%), followed by nursing aides (15.5%) and nurses (7.5%).

Figure 1 shows the proportion of records of accidents with biological material by professional category according to the year of the accident.

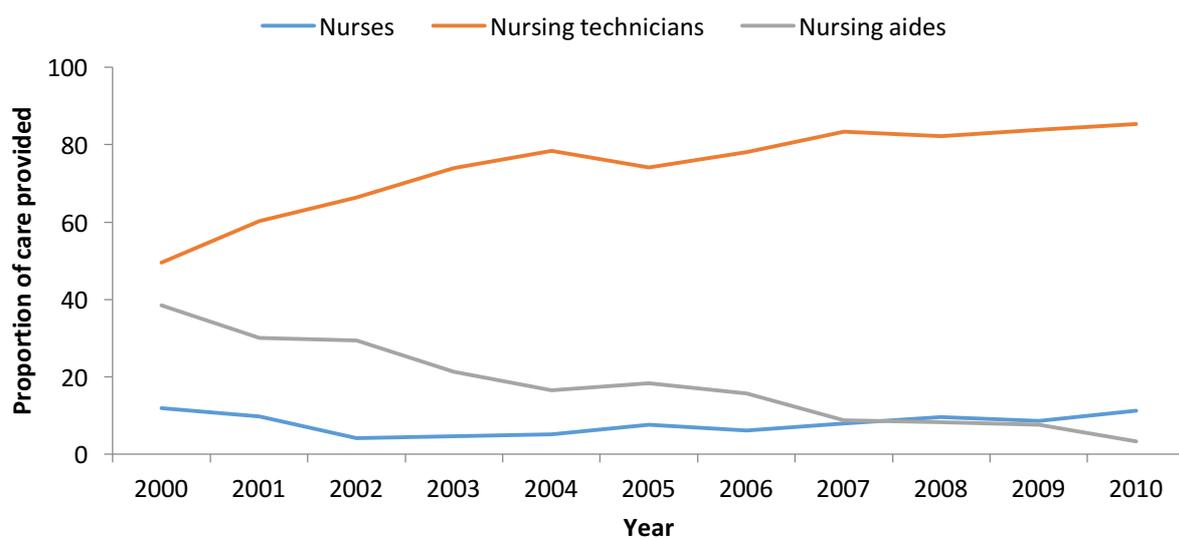


Figure 1: Proportion of accidents with biological material among the nursing staff and the year of care at a reference hospital in infectious disease in the state of Goiás, from 2000 to 2010. Goiânia, GO, Brazil, 2012.

The proportion of care per accident with nursing aides dropped over the years (χ^2 tendency=162.2; $p=0.000$) comparatively to nursing technicians and nurses.

Most records involved victims who worked in the city of Goiânia (1,812/2,569; 70.5%), 707 worked in other cities and 52 did not identify their origin. Figure 2 shows that the proportion of care to professionals who worked in other cities increased over the time (χ^2 tendency=137.7; $p=0.000$).

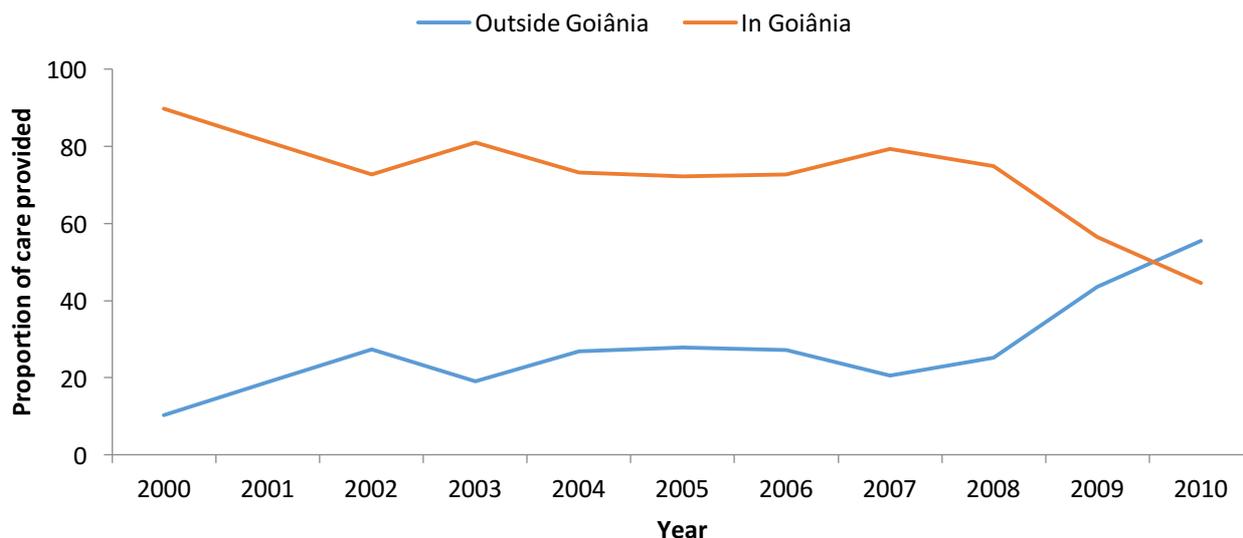


Figure 2: Distribution of the origin of victims of accident with biological material in records (N=2,569) of nursing professionals treated at the reference hospital in infectious disease in the state of Goiás, from 2000 to 2010. Goiânia, GO, Brazil, 2012.

In 858 (33.4%) records, the victim's type of institution was not reported. For the reported cases, 60.2% (1,030/1,711) were from private/associated institutions, 35.8% from public institutions (612/1,711) and 4.0% (69/1,711) from philanthropic institutions. In 63.8% of the care provided, the victims had sought the service on their own, and there was not any formal referral document from the employing institution requesting assistance. There was record of the work accident notification in 9.1% of the cases.

The prevalence of accidents involving sharps was 89.5% (2,299/2,569), of these, needles with lumen were involved in most of the percutaneous exposure cases (1,775/2,299; 77.2%). Mucous membrane exposure (oral/ocular), intact skin, non-intact skin and bites obtained 8.2%, 1.1%, 1.0% and 0.2% of the records, respectively. Information on body surface area was found in 88.4% (2,271/2,569) of the records, and 86.8% (1,971/2,271) involved the upper limbs, 9.9% (225/2,271) the face, 3.0% (68/2,271) the lower limbs and 0.3% (7/2,271) the upper body. Information on biological material involved in the accidents was presented in 75.2% (1,932/2,569) of the records and blood represented 88.6% (1,711/1,932) of the cases.

There was no identification of the accidents' circumstances in 45.5% (1,169/2,569) of the records. When they were informed (1,400), the main factors were: waste handling with 21.9% (307/1,400), which included inadequate disposal, handling of sharps' containers and recapping of needles; handling of vascular access with 20.8% (291/1,400) as well as venous/arterial puncture, removal of venous access and blood collection; followed by drug administration with 16.8% (236/1,400). Digital puncture was described separately as the procedure with the highest record in exposure, with 17.4% (244/1,400).

Regarding vaccination status against hepatitis B, 77.6% (1,993/2,569) presented the complete scheme. Among these, 82 (4.1%) informed the examination of anti-HBs test, being 59/82 (72.0%) characterized as responders to the vaccine and 23/82 (28.0%) as non-responders. Cases with incomplete vaccination information (16.6%) were included in the non-vaccinated group. This information was not presented in 4.3%

of the records and 1.5% did not know their vaccination status.

Information regarding the use of PPE at the time of the accident was not presented in 84.7% (2,177/2,569) of the records, and as for those that had this information (392), 118 said that they did not use any protective equipment. When there was record of the use of PPE (274/392; 69.9%), the majority (245/274; 89.4%) was related to percutaneous exposure cases, being the glove the most frequently mentioned (77.4%). Other objects mentioned were: gowns (10.6%); masks (8.8%); goggles (5.8%) and closed shoes (3.3%).

Table 1 presents the univariate analysis of the independent variables for the percutaneous accidents. There was a statistically significant association with gender ($p=0.000$), working outside the city of Goiânia ($p=0.000$), age ($p=0.006$) and vaccination against hepatitis B ($p=0.052$).

Table 1: Univariate analysis of factors associated with percutaneous accidents among nursing professionals treated at a reference hospital in infectious diseases, from 2000 to 2010. Goiânia, GO, Brazil, 2012.

Independent variables	Percutaneous accident*				OR	95% CI	p value
	Yes		No				
	N	%	N	%			
Gender							
Female	2121	92.3	231	85.6	2.01	1.38-2.91	0.000
Male	178	7.7	39	14.4	1		
Age							
>=35 years	1019	44.4	96	35.7	1.44	1.10-1.87	0.006
<35 years	1274	55.6	173	64.3	1		
Education level: complete higher education							
No	2005	90.2	231	88.2	1.24	0.83-1.85	0.291
Yes	217	9.8	31	11.8	1		
Category							
Nursing technician	1756	91.1	221	91.7	0.92	0.57-1.49	0.748
Nursing aide	371	68.3	29	59.2	1.48	0.80-2.70	0.222
Nurse	172	8.9	20	8.3	1		
Workplace							
Outside Goiânia	667	29.6	38	14.5	2.47	1.73-3.53	0.000
In Goiânia	1588	70.4	224	85.5	1		
Hepatitis B vaccination							
No	371	17.1	56	22.0	0.73	0.53-1.00	0.052
Yes	1795	82.9	198	78.0	1		

* Exposure variables do not always have the same "N" value in the study, due to the absence of information in some medical records.

Table 2 presents the adjusted analysis of logistic regression for the identification of factors independently associated with percutaneous accidents.

Table 2: Factors independently associated with percutaneous accidents among nursing professionals from 2000 to 2010. Goiânia, GO, Brazil, 2012.

Variable	Adjusted OR*	95% CI	p value
Female gender	1.94	1.31 – 2.88	0.001
Origin outside Goiânia	2.51	1.73 – 3.64	0.000

* Adjusted OR by age, education level, professional category and hepatitis B vaccination.

Women presented almost twice the chance of suffering percutaneous accidents when compared to men. In addition, accidents with professionals who worked outside the city of Goiânia were 2.51 times more likely to involve sharps when compared to those who worked within the city of Goiânia.

DISCUSSION

The prevalence of accidents among the nursing staff found in this study was similar to the findings of other national and international studies^(1-2,5,8) and different from a study conducted in Massachusetts/USA and another from Malacca/Malaysia, whose results showed a higher frequency of accidents among the medical staff⁽⁹⁻¹⁰⁾. The decreasing order of the record of accidents observed for nursing technicians (77.0%), nursing aides (15.5%) and nurses (7.5%) is similar to that found in the literature^(1-2,11). It is worth remembering that proportionally, nursing technicians represent the category with the highest number of professionals in their team, and that the nursing staff represents the highest number of professionals in the healthcare staff.

The identification of 10.1% of records with individuals who had more than one accident was lower than that found in two international studies⁽¹²⁻¹³⁾, which had 51.0% and 80.1%, respectively.

The majority of the records of accidents among women (91.6%) reflects on the history of nursing, which is predominantly performed by women. Several studies^(1-2,11-16) show the prevalence of women, both in occurrence and in notification of accidents with biological material among the nursing staff.

The median age found (33 years) among victims is similar to that found in a study conducted in the city of Minas Gerais⁽¹¹⁾. Victims aged between 20 and 30 years^(1,8,16) and between 30 and 40 years^(2,17) predominated in studies that used age ranges.

Regarding the origin of the victims, more than a quarter of the care was provided to individuals who had accidents outside the city where the reference service is located. The reference hospital in infectious diseases studied was the only reference service for accidents with biological material until 2006. After that, sentinel units were created (proposed as municipal and decentralization strategies of health actions with the purpose of sharing responsibilities among managers), and they seem to have contributed to the significant decrease of care for professionals from institutions of the city of Goiânia, leading to the understanding that there was a redistribution of these victims, who had the option of searching for sentinel units. However, it was observed that there was no decrease of care for professionals from other cities in the state of Goiás.

It is worth mentioning that when the victim has to move between cities to be treated, it increases the time between the accident and the first aid. This makes the early start of post-exposure prophylaxis difficult and increases workers' risk of infection⁽³⁾.

Most cases involved workers from private/associated institutions (60.2%) and without referral (63.8%), showing a deficiency associated with care management to victims of accident with biological material in the institutions and the underreporting of work accidents. These results point to a failure in complying with the Brazilian Regulatory Standard NR-32⁽¹⁸⁾ regarding the implementation of a healthcare program for injured workers and the obligation in filling the Employment Accident Notification (CAT, as per its acronym in

Portuguese), recommended in the abovementioned regulatory standard, and which had a very low frequency (9.1%).

The purpose of the NR-32 is to establish basic guidelines for the implementation of protective measures for the safety and health of healthcare professionals and those who perform health care and promotion activities in general⁽¹⁸⁾. A major step of this regulatory standard was the workers' co-responsibility on the health of healthcare professionals.

The predominant profile of percutaneous accidents involving needles with lumen in upper limbs, with blood as the most commonly described biological material, is similar to that found in other studies^(1-2,11-14). Accidents with hollow needles deserve more attention, because they present a higher risk due to the potential for storing a larger volume of blood⁽³⁾.

Regarding the accidents' circumstances, some of them could be avoided by the adoption of standard precaution measures, such as those caused by the recapping of needles and inadequate disposal of sharps. These behaviors were responsible for the high frequency of accidents in other studies^(2,8,11,14).

Also related to the inadequate handling of waste in health services, another important aspect is that several studies have shown that the consequences of this inadequate handling go beyond the worker who does the incorrect disposal, reaching professionals who, due to the nature of their work, are not in direct contact with patients, but handle waste derived from this care, such as the hygiene and cleaning staff and external waste collectors of the health service⁽¹⁹⁾.

Edict no. 939⁽²⁰⁾, which was published after the NR-32(18), regulated the obligation of using safety devices in sharps in healthcare services and its full implementation within three years. After this period, this edict was repealed by edict no 1748 of August 2011⁽²¹⁾, which allows the use of devices according to the market availability. A retreat in legal protection mechanisms for the workers' health in Brazil is observed. A study conducted in the UK identified a reduction of 86% in percutaneous accidents after the introduction of these safety devices⁽²²⁾.

The vaccination rate against hepatitis B (77.6%) found is among those identified in the literature, with rates ranging between 56% and 93.9%^(2,10-11,14,17), showing that the optimal of 100% has still not been achieved, although it is a safe, free and extremely effective measure. Regarding anti-HBs tests, the problem is even more serious, since the examination record index of this test in the present study was low (3.2%) and consistent with the literature⁽¹⁷⁾. In a study conducted at a reference hospital for victims of work accidents with exposure to biological material in the city of Curitiba, the application of this test among people treated was 81.5%, and 13.9% were non-responders to the vaccine⁽¹⁾.

Gloves, being the most frequently used PPE, were mentioned in 77.4% of the records in which this information was present, which is similar to the literature^(12,13). Gloves do not prevent perforation, but they act as a mechanical barrier that reduces the risk of contact with body fluids, which are potential links to pathogens⁽²²⁾.

The findings of this study, showing that being female was an important predisposing factor for the

occurrence of percutaneous accidents among professionals of the nursing staff, agree with the findings of other authors^(1,14). Regardless of the lower number of men (8.4%), women presented about twice the chance of suffering a percutaneous accident, which may indicate a higher demand for care when this type of accident happens among women, deserving further studies.

Regarding the origin of the victims, the results suggest that the notification might be associated with the type of exposure. Among victims who worked outside the city of Goiânia, mucocutaneous exposure cases were less notified than percutaneous cases, i.e., professionals had to move from their cities to notify in another city when they considered the accident serious. In the literature, the association between the type of accident and its notification is evidenced in studies that concluded that the notification rate was higher when the professional considered the accident more serious⁽²³⁻²⁴⁾.

CONCLUSIONS

From 2000 to 2010, 2,569 accidents with nursing staff members were recorded at a reference hospital in infectious diseases in the state of Goiás, totaling 44.6% of the records. Accidents with sharps represented about 90.0% and happened predominantly with needles with lumen in upper limbs and with the presence of blood. Most victims worked for private institutions in the city of Goiânia, had not been formally referred and few records contained information on the CAT filling. Vaccination against hepatitis B was the most recorded pre-exposure measure and information on the use of protective equipment was present in only 15.3% of the records, with gloves being the most frequently mentioned PPE.

The variables female gender and being outside the city of Goiânia had a statistically significant association and increased about twice the chance for percutaneous accidents. In the majority of the medical records, there was no record of information for several investigation variables, preventing further analysis. The detailed knowledge of the accidents' circumstances is important to identify practices developed by professionals who suggest risk behaviors for the exposure to biological material in the work environment and to establish preventive measures.

The findings of the present study consolidate the importance of biological risk in the professional nursing practice and suggest that the implementation of sentinel units for the care of victims with biological material has not yet presented a practical result, since workers were still leaving their cities for care. In addition, possibly associated with this difficulty, the workers evaluate the risk and seek for care when they consider the accident serious, such as the case of percutaneous accidents.

The nursing staff needs to search for mechanisms to face biological risks. Protocols of care, specialized areas and qualified teams are necessary; however, these actions will only be effective with workers who are aware of the risk, their rights and their responsibilities regarding the adoption of pre- and post-exposure measures, and of the working aspects involved. It is worth mentioning that nurses must have accountability and commitment to their team in the pursuit of work safety.

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REFERENCES

1. Giancotti GM, Haeffner R, Solheid NLS, Miranda FMD, Sarquis LMM. Caracterização das vítimas e dos acidentes de trabalho com material biológico atendidas em um hospital público do Paraná, 2012. *Epidemiol. Serv. Saúde* [Internet]. 2014 [cited 2016 jun 30];23(2):337-46. Available from: <http://dx.doi.org/10.5123/S1679-49742014000200015>.
2. Jefferson Martins R, Saliba Moimaz SA, Ispere Garbin AJ, Vicente Gonçalves PR, Saliba Garbin CA. Prevalência de Acidentes Com Material Biológico em um Município do Noroeste de São Paulo, Brasil, no Período de 2007 a 2011. *Cienc Trab* [Internet]. 2014 [cited 2016 jun 30];16(50):93-6. Available from: <http://dx.doi.org/10.4067/S0718-24492014000200006>.
3. Rapparini C, Lara LTR, Vitória MAV. Recomendações para atendimento e acompanhamento de exposição ocupacional a material biológico: HIV e Hepatites B e C [Internet]. Brasília: Ministério de Saúde; 2004 [cited 2016 jun 30]. Available from: http://www.aids.gov.br/sites/default/files/manual_acidentes_final_0.pdf.
4. Cardo DM, Culver DH, Ciesielski CA, Srivastava PU, Marcus R, Abiteboul D, et al. A Case–Control Study of HIV Seroconversion in Health Care Workers after Percutaneous Exposure. *N Engl J Med* [Internet]. 1997 [cited 2016 jun 30];337(21):1485-90. Available from: <http://dx.doi.org/10.1056/NEJM199711203372101>.
5. Ippolito G, Puro V, Heptonstall J, Jagger J, De Carli G, Petrosillo N. Occupational human immunodeficiency virus infection in health care workers: worldwide cases through September 1997. *Clin Infect Dis* [Internet]. 1999 [cited 2016 jun 30];28(2):365-83. Available from: <http://dx.doi.org/10.1086/515101>.
6. Rapparini C. Occupational HIV infection among health care workers exposed to blood and body fluids in Brazil. *Am J Infect Control*. 2006 [cited 2016 jun 30];34(4):237-40. Available from: <http://dx.doi.org/10.1016/j.ajic.2005.08.016>.
7. Lucena NO, Pereira FR, Barros FS, Silva NB, Alexandre MAA, Castilho MC, et al. Infecção pelo HIV-1 após acidente ocupacional, no Estado do Amazonas: primeiro caso documentado. *Rev Soc Bras Med Trop* [Internet]. 2011 [cited 2016 jun 30];44(5):646-7. Available from: <http://dx.doi.org/10.1590/S0037-86822011000500027>.
8. Hajjaji Darouiche M, Chaabouni T, Jmal Hammami K, Messadi Akrouf F, Abdennadher M, Hammami A, et al. Occupational blood exposure among health care personnel and hospital trainees. *Int J Occup Environ Med* [Internet]. 2014 [cited 2016 jun 30];5(1):57-61. Available from: <http://www.theijoem.com/ijoem/index.php/ijoem/article/view/321/456>.
9. Massachusetts Department of Public Health Occupational Health Surveillance Program. Sharps Injuries among Hospital Workers in Massachusetts, 2010: Findings from the Massachusetts Sharps Injury Surveillance System [Internet]. Boston: Massachusetts Department of Public Health; 2010 [cited 2016 jun 30]. Available from: <http://www.mass.gov/eohhs/docs/dph/occupational-health/injuries/injuries-hospital-2010.pdf>.
10. Bhardwaj A, Sivapathasundaram N, Yusof M, Minghat A, Swe K, Sinha N. The Prevalence of Accidental Needle Stick Injury and their Reporting among Healthcare Workers in Orthopaedic Wards in General Hospital Melaka, Malaysia. *Malays Orthop J* [Internet]. 2014 [cited 2016 jun 30];8(2):6-13. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4181076/>.
11. Julio RS, Filardi MBS, Marziale MHP. Acidentes de trabalho com material biológico ocorridos em municípios de Minas Gerais. *Rev Bras Enferm* [Internet]. 2014 [cited 2016 jun 30];67(1):119-26. Available from: <http://dx.doi.org/10.5935/0034-7167.20140016>.
12. Zhang MX, Yu Y. A study of the psychological impact of sharps injuries on health care workers in China. *Am J Infect Control J* [Internet]. 2013 [cited 2016 jun 30];41(2):186-7. Available from: <http://dx.doi.org/10.1016/j.ajic.2012.02.023>.
13. Muralidhar S, Singh PK, Jain RK, Malhotra M, Bala M. Needle stick injuries among health care workers in a tertiary care hospital of India. *Indian J Med Res* [Internet]. 2010 [cited 2016 jun 30];131(3):405-10. Available from: <http://www.ijmr.org.in/downloadpdf.asp?issn=0971-5916;year=2010;volume=131;issue=3;spage=405;epage=410;aulast=Muralidhar;type=2>.

14. Markovic-Denic L, Maksimovic N, Marusic V, Vucicevic J, Ostric I, Djuric D. Occupational exposure to blood and body fluids among health-care workers in Serbia. *Med Princ Pract* [Internet]. 2015 [cited 2016 jun 30];24(1):36-41. Available from: <http://dx.doi.org/10.1159/000368234>.
15. Wu HC, Ho JJ, Lin MH, Chen CJ, Guo YL, Shiao JS. Incidence of percutaneous injury in Taiwan healthcare workers. *Epidemiol Infect* [Internet]. 2015 [cited 2016 jun 30];143(15):3308-15. Available from: <http://dx.doi.org/10.1017/S0950268815000321>.
16. Beyera GK, Beyen TK. Epidemiology of exposure to HIV/AIDS risky conditions in healthcare settings: the case of health facilities in Gondar City, North West Ethiopia. *BMC Public Health* [Internet]. 2014 [cited 2016 jun 30];14(1):1283. Available from: <http://dx.doi.org/10.1186/1471-2458-14-1283>.
17. Jardim EMA, Carvalho PAM, Silva RP, Souza AC. Vacinação contra Hepatite B e resposta vacinal em trabalhadores da área da saúde envolvidos em acidentes com material biológico. *Acta de Ciências e Saúde* [Internet]. 2014 [cited 2016 jun 30];2(2):14-24. Available from: <http://www.ls.edu.br/actacs/index.php/ACTA/article/view/58>.
18. Portaria nº 485, de 11 de novembro de 2005 (BR). Aprova a Norma Regulamentadora nº 32 (Segurança e Saúde no Trabalho em Estabelecimentos de Saúde). *Diário Oficial da União* [Internet]. 16 nov. 2005 [cited 2016 jun 30]. Available from: <http://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?jornal=1&pagina=80&data=16/11/2005>.
19. Ream PSF, Tipple AFV, Barros DX, Souza ACS, Pereira MS. Biological risk among hospital housekeepers. *Arch Environ Occup Health* [Internet]. 2016 [cited 2016 jun 30];71(2):59-65. Available from: <http://dx.doi.org/10.1080/19338244.2014.927347>.
20. Portaria nº 939, de 18 de novembro de 2008 (BR). *Diário Oficial da União* [Internet]. 19 nov. 2008 [cited 2016 jun 30]. Available from: <http://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?data=19/11/2008&jornal=1&pagina=238>.
21. Portaria nº 1.748, de 30 de agosto de 2011 (BR). *Diário Oficial da União* [Internet]. 31 ago. 2011 [cited 2016 jun 30]. Available from: <http://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?data=31/08/2011&jornal=1&pagina=143>.
22. Adams D, Elliott TS. Impact of safety needle devices on occupationally acquired needlestick injuries: a four-year prospective study. *J Hosp Infect* [Internet]. 2006 [cited 2016 jun 30];64(1):50-5. Available from: <http://dx.doi.org/10.1016/j.jhin.2006.04.012>.
23. Jagger J, Perry J, Parker G, Phillips EK. Nursing 2011 survey results: Blood exposure risk during peripheral I.V. catheter insertion and removal. *Nursing* [Internet]. 2011 [cited 2016 jun 30];41(12):45-9. Available from: <http://dx.doi.org/10.1097/01.NURSE.0000407678.81635.62>.
24. Machado-Carvalhais HP, Martins TC, Ramos-Jorge ML, Magela-Machado D, Paiva SM, Pordeus IA. Management of occupational bloodborne exposure in a dental teaching environment. *J Dent Educ* [Internet]. 2007 [cited 2016 jun 30];71(10):1348-55. Available from: <http://www.jdentaled.org/content/71/10/1348.long>.