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Original Article

Accidents with biological material among health professionals in Brazil: a cross-sectional study involving medication administration

Acidentes com material biológico entre profissionais de saúde no Brasil: estudo transversal envolvendo administração medicamentosa

Accidentes con material biológico entre profesionales de la salud en Brasil: un estudio transversal sobre administración de medicamentos

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ABSTRACT

Background and Objectives: Healthcare professionals, particularly nursing technicians, are frequently exposed to occupational risks involving contaminated biological materials, such as blood, increasing their vulnerability to infections like HIV and hepatitis B and C. This study aimed to analyze the association between biological material exposure during medication administration among nursing technicians, compared to other healthcare professionals. **Methods:** A cross-sectional analytical study was conducted using 69.129 work-related accident notifications recorded in the SINAN database in 2022. Sociodemographic and clinical variables were analyzed. The association measure used was the Prevalence Ratio (PR), with 95% Confidence Interval (CI) and $p \leq 0.05$. **Results:** Most affected individuals were aged 26 to 45 years (61.3%) and female (76.9%). Blood was the main biological material involved (74.7%). Nursing technicians showed a 2.54 times higher prevalence of accidents during medication administration compared to other professionals (PR = 2.54; 95% CI: 2.46–2.62; $p < 0.0001$). The Southeast region of Brazil reported the highest number of cases. Although 84.8% were vaccinated against hepatitis B, underreporting remains a concern, with 30.4% of Work Accident Reports (CAT) not issued. **Conclusion:** The high frequency of accidents among nursing technicians highlights the urgent need for public policies focused on prevention, improved reporting practices, and proper use of personal protective equipment (PPE). Underreporting compromises health surveillance and calls for educational and organizational strategies to enhance workplace safety in healthcare settings.

Keywords: Accidents. Occupational Exposure. Biomaterial. Licensed Practical Nurses.

RESUMO

Justificativa e Objetivos: Profissionais de saúde, especialmente técnicos de enfermagem, estão expostos a riscos ocupacionais relacionados ao contato com materiais biológicos contaminados, como sangue, elevando o risco de infecções por HIV e hepatites B e C. Este estudo teve como objetivo analisar a associação entre acidentes com material biológico durante a administração de medicamentos entre técnicos de enfermagem, comparando-os a outros profissionais da área da saúde. **Métodos:** Foi realizado um estudo transversal analítico, baseado em 69.129 registros de acidentes de trabalho notificados ao SINAN em 2022. Foram analisadas as variáveis sociodemográficas e clínicas. A medida de associação utilizada foi a Razão de Prevalência (RP), com IC95% e $p \leq 0.05$. **Resultados:** A maioria dos acidentados tinha entre 26 e 45 anos (61,3%) e era do sexo feminino (76,9%). O sangue foi o principal material biológico envolvido (74,7%). Técnicos de enfermagem apresentaram prevalência de acidentes 2,54 vezes maior durante a administração de medicamentos em comparação a outros profissionais (RP = 2,54; IC95%: 2,46–2,62; $p < 0,0001$). A maioria dos casos foi registrada na região Sudeste do Brasil. Apesar de 84,8% estarem vacinados contra hepatite B, a subnotificação permanece um problema, com 30,4% das CATs ignoradas. **Conclusão:** A elevada frequência de acidentes com técnicos de enfermagem evidencia a necessidade de políticas públicas voltadas à prevenção, qualificação para notificação e uso adequado de EPIs. A subnotificação compromete a vigilância em saúde e exige estratégias educativas e organizacionais para aprimorar a segurança dos profissionais no ambiente assistencial.

Descriptores: Acidentes. Exposición Ocupacional. Material Biológico. Técnicos de Enfermagem.

RESUMEN

Justificación y Objetivos: Los profesionales de la salud, especialmente los técnicos de enfermería, están frecuentemente expuestos a riesgos ocupacionales relacionados con el contacto con materiales biológicos contaminados, como la sangre, lo que aumenta su vulnerabilidad a infecciones como el VIH y las hepatitis B y C. Este estudio tuvo como objetivo analizar la asociación entre los accidentes con material biológico durante la administración de medicamentos entre técnicos de enfermería, en comparación con otros profesionales de la salud. **Métodos:** Estudio transversal analítico, basado en 69.129 notificaciones de accidentes laborales registradas en el sistema SINAN en 2022. Se analizaron variables sociodemográficas y clínicas. La medida de asociación utilizada fue la Razón de Prevalencia (RP), con IC del 95% y $p \leq 0,05$. **Resultados:** La mayoría de la población que sufrió accidentes tenía entre 26 y 45 años (61,3%) y era de sexo femenino (76,9%). La sangre fue el principal material biológico involucrado (74,7%). Los técnicos de enfermería presentaron una prevalencia de accidentes 2,54 veces mayor durante la administración de medicamentos en comparación con otros profesionales (RP = 2,54; IC95%: 2,46–2,62; $p < 0,0001$). La mayoría de los casos se notificaron en la región Sudeste de Brasil. Aunque el 84,8% estaba vacunado contra la hepatitis B, la subnotificación fue significativa (30,4% de las CAT no emitidas). **Conclusiones:** La alta frecuencia de accidentes entre técnicos de enfermería resalta la necesidad urgente de políticas públicas enfocadas en la prevención, la notificación adecuada y el uso correcto de Equipos de Protección Individual (EPI). La subnotificación compromete la vigilancia en salud y exige estrategias educativas y organizativas para mejorar la seguridad en el entorno asistencial.

Palabras Clave: Accidentes. Exposición Profesional. Biomaterial. Enfermeros Diplomados.

INTRODUCTION

Every day, healthcare professionals face significant risks to their health and well-being due to the very nature of their work. Continuous contact with a variety of patients; in different contexts (home care, outpatient care, or surgery); and daily exposure to biological materials contaminated by microbial agents—including bacteria, viruses, and fungi—or sharp objects subject to contamination can aggravate the risks and, if handled incorrectly, result in infections, allergies, or toxicity to these professionals' bodies.¹

Among the various categories of healthcare professionals, nursing technicians are the most exposed to risk, since their activities require constant contact with patients in different care settings.¹ Thus, the continuous exercise of healthcare practice, especially by professionals who perform invasive procedures, increases the risks of exposure to potentially contaminated biological materials. Among the infectious agents most frequently associated with these accidents are hepatitis B and C viruses, as well as HIV, whose occupational transmission, although less frequent, still represents a significant concern globally.²

Occupational exposure to biological material can occur in several ways, including percutaneous exposure mediated by sharp or piercing instruments such as needles, scalpels, and blades. In addition, there is a risk in circumstances inherent to the work of these healthcare professionals, such as performing laboratory procedures involving punctures, collections, and especially the administration of medications.³

Given the scarcity of studies on the subject, this study aims to investigate the association between the occurrence of accidents with contaminated biological materials during the administration of medications among nursing technicians, in comparison with other health professions.

METHODS

An epidemiological, cross-sectional analytical study was conducted using individual data collected from the Notifiable Diseases Information System (SINAN) between January and December 2022. Data extraction and analysis took place in October 2024.

All records of occupational accidents due to exposure to biological material reported in 2022, classified under the ICD-10 code Z20.9, were included, provided that the variable "circumstances of the accident" was filled in as "administration of medication." This variable is part of the standard SINAN notification form and represents, according to the system guidelines, accidents related to the handling of medications during care procedures, such as the preparation and administration of drugs, injections, infusions, and the like. Duplicate

records and cases with missing data on the occupation of the accident victim or the circumstances of the accident were excluded.

The independent variable was professional occupation, categorized as nursing technicians and other health professionals. The dependent variable was the circumstances of the accident, dichotomized into "medication administration" and "other." The following descriptive variables were selected: race/color, age, gender, education, geographic distribution, occupation, and circumstances of the accidents. Thus, these were duly verified and associated among nursing technicians in order to understand how these variables were related to the aforementioned events.

The sample for this study included all records of occupational accidents due to exposure to biological material resulting from medication administration among healthcare professionals in Brazil in 2022, totaling 69,129 notifications.

It should be noted that this study is subject to possible methodological biases, among which notification bias and exposure classification bias stand out. Reporting bias occurs due to underreporting of accidents with biological materials in SINAN, since not all professionals formally record events, either due to ignorance of the obligation, fear of reprisals, or excessive work demands. This factor can lead to an underestimation of the actual prevalence of accidents, especially among professional groups with less access or incentive to report. Exposure classification bias may be present in the categorization of professions and in the identification of the exact moment of exposure to biological material. As records are based on self-reported information or information filled out by third parties, there is a risk of inconsistencies in the definition of the circumstances of the accident, such as the administration of medications, which may affect the accuracy of association estimates. Despite these limitations, the use of a national and standardized database helps to minimize these distortions and ensure greater reliability of results.

The descriptive analysis was performed using *Jamovi* software (version 1.6), and the association calculations were conducted using *OpenEpi* (version 3.01), with an estimated Prevalence Ratio (PR), 95% confidence interval, and statistical significance of $p \leq 0.05$.

As this is a public, anonymized database with unrestricted access, there was no need for ethical review, in accordance with Resolutions No. 466/2012, 510/2016, and 580/2018 of the Ministry of Health.

RESULTS

More than 50% of the sample is in the 26 to 45 age group. In older people (66+), this figure is less than 1%. There is a noticeable higher frequency in females

(76.9%) compared to males (23.1%). In Brazil, the regions with the highest number of cases were the Southeast (45.3%), Northeast (21.5%), and South (18.5%). A higher incidence was found among white and brown individuals (75%). Only 26.7% of accident victims had completed higher education, and 42.5% had completed secondary education (Table 1).

Table 1. Sociodemographic characteristics of professionals injured by biological material in Brazil in 2022.

	Age	N (%)
	18 - 25	15386 (22.3)
	26 - 35	24219 (35.1)
	36 - 45	18132 (26.2)
	46 - 55	8102 (13.5)
	56-65	2348 (3.4)
	66+	348 (0.4)
	Total	68535
Sex		
Female		53128 (76.9)
Male		15998 (23.1)
Ignored		3 (0.0)
Total		69129
Region		
North		4071 (5.8)
Northeast		14845 (21.5)
Mid-west		5187 (7.4)
Southeast		31312 (45.3)
South		12835 (18.5)
Total		64197
Race/Color		
White		32893 (47.6)
Brown		25931 (37.5)
Indigenous		163 (0.2)
Black		4897 (7.1)
Yellow		540 (0.8)
Ignored		4651 (6.7)
Total		69.075
Education		
Illiterate		53 (0.1)
1st to 4th grade incomplete in elementary school		465 (0.7)
Complete 4th grade of elementary school		376 (0.6)
Incomplete 5th to 8th grade of elementary school		1065 (1.6)
Complete elementary school		1214 (1.8)
Incomplete high school		1631 (2.5)
Complete high school		28024 (42.5)
Incomplete higher education		6213 (9.4)
Complete higher education		17610 (26.7)
Not applicable		461 (0.7)
Ignored		8808 (13.4)
Total		65920 (100.0)

Regarding clinical variables, 42.4% of individuals filed a Work Accident Report (WAR), while 21.8% did not file one and 30.4% ignored this information. 84.8% were immunized against Hepatitis B. The main biological material during contamination was blood (74.7%). Regarding the evolution of cases, 37.9% were discharged with a negative source patient and 25.6% were discharged without serological conversion (Table 2).

Table 2. Clinical characteristics of healthcare workers injured by biological material in Brazil in 2022.

WAR issuance	N (%)
Yes	29163 (42.2)
No	15054 (21.8)
Ignored	20985 (30.4)
Does not apply	3885 (5.6)
Total	69087
Hepatitis B immunization	
Vaccinated	56547 (84.8)
Not Vaccinated	3177 (4.8)
Ignored	6951 (10.4)
Total	66675
Biological material	
Blood	50357 (74.7)
Cerebrospinal fluid	442 (0.7)
Blood-tinged fluid	2838 (4.2)
Pleural fluid	129 (0.2)
Serum/plasma	302 (0.4)
Amniotic fluid	104 (0.2)
Ascites fluid	69 (0.1)
Other	8386 (12.4)
Unknown	4744 (7.0)
Total	67371
Evolution	
Discharge with serological conversion	3287 (6.2)
Discharge without serological conversion	13628 (25.6)
Discharge of negative source patient	20163 (37.9)
Abandonment	5617 (10.6)
Death due to accident	58 (0.1)
Death due to other cause	18 (0.0)
Unknown	10414 (19.6)
Total	53185 (100.0)

With the data obtained, it is possible to observe the association between being a nursing technician or other professional and becoming infected during the administration of medication or in other circumstances. In total, we have 69,129 people, of whom 26,652 are nursing technicians, with 8,542 suffering accidents during the administration of medication, while 18,110 suffered accidents on other occasions. Among the 41,109 other professionals, 5,188 suffered accidents with medication and 35,921 suffered accidents in other ways. In total, there were exposures in 13,730 people contaminated when administering medication and 54,031 in other ways. (Table 3).

Table 3. Association between occupation and accident circumstances.

Occupation	Circumstance			PR (95%CI)	p
	Medication	Others	Total		
Technical	8542	18110	26652	2.54	<0,00001
Others	5188	35921	41109	(2.462 - 2.619)	

Abbreviation: PR: Prevalence ratio. CI: Confidence interval. P: p-value.

The data analysis obtained an PR of 2.5 and a p-value of 0.0001. This indicates that nursing technicians have a significantly higher prevalence of accidents, facing risks 2.5 times higher than their colleagues in other areas. In addition, the p-value of 0.0001 suggests that this association is statistically significant, showing that the

higher occurrence of accidents is not a matter of chance. These results highlight the urgent need to develop health and safety policies aimed at preventing accidental injuries and protecting these professionals, contributing to reducing the risk of contamination by biological materials.

DISCUSSION

Accidents involving biological materials, whether contaminated or not, are very common, especially among healthcare professionals who are in constant contact with these types of substances. Given this, in 2022, we had a total of 69,130 cases, a noticeable increase when compared to data from 2014 with 47,292 cases, with nursing technicians being the most affected professionals with 26,652 reports.³

After analyzing the data obtained, it was possible to see that most of those involved in accidents with biological materials were white, female workers. Most professionals involved in accidents with biological materials are women, reflecting the female predominance in the healthcare workforce, especially in nursing. This predominance, combined with the work overload resulting from balancing professional life and domestic responsibilities, may increase vulnerability to occupational accidents. In addition, factors such as long working hours, care pressures, and the absence of effective preventive measures contribute to this greater susceptibility among women.^{4,5,6}

In this sense, it was also observed that the age group most affected by accidents with biological materials was 26 to 45 years old. The high number of accidents among workers in this age group may also be associated with their limited experience in the field and lack of skill in handling instruments, making it important to spend more time in their work activities and health service routines.⁷ Thus, the data found correspond to the literature.

It was also observed that the level of education among injured workers was mainly high school completion. Professionals with lower levels of education are at greater risk of exposure to accidents involving sharp objects. This vulnerability may be associated with less professional experience and a lack of adequate training in safe practices for handling sharp and piercing materials.⁸

After a work accident occurs, it is necessary to fill out the WAR, which is the accident notification form used after exposure to biological material, for example. However, it is not always filled out, leading to underreporting of these incidents. Underreporting may be related to a lack of knowledge about the importance of this record for epidemiological analyses, as well as the excessive bureaucracy involved in reporting an accident.⁷ Given this, the data found, with 42.2% of

forms issued and 30.4% ignored, correspond to the findings in other literature.

Another important factor to be analyzed is related to the vaccination status against the hepatitis B virus (HBV). In the data found, it was possible to note that 84.8% of workers involved in accidents were vaccinated, which is a large number when compared to those who were not immunized and ignored, totaling 15.2%. However, even though this is a low figure in relation to those who received the vaccine doses, it is a significant figure, mainly because the main accidents involved healthcare professionals, since the vaccine is effective and free, offered by the SUS (Brazilian Unified Health System) in the National Immunization Plan (PNI).⁷

Furthermore, analysis of the data on organic materials most commonly present in accidents revealed a predominance of incidents involving blood, accounting for 50,357 (74.7%) occurrences, as it is handled for various tests. This number may be predominant mainly when associated with the handling of lumen needles, reaffirming data found in other literature. The risk of contamination by diseases such as hepatitis B, hepatitis C, and HIV is considered low, a fact that can be confirmed by the percentage of victims who progressed to discharge without serological conversion (25.6%). However, a considerable number (19.6%) of patients abandoned follow-up. Adherence to clinical follow-up after occupational exposure to biological materials is crucial for the prevention of infections among healthcare professionals. However, studies indicate that the rate of abandonment of post-exposure follow-up can be significant. For example, a survey conducted at a university hospital in Malaysia revealed that 51.4% of healthcare professionals did not complete the recommended follow-up after injuries from sharp objects. These findings underscore the importance of implementing effective strategies, such as regular training, proper use of personal protective equipment (PPE), and provision of accessible information on the safe disposal and handling of materials, to ensure the safety and well-being of these professionals.⁹

It is noted that the most affected region in Brazil was the Southeast. Although legally mandatory, the reporting of occupational accidents is, in practice, subject to underreporting, negatively impacting epidemiological surveillance and the implementation of effective preventive measures. Factors such as the perception of low risk associated with minor injuries, lack of knowledge about the risks involved, and the absence of clear reporting protocols contribute significantly to this underreporting. In addition, work overload and resource shortages in hospital settings can make it difficult to comply with the steps necessary for proper reporting of these incidents. This may have been the case in other regions of Brazil, which reported a

lower number of cases.¹⁰ However, the Southeast, on the other hand, is also the region with the highest population density in the country, the most developed health network, and a concentration of health professionals and workers in sectors that deal with biological materials, increasing the likelihood of occurrences.

Thus, since the study was conducted using secondary data, it is important to highlight the existence of a possible limitation regarding information classified as “ignored” due to non-completion of the notification form, which may hinder a reliable presentation of the results, as well as the influence of unmeasured factors such as confounding factors such as the workload of nursing technicians compared to other professions. Another inherent limitation of a cross-sectional study is the impossibility of measuring and establishing causality between variables.

Despite the limitations described, the findings of this study offer a relevant contribution to understanding the occupational risks faced by nursing technicians in the administration of medications. The use of a comprehensive national database, such as SINAN, allowed for the analysis of a large number of notifications, providing a comprehensive view of the occurrence of accidents with biological materials in Brazil. In addition, the application of robust statistical measures, such as PR with confidence interval, strengthens the reliability of the results. Thus, this study reinforces the need for policies aimed at the safety of healthcare workers and serves as a basis for future investigations that may explore strategies to mitigate occupational risks in this population.

The findings of this study show a statistically significant association between the occupation of nursing technician and the higher frequency of accidents with biological material during the administration of medications, which demonstrates the occupational vulnerability of this category, which is in a position of greater exposure to biological risks in the healthcare context. The high proportion of accidents involving blood, the predominance of notifications in the Southeast region, and persistent underreporting, even in the face of high vaccination coverage against hepatitis B, indicate persistent failures in the processes of prevention, notification, and surveillance of occupational health.

In this context, there is an urgent need to implement more effective and targeted public policies that promote safe working conditions, ongoing education on biosafety measures, and incentives for the systematic reporting of occupational exposures, in addition to raising awareness about the proper completion of WARs.

It is recommended that future studies be designed to include in-depth contextual and structural factors that

contribute to the occurrence and underreporting of these events, including variables such as number of employment relationships, infrastructure, institutional culture, and access to PPE. Longitudinal studies with a qualitative approach can contribute to strengthening protection strategies, intervention planning, and evidence-based policy formulation.

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AUTHORS' CONTRIBUTIONS

Anna Júlia Rocha Azevedo contributed to writing and constructing the article's introduction, searching for existing literature on the topic in databases such as PubMed and the

Virtual Health Library, and collaborated with the creation of the slides. **Caio Pires Silva** contributed by cleaning the raw Excel database, leaving only useful variables for the study. He compared data in the discussion, searching for existing literature on the topic in databases such as PubMed and the Virtual Health Library, aiming to identify whether or not it related to the data found in the results, in order to build a coherent discussion that justified the values found in the study. He collaborated on the preparation of the slides for the study presentation and contributed to the introduction. **João Pedro da Silva Rocha** contributed by cleaning the database and uploading it to Jamovi. Processed the data in the program and created the variable tables. Used Excel to sum the data of interest, created the contingency table, and uploaded it to Open Epi. Reviewed the text, making some of the changes suggested by the professor. Helped create the slides. **Jamile de Miranda Tavares** contributed mainly to the introduction and methodological part of the article - allocating the association measures, also contributing to the discussion of the body of the article, revised the text and corrected spelling, semantics, and the part in which the professor guided us. Elaborated with the creation of the slides. **Gabriel Silva Pinto** contributed to the preparation of the introduction, searching for existing literature on the topic in databases such as PubMed and the Virtual Health Library, reviewed the text and corrected spelling and semantic errors in the result and collaborated with the creation of the slides. **Mariana Perruso Lyrio** contributed by cleaning, in Excel, the secondary database collected from Sinan on workplace accidents involving exposure to biological material, leaving only the variables of interest used in the study. He described the data obtained using tables generated by Jamovi, comparing the percentages found among sociodemographic and clinical variables, and the association between occupation and accident circumstances. He helped write the discussion and search for articles to explain the results found in the tables. He reviewed the text and corrected parts that the professor requested during the last meeting before the presentation. He arranged the references for the articles used. He collaborated on the preparation of the slides. **Caroline Santos Silva** contributed as a study advisor, assisting in all stages of the article's development. She reviewed and corrected all sections of the work, ensuring scientific and textual coherence. She formatted the manuscript according to the journal's requirements, guided the development of the discussion and methodology, and suggested adjustments and improvements. Furthermore, she oversaw the search and selection of relevant references, assisted in the interpretation of the results, and guided the final structuring of the article for submission.

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.

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