

Occurrence of occupational accidents involving potentially contaminated biological material among nurses

Ocorrência de acidentes de trabalho com material biológico potencialmente contaminado em enfermeiros

Marília Duarte Valim¹

Maria Helena Palucci Marziale¹

Miyeko Hayashida¹

Miguel Richart-Martínez²

Keywords

Accidents, occupational; Universal precautions; Security measures; Occupational health nursing; Exposure to biological agents

Descritores

Acidentes de trabalho; Precauções universais; Medidas de segurança; Enfermagem do trabalho; Exposição a agentes biológicos

Submitted

April 7, 2014

Accepted

May 26, 2014

Corresponding author

Marília Duarte Valim
Bandeirantes Avenue, 3900, Ribeirão Preto, SP, Brazil. Zip Code: 14040-902
duartevalim@usp.br

DOI

<http://dx.doi.org/10.1590/1982-0194201400047>

Abstract

Objective: To investigate the occurrence and characteristics of accidents involving potentially contaminated biological material in nurses.

Methods: Cross-sectional study involving 121 nurses. The research instrument was a self-applied questionnaire with sociodemographic and occupational accident-related variables.

Results: Sixty-five (53.8) nurses were victims of occupational accidents involving exposure to potentially contaminated biological material. Sixty-three (52.1%) were related to piercing-cutting materials and 22 (18.2%) to exposure of the mucosa and/or non-intact skin. No statistically significant difference between the groups was found in terms of accident events and reporting ($p=0.791$ and $p=0.427$); knowledge of the immune response ($p=0.379$); change of piercing-cutting material collector ($p=0.372$) and training on standard precautions ($p=0.158$). A statistically significant difference in the training was found ($p=0.014$), as nurses working at smaller establishments indicated greater desire to participate.

Conclusion: Accidents are frequent among the nurses and training is positively related with adherence to standard precautions.

Resumo

Objetivo: Investigar ocorrência e características dos acidentes com material biológico potencialmente contaminado em enfermeiros.

Métodos: Estudo transversal que incluiu 121 enfermeiros. O instrumento de pesquisa foi um questionário autoaplicável com variáveis sociodemográficas e relacionadas a acidentes de trabalho.

Resultados: Em relação à ocorrência de acidente do trabalho com exposição a material biológico potencialmente contaminado entre enfermeiros, 65 (53,8%) foram vítimas. Destes, 63 (52,1%) por perfurocortantes e 22 (18,2%) por exposição à mucosa e/ou pele não íntegra. Não houve diferença estatisticamente significativa entre os grupos quanto à ocorrência e notificação do acidente ($p=0,791$ e $p=0,427$); conhecimento da resposta vacinal ($p=0,379$); troca de recipiente de perfurocortantes ($p=0,372$) e treinamento sobre precauções padrão ($p=0,158$). Com relação ao treinamento foi verificada diferença estatisticamente significativa ($p=0,014$) uma vez que enfermeiros nos estabelecimentos menores relataram maior desejo de participação.

Conclusão: Os acidentes são frequentes entre os enfermeiros e o treinamento relaciona-se positivamente à adesão às precauções-padrão.

¹Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP, Brazil.

²Universidad de Alicante, Alicante, Spain.

Conflicts of interest: no conflicts of interest to declare.

Introduction

The double goal of the standard precautions is to protect health professionals against possible occupational contamination in care delivery and to prevent healthcare-related infections.⁽¹⁾ In occupational health, the possibility of contamination by occupationally relevant pathogens like the HIV virus and the HBV and HCV virus can be prevented.⁽²⁾ In 1996, 18 years ago, the Centers for Disease Control and Prevention (CDC) established the standard precautions, which contain the main concepts of universal precautions and isolation of body substances, based on the principle that any body fluids (except sweat) can contain infectious agents.⁽³⁾

The infection by the HIV virus in the United States among professionals who did not report other than occupational risk factors was investigated in a CDC protocol entitled “Cases of Public Health Importance” (COPHI).⁽⁴⁾

In that source, it is reported that records between 1981 and 2010 indicate that 57 North American workers were victims of seroconversion after occupational accidents involving exposure to potentially contaminated biological material, although at least 143 cases are under investigation, the most recent of which happened in 2009. Therefore, the number of professionals who caught the infection is uncertain. In addition, there is possible underreporting.

In developing countries, the surveillance and control systems need to be improved and health establishments need to encourage reporting,^(5,6) as there are no precise data about the number of cases of seroconversion to HIV and hepatitis B and C among health professionals in the Brazilian context.

In Brazil, occupational accidents involving exposure to potentially contaminated biological material are considered a health problem of compulsory reporting and should be notified on a form standardized by the Ministry of Health in the National Disease Notification System - SINAN-NET and in sentinel networks, such as the Occupational Health Referral Centers - CEREST.⁽⁷⁾ In a study undertaken to analyze these accidents, important gaps were appointed, showing the need to train the professionals responsible for the records.⁽⁶⁾ Studies

indicate the need for training and awareness-raising of the workers about the adherence to standard precautions^(8,9), as these accidents are still frequent and can entail severe consequences for the workers' physical and psychosocial wellbeing.⁽¹⁰⁾

Adherence to standard precautions is the main strategy to protect workers against exposure to transmissible pathogens and to protect patients,⁽¹¹⁾ but adherence is below recommended levels.^(8,12) A study found that training and knowledge about the theme positively influence the adherence.⁽¹³⁾ In the same context, a study at hospitals and medical centers in Ethiopia identified that more than half of the health workers possessed inappropriate knowledge about the standard precautions and that 95.5% actually wanted to receive some kind of training.⁽¹⁴⁾

Adherence to infection control and safety practices can also be influenced by the size of the establishments. Studies show that adherence to safety measures is higher in larger hospitals when compared to smaller hospitals and establishments.^(5,15) One of the reasons can be the fact that smaller establishments are generally more basic and have a more limited structure and less activities of the infection control commissions.⁽⁵⁾

It was observed that the constant presence of training, a prepared and exclusive team for infection control and patient safety, greater financial investments and participation of organizational management in these activities are positively related with better infection control practices.^(16,17) As the human and financial resources vary significantly among different types of health establishments, teaching hospitals tend to exert infection control practices more effectively than municipal or philanthropic hospitals, which are often smaller and receive less financial incentives.⁽¹⁷⁾

The objective in this study was to investigate and compare the occurrence and characteristics of accidents involving biological material in nurses at a teaching hospital and smaller health establishments.

Methods

A cross-sectional study was undertaken at health establishments in two Brazilian cities between Sep-

tember and December 2012, including one teaching hospital and three smaller institutions.

The teaching hospital is characterized as size IV and is considered a referral center for high-quality research areas. The items assessed for the characterization as size IV are: 300 beds or more, 30 of which for the intensive care unit (ICU); more than eight surgery rooms; reference level III for urgency and emergency and ICU and four or more high-complexity sectors.⁽¹⁸⁾ The smaller establishments include one philanthropic hospital, one private hospital that also offers beds to the Unified Health System (SUS) and an emergency care unit affiliated with a regional health insurance. The philanthropic institution offers 155 beds; the other hospital 78 beds, the emergency care service consists of an emergency unit and a medication room and eight beds for observation.

Nurses were included with at least three months of professional experiences, who were not on holiday, medical leave or leave of absence. Professionals in exclusively administrative functions or not present at the place of work after two consecutive attempts were excluded.

The sample was randomly composed of 120 nurses from the teaching hospital and the nurses working at the smaller establishments who complied with the inclusion criteria, totaling 39 professionals. It should be highlighted that, in 2011, 411 nurses worked at the teaching hospital. The final sample consisted of 121 nurses, 91 from the teaching hospital and 30 from the smaller establishments. Therefore, the response rate corresponded to 75.8% for the university hospital and 77.0% for the other establishments.

The questionnaire with sociodemographic characteristics included the following variables: sex; work sector; birth date; education level; workplace and length of professional experience. The following variables were considered related to the occurrence of an occupational accident with exposure to potentially contaminated biological material: vaccination for Hepatitis B and knowledge about the anti-HBs antibody; accident reporting; practice of change of disposal container for piercing-cutting

material; participation and desire to participate in training about standard precautions.

The responsible researchers provided the workers with the questionnaires during their work hours. As the questionnaire was self-explained, the participants were advised to complete it when they had time and to leave the completed questionnaires in a sealed box in the nursing head's office in each sector for the researcher to collect. The box was available for approximately two weeks in each sector and, during the shift after they had received the questionnaire, the researcher contacted the nurses to know if they had handed it in. In case they had not answered it yet, the researcher used the occasion to remind them about the importance of their participation.

The numerical variables are described using descriptive statistics, calculating the means, medians and standard deviations. The nominal categorical variables are described or displayed in frequency tables. Pearson's chi-square test was applied for the categorical or dichotomous variables, such as "participation in training about SP", "change of piercing-cutting material container" and "knowledge about anti-HBs antibody" to compare whether there was a statistically significant difference between the two groups of nurses. For the variables "accident reporting" and "desire to participate in training", Fisher's exact test was applied. For the variable "number of accidents involving piercing-cutting material", the Mann-Whitney test was applied as no normal distribution was verified.

The development of the study complied with Brazilian and international standards for research involving human beings.

Results

The participants mainly included women, between 20 and 40 years of age. The mean age at the teaching hospital was 37.4 years (SD±8.95), median 35, maximum 58 and minimum 23 years. At the smaller establishments, the mean age was 32.5 years, median 33, minimum 23 and maximum 50 years of age. The majority (51.2%) held

a specialist degree and only 8.3% a Master's and/or Doctoral degree, as demonstrated in table 1.

Table 1. Distribution of the nurses (n=121) according to sex, age range, education and place of work

Variables	n(%)
Gender	
Female	110(90.9)
Male	11(9.1)
Age range (years)	
20 to 30	38(31.4)
31 to 40	50(41.3)
41 to 50	18(14.9)
≥ 51	12(9.9)
Missing data	3(2.5)
Education level	
Higher	34(28)
Specialization ongoing	6(5)
Specialization	62(51.2)
Master's ongoing	2(1.7)
Master's	8(6.6)
Doctoral ongoing	6(5)
Doctoral	2(1.7)
Place of work	
Teaching hospital	
Emergency unit	32(26.4)
Teaching hospital	59(48.8)
Smaller health establishments	
Philanthropic hospital	16(13.2)
Private hospital	7(5.8)
Emergency care	7(5.8)

The length of professional experience corresponded to between three months and five years for 31.4%, between six and ten years for 23.1%, between 11 and 15 years for 20.7% and 16 years or more for 24.8%. The mean length of professional experience was 10.1 years (SD 7.22). As regards the sector, 31 nurses (25.5%) were allocated to medical and surgical clinics; 29 (23.8%) belonged to adult, neonatal and/or pediatric intensive care units; 10 (8.4%) worked in emergency care; nine (7.4%) in pediatrics; eight (6.6%) belonged to the gynecology and obstetrics sector and 34 (28.3%) to the other sectors investigated: orthopedics, dermatology and immunology, psychiatrics, neurology, coronary unit, infectious diseases, outpatient clinics, hematology and liver transplantation.

Concerning the occurrence of occupational accidents involving exposure to potentially contaminated biological material among nurses, 65 (53.8%) were victims. Sixty-three (52.1%) involved piercing-cutting material and (18.2%) exposure of

the mucosa and/or non-intact skin. It should be highlighted that 50.5% of the nurses at the teaching hospital affirmed they had been victims of occupational accidents with piercing-cutting material, against 56.7% at the smaller establishments.

The results show that 81.4% and 92.9% of the victims at the teaching hospital and smaller establishments, respectively, notified the events. Among the justifications for not reporting, two nurses indicated that they did not consider notification necessary and two that they did not consider the occupational accident they were victims of as dangerous; two did not notify due to forgetting or the stress the accident caused and one justified the delay in returning to the responsible units.

The vaccination schedule for hepatitis B was complete in 97.5% of the nurses, but 46.2% of the nurses at the teaching hospital indicated not having the recommended immune response and 26.4% did not know the response. At the smaller establishments, 36.7% indicated not knowing about the presence of the anti-HBs antibody and 40.0% could not provide this important information.

The data revealed that 44.0% and 53.3% of the sectors at the teaching hospital and at the smaller establishments, respectively, did not change the piercing-cutting material collector after one-third had been filled.

Concerning the participation in training about standard precautions, 87.9% of the nurses at the teaching hospital and 80.0% at the smaller establishments affirmed they had participated in institutional training. Nevertheless, 96.7% of the nurses at the smaller establishments indicated the desire to participate, against 77.7% at the teaching hospital.

No statistically significant difference between the groups was found regarding the accident occurrence and notification ($p=0.791$ and $p=0.427$); knowledge about the immune response ($p=0.379$); change of the container ($p=0.372$) and training about standard precautions ($p=0.158$). As regards the desire to participate in training, a statistically significant difference was verified ($p=0.014$), as nurses working at the smaller establishments indicated greater desire to participate (Table 2).

Table 2. Occurrence and notification of accidents involving biological material according to piercing-cutting material, immune response, container change, participation and desire to participate in training

Variables	Teaching hospital n(%)	Smaller establishments n(%)	p-value
Accident with piercing-cutting material			
Yes	46(50.5)	17(56.7)	0.791*
No	45(49.5)	13(43.3)	
Accident reporting			
Yes	35(81.4)	13(92.9)	0.427**
No	8(18.6)	1(7.1)	
Knowledge immune response			
Yes	24(26.4)	7(23.3)	0.379*
No	42(46.2)	11(36.7)	
Unknown	24(26.4)	12(40.0)	
Did not answer	1(1.0)	-	
Change of containers			
Yes	51(5.0)	14(46.7%)	0.372*
No	40(44.0)	16(53.3)	
Participation in training			
Yes	80(87.9)	24(80.0)	0.158*
No	9(9.9)	6(20.0)	
Did not answer	2(2.2)	-	
Desire to participate in training			
Yes	70(77.7)	29(96.7)	0.014**
No	21(22.3)	1(3.3)	

*Application of Pearson's Chi-square test **Application of Fisher's exact test

Discussion

The research findings are important to compare the occurrence of occupational accidents involving exposure to potentially contaminated biological material in different establishments.

No significant difference was found in the occurrence and characteristics of the occupational accidents with regard to the establishments studied. As to the training about standard precautions, no statistically significant difference was verified, despite the larger proportion of nurses who participated at the teaching hospital. Nurses from the smaller establishments demonstrated greater desire to participate in updated about the theme, with a statistically significant difference.

The sociodemographic analysis results are demonstrated in other studies⁽¹⁹⁾ and show that nursing is still a predominantly female profes-

sion, with ages below 40 years. Most of the nurses (52.40%) had some kind of specialization, which is possibly associated with the teaching hospital, which needs to attend to different highly complex specialties.

As regards the occurrence of occupational accidents with piercing-cutting material, the same proportion was found in other studies,⁽¹⁹⁾ which may be related with the number of invasive procedures nurses perform, such as venipuncture, serum therapy, collection of laboratory tests, capillary glucose, among others.⁽²⁰⁾

What non-reporting is concerned, the justifications that they consider reporting unnecessary or attribute a low level of danger to the accident are in accordance with other findings.⁽²⁰⁾ It is known that the risk of catching the HCV virus after occupational exposure ranges between 1.8% and 0.3 to 0.5% for the HIV virus in cases of percutaneous exposure. As for the hepatitis B virus, these percentages range between 6 and 30%.⁽²¹⁾ Hence, the need to report the accident and monitor the victim for six months after the exposure is highlighted, including serology tests and correct completion of the case evolution in SINAN NET.⁽⁷⁾

The vaccination schedule for hepatitis B and the lack of knowledge about the antibody is also in line with the research. In one study, it is indicated that, although 99.8% of the victims indicated a complete schedule for hepatitis B, only 40% referred the presence of the anti-HBs antibody, while 16.1% indicated no response, 18.5% that they did not take the test and 20% did not complete this important information.⁽⁶⁾ The results about the change of the piercing-cutting material collector differ from guidelines for health establishments and encourage the proposal of prevention and intervention measures.⁽²²⁾

As regards the participation in training about standard precautions, the desire to participate in both groups of nurses was considerable, arousing reflections about the impact of the previously proposed training. It should be highlighted that the occurrence of accidents involving biological material in the research groups drive towards the formulation and implementation of prevention and control measures, as more than half of the nurses reported having suffered at least

one type of exposure to potentially contaminated biological material in their professional career. Study variables related to the occurrence of accidents, such as the presence of the anti-HBs antibody and the change of collectors lead to the conclusion that important safety measures are not being practiced.

In a study involving 1444 Chinese nurses, it was revealed that only half had received training about standard precautions, and 98.2% expressed the desire to receive training.⁽⁵⁾ In a study developed in Jamaica, nurses and physicians wanted to participate in training, as well as qualification related to the control of healthcare related infections.⁽⁸⁾

Professional education based on the principles and reasons for the monitoring of safety practices are critical elements of standard precautions, as they facilitate the correct decision process and promote adherence.⁽²³⁾ As studies reveal that training is directly related with nurses' adherence to standard precautions,^(5,9) continuous training of the workers is suggested with a view to the adherence to safety measures.

Simply offering training is not sufficient though, as studies evidence that knowledge about the standard precautions remained below desirable levels, even after training, which reinforces the need for evidence-based training contents and forms.⁽²⁴⁾ Even after training, the study reveals that only 47% of the workers considered the risk of body fluid droplets in the eye mucosa a possible source of contamination, only 63% understood the basic concept of standard precautions and only 53.24% perceived the need to use a mask in the physical examination of patients with respiratory symptoms.

A multimodal strategy by Brazilian health agencies to achieve adherence to hand washing indicates that a set of actions is needed to overcome different behavioral obstacles and barriers. The institutions need to guarantee the infrastructure needed to permit the correct practice of the procedure and provide training and continuing education with assessment and feedback of the data related to the workers' practice, perception and knowledge about the theme.⁽²⁵⁾

The same source indicates that, to achieve adherence to the standard precautions, an environment needs to be created that facilitates the professionals' sensitization to patient safety, so as to include active

participation at the institutional and individual level. A review of factors that influence adherence indicates that variables like the organizational safety climate, perceived obstacles, professional degree, care delivery to a smaller number of patients, risk personality and self-efficacy should not be ignored.⁽²⁶⁾

Conclusion

Accidents involving exposure to biological material are frequent. Although the professionals reported having received training about standard precautions, there was a great desire for reinforcement on the theme.

Collaborations

Valim MD participated in the conception of the project, analysis and interpretation of the data, writing of the article and relevant critical review of the intellectual content. Marziale MHP participated in the conception of the project, analysis and interpretation of the data, writing of the article, relevant critical review of the intellectual content and approval of the final version for publication. Richart-Martínez and Hayashida M participated in the analysis and interpretation of the data and relevant critical review of the intellectual content.

References

1. Siegel JD, Rhinehart E, Jackson M, Chiarello L. Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings [Internet]. 2007 [cited 2012 Jan 01]. Available from: <http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/isolation2007.pdf>.
2. Kuhar DT, Henderson DK, Struble KA, Heneine W, Thomas V, Cheever LW, Gomaa A, Panlilio AL; US Public Health Service Working Group. Update US Public Health Service guidelines for the management of occupational exposures to human immunodeficiency virus and recommendations for postexposures prophylaxis. *Infect Control Hosp Epidemiol.* 2013;34 (9):875-92.
3. Garner JS. Guideline for isolation precautions in hospitals. The Hospital Infection Control Practices Advisory Committee. *Infect Control Hosp Epidemiol.* 1996;17(1):53-80.
4. Centers for Disease Control and Prevention (CDC). Department of Health and Human Services - USA. Surveillance of Occupationally Acquired HIV/AIDS in Healthcare Personnel, as of December 2010 [Internet]. 2010 [cited 2014 Feb 02]. Available from: <http://www.cdc.gov/HAI/organisms/hiv/Surveillance-Occupationally-Acquired-HIV-AIDS.html>.
5. Luo Y, He GP, Zhou JW, Luo Y. Factors impacting compliance with standard precautions in nursing, China. *Int J Infect Dis.* 2010;14(12):e1106-14.

6. Valim MD, Marziale MHP. Evaluating occupational exposure to biological material in health services. *Texto & Contexto Enferm*. 2011; 20(Spec):138-46.
7. Ministério da Saúde (BR). Portaria nº 777/GM de 28 de abril de 2004: dispõe sobre os procedimentos técnicos para a notificação compulsória de agravos à saúde do trabalhador em redes de serviço sentinela específica, no Sistema Único de Saúde. Brasília (DF): MS; 2004 [citado 2010 Fev 2]. Disponível em: <http://dtr2001.saude.gov.br/sas/PORTARIAS/Port2004/GM/GM-777.htm>.
8. Foster TM, Lee MG, Mcgaw CD & Frankson MA. Knowledge and practice of occupational infection control among healthcare workers in Jamaica. *West Indian Med J*. 2010;59(2):147-52.
9. Li L, Chungqing L, Zunyou W, Jihui G, Jia M & Zhihua Y. HIV-related avoidance and universal precaution in medical settings: opportunities to intervene. *Health Ser Res*. 2011;46(2):617-31.
10. Araújo TM, Barros LM, Caetano JA, Araújo FN, Ferreira Junior FC, Feitosa AC. Acidente ocupacional e contaminação pelo HIV: sentimentos vivenciados pelos profissionais de enfermagem. *Rev Pesqui Cuid Fundam*. 2012;4(4):2972-9.
11. World Health Organization. Practical guidelines for infection control in health care facilities [Internet]. Manila: WPRO Regional Publication; 2007 [cited 2014 Jan 20]. Available from: http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf.
12. Efstathiou G, Papastravou E, Raftopoulos V, Merkouris A. Compliance of Cypriot nurses with standard precautions to avoid exposure to pathogens. *Nurs Health Sci*. 2011;13(1):53-9.
13. Askarian M, Mclaws ML, Meylan M. Knowledge, attitude, and practices related to standard precautions of surgeons and physicians in university-affiliated hospitals of Shiraz, Iran. *Int J Infect Dis*. 2007;11(1):213-9.
14. Reda AA, Vandeweerd JM, Syre TR, Egata G. HIV/AIDS and exposure of healthcare workers to body fluids in Ethiopia: attitudes toward universal precautions. *J Hosp Infect*. 2009;71(2):163-9.
15. Osborne S. Influences on compliance with standard precautions among operating room nurses. *Am J Infect Control*. 2003;31(7):415-23.
16. Fukuda H, Imanaka Y, Hayashida K. Cost of hospital-wide activities to improve patient safety and infection control: a multi-centre study in Japan. *Health Policy*. 2008;87(1):100-11.
17. Fukuda H, Imanaka Y, Hirose M, Hayashida K. Factors associated with system-level activities for patient safety and infection control. *Health Policy*. 2009 89(1): 26-36.
18. Brasil. Ministério da Saúde. Portaria nº 2224 de 5 de dezembro de 2002. Dispõe sobre o sistema de classificação hospitalar do Sistema Único de Saúde. In: Diário Oficial da República Federativa do Brasil. Brasília (DF): MS; 2002 [citado 2014 Fev 2]. Disponível em: <http://www.jusbrasil.com.br/diarios/767477/dou-secao-1-06-12-2002-pg-37/pdfView>.
19. Gomes AC, Agy LL, Malaguti SE, Canini SR, Cruz ED, Gir E. Acidentes ocupacionais com material biológico e equipe de enfermagem em um hospital-escola. *Rev Enferm UERJ*. 2009;17(2): 220-3.
20. Pimenta FR, Ferreira MD, Gir E, Hayashida M, Canini SR. Atendimento e seguimento clínico especializado de profissionais de enfermagem acidentados com material biológico. *Rev Esc Enferm USP*. 2013; 47(1): 98-204.
21. Centers for Disease Control and Prevention (CDC). Workbook for designing, implementing and evaluating a sharp injury prevention program. [Internet]. 2008 [cited 2014 Fev 2]. Available from: www.cdc.gov/sharpsafety.
22. Brasil. Ministério do Trabalho e Emprego. Riscos biológicos: guia técnico - os riscos biológicos no âmbito da NR 32. Brasília (DF): MTE; 2008.
23. Centers For Disease Control And Prevention (CDC). National Center for Emerging and Zoonotic Infectious Diseases. Infection Prevention Checklist for Outpatient Settings: Minimum Expectations for Safe Care. [Internet]. 2011 [cited 2014 14 Fev]. Available from: <http://www.cdc.gov/HAI/settings/outpatient/checklist/outpatient-care-checklist.html>.
24. Sax H, Perneger T, Hogonnet S, Herrault P, Chraiti MN, Pittet D. Knowledge of standard and isolation precaution in a large teaching hospital. *Infect Control Hosp Epidemiol*. 2005;26 (3):298-304.
25. Brasil. Ministério da Saúde (BR). Anexo 1: Protocolo para a prática de higiene das mãos em serviços de saúde. Brasília (DF): MS; 2004 [citado 2014 Jan 13]. Disponível em: http://www.sbpcc.org.br/upload/conteudo/protocolo_higiene_maos_09jul2013.pdf.
26. Valim MD, Marziale MH, Richart-Martínez M, Sanjuan-Quiles A. Instruments for evaluating compliance with infection control practices and factors that affect it: an integrative review. *J Clin Nurs*. 2013;22 (17):1-18.