

# Occupational accidents due to exposure to biological material in the multidisciplinary team of the emergency service

ACIDENTES OCUPACIONAIS POR EXPOSIÇÃO A MATERIAL BIOLÓGICO ENTRE A EQUIPE MULTIPROFISSIONAL DO ATENDIMENTO PRÉ-HOSPITALAR

ACCIDENTES OCUPACIONALES POR EXPOSICIÓN A MATERIAL BIOLÓGICO ENTRE EL EQUIPO MULTIPROFESIONAL DE ATENCIÓN PRE HOSPITALARIA

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## ABSTRACT

This transversal, survey-based research was carried out with a multiprofessional emergency care team in Belo Horizonte, between June and December 2006. The study aimed at estimating the incidence of occupational accidents by exposure to biological material, post-accidents conducts and demographic determinant factors. The study applied a structured questionnaire and descriptive analyses, as well as incidence calculations and logistic regression. The incidence of accidents with biological material reached 20.6%, being 40.8% by sharp materials and 49.0% by body fluids; 35.3% of the accidents took place among physicians and 24.0% among nurses. Post-accidents procedures: no medical assessment, 63.3%; under-notification, 81.6%; no conduct, 55.0%; and no serological follow-up, 61.2%. Factors associated with accidents: working time in the institution (Odds Ratio - OR, 2.84; Credible Interval - CI 95% - 1.22-6.62); working in advanced support units (OR=4.18; CI 95% - 1.64-10.64); and interaction between working time in the institution and working in Basic Support Unit (OR 0.27; CI 95% - 0.07-1.00). In order to reduce accidents, the implementation of post-accident protocols and follow-up, as well as under-notification norms, are suggested.

## KEY WORDS

Emergencies.  
Emergency medical services.  
Accidents, occupational.  
Occupational accidents registry.  
Occupational health.

## RESUMO

Estudo transversal, tipo survey, realizado com a equipe multiprofissional de Atendimento Pré-hospitalar (APh) de Belo Horizonte, entre junho e dezembro de 2006. Objetivou-se determinar a incidência dos acidentes ocupacionais por exposição a material biológico, condutas pós-acidente, e fatores demográficos determinantes. Utilizou-se questionário estruturado, análise descritiva, cálculo de incidências e regressão logística. A incidência de acidentes com material biológico foi de 20,6%: 40,8% por perfuro-cortantes e 49,0% por fluidos corporais; 35,3% entre médicos e 24,0% entre enfermeiros. Condutas pós-acidente: sem avaliação médica, 63,3%; subnotificação, 81,6%; nenhuma conduta, 55,0%; e, sem acompanhamento sorológico, 61,2%. Estiveram associados ao acidente: tempo na instituição (Odds ratio-OR 2,84; Intervalo de confiança-IC 95% 1,22-6,62), lotação na Unidade de Suporte Avançado (OR 4,18; IC 95% 1,64-10,64); interação: tempo na instituição e lotação na Unidade de Suporte Básico (OR 0,27; IC 95% 0,07-1,00). Sugere-se a implantação de protocolos pós-acidentes, visando a sua redução; a subnotificação e o aumento do acompanhamento pós-acidente.

## DESCRITORES

Emergências.  
Serviços médicos de emergência.  
Acidentes de trabalho.  
Notificação de acidentes de trabalho.  
Saúde do trabalhador.

## RESUMEN

Estudio transversal, tipo survey, realizado con el equipo multiprofesional de Atención Pre Hospitalaria (APh) de Belo Horizonte entre junio y diciembre de 2006. Se objetivó determinar la incidencia de los accidentes ocupacionales por exposición a material biológico, las conductas después del accidente y los factores demográficos determinantes. Se utilizó un cuestionario estructurado, el análisis descriptivo, el cálculo de incidencias y la regresión logística. La incidencia de accidentes con material biológico fue de 20,6%: 40,8% por punzo cortantes y 49,0% fluidos corporales; 35,3% entre médicos y 24,0% entre enfermeros. Conductas después del accidente: sin evaluación médica, 63,3%; subnotificación, 81,6%; ninguna conducta, 55,0%; y, sin acompañamiento serológico, 61,2%. Estuvieron asociados al accidente: tiempo en la institución, (Odds ratio-OR 2,84; Intervalo de confianza-IC 95% 1,22-6,62), asignado en la Unidad de Soporte Avanzado, (OR 4,18; IC 95% 1,64-10,64); interacción: tiempo en la institución y asignado en la Unidad de Soporte Básico, (OR 0,27; IC 95% 0,07-1,00). Se sugiere: la implantación de protocolos después de accidentes, con el objetivo de reducirlos; la subnotificación y el aumento del acompañamiento después del accidente.

## DESCRIPTORES

Urgências médicas.  
Servicios médicos de urgência.  
Accidentes de trabajo.  
Notificación de accidentes del trabajo.  
Salud laboral.

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## INTRODUCTION

Studies show that healthcare professionals are exposed to the risk of acquiring infections in the course of their occupational activities<sup>(1-2)</sup>. Health workers have contracted diseases such as hepatitis B, hepatitis C and HIV due to accidental exposure to biologic material, resulting from percutaneous lesions and/or contact with contaminated blood in the mucous membrane or wounded skin<sup>(3-4)</sup>.

The average risk of acquiring HIV for all types of percutaneous infections is 0.3%, according to the Center of Disease Control (CDC)<sup>(5)</sup>. Regarding infections by the hepatitis B virus, the risk of occupational transmission after a percutaneous accident is 30.0% higher than in the general population<sup>(6)</sup>.

For the Hospital Infection Control Commission, measures to prevent occupational exposure to disease form a fundamental part of policy regulations, with the goal of minimizing infection transmission risks for patients and healthcare professionals. In this context, bio-safety recommendations are required for the prevention and control of exposure to infectious-contagious diseases. Permanent educational programs must be implemented, emphasizing good practices, immunization and endemic control.

Among healthcare professionals, those from the Pre-hospital Care service (PHC) stand out, due to the increased risks of accidents during their occupational activities. Risks are higher due to the fact that direct care for patients is provided outside the hospital environment, since PHC has the aim of maintaining life and minimizing sequelae in urgent and emergency situations before a specialized unit institution arrives.

Highly complex and invasive procedures are performed more and more often in PHC.. They comprise intubations, aspiration of tracheal contents, reattachment of vessels due to traumatic amputations, containment of bleeding, peripheral and central access, and open-chest cardiac massage, among others. These procedures render PHC workers as susceptible to occupational accidents as any other healthcare professional. However, contamination risks can be even greater depending on their position in the team, if contact with patients is more direct and more frequent<sup>(7)</sup>.

Considering these high-risk occupational conditions the PHC team is exposed to, this study aimed to determine the incidence of occupational accidents due to biologic material exposure. It was carried out in the PHC multi-professional team of a public hospital in Belo Horizonte-MG. The study also aimed to identify the procedures performed after accidents and the demographic factors that determine these incidents.

## METHOD

### *Type, location and study population*

This was a cross-sectional study, and consisted of a survey administered to the professionals of the multi-professional team of the Public Pre-hospital Care (PHC) Service of Belo Horizonte. These teams are organized into 18 mobile units, of which three are Advanced Support Units (ASU) and 15 are Basic Support Units (BSU). Each ASU multi-professional team comprised a physician, a nurse and a driver; the BSU comprised nursing technicians/assistants and the driver, according to the requirements of the PHC regulation in Brazil<sup>(8)</sup>.

All PHC multi-professional team members were participants in this study, except those who were on vacation, had a day off or were on medical leave. After the research objectives were made clear to the subjects, each of them signed a Free and Informed Consent Form.

This study was performed between June and December of 2006, after booking an appointment with the PHC Service Coordination. A structured questionnaire was used. It was self-administered and anonymous, ensuring the preservation of the professionals' anonymity, according to resolution 196/96 of the National Council of Health<sup>(9)</sup>. The instrument collected demographic data, information on the occurrence of accidents involving perforating-cutting materials and post-accident conduct. It was validated by three nationally recognized specialists in these areas of expertise. The pilot test was performed in the PHC Service with characteristics similar to this study.

The project was approved by the Ethics on Research Committees of the Federal University of Minas Gerais and the Mayor's Office of Belo Horizonte, under protocol # 458/05.

### *Statistical analysis*

Data were analyzed using Statistical Products and Service Solutions (SPSS) software for Windows, version 11.5: SPSS, Inc. Chicago, Ill. A descriptive analysis was performed. In order to verify the association between variables, Chi-square and Fisher's Exact Tests were used (with level of significance of  $p < 0.05$ ). After that, one-way ( $p < 0.02$ ) and multiple ( $p < 0.05$ ) logistic regression analyses were performed to describe the relationship between demographic variables and occupational accidents<sup>(10-11)</sup>.

## RESULTS

Of the 262 professionals at the public PHC in Belo Horizonte, 238 participated in the study; 9.2% of professional did not participate. Of the participants ( $n=238$ ), 14.3%

Among healthcare professionals, those from the Pre-hospital Care service (PHC) stand out, due to the increased risks of accidents during their occupational activities.

were physicians, 10.5% were nurses, 47.5% were nursing technicians/assistants, and 27.7% were drivers. Most professionals (66.8%) were male; 58.4% had been actively employed by the hospital for less than or equal to two years, and 69.7% of professionals worked in a Basic Support Unit (BSU). There was no statistically significant difference in professionals' age or year of graduation.

The incidence of occupational accidents involving biological material in the year prior to the study was 20.6%. Of the professional who had accidents, 49.0% had accidents due to contact with bodily fluids, 40.8% due to perforating-cutting material, and 10.2% due to both (Table 1).

**Table 1** - Occupational accidents due to biologic material exposure in the multi-professional team in Pre-hospital Care - Belo Horizonte - 2006

<b>Incidence and Action After the Occupational accident</b>	<b>N</b>	<b>%</b>
<b>Accidents due to perforating-cutting material/contact with bodily fluids in the last year</b>		
No	189	79.4
Yes	49	20.6
<b>Contact vehicle</b>		
Bodily fluids	24	49.0
Perforating-cutting material	20	40.8
Both	5	10.2
<b>Medical evaluation</b>		
Yes	18	36.7
No	31	63.3
<b>OAR</b>		
Yes	9	18.4
No	40	81.6
<b>Action taken immediately after the accident</b>		
Quick HIV test if patient was known to be positive carrier: administration of antiretroviral medicines less than 2hrs after the accident	1	2.0
Quick HIV test if patient was known to be a positive carrier: administration of antiretroviral medicines more than 2hrs afterwards accident	1	2.0
Quick HIV test if patient was a negative carrier	20	40.8
None. patient seemed healthy	27	55.1
<b>Serologic follow-up performed after the accident</b>		
Immediately after the accident. at 3 and 6 months and at 1 year	8	16.3
Immediately after the accident and at 3 months	4	8.2
Single test after the accident	7	14.3
Not performed	30	61.2

Among the professionals who had accidents, only 36.7% were subjected to medical evaluation after the accident and only 18.4% of cases were reported using an Occupational Accident Report (OAR).

It was demonstrated that in 55.1% of the accidents, no action was taken immediately after the accident and that in 61.2% of the accidents, the recommended serologic follow-up was not performed.

Analysis of occupational accidents due to biologic material exposure analysis by professional category showed that physicians were the professionals that had the most accidents, at 35.3%; among these cases, contact with bodily fluids accounted for 83.3% of accidents. For none of these accidents was a post-accident medical evaluation performed and for only 16.7% of the accidents was a serologic follow-up performed after one year. The fact that an OAR was not issued in any of these cases is striking (Table 2).

**Table 2** - Occupational accidents due to biologic material exposure and post-accident action by professional category in Pre-hospital Care - Belo Horizonte - 2006

Occupational Accident	Doctors (n=34)	Nurses (n=25)	Nursing Tech/Assist. (n=113)	Driver (n=66)
<b>Occupational accidents in the last year</b>	35.3	24.0	17.7	16.7
<b>Contact vehicle</b>				
Bodily fluids	83.3	33.3	45.0	27.3
Perforating-cutting material	16.7	50.0	35.0	72.7
Both	0.0	16.7	20.0	0.0
<b>Post accident medical evaluation</b>	16.7	33.3	30.0	72.7
<b>OAR submitted</b>	0.0	0.0	20.0	45.5
<b>Action taken immediately after the accident</b>				
Quick HIV test if patient was known to be positive carrier: administration of antiretroviral medicines less than 2hrs after the accident	0.0	0.0	5.0	0.0
Quick HIV test if patient was known to be positive carrier: administration of antiretroviral medicines less than 2hrs after the accident	0.0	0.0	5.0	0.0
Quick HIV test for negative carriers:	33.3	33.3	30.0	72.7
None, patient seemed healthy	66.7	66.7	60.0	27.3
<b>Post-accident serologic follow up</b>				
Immediately post-accident, 3 and 6 months and 1 year	16.7	0.0	25.0	9.1
Immediately post-accident and at 3 months	0.0	0.0	5.0	27.3
Only one exam post-accident	16.7	16.7	0.0	36.4
Not performed	66.7	83.3	70.0	27.3

Nurses had the second higher rate of occupational accidents at 24.0%. Among these, 50.0% of accidents were associated with perforating-cutting materials, 33.3% were associated with bodily fluids and 16.7% with both. Post-accident medical evaluations were performed in only 33.3% of the cases; and none of these cases had an OAR issued or had serologic follow-up after one year.

The incidence of accidents due to occupational exposure to biologic material among nursing technicians/assistants was 17.7%, where 45.0% of these instances involved contact with bodily fluids, 35.0% with perforating-cutting materials and 20.0% with both. Among those that had accidents, in only 30.0% of the instances were medical evaluations performed, only 20.0% of the accidents were reported, and serologic follow-up for one year was done for only 25.0% of individuals.

The lowest percentage of accidents, 16.7%, was observed among drivers, with 72.7% of these accidents due to contact with perforating-cutting materials. In all cases, medical evaluations were performed; however, only 45.5% of these cases were reported and only 9.1% of the professionals evaluated had serologic follow up at one year.

In the one-way logistic regression analysis using *occupational accident* as dependent variable and demographic categories as independent variables, *professional category*, *time in the institution* and *unit* were the independent variables with statistically significant associations (Table 3).

Using the multivariate model, only *time in the institution* and *unit*, and the interaction between time in institution and unit, were considered in the model due to their biologic feasibility although it is within statistic significance values ( $p=0.05$ ). The probability that a professional with more than two active years in PHC would be involved in an accident due to exposure to biologic material in the prior year was estimated to be approximately three times higher than of a professional with less than two active years (OR=2.84; 95% confidence interval [CI]: 1.22 -6.62;  $p = 0.015$ ); professionals in ASU were four times more likely than professionals in BSU (OR = 4.18; 95% CI: 1.64 – 10.64;  $p = 0.003$ ) to be involved in an accident due to exposure to biologic material; and professionals in BSU with less than two years active time were approximately three times more likely than other professionals to have such an accident (OR = 0.27; 95% CI: 0.07 – 1.00;  $p = 0.051$ ).

**Table 3** - One-way regression of occupational accidents due to biologic material exposure on demographic data for professionals in Pre-hospital Care - Belo Horizonte - 2006

Demographic Variables	Accident (n=49) %	No Accident (n=189) %	Odds Ratio (CI)	p-value
<b>Professional Category</b>				
Driver	16.7	83.3	1.00	<b>0.131</b>
Nursing technician/assistant	17.7	82.3	1.08 (0.48 – 2.41)	
Nurses	24.0	76.0	1.58 (0.51 – 4.86)	
Doctors	35.3	64.7	2.73 (1.05 – 7.09)	
<b>Gender</b>				
Female	20.3	79.7	1.00	0.928
Male	20.8	79.2	1.03 (0.53 – 2.01)	
<b>Age</b>				
< 33 years old	20.3	79.7	1.00	0.917
≥ 33 years old	20.9	79.1	1.03 (0.55 – 1.94)	
<b>Year of graduation</b>				
Before 1998	21.5	78.5	1.00	0.806
After 1998	23.1	76.9	1.10 (0.53 – 2.26)	
<b>Time in the institution</b>				
≤ 2 years	16.5	83.5	1.00	<b>0.070</b>
> 2 years	26.3	73.7	1.80 (0.95 – 3.82)	
<b>Unit</b>				
BSU	16.3	83.7	1.00	<b>0.014</b>
ASU	30.6	69.4	2.27 (1.18 – 4.33)	

## DISCUSSION

The rate of occupational accidents among public PHC workers in Belo Horizonte was high. As they performed pre-hospital care, these professionals were exposed to occupational risks as they handled, directly or indirectly, bodily secretions from potential carriers of disease. Some characteristics associated with working in PHC stand out: overload, intense working rhythm, rapid decision making, stress, poor working conditions, and insufficient or poorly maintained equipment<sup>(7)</sup>.

By professional category, physicians and nurses had the highest rates of occupational accidents due to exposure to biologic material. This shows that these professionals are more exposed while providing service to critically ill patients, as they perform invasive procedures, have more contact with blood and bodily fluids, and are subjected to greater stress and are expected to produce results rapidly and efficiently, in addition to a higher level of exposure<sup>(4,7)</sup>.

Results of this study, indicate, however, that the driver category was the one with the highest rate of accidents with perforating-cutting material, even though drivers are not directly involved in invasive procedures. In the multi-professional team of PHC, drivers are responsible for helping the nursing professionals to clean the location and dispose of the used material. That alone can explain these

occurrences. These findings are consistent with results of other studied performed on ambulance drivers in urgency care. We verified that these professionals are exposed to occupational risks, despite already being exposed to specific risks associated with driving<sup>(12)</sup>. This is due to the fact that ambulance drivers often need to assume functions other than driving. They are then at risk for occupational accidents in addition to being subjected to other risks to their health<sup>(12)</sup>.

The incidence of occupational accidents due to biologic material exposure has been reported at rates that vary between 11 and 41.9% among nursing workers, 17 to 46.1% among physicians and 28.0% among medical students. This data confirms that the more contact with patients, the higher the risk of occupational accidents involving biologic material<sup>(13-14)</sup>.

Under-reporting constitutes another great challenge found in literature that impairs the study of occupational accidents. This fact reflects the lack of knowledge or attention of health professionals regarding the risks and severity of accidents that involve biologic material and the potential transmission of HIV and hepatitis<sup>(8,15)</sup>.

The fact that health professionals often fail to report occupational accidents suggests lack of information and interest among health professionals regarding the epidemiologic and legal aspects involved. It is important to in-

form health professionals that the severity of accidents due to biologic material exposure can only be evaluated if the report is made and serologic follow-up is performed as recommended by the Department of Health<sup>(5,13)</sup>.

Studies focused on nursing professionals revealed that in 2.4% of accidents, medical evaluation was performed without the submission of an OAR and 39.1% with OAR<sup>(14)</sup>.

Regarding immunization, one study<sup>(15)</sup> indicates that 65.0% of workers reported not having received all three doses of hepatitis B vaccine. The authors point out that after medical evaluation, prophylaxis with anti-retroviral medicines was administered in 43.7% of accidents. Among these, 43% of workers did not finish the prophylaxis due to side effects of the medication<sup>(15)</sup>.

Despite the scarcity of studies on PHC and occupational accidents, a study carried out in the pre-hospital rescue team of a fire department showed that none of the professionals who had accidents went through medical evaluation. Therefore, reports were not submitted and serologic follow-ups were not performed<sup>(7)</sup>.

In this study, drivers were the professionals that went through more medical evaluations (72.7%) and presented a higher rate of OAR submission (45.5%). However, in more than 50.0% of drivers accidents, the driver did not receive the recommended serologic tests. The serologic follow-up is crucial, because it is the only way to detect serum-conversion<sup>(17)</sup>.

The Department of Health, according to the Center of Diseases Control and Prevention policies, has published and regulated procedures to be followed in the event of becoming exposed to biologic material. These procedures comprise local care for the exposed area, prophylactic medication and serologic follow-up for Hepatitis B and HIV. Prophylaxis with zidovudine (ZDV) was associated with an 81% reduction in risk of acquiring HIV after occupational exposure. This document also lays out the Standard Regulations and Precautions for the use of personal protective equipment (PPE) and appropriate disposal of perforating-cutting material, among other bio-safety measures<sup>(18)</sup>.

The PHC service studied still is not providing health professionals with the protocols for forwarding, evaluation and follow-up for accidents. When an accident occurs, the nurse and physician present at the event only guide professionals to go to a reference hospital and perform the medical evaluation and serologic exams for HIV and Hepatitis B and C.

In this study of occupational accidents, the high level of under-reporting, reflects a lack of understanding among professionals of their rights and health risks and the failure of the emergency sector to evaluate and follow up the worker, which is especially problematic considering the high-risk nature of PHC activity.

Different rates of accidents between ASU and BSU may relate to a higher number of invasive procedures performed,

proximity with patients, possible inappropriate use of PPE, stress, and working long hours, among other factors that expose some professionals to higher risks of accident than others. The Advanced Support Unit concentrates all these characteristics, favoring higher rates of occupational accidents among professionals<sup>(4)</sup>.

Longer periods working in the institution can favor a 'better adjustment' of professionals to the service routine. Longer tenure is associated a higher rate of adherence to standard precautionary measures that are essential to prevent accidents. The relationship between professional activity average and the rate of accidents ranges from 1 to 6 years. Work overload is one of the main factors that results in fatigue and the occurrence of accidents. Also, technical expertise acquired by workers can lead to greater risk of exposure. As they perform their professional activities, workers become more secure about their technical precision. Thus, they are more prone to practice risky behaviors and may fail to take the risks they are exposed to in their tasks seriously<sup>(18)</sup>.

On the other hand, professionals with more active time in PHC, although they demonstrate effective professional activity, may be more willing to adopt standard precautionary measures. In addition, most of them work in a less complex procedures unit, the BSU. In other words, they are less likely to be exposed to occupational accidents. Although they have recent technical education and little experience in PHC, they seem more protected, since they are less exposed to invasive procedures.

Public PHC professionals have elevated rates of occupational accidents. This reflects their low adherence to standard precautionary measures. When the relationship between the use of PPE and accidents events was analyzed in other studies, among the 73.0% of accidents with blood exposure, 20.8% of professionals reported that they were not using PPE at the time of the accident. The workers justified this by their belief that the procedure was performed did not put them at risk for exposure risk to human bodily fluids, probably due to their *ability and expertise*<sup>(15)</sup>.

Another important factor is that when an accident occurred, the necessary procedures were not taken. In other words, individuals that had the accident did not seek out medical care and did not report the accident. Thus, they were not subjected to the serologic follow-up protocols recommended by the Department of Health<sup>(17)</sup>.

## CONCLUSION

Based on the results from this study, we suggest the implementation of permanent educational programs, supported by theme seminars and/or clinical meetings, in order to minimize recurrence of occupational accidents, to increase reporting rates, and to improve post-accident follow-up. We consider that parallel to this initiative, there

must be an implementation of a formal protocol to guide and follow up professionals who have had accidents due to biologic material exposure.

Hence, we intend to improve knowledge and actions of the PHC team, informing their members about the importance of developing safe practices to protect their own health.

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