

ARTIGO ORIGINAL / ORIGINAL ARTICLE

Acidentes de Trabalho com Risco Biológico em Profissionais de Saúde e o seu Impacto Económico num Hospital Central de Portugal

Economic Burden of Work accidents with Bloodborne Pathogens in Healthcare Workers in a Central Hospital of Portugal

/ V. Pinheiro¹ / C. Pestana¹ / P. Ferraz¹
/ A. Afonso¹ / C. Belo¹ / I. Antunes¹

¹Occupational Health Department, Coimbra Hospital and University Centre (CHUC), Coimbra, Portugal.

Patrocínios:

O presente estudo não foi patrocinado por qualquer entidade

Correspondência:

Vitor César Arantes Pinheiro
Occupational Health Department, Hospitais da Universidade de Coimbra, Centro Hospitalar e Universitário de Coimbra, Coimbra, Portugal.
Rua José Pinto Loureiro nº49 R/CEsq
3000-235 Coimbra
Contact: +351 913416119
E-mail: Vitorpinheiro125@gmail.com

Artigo recebido em
16/11/2017

Artigo aceite para publicação em
20/12/2017

/ Resumo

Introdução: Os acidentes de trabalho com exposição a agente biológico representam não só um elevado risco de transmissão de infeções transmissíveis para os profissionais de saúde (PS), como também um elevado impacto socioeconómico para as instituições e para a sociedade.

Métodos: Estudo retrospectivo dos acidentes de trabalho com exposição a agentes biológicos, reportados ao Serviço Saúde Ocupacional do Centro Hospitalar e Universitário de Coimbra em 2016.

Resultados: Foram reportados 171 acidentes de trabalho (2,23/100/ano), mais prevalentes em enfermeiros (48,54%), género feminino (78,9%) e serviços cirúrgicos. A “exposição a objetos cortantes” (91,23%) foi a principal causa e as mãos a região corporal mais afetada (89,47%). O estado serológico da fonte era desconhecido em 27,49% dos casos. Dez Profissionais de Saúde realizaram profilaxia pós-exposição (PEP).

O custo total, devido aos custos com o serviço de urgência (10310,44 euros), consultas (7409,00 euros) testes laboratoriais (1462,63 euros), e PEP (7378,00), foi de 26560,07 euros, com média de 155,32 euros por episódio.

Conclusão: Verificou-se uma baixa incidência de acidentes com exposição ocupacional a agente biológico, gerando contudo custos elevados. A observação inicial no Serviço de Saúde Ocupacional diminuiu os custos. Também a investigação epidemiológica, em casos de fonte desconhecida, permitiu que menos PS instituísem PEP, com grande impacto nos custos totais.

Palavras-chave: Acidentes de Trabalho; Risco Biológico; Profissionais de Saúde; Custo Económico

/ Abstract

Introduction: Healthcare workers (HCW) are at risk of infection with bloodborne pathogens from work accidents with exposure to biological agents. The management of this occupational exposure has an important economic impact.

Methods: Retrospective study of work accidents with exposure to biological agents reported to the Occupational Medicine Department of the Coimbra University Hospital, during the year of 2016.

Results: In 2016, 171 occupational exposures to biological agents were reported to the Department of Occupational Medicine (2.23/100/year). They were more frequent in women (78.9%), nurses (48.54%), and surgical departments. Exposition to sharp objects (91.23%) was the main cause. Moreover, hands were the body part most affected (89.47%). The source patient serology was unknown in 27.49% of the cases. Finally, ten HCW had been prescribed with post-exposure prophylaxis (PEP). Regarding financial costs, the global cost was due to emergency service (10310.44 euros), clinical appointments (7409.00 euros), laboratory testing (1462.32 euros) and PEP (7378.00), with a total of 26560.07 euros, resulting in an average of 155.32 euros for each work accident.

Conclusion: We observed a low incidence of work accidents, despite they represented a high economic burden. First observation in our department highly decreased the costs. Moreover, epidemiologic study in the cases of unknown source, reduced the cases of PEP institution, with high impact on the final cost of the work accidents.

Keywords: Work accidents; Biological Risk; Healthcare Workers; Economic Burden

/ Introduction

Physicians, nurses and other healthcare workers (HCW) are at risk of infection with bloodborne pathogens, in consequence of occupational exposure to biological agents.^{1,2} They can be potentially exposed by two ways: the first one consists in a percutaneous lesion in which an HCW is injured by a sharp object; the second is mediated by contact of a mucous membrane or non-intact skin with blood, tissue, or other potentially infectious body fluids.³ Risk factors are lack of training, instrument and risk procedure, fatigue and stress.⁴ A recent review reported incidence rates of sharps injuries ranging from 1.4 to 9.5 per 100 HCWs, resulting in a weighted mean of 3.7/100 HCWs per year.¹ Importantly, there is a high number of injuries that are not reported.⁴ The most common reasons for underreporting are the belief that the exposure has a low risk of infection, lack of knowledge of reporting systems and the assumption that it is difficult to notify.⁴ Nevertheless, work accidents with biological risk can represent a huge emotional distress and a high economic burden for the institutions and/or insurance companies and governments.^{1,5-8}

Many strategies have been developed to reduce the incidence of sharps injuries, such as: identifying the risk of blood exposure, the implementation of policies to minimize the risk, education and training of HCW to achieve a safe workplace, the enhancing of the reporting system, the use of double-gloving and of safety-engineered sharps devices.⁴ In many countries, these policies have reduced the incidence of sharps injuries as well as the economic burden.^{4,9} Prevention is the key factor to avoid disease transmission and the economic burden of work accidents with biological risks.²

However, in Portugal there is a lack of studies about the incidence and economic consequences of occupational exposure to biologic agents in HCW.¹⁰

/ Objective

The primary outcome of our work is to assess the incidence and characterization of occupational exposure to biological agents. The secondary outcome is to assess the direct economic costs of work accidents with biological risks in HCW.

/ Material and Methods

A retrospective study based on work accidents with exposure to biological agents reported to the Occupational Health Department of the Coimbra Hospital and University Centre, during the year of 2016. We used the anonymous questionnaires from Government Health Department – “Inquérito aos Acidentes de Trabalho em Serviço e Doenças Profissionais” (annex 1) applied to the HCW at the moment they reported their work accidents. Items concerning the management of the costs of these accidents were listed: emergency service, follow-up appointments, laboratory testing, and PEP. The costs were requested to the “Glintt – Global Intelligent Technologies S.A.”, the company responsible for the management of this issue in our institution.

The follow-up appointments were performed according to the Portuguese Occupational Health Society recommendations¹¹, i.e., if the sample was negative for all bloodborne pathogen we assess the HCW for the first time and we check again six months later; if it was unknown, positive to HCV or HBV we evaluate at the beginning (0 months), and after three and six months, we also performed hepatic analysis (aminotransferases) at six weeks and an additional transaminases evaluation at three months in the case of HCV positive sample; when the source is HIV positive, HCW is usually observed in infectious diseases appointment (usually four times) in case of doing PEP, otherwise we evaluated the HCW at 0, 1, 3 and 6 months.¹¹

/ Results

From a total of 452 work accidents reported to the Occupational Health Department of the Coimbra Hospital and University Centre during the year of 2016, we found 171 accidents with exposure to biological agents. Mean age of the affected HCW was 41.36 ± 10.81 years old, being most of them females ($n=135$ – 78.9%). Nurses were most affected ($n=83$; 48.54%), followed by physicians ($n=43$; 25.15%) and operational assistants ($n=41$; 23.98%) (second and third, respectively), and finally the less affected were the technical assistants ($n=4$; 2.34%) (Table 1). When we consider these results compared to the total of HCW, we found also higher frequency in females (2.40% vs 1.76% in males) and nurses (2.97% vs 2.50% in

doctors; 2.52% in operational assistants; and 0.56% in technical assistants) (Table 1). The most affected departments were: internal medicine ($n=19$), central operating theatre ($n=15$), intensive care unit ($n=14$), general surgery ($n=12$), orthopaedics ($n=11$) and emergency service ($n=9$) (Table 2).

The main cause for the work accidents was the “exposition to sharp objects” ($n=167$, 97.66%), followed by cutaneous-mucosal contact with blood or other body fluids contaminated with blood ($n=4$, 2.34). Hands were the most injured body part in 153 cases (89.47%), followed by eyes ($n=11$, 6.43%), trunk ($n=3$, 1.75%), and finally head and legs both with two cases (1.17%). Concerning the source of the work accident, most of them were known and negative for infective pathogens ($n=108$, 63.16%), 47 cases (27.49%) were unknown, while seven cases (4.09%) were positive for hepatitis C virus (HCV), five cases (2.92%) were positive for HIV, and four (2.34%) were positive for hepatitis B virus (HBV). A representative amount of HCW was not using gloves at the moment of the accident occurred ($n=20$, 11.7%).

Regarding HCW and their immune status for Hepatitis B, 137 cases (80.12%) had documented immunity at the moment of the accident, all the others were immediately vaccinated and/or did the *Hepatitis B Immune Globulin* (HBIG), according to the work accident assessment. Furthermore, ten HCW have done PEP to human immunodeficiency virus. Fortunately, we had no evidence of disease transmission six months after the work accident.

As already described,¹² the work accidents have a high economic impact. Herein, we calculated the direct costs of this occupational exposure, which includes the emergency service costs, the appointments in the occupational health department and/or infectious diseases department, laboratory testing and PEP (usually 400mg raltegravir, 2 i.d., and 245mg tenofovir disoproxil plus 200mg emtricitabine, i.d., 4 weeks long). We showed that the cost of these work accidents was high, with a total of 26560.07 euros, corresponding to an average of 155.32 euros per work accident. The most expensive were the 92 episodes of emergency service, with a total cost of 10310.44 euros ($112.07\text{€} \times 92$).

TABLE 1 - MOST AFFECTED HCW BY WORK ACCIDENTS, AND ITS RATE BY PROFESSIONAL CATEGORY

PROFESSION	N	RATE OF WORK ACCIDENTS BY PROFESSION
Nurses	83	2.97%
Doctors	43	2.50%
Operational assistants	41	2.52%
Technical assistants	4	0.56%
Total	171	

TABLE 2 - NUMBER OF WORK ACCIDENTS BY SERVICE

DEPARTMENT	N
Internal Medicine	19
Central Operating Theatre	15
Intensive Care Unit	14
General Surgery	13
Orthopaedics	11
Emergency service	9
Imagology	7
Plastic Surgery	6
Anaesthesiology	6
Obstetrics	6
Vascular Surgery	4
Ophthalmology	4
Haematology	4
Pneumology	4
Gastroenterology	4
Cardiology	4
Hepatic Transplants	3
Dermatology	3
Oncology	3
Otorhinolaryngology	3
Cardio-thoracic Surgery	3
Neurology	3
Psychiatry	3
Nuclear Medicine	2
Renal Transplants	2
Maxilla-facial Surgery	2
Endocrinology	2
Pathologic Anatomy	2
Neurosurgery	2
Clinical Pathology	2
Gynaecology	2
Dialysis	1
Infectious diseases	1
Stomatology	1
Sterilization	1
Total	171

Moreover, we had 204 appointments in occupational medicine department (6324 euros = 31€ x 204) and 35 in infectious diseases department (1085 euros = 31€ x 35), both representing a total cost of 7409 euros. PEP has a financial cost of 7378 euros, and was due to ten cases solely (737.80 euros per case of PEP), which represents a high burden in each case that needs prophylaxis. Laboratory testing with 1462.63 euros was the less expensive item, but in this case, we observed some variability due to the need to have virology and/or hepatic analysis (transaminases) altogether with other different follow-up analysis in some specific cases (Table 3).

TABLE 3. DIRECT COSTS OF THE WORK ACCIDENTS WITH BIOLOGICAL RISK

	EPISODES	COST
Emergency service	92	10310.44
Occupational medicine appointments	204	6324.00
Infectious diseases appointments	35	1085.00
Laboratory testing	∅	1462.63
Post-exposure prophylaxis	10	7378.00
TOTAL		26560.07

∅ non-applicable, as there were several different laboratory testings and the prices also differ.

/ Discussion

Sharps injuries and the related risk of infections such as HBV, HCV, and HIV, still represent one of the major occupational health risks for HCW.¹³ In our institution, the source of injury and the exposed HCW are assessed according to an optimized protocol, in accordance with the Centre for Diseases Control and Prevention guidelines¹⁴ and also according to the Portuguese Occupational Health Society recommendations.¹¹ At the study date, we followed the recommendations that were in force, later revised in 2017.

The 171 work accidents that were reported, represents 2.23/100 HCW per year, which is below the expectations,¹ probably due to the underreporting of the work accidents.¹⁵ This fact, emphasizes the need to improve our reporting system in order to minimize the lack of communication of work accidents, and therefore avoiding possible consequences going undetected. Females and nurses were the most affected, which is in accordance with previous studies.^{1,16} Nurses were the most representative health professional category in our institution (36.43%) composed mainly by females (78.18%), and they frequently do several blood samplings, intravenous drugs preparation and administration, wound care and glycemia

measurements, which may justify the higher number of work accidents in this workers class. The surgical departments, or the ones with more surgical/invasive procedures, were the most affected as these proceedings have a higher risk of work accident with biological risk. However, we cannot find out the total number of this kind of risk procedures in each department. "Exposition to sharp objects" was the main cause of the work accidents, mainly caused by needlestick injuries and also scalpel and other surgical instruments, which are used very frequently in surgical procedures.² Thus, it is expected that the hands were the most affected part of the body in most of the times (89.47%). We found that 20 HCW (11.7%) were not using gloves at the moment of the accident. This number may be due to procedures that do not necessarily require glove using. Also, this number is low when compared with the only study performed in Portugal (41.5%).¹⁰ Nevertheless, as the correct use of gloves is one of the most important preventive strategy, it emphasizes the need to do awareness campaigns for the use of gloves during all interventional procedures. Moreover, needle protective devices can also have a role in preventing these type of injuries.¹⁷ However, previous studies failed to demonstrating a clear beneficial effect.^{18,19} It should be considered particularly in high-risk areas, after training, education, evaluation, and cost-benefit analysis.¹³ In the operating room, there is moderate-quality evidence that double gloving compared to single gloving during surgery reduces perforations and blood stains on the skin, indicating a decrease in percutaneous exposure incidents.²⁰ According to the same authors, there is low-quality evidence that triple gloving and the use of special gloves can further reduce the risk of glove perforations compared to double gloving with normal material gloves.²⁰ The same review also noticed that there were no indications that using more layers of gloves decreased the sensitivity of the fingers.²⁰ Further studies are needed to evaluate the effectiveness and cost-effectiveness of special material gloves and triple gloves, as well as the use of gloves in other occupational groups.

Follow-up and treatment of sharps injuries and their consequences represent a significant cost impact.²¹ Direct costs vary greatly, as the possibilities regarding the epidemiologic context and/or infectivity of the source, susceptibility of the HCW, and the tests needed for post-exposure evaluation may differ. The necessity of PEP in an exposed HCW can considerably rise up the financial costs,²² as we observed in this study.

After assessing the epidemiologic context, the need of PEP is discussed between the occupational physician, infectious diseases physician and the HCW. PEP was prescribed to ten HCW, explained by the five positive cases of the source and by the unknown sources in 47 cases. Therefore, the number of HCW doing PEP could be surprisingly higher as there were many cases of unknown source. Herein, in case of unknown source, our department, if possible, evaluates all the patients that are present in the room at the moment of the accident about their epidemiologic context, namely intravenous drugs abuse, non-protected sex history with

new partner, blood transfusions and originating from an endemic area to HIV, HCV and HBV. Thus, we excluded the necessity of doing PEP in several cases, which had a huge impact on the final cost of these work accidents.

In the specific case of HBV, HCW should all be vaccinated, and the response should also be appropriately documented and readily available in case of injury. It is the responsibility of the Occupational Health Departments to check the immunity status of the HCW regarding HBV with an Anti-HBs title above 10mUI/ml. We observed 22 (12.87%) HCW without immunity for Hepatitis B. Notwithstanding these results are much lower than the data published in Portugal (>50% of HCW without immunity for Hep B).¹⁰ This could be partially explained by the high number of HCW that are vaccinated in the admission and periodic exams. We also observed 12 (7.02%) with unknown immunity for Hepatitis B. In fact, our service is very recent and is in charge of a high number of workers, which can lead to some delay in checking immunity status. Nevertheless, an effort needs to be done to identify those HCW, vaccinate and document their immunity status. Importantly, treating the long-term complications of needlestick injuries, such as HIV and hepatitis B and C infections, can be very expensive to manage.²² Moreover, we had not any case of confirmed transmission. We don't have any Portuguese study to compare our results, but some international works reported an average cost of needlestick injuries of 631.61 euros (range 168.26- 1.429.78 euros), which means that we have lower average cost than other countries.^{12,23}

Even though the value we got seems high, as we explained before, it is under the expected for this amount of work accidents, as protocols are often not followed strictly. In fact, we found that HCW frequently misses follow-up appointments, sometimes there is overlap between follow-up appointments and periodic exams, as well as a low perception of the risk or a high fear of disease transmission, could all lead to several shortcomings to the protocol, leading to high misrepresentation of the total costs. Considering that work-accidents management could normally lead at least to two or three appointments, according to recommendations that were in force, we estimate the costs as if the protocols were completely fulfilled. Therefore, we estimate that we could have 240 more appointments (the difference between the number of total appointments observed, and the total of the expected according to the assessment of the work-accidents) in our department, which mean that the final costs could be 7440 euros higher than it was. Furthermore if we take into account the laboratory testing we could have an increase in costs of at least 2162,4 euros (considering the mean value of our requests), which means that the total cost could be as high as 36161.47 euros, corresponding to a mean of 211.48 euros per work accident. Of note, emergency room service has a fixed cost (112.07 euros), which is higher than the cost of the appointment in the occupational medicine department (31 euros). Thus, the total cost could be lower if HCW were seen primarily in our department.

Therefore, promoting work accidents notification in our department (when in work schedule), is one of the strategies that is currently in development.

Indirect costs were not calculated, as they are very difficult to calculate, and sometimes not quantifiable.²¹ Nevertheless, it can range from very different values, mostly higher than the direct costs.^{12,23-25} The indirect costs are relatively consistent between studies, and they mostly refer to lost productivity, which is usually calculated in minutes spent in baseline and follow-up visits by the exposed HCP and more rarely on days of staff absence.¹² Furthermore, none of the work accidents resulted in absenteeism as most of the accidents had small physical body impact.

/ Conclusion

We report a low incidence of work accidents when compared to other authors. Nevertheless, we observed a high cost of such accidents. Nurses and females were the personnel most affected, even when compared to the total number of HCW, explained by the higher ratio of female nurses and its high frequency of blood sampling procedures. First observation in our department highly decreased the costs of these work accidents. Also, our intervention in the case of unknown source, due to the epidemiologic study, allowed less cases of PEP institution, which have a high impact on the final cost of the work accidents.

/ Bibliography

- Elseviers MM, Arias-Guillén M, Gorke A, Arens H-J. Sharps injuries amongst healthcare workers: review of incidence, transmissions and costs. *J Ren Care*. 2014;40(3):150-156.
- Coppola N, De Pascalis S, Onorato L, Calò F, Sagnelli C, Sagnelli E. Hepatitis B virus and hepatitis C virus infection in healthcare workers. *World J Hepatol*. 2016;8(5):273-281.
- Centers for Disease Control and Prevention. <https://www.cdc.gov/niosh/stopsticks/bloodborne.html#HCV>.
- Gopar-Nieto R, Juárez-Pérez CA, Cabello-López A, Haro-García LC, Aguilar-Madrid G. [Overview of sharps injuries among health-care workers]. *Rev Med Inst Mex Seguro Soc*. 53(3):356-361.
- Solano VM, Hernández MJ, Montes FJ, Arribas JL. [Update of the cost of needlestick injuries in hospital healthcare personnel]. *Gac Sanit*. 19(1):29-35.
- Glenngård AH, Persson U. Costs associated with sharps injuries in the Swedish health care setting and potential cost savings from needle-stick prevention devices with needle and syringe. *Scand J Infect Dis*. 2009;41(4):296-302.
- O'Malley EM, Scott RD, Gayle J, et al. Costs of management of occupational exposures to blood and body fluids. *Infect Control Hosp Epidemiol*. 2007;28(7):774-782.
- Lee JM, Botteman MF, Xanthakos N, Nicklasson L. Needlestick injuries in the United States. Epidemiologic, economic, and quality of life issues. *AAOHN J*. 2005;53(3):117-133.
- Armadans Gil L, Fernández Cano MI, Albero Andrés I, et al. [Safety-engineered devices to prevent percutaneous injuries: cost-effectiveness analysis on prevention of high-risk exposure]. *Gac Sanit*. 20(5):374-381.
- Martins MD da S. Epidemiologia Dos Acidentes De Trabalho Em Instituições Públicas De Saúde – Fatores Associados E Repercussões. *Inst Ciências Biomédicas Abel Salazar*. 2014:233.
- Leite ES, Galvão LM. Acidentes de Trabalho Com Exposição a Sangue e a Outros Fluidos Orgânicos. 2017.
- Mannocci A, De Carli G, Di Bari V, et al. How Much do Needlestick Injuries Cost? A Systematic Review of the Economic Evaluations of Needlestick and Sharps Injuries Among Healthcare Personnel. *Infect Control Hosp Epidemiol*. 2016;37(6):635-646.
- Trim JC, Elliott TSJ. A review of sharps injuries and preventative strategies. *J Hosp Infect*. 2003;53(4):237-242.
- CDC(2001). Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HBV, HCV, and HIV and Recommendations for Postexposure Prophylaxis. *MMWR. Recommendations and Reports: Morbidity and Mortality Weekly Report. Recommendations and*. In: ; 2001:1-52.
- Benítez Rodríguez E, Ruiz Moruno AJ, Córdoba Doña JA, Escolar Pujolar A, López Fernández FJ. Underreporting of percutaneous exposure accidents in a teaching hospital in Spain. *Clin Perform Qual Health Care*. 7(2):88-91.
- Shiferaw Y, Abebe T, Mihret A. Sharps injuries and exposure to blood and bloodstained body fluids involving medical waste handlers. *Waste Manag Res*. 2012;30(12):1299-1305.
- Hanmore E, Maclaine G, Garin F, Alonso A, Leroy N, Ruff L. Economic benefits of safety-engineered sharp devices in Belgium – a budget impact model. *BMC Health Serv Res*. 2013;13(1):489.
- Lavoie M-C, Verbeek JH, Pahwa M. Devices for preventing percutaneous exposure injuries caused by needles in healthcare personnel. Lavoie M-C, ed. *Cochrane database Syst Rev*. 2014;(3):CD009740.
- Phillips EK, Conaway M, Parker G, Perry J, Jagger J. Issues in understanding the impact of the Needlestick Safety and Prevention Act on hospital sharps injuries. *Infect Control Hosp Epidemiol*. 2013;34(9):935-939.
- Mischke C, Verbeek JH, Saarto A, Lavoie M-C, Pahwa M, Ijaz S. Gloves, extra gloves or special types of gloves for preventing percutaneous exposure injuries in healthcare personnel. Verbeek JH, ed. *Cochrane database Syst Rev*. 2014;(3):CD009573.
- Oh HS, Yoon Chang SW, Choi JS, Park ES, Jin HY. Costs of postexposure management of occupational sharps injuries in health care workers in the Republic of Korea. *Am J Infect Control*. 2013;41(1):61-65.
- Leigh JP, Gillen M, Franks P, et al. Costs of needlestick injuries and subsequent hepatitis and HIV infection. *Curr Med Res Opin*. 2007;23(9):2093-2105.
- Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. *Med Devices Evid Res*. 2017;Volume 10:225-235.
- Jallon R, Imbeau D, de Marcellis-Warin N. A process mapping model for calculating indirect costs of workplace accidents. *J Safety Res*. 2011;42(5):333-344.
- Jallon R, Imbeau D, de Marcellis-Warin N. Development of an indirect-cost calculation model suitable for workplace use. *J Safety Res*. 2011;42(3):149-164.