

SPATIAL ANALYSIS AND EPIDEMIOLOGICAL PROFILE OF OCCUPATIONAL ACCIDENTS WITH BIOLOGICAL MATERIAL

ANÁLISE ESPACIAL E PERFIL EPIDEMIOLÓGICO DE ACIDENTES DE TRABALHO COM MATERIAL BIOLÓGICO

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ABSTRACT: **Aim:** This study analyzed the spatial distribution and profile of occupational accidents with biological material in the state of Paraná. **Methodology:** This was an exploratory, cross-sectional, retrospective, and descriptive study using occupational accident reports in the Information System for Notifiable Diseases (SINAN) in 2019 and 2020. The analysis identified three homogeneous health regional areas, and the region comprising Paranaguá, Apucarana, and Londrina showed the highest incidence of accidents across all analyzed variables. **Results:** More new cases were observed among male workers, those under 18 years old, and those with education up to elementary school level I in all three areas. In terms of prevalence, the female sex and the age group of 18 to 64 years were more prominent, and blood was the most common biological material. **Conclusions:** This highlights the need to implement an organizational culture focused on prevention, especially targeting these groups at higher risk. **KEYWORDS:** Health Information Systems. Occupational Accidents Report. Occupational Health.

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RESUMO: **Objetivo:** Analisar a distribuição espacial e o perfil de acidentes de trabalho com material biológico no Paraná. **Metodologia:** Realizou-se uma pesquisa exploratória, transversal, retrospectiva e descritiva, por meio das notificações de acidentes de trabalho, registradas pelo Sistema de Informação e Agravos de Notificação (SINAN) de 2019 e 2020. Os agrupamentos consolidaram três áreas homogêneas de regionais de saúde, sendo que aquela composta por Paranaguá, Apucarana e Londrina apresentou o maior coeficiente de incidência de acidentes em todas as variáveis analisadas. **Resultados:** Observou-se um maior número de novos casos entre trabalhadores do sexo masculino, menores de 18 anos e com nível de escolaridade até o ensino fundamental I, nas três áreas. Entretanto, na análise de prevalência sobressai-se o sexo feminino, idade de 18 a 64 anos, o sangue como material orgânico prevalente. **Conclusão:** Isso aponta para a necessidade de implementar uma cultura organizacional focada na prevenção, visando especialmente esses grupos de maior risco. **PALAVRAS-CHAVE:** Notificação de Acidentes de Trabalho. Saúde Ocupacional. Sistemas de Informação em Saúde.

INTRODUCTION

The International Labour Organization (ILO) estimates that around 395 million non-fatal accidents occur annually and almost 3 million people die from occupational accidents or diseases worldwide. In order to ensure safer environments, the ILO introduced a new plan for the years 2024 to 2030, with incentives to improve national Occupational Health and Safety structures, strengthen coordination and investment in these segments, improve management systems to guide transformations, and reduce risks to workers¹.

In Brazil, in 2022, there were around 613 thousand reports of work accidents among professionals with formal employment contracts, with São Paulo being the state with the highest number of reports. This translates into around 18 million lost work days during the period of sick leave, and an expense of over 70 billion reais in disability pensions alone in 2021².

Work accidents are defined as those caused by the exercise of work or on the way between work and home, capable of causing physical or mental harm to workers, whether temporary, permanent, or fatal³. In order to record data regarding health-related injuries to workers in Brazil, it is necessary to make a mandatory notification using a form, standardized by the Ministry of Health, in accordance with the flow in the Health Information System (SINAN). At the same time, it is necessary to issue an Occupational Accidents Registry (CAT, in Portuguese)^{3,4}.

By definition, a work accident involving exposure to biological material involves exposure to potentially infectious blood and fluids. Contact with such contaminants can be direct or indirect and can be percutaneous or through contact with mucous membranes and skin⁵.

The number of accidents reported to the population with formal employment contracts increased from 393,071 in 2002 to 612,920 in 2022 in Brazil; hospital care activities are the sector with the highest number of reports². Therefore, healthcare workers are particularly affected by accidents with exposure to biological material. They commonly occur through sharp objects, with some of the main causes being incorrect handling, disposal, and recapping of needles, which can be prevented⁶.

These injuries can also affect workers in other sectors, such as funeral services, the beauty industry, public safety, garbage collection, and cleaning services^{7,8}. Such accidents can lead to severe harm to the affected professionals, such as psychosocial problems, which can alter family, work, and social ties⁹.

In order to prevent harm to workers, some standards have been created. Biosafety in health facilities in Brazil is the subject of Regulatory Standard 32 (NR 32), which aims to establish guidelines on safety measures for health service workers, one of which would be the proper use of Personal Protective Equipment (PPE). NR 6 defines PPE as any device used by professionals to protect them from risks and threats to their safety that may occur at work^{10,11}. Considering that the risk of contamination is universal, using the equipment correctly is essential. Despite all the inherent dangers, many professionals do not use it properly^{6,7}.

In the case of accidents involving biological material, health professionals often consider the accident to be minor and therefore believe that it does not need to be reported. Other reasons for this behavior include lack of time to leave the workplace, delay in post-accident care, work overload, and lack of knowledge about how to report the accident.¹² Therefore, it is imperative to maintain periodic training for professionals to modify behaviors and provide adequate health promotion and prevention of injuries⁶.

From this perspective, research indicates a relationship between sociodemographic factors such as age, education, work regime, and accidents involving biological material.^{7,13} Therefore, considering the heterogeneity of socioeconomic, demographic, and environmental conditions, identifying the geographic area of work accidents with biological material can be the starting point for outlining

measures to improve working conditions.⁸ Thus, the goal of this research was to analyze the spatial distribution and profile of reports of work accidents involving biological material in the state of Paraná.

METHODOLOGY

This was an exploratory, cross-sectional, retrospective, and descriptive study, whose data source was the reports of occupational accidents with biological material in the state of Paraná, reported to the Health Information System (SINAN), for the 2019-2020 period. The information was obtained from the SINAN database, which is fed by the Occupational Accident Reports, which include the variables investigated. The notifications were analyzed considering the 22 Health Regional Divisions of Paraná. This study was conducted in accordance with the ethical principles of research, including obtaining approval from the Research Ethics Committee of the responsible institution, with approval number 4.951.849.

The data were analyzed using the Statistical Analysis Software (SAS) application, based on data generated in the Excel application, and the thematic map was created using the Quantum GIS 3.6.2 software. To measure the coefficient of incidence of occupational accidents (CI), the number of occupational accidents involving biological material was divided by the number of employment relationships related to two categories of the Brazilian Classification of Occupations (“Professionals in Biological, Health, and Related Sciences” and “High School Technicians in Biological, Biochemical, Health, and Related Sciences”), the result of which was multiplied by 10,000 for each health regional division¹⁴. By definition, the coefficient of incidence (CI) is a relative and secondary measure, calculated by dividing the number of new cases by the number of people exposed to risk in the same period, multiplied by a constant¹⁵. In this case, the denominator was considered to be health workers, with subsequent multiplication by 10,000.

In order to set homogeneous groups of health regional divisions based on the CI of work accidents, a Cluster Analysis was run. The Complete Linkage method with Euclidean distance was used to form the clusters. The matrix composed of the incidence by sex, education, and age groups for 2019 and 2020 was considered as input. After determining the homogeneous areas of behavior, the clusters of health regional divisions (RS) were characterized using the geographic map, frequency tables, and descriptive measures.

Another analysis performed was the prevalence of work accidents involving biological material. By definition, prevalence refers to all cases of an injury in the population at a given time.¹⁵ To calculate prevalence, a percentage analysis of the absolute number of work accidents with biological material in Paraná from 2019 to 2020 was used. Thus, percentage distribution tables were used, in which the percentage of people affected among the categories of each variable per group and for the total of each area was presented. The variables analyzed were sex, age group, education, professional occupation and employment status; type of exposure; types of organic materials involved in the accident; and type of accident. In addition, the use of PPE equipment and the percentage of people affected who had a work accident report issued were analyzed.

RESULTS

Figure 1 illustrates the spatial distribution of the CI of work accidents in the health regional divisions of Paraná, with the darker tones representing the locations with the highest incidences. There are homogeneous areas among the health regional divisions in Paraná, regarding work accidents. Those located in Maringá, Cianorte, Ivaiporã, Pato Branco, and Telêmaco Borba presented the classification with the highest CI of work accidents. On the other hand, Guarapuava, União da Vitória, Curitiba, Cornélio Procópio, and Jacarezinho presented the classification with the lowest CI.

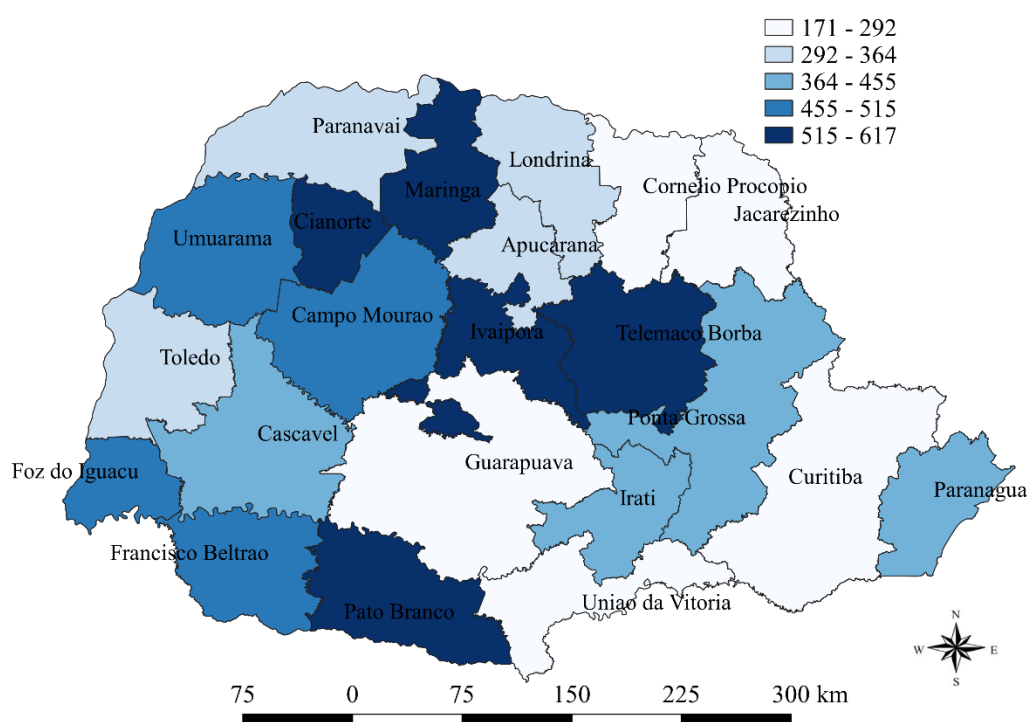


Figure 1 – Spatial distribution of occupational accident CI by health regional division in the state of Paraná.
Source: research data.

Based on the CI matrix of work accidents, three homogeneous areas of health regional divisions (RS) were obtained. Area I is made up of nine RS: Irati, Guarapuava, União da Vitória, Cianorte, Cornélio Procópio, Jacarezinho, Toledo, Telêmaco Borba, and Ivaiporã; area II is made up of ten RS: Metropolitan Region, Ponta Grossa, Pato Branco, Francisco Beltrão, Foz do Iguaçu, Cascavel, Campo Mourão, Umuarama, Paranavai, and Maringá; finally, area III is made up of three RS: Paranaguá, Apucarana, and Londrina (Figure 2).

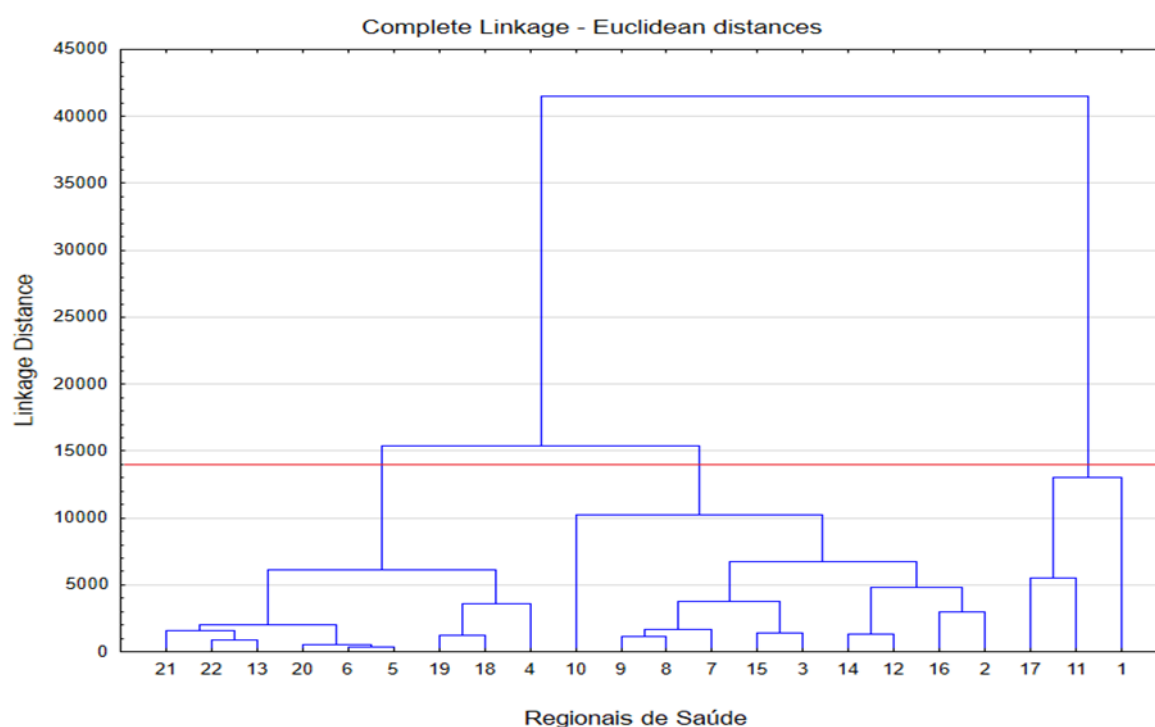


Figure 2 – Dendrogram showing the hierarchical relationship between health regional divisions in the state of Paraná according to occupational accidents with biological material in the period from 2019 to 2020. Source: research data.

Area III had the highest CI in all variables analyzed (Table 1). As for gender, there was a greater number of new cases among men, who were much more affected than women, in all areas. When analyzing the age group, the most affected workers were those under 18 years old. In the variable education, the CI was higher among those who had up to initial elementary education I, in all three areas.

Table 1 – Coefficient of incidence by groups by homogeneous areas of health regional divisions, for the variables sex, age group, and education (for every 10,000 inhabitants), state of Paraná (PR), 2019-2020.

Variable	Area I	Area II	Area III
Gender			
Female	82.20	81.36	94.07
Male	979.66	977.42	1194.15
Total	652.85	585.86	747.56
Age group			
Under 18	592.59	8235.29	33333.33
Between 18 and 64	330.41	290.53	367.32
Over 64	391.64	109.97	274.73
Total	664.22	578.65	743.01
Education			
Illiteracy	0.00	0.00	0.00
Early Elementary	1166.18	2646.57	3828.13
Elementary	685.25	699.59	990.48
High School	447.12	332.75	491.07
Higher Education	162.04	153.30	149.63
Total	611.07	503.92	645.36

Source: research data.

Regarding the prevalence of work accidents with biological material, Area II comprised the group with the highest prevalence of work accidents; Area III was in an intermediate position; and Area I had the lowest prevalence (Table 2). The prevalence of accidents was higher among females in all areas. Of all accidents that occurred in Paraná between 2019 and 2020, 69.93% of them occurred in Area II.

Table 2 – Profile of workers, by reported cases of work accidents, with exposure to biological material, in health services according to sex, age group, education, professional occupation, and employment status by homogeneous areas of health regional divisions, Paraná (PR), 2019-2020.

Variable	Area I		Area II		Area III	
	n	%	n	%	n	%
Gender						
Female	949	81.67	4,541	78.78	1,069	81.23
Male	213	18.33	1,223	21.22	247	18.77
Total	1,162	14.10	5,764	69.93	1,316	15.97
Age group						
Under 18	8	0.70	28	0.49	20	1.53
Between 18 and 64	1,127	98.00	5,663	98.97	1,273	97.32
Over 64	15	1.30	31	0.54	15	1.15
Total	1,150	14.06	5,722	69.95	1,308	15.99
Education						
Early Elementary	40	3.68	158	3.17	49	4.31
Elementary	59	5.43	204	4.09	52	4.58
High School	676	62.19	3,046	61.14	745	65.58
Higher Education	312	28.70	1,574	31.59	290	25.53
Total	1,087	15.09	4,982	69.15	1,136	15.77
Professional occupation						
Laboratory assistant/dental health assistant	35	3.01	247	4.29	42	3.19
Household waste collector	17	1.46	104	1.80	20	1.52
Cleaning worker/interior building worker	72	6.20	312	5.41	102	7.75
Nurse	72	6.20	521	9.04	109	8.28
Student	80	6.88	426	7.39	70	5.32
Physician	55	4.73	242	4.20	52	3.95
Nursing technician	482	41.48	2,238	38.83	555	42.17
Nursing Assistant	50	4.30	282	4.89	76	5.78
Dentist/biomedical/pharmacist/surgery technician	77	6.63	295	5.12	48	3.65
Other	222	19.10	1,097	19.03	242	18.39
Total	1,162	14.10	5,764	69.93	1,316	15.97
Employment status						
Self-employed	69	6.07	281	5.08	83	6.47
With a formal employment contract	639	56.20	3,084	55.71	778	60.69
Unregistered	46	4.05	127	2.29	22	1.72
Public servant	258	22.69	1,272	22.98	243	18.95
Other	125	10.99	772	13.95	156	12.17
Total	1,137	14.29	5,536	69.59	1,282	16.12

Source: research data.

Regarding age group, the group most affected in all areas was the 18 to 64 age group. When considering education, the highest prevalence of work accidents with biological material occurred among professionals who had completed high school, with more than 60% of the total, in the three areas analyzed.

The main occupation affected is nursing technicians/auxiliaries, accounting for 40% of the total number of professionals affected in all areas. Concerning employment status, the majority had formal employment contracts.

As for the circumstances of the accident, most were percutaneous in all areas, affecting more than 75% of the total. The prevalent organic material was blood, which exceeded $\frac{3}{4}$ of the accidents in the three areas. The main cause of accidents was sharp objects, representing more than 40% of the accidents in all areas.

One of the main PPEs that were not being used by professionals at the time of the accident was glasses; in all areas, more than $\frac{3}{4}$ did not use this equipment. Another PPE with lower adherence was a face shield. Furthermore, in the three areas, less than half of the affected professionals wore masks and the use of boots did not reach 30%. The PPEs that had the highest adherence were gloves and aprons. Area III had the highest percentage of CAT issuance.

DISCUSSION

The CI of work accidents revealed a greater number of new cases among male workers in the three areas, with more than 10 times more cases among women. Regarding age group, there were many more new accidents involving workers under 18 in all areas, compared to the other age groups. In area III, there was a very significant number, approximately 100 times higher than the age group of 18-64 years. A possible explanation for this is that people affected under 18 years of age are interns or students in the health area. Considering that practical activities in places such as hospitals are necessary for the training of health workers, students become exposed to the same risks as more experienced professionals, such as handling sharp objects and contact with blood and body fluids¹⁶. Therefore, the lack of experience and technique is believed to favor injuries among younger workers¹⁷.

As for education, the CI of accident victims was higher in those who studied up to elementary school I, in all areas. Education and work accidents have a negative relationship, whether with biological material or serious accidents, in Brazil¹⁷. Groups with lower education include nursing technicians and assistants, who constitute more than 42% of the total workers in this study. This reveals that professionals with lower levels of education are more susceptible to accidents, and it is possible to correlate work accidents with low levels of education^{7, 18, 19}.

On the prevalence of work accidents with biological material, women stood out in all areas analyzed, especially area II. Therefore, when compared with the data in Table 1, the prevalence is higher among women, but the CI reveals that new cases have increased among men.

Since women are the predominant gender in most health professions, they are expected to be the most affected by accidents. In addition, tiring and long working hours combined with household and family chores can lead to greater exhaustion and, consequently, make them more susceptible to work accidents with biological material^{7, 17, 20}.

The most affected age group is from 18 to 64 years old, representing about 98% of the total accidents, constituting the economically active population. This contrasts with the results in Table 1, which reveal that the highest CI of accidents in 2019 and 2020 has been with workers under 18 years old, therefore this age group is at greater risk of being affected, at the moment.

Regarding the most affected occupations, nursing technicians and assistants coincide with the literature, since nursing professionals belong to the group most exposed to risks, both due to the longer period they spend at work in contact with patients and precarious working conditions, and the large number of procedures performed²¹. In addition, the proportion of nursing technicians and assistants is higher than other professions that work in health services, therefore, high numbers were expected⁹. As for cleaning professionals or those responsible for disinfection, they are also subject to such injuries and represent a significant number of accident victims, which is supported by the literature¹⁸. Another category that draws attention is students, who are often affected precisely because of the lack of experience in activities and the lack of information on preventing accidents at work^{7,19}.

When analyzing the circumstances of the accidents, the three areas are more likely to involve sharp objects, followed by improper disposal. This reveals one of the possible reasons for accidents involving people who work in the cleaning sector of health services and even garbage collectors. These professionals often have a high work pace, without the use of PPE, which can result in injuries²².

The most prevalent type of organic material was blood and the main agent was sharp objects. Thus, the percutaneous route represents the majority of injuries, which is supported by the literature^{7,17}. Thus, corroborating the results regarding the most affected occupations, the nursing team is in fact the most affected, possibly because they perform more procedures that handle sharp objects, such as needles¹⁹.

In order to prevent work accidents involving exposure to biological material, biosafety is recommended by NR 32, in which one of the protective measures is the correct use of PPE¹⁰. However, despite this, high percentages of non-use of PPE were observed in all homogeneous areas. The dynamics of work can influence the use of PPE since professionals use it only when they believe there are risks. However, it is extremely important to use the equipment in all procedures²⁰. Even though the use of PPE does not completely eliminate the risk of accidents, professionals who do not use the equipment are more vulnerable to work accidents²².

The low issuance of CATs in area I is noteworthy, carried out in approximately 36% of cases, a percentage below that found in a study that analyzed Brazilian data, in which the issuance was approximately 51% of total occurrences²³. In addition, there is much data ignored or left blank in the reports evaluated, which impacts the quality of the discussion²⁴. There are several possible reasons for this, such as lack of knowledge about the obligation to issue a CAT, considering the accident as of little importance, fear of losing the job, and criticism of inadequate practices at work²³. Underreporting does not allow for complete knowledge of the epidemiological situation, making it impossible to obtain real data. Consequently, prevention measures targeted at the most affected groups are negatively affected⁶.

The COVID-19 pandemic has made work activities a breeding ground for the spread of the new virus, particularly in the healthcare sector²⁵. According to the National Institute of Social Security, there were 19 cases of work accidents in Brazil during 2018 and 2019, involving ICD U07 (COVID-19) and B34 (Viral diseases, location unspecified). In 2020 and 2021, there was an increase to 12.3 thousand work accidents reported with these ICDs recommended for recording cases of COVID-19 in the country²⁶. The primary database used in this research predominantly employed ICD "Z209" for most notifications, referring to exposure to an unspecified communicable disease. Consequently, it was impossible to distinguish which entries in the database pertained to COVID-19.

A possible practical implication for reducing these injuries is an organizational work culture focused primarily on the training and ongoing education of professionals. In particular, those in the health area regarding the correct disposal of sharp materials, use of PPE in risk events, and encouraging the training of younger professionals with the support of more experienced ones. Furthermore, improving working conditions and reducing workloads to avoid overload and errors that can lead to

accidents, promoting adequate health care for affected workers, and finally, encouraging the reporting of work accidents and the correct completion of forms, with the aim of obtaining more reliable data on work accidents involving exposure to biological material.

CONCLUSION

The groups formed in the three homogeneous areas of RS and the analyses performed indicated the distinction between the prevalence and incidence of work accidents with biological material. In the prevalence analysis, females, aged 18 to 64 years, stood out, with blood as the prevalent organic material. However, CI predominated in men, under 18 years and with up to complete elementary school, which implies a greater risk of involvement in this group. Observing the groups that have been most affected and their location, it is clear that there is a need for ongoing training of professionals, intending to prevent accidents and promote health.

The lack of information is an important limitation of the study due to missing data or inaccuracies in the information in the notification forms, compromising a more accurate characterization of work accidents with biological material. Added to this is the underreporting and low issuance of the CAT. Another limitation of the study is the lack of uniformity regarding the ICDs related to COVID cases in the database, possibly leading to underreporting. Despite the limitations, this study stands out as important in demonstrating the recent panorama of the scenario of work accidents with exposure to biological material.

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REFERENCES

1. OIT. Nearly 3 million people die of work-related accidents and diseases. Montreal, 2023. [Internet]. Organização Internacional do Trabalho. [citado em 2023 jan 5]. Disponível em: <https://www.ilo.org/resource/news/nearly-3-million-people-die-work-related-accidents-and-diseases>
2. Ministério Público do Trabalho. Observatório Digital de Saúde e Segurança no Trabalho – Plataforma SmartLab [Internet]. Brasília, 2023. [citado 2023 jan 6]. Disponível em: <https://smartlabbr.org/>

3. Brasil, Ministério da Saúde. Acidente de trabalho [Internet]. Brasília (DF), 2023. [citado em 2024 out 24]. Disponível em: <https://www.gov.br/saude/pt-br/composicao/svsa/saude-do-trabalhador/vigilancia-em-saude-do-trabalhador-vigisat/doencas-e-agrivos-relacionados-ao-trabalho/acidente-de-trabalho>
4. Brasil, Ministério da Economia. Portaria Nº 4334, de 15 de abril de 2021. [Internet]. Comunicação de Acidente de Trabalho. Brasília (DF), 2021 [citado em 2024 out 24]. Disponível em: <https://www.in.gov.br/en/web/dou/-/portaria-seprt/me-n-4.334-de-15-de-abril-de-2021-314637705>
5. Brito, RS, Ferreira, SM. Acidentes com exposição a material biológico com profissionais do serviço de atendimento móvel de urgência. *Enferm. Foco*. 2023; 14 (1): e-202320. <https://doi.org/10.21675/2357-707X.2023.v14.e-202320>
6. Barbosa ASAA, Diogo G, Salotti SRA, Silva SMUR. Subnotificação de acidente ocupacional com materiais biológicos entre profissionais de Enfermagem em um hospital público. *Rev Bras Med Trab*. 2017;15(1):12-7. DOI: <https://doi.org/10.5327/Z1679443520177034>. Disponível em: <https://pesquisa.bvsalud.org/portal/resource/pt/biblio-833204>
7. Bertelli C, Martins BR, Krug SBF, Petry AR, Fagundes P de S. Occupational accidents involving biological material: demographic and occupational profile of affected workers. *Rev Bras Med Trab*. 2020;18(4):415-24. <https://doi.org/10.47626/1679-4435-2020-534>
8. Spagnuolo RS, Baldo RCS, Guerrini IA. Análise epidemiológica dos acidentes com material biológico registrados no Centro de Referência em Saúde do Trabalhador – Londrina-PR. *Rev Bras Epidemiol*. 2008;11(2):315-23. <https://doi.org/10.1590/S1415-790X2008000200013>
9. Bastos ECB, Costa ANB, Melo TS. Perfil epidemiológico dos acidentes de trabalho notificados em um hospital de ensino do Ceará. *Essentia*. 2019;20(1):41-9. Disponível em: <https://essentia.uvanet.br/index.php/ESSENTIA/article/view/193>
10. Brasil, Ministério do Trabalho e Previdência Social. Portaria GM n.º 1.748, de 30 de agosto de 2011 [Internet]. Norma Regulamentadora 32 (Segurança e saúde no trabalho em serviços de saúde). Brasília, DF, 2011 [citado em 2022 maio 08]. Disponível em: <https://www.gov.br/trabalho-e-emprego/pt-br/aceso-a-informacao/participacao-social/conselhos-e-orgaos-colegiados/comissao-tripartite-partitaria-permanente/arquivos/normas-regulamentadoras/nr-32-atualizada-2022-2.pdf>
11. Brasil, Ministério do Trabalho. Equipamento de Proteção Individual. Norma Regulamentadora Nº 6 [Internet]. Brasília, DF, 2023 [citado em 2023 maio 08]. Disponível em: <https://www.gov.br/trabalho-e-emprego/pt-br/aceso-a-informacao/participacao-social/conselhos-e-orgaos-colegiados/comissao-tripartite-partitaria-permanente/arquivos/normas-regulamentadoras/nr-06-atualizada-2022-1.pdf>
12. Vieira KMR, Vieira Jr FU, Bittencourt ZZLC. Subnotificação de acidentes de trabalho com material biológico de técnicos de enfermagem em hospital universitário. *Rev Baiana Enferm*. 2020;34. <https://doi.org/10.18471/rbe.v34.37056>
13. Vieira KMR, Vieira Jr FU, Bittencourt ZZLC. Acidentes de trabalho com material biológico em um hospital escola. *Rev Bras Enferm*. 2019;72(3):737-43. <https://doi.org/10.1590/0034-7167-2018-0630>

14. Ministério do Trabalho e Previdência. Cadastro Geral de Empregados e Desempregados (CAGED) [Internet]. Brasília (DF), 2021 [Citado 2022 jul 10]. Disponível em: <https://bi.mte.gov.br/bgcaged/login.php>
15. Rouquayrol, MZ; Gurgel, M. Epidemiologia e Saúde. 8 ed [Internet]. Rio de Janeiro: Medbook; 2018. 752 p.
16. Gomes SV, Rodrigues CM de A, Pereira EKA, Handem P de C, Passos, JP. Acidentes de trabalho no campo da prática dos acadêmicos de enfermagem. Rev Pesqui Univ Fed Estado Rio J Online. 2015;7(4):3366-74. DOI: <https://doi.org/10.9789/2175-5361.2015.v7i4.3366-3374> Disponível em: <https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1029878>
17. Gomes SCS, Caldas AJM. Incidência de acidentes de trabalho com exposição a material biológico em profissionais de saúde no Brasil, 2010–2016. Rev Bras Med Trab. 2019;17(2):188-200. DOI: <https://doi.org/10.5327/Z1679443520190391>. Disponível em: <https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1015199>
18. Gomes SCS, Mendonça, IVS; Oliveira, LP, Caldas A de JM. Acidentes de trabalho entre profissionais da limpeza hospitalar em uma capital do Nordeste, Brasil. Ciência & Saúde Coletiva. 2019;24(11):4123-32. <https://doi.org/10.1590/1413-812320182411.26752017>
19. Pereira MS, Rocha, FC; Dias, JLC, Neto GR de A, Piris AP, Andrade DLB. Acidentes de trabalho com exposição a materiais biológicos entre trabalhadores no norte de Minas Gerais. Rev Pesqui Cuidado É Fundamental Online. 2021;13(1):1122-28. <https://doi.org/10.9789/2175-5361.rpcf.v13.9017>
20. Forekevicz G, Rossa R, Schwab A, Birolim MM. Acidentes com material biológico: uma análise com profissionais de enfermagem. Rev Enferm UFSM. 2021;11(1). DOI: <https://doi.org/10.5902/2179769263570>
21. Ozonam MAQ, Dalri R de C de MB, Suazo SV, Santos SVM dos, Galdino MJQ, Robazzi ML do CC. Associação dos acidentes de trabalho com a satisfação ocupacional de profissionais de enfermagem da área hospitalar. Saúde e Pesqui. 2021;14(4):1-12. <https://doi.org/10.17765/2176-9206.2021v14n4e7836>
22. Manguiera LA, Guedes MO, Guntzel CR, Vasconcelos MS, Neves TV. Profile of victims of occupational accidents involving exposure to biological material notified in the city of Palmas, state of Tocantins, Brazil. Rev Bras Med Trab. 2023;21(2):e2022869. <http://doi.org/10.47626/1679-4435-2022-869>
23. Souza HP, Otero UB, Silva VSP. Perfil dos trabalhadores de saúde com registros de acidentes com material biológico no Brasil entre 2011 e 2015: aspectos para vigilância. Rev Bras Med Trab. 2019;17(1):106-18. DOI: <https://doi.org/10.5327/Z1679443520190305>. Disponível em: <https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1000362>
24. Ornelas SC, Afonso G de A, Paula HS de, Freitas GF de, Ornelas SC, Ferraz SS. Perfil epidemiológico dos acidentes por material biológico em médicos da atenção primária em Minas Gerais, de 2012 a 2021. Rev Bras Med Fam Comunidade. 2024;19(46):3725. [https://doi.org/10.5712/rbmfc19\(46\)3725](https://doi.org/10.5712/rbmfc19(46)3725)

25. Maeno M. COVID-19 como uma doença relacionada ao trabalho. Rev Bras Saúde Ocup. 2021;46(1):46-54. <https://doi.org/10.1590/2317-6369ED0000121>
26. Ministério Público do Trabalho. Observatório Digital de Saúde e Segurança no Trabalho – Plataforma SmartLab [Internet]. COVID-19. Brasília, 2023. [citado 2023 nov 8]. Disponível em: <https://smartlabbr.org/sst/localidade/0?dimensao=covid>.