Occupational accidents with biological material and protective measures adopted in COVID-19

Acidentes de trabalho com material biológico e medidas protetivas adotadas na COVID-19

Accidentes laborales con material biológico y medidas de protección adoptadas durante el COVID-19

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Abstract

Objective: To assess the occurrence of occupational accidents with biological material and the protective measures adopted by health professionals during the COVID-19 pandemic in a hospital complex in southern Brazil.

Methods: This is descriptive, analytical, exploratory and quantitative research, developed in a hospital complex in southern Brazil. Participants were health professionals (nursing assistants and technicians, nurses, physiotherapists and physicians) who worked at COVID-19 units. Data were collected from May to August 2021, using a structured instrument for an online interview about the socio-occupational profile, work history and protective measures. Analysis was descriptive, and with chi-square, Fisher's exact and odds ratio tests were used.

Results: Of 104 participants, the average age was 35.8 years, 84.6% female, 57.7% were nurses, 38.5% had COVID-19, 5.8% had occupational accidents with biological material. Regarding protective measures, it should be noted that the use of a face shield or goggles reduced the chances of accidents. Regarding personal protective equipment use in aerosol-generating procedures, participants who used it most of the time, rather than always as recommended, showed an increased risk of occupational accidents with biological material (p=0.015 OR:7.67 [1.16-50.63]).

Conclusion: The research inferred that there was an association between the occurrence of accidents and compliance with protective measures. It reinforces the importance of implementing measures that contribute to health professionals' safety and minimize exposure to risks and health problems.

Resumo

Objetivo: Avaliar a ocorrência de acidentes de trabalho com material biológico e as medidas protetivas adotadas por profissionais de saúde, durante a pandemia por COVID-19, em um complexo hospitalar do sul do Brasil.

Métodos: Pesquisa descritiva, analítica, exploratória e quantitativa, desenvolvida em um Complexo Hospitalar do Sul do Brasil. Os participantes foram profissionais de saúde (auxiliares e técnicos de enfermagem, enfermeiros, fisioterapeutas e médicos), que atuaram em unidades COVID-19. Realizou-se a coleta de dados de maio a agosto de 2021, por meio de um instrumento estruturado para entrevista on-line sobre perfil sócio-ocupacional, histórico laboral e medidas protetivas. A análise ocorreu de forma descritiva e com testes de qui quadrado, exato de Fisher *e odds ratio*.

Resultados: De 104 participantes, a média de idade foi 35,8 anos, 84,6% do sexo feminino, 57,7% eram enfermeiros, 38,5% tiveram COVID-19, 5,8% tiveram acidentes de trabalho com material biológico. Sobre

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as medidas protetivas destaca-se que o uso do protetor facial ou óculos de proteção diminuiu as chances da ocorrência de acidentes. Quanto ao uso de equipamentos de proteção individual em procedimentos geradores de aerossóis, os participantes que fizeram uso na maioria das vezes, ao invés de sempre conforme recomendado, apresentaram risco aumentado para acidente de trabalho com material biológico (p=0,015 OR:7,67 [1,16-50,63]).

Conclusão: A pesquisa inferiu que houve associação entre a ocorrência dos acidentes e adesão às medidas protetivas. Reforça-se a importância da implementação de medidas que contribuam para a segurança dos profissionais de saúde e minimizem a exposição a riscos e agravos à saúde.

Resumen

Objetivo: Evaluar los casos de accidentes laborales con material biológico y las medidas de protección adoptadas por profesionales de la salud durante la pandemia por COVID-19, en un complejo hospitalario del sur de Brasil.

Métodos: Investigación descriptiva, analítica, exploratoria y cuantitativa, llevada a cabo en un complejo hospitalario del sur de Brasil. Los participantes fueron profesionales de la salud (auxiliares y técnicos de enfermería, enfermeros, fisioterapeutas y médicos) que trabajaron en unidades de COVID-19. Se realizó la recopilación de datos de mayo a agosto de 2021, por medio de un instrumento estructurado de una encuesta en línea sobre el perfil sociolaboral, historial laboral y medidas de protección. El análisis se llevó a cabo de forma descriptiva y con prueba χ^2 de Pearson, prueba exacta de Fisher y *odds ratio*.

Resultados: De 104 participantes, el promedio de edad fue 35,8 años, el 84,6 % de sexo femenino, el 57,7 % era enfermero, el 38,5 % tuvo COVID-19, el 5,8 % tuvo accidentes laborales con material biológico. Sobre las medidas de protección, se destaca que el uso del protector facial o anteojos de protección redujo las probabilidades de episodios de accidentes. Respecto al uso de equipos de protección individual en procedimientos generadores de aerosoles, los participantes que los utilizaron la mayoría de las veces, en lugar de siempre como recomendado, presentaron riesgo aumentado de accidente laboral con material biológico (p=0,015 OR:7,67 [1,16-50,63]).

Conclusión: La investigación infirió que hubo relación entre los casos de accidentes y la adherencia a medidas de protección. Se refuerza la importancia de implementar medidas que contribuyan a la seguridad de los profesionales de la salud y minimicen la exposición al riesgo de agravios de la salud.

Introduction

The Coronavirus Disease 2019 (COVID-19), responsible for the Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2), broke out in China in December 2019 and spread to several countries.[1] In Brazil, COVID-19 reached, by September 2022, 34,654,190 cases and 685,927 deaths.[2] This high number of infected people impacted health services and affected around 3.5 million frontline workers to the pandemic.[3]

Given this scenario, health professionals were exposed to SARS-CoV-2 and the risk of acquiring infectious diseases resulting from occupational accidents with biological material (OABM);[4] events that can occur in professional practice with exposure to biological fluids.[5,6]

In the state of Paraná, until September 2022, more than 36 thousand cases of COVID-19 were reported among health workers and 1,232 deaths. Among them are nursing professionals, with 8,401 confirmed cases and 268 deaths.[2]

Thus, protective measures aimed at protecting health and safety[7] contribute to reducing COVID-19 and OABM in this working class.[8] Among the protective measures are personal protective equipment (PPE) such as gloves, goggles, masks, face shield, apron and biosafety procedures, such as hand hygiene, which must be used by health professionals.[9,10]

It is worth emphasizing the importance of PPE availability associated with adequate working conditions and compliance with protective measures to reduce potential health risks for health professionals.[11]

Thus, the research aimed to assess the occurrence of OABM and the protective measures adopted by health professionals, during the COVID-19 pandemic, in a hospital complex in southern Brazil.

Methods

This is descriptive, analytical, exploratory research with a quantitative approach, developed in a university hospital complex (UHC) in southern Brazil between May and August 2021. Participants were 104 health professionals, including nursing assistants and technicians, nurses, physiotherapists and physicians, over 18 years old and who worked in the fight against COVID-19. Health professionals absent from the institution during the period of data collection, due to medical, maternity or vacation leaves were excluded. Participants selection took place using the "snowball" non-intentional and non-probabilistic sampling technique, due to

the critical scenario of the pandemic. The invitation to participate was made to health professionals through hospital communication or e-mail, and those interested filled out the Informed Consent Form (ICF), available via Google Forms.

Subsequently, data were collected through individual online interviews, with time and technological resources defined with participants. In this step, a questionnaire prepared by the researchers was used, adapted from the World Health Organization instrument called: "Health workers exposure risk assessment and management in the context of COVID-19 disease". The questionnaire consists of 41 closed-ended questions, with multiple-choice and Likert-type response options (always, as recommended, most of the time, occasionally, rarely or never). The investigated variables were socio-occupational profile, work history, professional exposure, illness due to COVID-19, OABM and protective measures used. Participants with OABM were compared with those who did not, and the occurrence of OABM was associated with compliance with protective measures. After data collection, the information was analyzed in the R environment.[12] For statistical analysis, simple and absolute frequencies were used to characterize the sample, and chi-square or Fisher's exact tests, for associations. The intensity of associations was calculated using the Odds Ratio (OR), with a 95% confidence interval ($p<0.05$).

This research was approved by the UHC Research Ethics Committee, under Opinion 4,685,713 and CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 37962720.5.0000.0096.

Results

Participants were 104 health professionals, with a mean age of 35.8 years; 84.6% (n=88) were female; 58.7% (n=61) were white; 77.9% (n=81) completed higher education; 57.7% (n=60) were nurses; 75% (n=78) used their own transport to travel to work; and 83.7% (n=87) had no comorbidities, however 38.5% had COVID-19. Regarding the association between the socio-occupational profile and OABM, the results show that 5.8% (n=6) of professionals had accidents, 6.8% (n=6) being female and 9.1% (n=4) between 30 and 39 years. When analyzing the means of transport for commuting to work, professionals who used their own transport and 94.9% (n=74) had a lower risk for OABM (OR: 0.14 [0.02-0.93]) (p =0.02). Among professionals with comorbidities, 17.6% (n=3) mentioned OABM (p=0.022). Regarding occupation, compared to nurses, nursing technicians had a lower risk for OABM (OR:0.35 [0.04-3.18]) (Table 1).

Table 1. Socio-occupational profile related to OABM

Socio-occupational profile	Accident n = 6 n(%)	Without accident n = 98 n(%)	p-value	OR [95%CI]
Age				
18 to 29	1(4.5)	21(95.5)	-	Ref.
30 to 39	4(9.1)	40(90.9)	0.511	2.1 [0.22-20.01]
40 to 49	1(3.3)	29(96.7)	0.822	0.72 [0.04-12.25]
50 to 59	0(0)	8(100)	0.54	-
Sex				
Male	0(0)	16(100	-	Ref.
Female	6(6.8)	82(93.2)	0.282	-
Means of transport				
Uber	2(28.6)	5(71.4)	-	Ref.
Public	0(0)	9(100)	0.086	-
On foot	0(0)	10(100)	0.072	-
Own transport	4(5.51)	74(94.9)	0.02	0.14 [0.02-0.93]
Comorbidities				
No	3(3.4)	84(96.6)	-	Ref.
Yes	3(17.6)	14(82.4)	0.022	6 [1.1-32.76]
Profession/occupation				
Nurse	5(8.3)	55(91.7)	-	Ref.
Nursing technician or assistant	1(3.1)	31(96.9)	0.335	0.35 [0.04-3.18]
Physiotherapist	0(0)	3(100)	0.6	-
Physician	0(0)	9(100)	0.369	-

With regard to the operating sector, the ICU resulted in a greater number of OABM, 10.3% (n=4), however there was no significant difference with the other sectors (Table 2).

Table 2. Occupational history related to OABM

Occupational history	Accident n = 6 n(%)	Without accident n = 98 n(%)	p-value	OR [95%CI]
Business sector				
Outpatient clinic	0 (0)	2 (100)	-	Ref.
Emergency	0 (0)	6 (100)	-	-
Medical unit	0 (0)	21 (100)	-	-
Intensive Care Unit	4 (10.3)	35 (89.7)	0.633	-
Others*	2 (5.6)	34 (94.4)	0.732	-
More than one work activity				
No	5 (6.6)	71 (93.4)	-	Ref.
Yes	1 (3.6)	27 (96.4)	0.56	0.53 [0.06-4.71]

*Other sectors such as surgical, nephrology, pediatrics, psychiatry and chemotherapy centers

When comparing the risk of exposure of professionals related to OABM, on the safety variable in the work environment in relation to COVID-19, 96% (n=48) mentioned being safe and had no accidents (p=0.045). However, when performing aerosol-generating procedures, 6.7% (n=6) reported accidents. As for OABM during the pandemic, there was a statistical difference (p<0.001) for the accident type variable, corresponding to splash of biological liquid or secretions and sharps. As well as for CAT issuance, in cases where there was registration, 100% (n=3) (p<0.001) and in those that did not occur, 100% (n=3) (p<0.001) (Table 3).

Table 3. Professionals' exposure related to OABM

Professionals' exposure	Accident n = 6 n(%)	Without accident n = 98 n(%)	p-value	OR [95%CI]
Workplace safety in relation to COVID-19				
Exposed	2(22.2)	7(77.8)	-	Ref.
Insecure	1(6.7)	14(93.3)	0.265	0.25 [0.02-3.25]
Partially	0(0)	8(100)	0.156	-
Safe	2(4)	48(96)	0.045	0.15 [0.02-1.21]
Safe with PPE	0(0)	10(100)	0.115	-
Very protected	1(8.3)	11(91.7)	0.368	0.32 [0.02-4.2]
Aerosol generating procedures				
No	0(0)	14(100)	-	Ref.
Yes	6(6.7)	84(93.3)	0.319	-
Type of accident				
No	0(0)	98(100)	-	Ref.
Biological liquid/secretions	1(100)	0(0)	<0.001	-
Sharp	5(100)	0(0)	<0.001	-
Occupational Accident Report (CAT) issue:				
Not applicable	0(0)	98(100)	-	Ref.
Yes	3(100)	0(0)	<0.001	-
No	3(100)	0(0)	<0.001	-

Among the professionals who recalled the actions taken by the health facility during the OABM-related COVID-19 pandemic, such as providing written information, 96.7% (n=89) had a lower risk of accidents (p=0.002) (OR: 0.1 [0.02.058]). Among participants who mentioned distancing from patients, 98.6% (n=68) had a lower risk of accidents (p=0.008) (OR:0.09 [0.01-0.79]). Likewise, for professionals who mentioned distancing from employees, the risk of OABM was lower (p=0.05) (OR:0.2 [0.02-1.15]). In 96.8% (n=90) of participants who reported carrying out respiratory etiquette, there was no OABM (p=0.001) (OR:0.09 [0.02-0.51]) (Table 4).

Table 4. Actions taken during the pandemic

Actions taken	Accident n = 6 n(%)	Without accident n = 98 n(%)	p-value	OR [95%CI]
Written information				
No	3(25)	9(75)	-	Ref.
Yes	3(3.3)	89(96.7)	0.002	0.1 [0.02-0.58]
Patient distancing				
No	5(14.3)	30(85.7)	-	Ref.
Yes	1(1.4)	68(98.6)	0.008	0.09 [0.01-0.79]
Employee distancing				
No	4(12.5)	28(87.5)	-	Ref.
Yes	2(2.8)	70(97.2)	0.05	0.2 [0.02-1.15]
Respiratory etiquette				
No	3(27.3)	8(72.7)	-	Ref.
Yes	3(3.2)	90(96.8)	0.001	0.09 [0.02-0.51]

In compliance with protective measures and OABM, it was found that when always used, face shield or goggles decreased the chances of OABM. In this case, there was a statistical difference when compared with those who had an accident and used it most of the time, 14.8% (n=4) (p<0.001), occasionally, 14.3% (n=1) (p<0.001) and rarely, 25% (n=1) (p<0.001). Regarding the variable decontamination of high-touch surfaces, participants who performed the action rarely, compared to always, as recommended, the risk of OABM was higher (p=0.002) (OR: 35.1 [1-410.71]). Regarding PPE use in aerosol-generating procedures, participants who used it most of the time, 25% (n=2), had a higher risk of OABM (p=0.015) (OR:7.67 [1.16-50.63] than those who always use it as recommended (Table 5).

Table 5. Protective measures related to OABM

Protective measures	Accident n = 6 n(%)	Without accident n = 98 n(%)	p-value	OR [95%CI]
Face shield or goggles				
Always as recommended	0(0)	66(100)	-	Ref.
Mostly	4(14.8)	23(85.2)	<0.001	-
Occasionally	1(14.3)	6(85.7)	<0.001	-
Rarely	1(25)	3(75)	<0.001	-
Decontamination of surfaces				
Always as recommended	2(3.1)	63(96.9)	-	Ref.
Mostly	2(11.1)	16(88.9)	0.16	3.94 [0.51-30.14]
Occasionally	1(5.3)	18(94.7)	0.651	1.75 [0.15-20.42]
Rarely	1(50)	1(50)	0.002	35.1 [1.41-705.41]
PPE in aerosol generation procedures				
Always as recommended	4(4.2)	92(95.8)	-	Ref.
Mostly	2(25)	6(75)	0.015	7.67 [1.16-50.63]

Discussion

The results of this research showed an association between the occurrence of OABM and compliance with protective measures. Of the 104 participants, 84.6% were female. A Brazilian study, carried out with health professionals during the pandemic, showed a predominance of females, with 84.7%.[13] These data reinforce the role of women in coping with COVID-19.

Participants' mean age was 35.8 years and corroborates a cross-sectional study carried out in 2020, in northeastern Brazil, with 1,354 health professionals working in COVID-19, whose mean age was 34.2 years.[13] These findings highlight that the workforce of professionals working in the pandemic was composed of young people, even considering that older adults were reassigned to administrative activities.

Health professionals with chronic diseases were removed from occupational activities. In this research, 83.7% had no previous disease. Corroborating this result, a systematic review found that among 119,883 health professionals, there was a prevalence of 51.7% with COVID-19 and 18.4% had comorbidities.[14]

It was evident in the findings that 77.9% of participants had completed higher education and 57.7% were nurses. According to the literature,[15] nursing professionals account for more than 50% of health professionals in Brazil.

The results indicated that 75% of participants used their own transport to go to work and this is indicated in the literature[16] as a biosafety practice adopted by the population during the pandemic.

In this survey, 38.5% of health professionals had COVID-19. It should be noted that the risk of contamination was high due to the care given to infected patients, i.e., COVID-19 is a work-related disease, due to its ability to spread in the occupational environment.[17] Among the health professionals with the highest record of COVID-19 are nurses[18] and factors such as precarious working conditions, double employment, low wages, work overload, lack of inputs and human resources, influenced the contamination of the professional category.

The above information is confirmed by the literature,[19] which emphasizes that the precariousness of working conditions in nursing already existed before COVID-19, but they were aggravated in the pandemic, which contributed to the illness of these professionals. Thus, it is stated that the work environment has occupational risks that can compromise professionals' safety and health.[20]

In view of this, the need to intensify protective measures in health services is highlighted, seeking to prevent OABM,[20] such as the correct use and proper management of PPE due to the risk of contamination in donning and undressing.[20,21]

In this research, 5.8% of participants had OABM, which suggests flaws in using protective measures, and may have resulted in accidents and risk of contamination by infectious diseases. In the literature, OABM was also identified among health professionals on the front line of COVID-19 and it is suggested that the lack of adequate PPE use corroborated this situation.[22,23] Thus, the importance of protective measures for health professionals is highlighted.

In the association of socio-occupational profile and OABM, it was identified that nursing technicians had a lower risk for OABM compared to nurses. Opposing this finding, studies found that mid-level professionals were the second occupational class with the highest OABM records.[24-26]

In the correlation of occupational history with OABM, in the sector of activity, the ICU was the area with the highest number of OABM. International study exposes that the ICU for treating critical patients has a high risk of accidents and contamination by infectious diseases.[27] Complementarily, the ICUs have urgent demands and work overload, which increases the risk of accidents and justifies the research results

Regarding the risk of exposure of professionals related to OABM, 96% mentioned being safe in the work environment and had no accident. However, 6.7% reported OABM during aerosol-generating procedures. In this situation, the spread of aerosols is present between care procedures and poses a risk for adverse events.[28]

Other relevant data were about OABM with splash of biological liquid, sharps and CAT. A study carried out with 80 nurses, 3.8% had OABM and high risk for COVID-19 infection.[23] It should be mentioned that OABM are compulsory notification events and the correct completion must be done by the health services as well as the CAT.[26] In this research, the issue of CAT occurred in only half of the accidents, however, immediate information about the accident is essential for the development of preventive strategies.

In Brazil, a time trend analysis of percutaneous accidents among health professionals carried out in 2022 revealed that between 2007 and 2019, there were records of 761 OABM percutaneously, 50.3% of which were caused by materials without a safety device.[29]

According to the literature, the most common OABM involve sharps, even devices with a safety system.[29,30] These episodes are linked to ignorance of the risks, inattention, failure to activate security or incorrect handling of devices and even self-confidence from the experience.[29,30] Thus, it is necessary to invest in measures that encourage and provide safety to health professionals.

Associations of biosafety actions promoted by the service during the pandemic were also carried out, such as providing written information, distancing patients and employees, respiratory etiquette, with OABM, these contributing variables with a lower risk of accidents.

Corroborating these findings, a systematic review showed that hand hygiene in association with distance and respiratory etiquette decreases exposure to adverse events,[31] which demonstrates that the implementation of these measures are effective in preventing OABM.

In the association between compliance with protective measures and OABM, a face shield was a protective factor and reduced accidents. In this perspective, the data are in line with the literature[32] that describe that using PPE such as masks, apron, gloves and face shield, during care, minimize the risk of contamination by pathogens.

It is noteworthy that the incorporation of protective measures in health services required a change in professionals' behavior,[33] such as compliance with recommendations, change of culture, which enables care to be exercised with less risk of contamination.

As for the decontamination of surfaces, it was found that the participants who performed the action rarely, instead of always, as recommended, were susceptible to OABM. In agreement with this data, authors[34] emphasized that the decontamination of places close to the patient contributes to less exposure to pathogens.

In PPE use, while carrying out aerosol-generating procedures, those who used it most of the time had a greater chance of risk for OABM. Thus, it is stated that the probability of exposure to infectious diseases is greater when there is failure to adhere to protective measures.

Finally, OABM prevention is relevant through the implementation and compliance with protective measures and permanent health education practice with a view to this issue.[35] These initiatives contribute to health promotion and safe care.

As research limitations, the sampling technique and sample size are pointed out, which is justified by the critical scenario of the pandemic, in data collection, and the exhaustion of professionals, a factor that hinders participation. However, the results highlight the notoriety of protective measures for health professionals' safety in their occupational activities.

Conclusion

It is concluded that there was an association between the occurrence of OABM and compliance with protective measures. It was found that using protective measures, such as PPE, was one of the protective factors to prevent the occurrence of OABM. Furthermore, the implementation of these measures during aerosol-generating procedures contributed to the safety of professionals in coping with the COVID-19 pandemic. In addition, they minimize the risks of exposure and harm to the health of these workers. The importance of this research for health professionals is highlighted and it is expect-

ed that the results found will encourage compliance with protective measures in health services as well as the performance of other researches focused on workers' health.

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Collaborations

Aguiar BF, Silva RM, Camponogara S, Sarquis LMM and Miranda FMD'A contributed to the project design, data analysis and interpretation, article writing, relevant critical review of the intellectual content and final approval of the version to be published.

References

1. Gao Z, Xu Y, Sun C, Wang X, Guo Y, Qiu S, et al. A systematic review of asymptomatic infections with COVID-19. J Microb Imm Infect. 2021;54(1):12-6.
2. Paraná. Secretaria de Estado da Saúde do Paraná. Informe Epidemiológico. Curitiba: SESA-PR, 2022 [citado 2022 Set 22]. Disponível em: https://www.saude.pr.gov.br/Pagina/Coronavirus-COVID-19
3. Conselho Federal de Enfermagem (COFEN). Profissionais de saúde em tempos de COVID-19. Brasília (DF): COFEN; 2020 [citado 2022 Set 22]. Disponível em: http://www.cofen.gov.br/artigo-profissionais-de-saude-em-tempos-de-COVID-19_78151.html
4. Gallasch CH, Cunha ML, Pereira LA, Silva-Junior JS. Prevention related to the occupational exposure of health professionals workers in the COVID-19 scenario. Rev Enfermagem UERJ. 2020;28:49596.
5. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Protocolo de Exposição a materiais biológicos. Brasília (DF): Ministério da Saúde; 2006 [citado 2022 Set 22]. Disponível em: https://bvsms.saude.gov.br/bvs/publicacoes/protocolo_expos_mat_biologicos.pdf
6. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Vigilância em saúde: ações inovadoras e resultados: gestão 2011-2014. Brasília (DF): Ministério da Saúde; 2015 [citado 2022 Set 22]. Disponível em: https://bvsms.saude.gov.br/bvs/publicacoes/vigilancia_saude_acoes_inovadoras_resultados_gestao_2011_2014.pdf
7. Brasil. Agência Nacional de Vigilância Sanitária. Nota Técnica GVIMS/GGTES/ANVISA Nº 07/2020. Orientações para a prevenção da transmissão de COVID-19 dentro dos serviços de saúde. Brasília (DF): Ministério da Saúde; 2020 [citado 2022 Set 22]. Disponível em: https://www.gov.br/anvisa/pt-br/centraisdeconteudo/publicacoes/servicosdesaude/notas-tecnicas/nota-tecnica-gvims-ggtes-anvisa-no-07-2020#:~:text=Recomenda%C3%A7%C3%B5es%20de%20prote%C3%A7%C3%A3o%20aos%20trabalhadores,19%20e%20outras%20s%C3%ADndromes%20gripais
8. Teixeira CF, Soares CM, Souza EA, Lisboa ES, Pinto IC, Andrade LR, et al. The health of healthcare professionals coping with the COVID-19 pandemic. Cien Saude Colet. 2020;25:3465-74.
9. Brasil. Agência Nacional de Vigilância Sanitária (ANVISA). Nota técnica GVIMS/GGTES/ANVISA Nº 04/2020. Orientações para serviços de saúde: medidas de prevenção e controle que devem ser adotadas durante a assistência aos casos suspeitos ou confirmados de infecção pelo novo cononavírus (SARS-CoV-2). Brasília (DF): ANVISA; 2020 [citado 2022 Set 22]. Disponível em: http://portal.anvisa.gov.br/documents/33852/271858/Nota+T%C3%A9cnica+n+04-2020+GVIMS-GGTES-ANVISA/ab598660-3de4-4f14-8e6f-b9341c196b28
10. Nery VD, Linares MD, Martins B, Reis MB, Campos MM, Taminato M, et al. Professional nursing practice environment from students' perspective in COVID-19. Acta Paul Enferm. 2022;35:eAPE00122.
11. Pretti H, Rocha DP, Dourado FN. Biossegurança: os riscos, medidas e prevenção para os profissionais de enfermagem. Res Society Development. 2022;11(3):e27211326503.
12. R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna: R Core Tea; 2021 [cited 2022 Sep 22]. Available from: https://www.R-project.org/
13. Coelho MM, Cavalcante VM, Cabral RL, Oliveira RM, Nogueira PS, Silva FA, et al. Work context and clinical manifestations of COVID-19 in health professionals. Acta Paul Enferm. 2022;35:eAPE0163345.
14. Gholami M, Fawad I, Shadan S, Rowaiee R, Ghanem H, Khamis AH, et al. COVID-19 and healthcare workers: A systematic review and meta-analysis. Int J Infect Dis. 2021;104:335-46.
15. Silva MC, Machado MH. Health and Work System: challenges for the Nursing in Brazil. Cien Saude Colet. 2019;25:7-13.
16. Lima IE, Melo GC, Santos GM. Evaluation of the biosafety practices adopted by the population of Maceió-AL during the COVID-19 pandemic. Res Society Development. 2022;11(9):e51211932288.
17. Moreira MD, Meirelles LC, Cunha LA. COVID-19 in the working environment and its consequences on the health of workers. Saúde Debate. 2022;45:107-22.
18. Ribeiro AA, Oliveira MV, Furtado BM, Freitas GF. Impacts of the COVID-19 pandemic on Brazilian nurses' lives, health and work. Acta Paul Enferm. 2022;35:eAPE01046.
19. Silva RP, Valente GS, Camacho AC. Risk management in the scope of nursing professionals in the hospital setting. Rev Bras Enferm. 2020;73(6):e20190303.
20. Passos EA, Marziale MH. Conhecimento e atitudes de profissionais de enfermagem de um hospital paulista frente às precauções padrão. Cogitare Enfermagem. 2020;25:e66744.
21. Costa FA. Os desafios dos profissionais de enfermagem Diante da pandemia COVID-19: O contexto dos EPI's. Rev Ibero-Am Human Ciên Edu. 2022;8:263-71.
22. Albaqawi HM, Pasay-An E, Mostoles R, Villareal S. Risk assessment and management among frontline nurses in the context of the COVID-19 virus in the northern region of the Kingdom of Saudi Arabia. Appl Nurs Res. 2021;58:151410.

23. Galeno JA, Freire FD, Carvalho GT, Silva MC, Mouta AA, Beltrão RP, et al. Indispensabilidade do Uso de Equipamentos de Proteção Individual. Ensaios Ciências. 2021;25(5 esp):541-5.

24. Miranda FM, Cruz ED, Félix JC, Kalinke LP, Mantovani MD, Sarquis LM. Profile of Brazilian workers victims of occupational accidents with biological fluids. Rev Bras Enferm. 2017;70(5):1061-8.

25. de Souza HP, Otero UB, da Silva VD. Profile of healthcare workers involved in accidents with exposure to biological materials in Brazil from 2011 through 2015: surveillance aspects. Rev Bras Med Trab. 2020;17(1):106-18.

26. Soares RZ, Schoen AS, Benelli KD, Araújo MS, Neves M. Análise dos acidentes de trabalho com exposição a material biológico notificados por profissionais da saúde. Rev Bras Med.Trab. 2019;17(2):201-8.

27. Grota PG, Grant PS. Environmental infection prevention: priorities of patient safety collaboration. Crit Care Nurs Q. 2018;41(1):38-46.

28. Assunção AA, Simões MR, Maia EG, Alcantara MA, Jardim R. COVID-19: a study of personal protection protocols for health workers. Bras. Saúde Ocup. 2021;46:e32.

29. Pereira RS, Santos CA, Pimenta AM. Tendência temporal dos acidentes por exposição percutânea em um hospital público no Brasil, 2007-2019. Rev Bras Enferm. 2022;75(6):e20220046.

30. Santos LT, Rocha FL, Marziale MH. Agulhas com dispositivos de segurança e a prevenção de acidentes: revisão integrativa. Rev Bras Enferm. 2018;71:3084-92.

31. Taminato M, Mizusaki-Imoto A, Saconato H, Franco ES, Puga ME, Duarte ML, et al. Homemade cloth face masks as a barrier against respiratory droplets-systematic review. Acta Paul Enferm. 2020;3:eAPE20200103. Review.

32. Duan X, Sun H, He Y, Yang J, Li X, Taparia K, et al. Personal Protective equipment in COVID-19: impacts on health performance, work-related injuries, and measures for prevention. J Occup Environ Med. 2021;63(3):221-5.

33. Sousa FJ, Cronemberger IH. CIPA e COVID 19 – Prevenção e segurança do trabalho. RECIMA. 2021;e2111015.

34. Khalil MM, Alam MM, Arefin MK, Chowdhury MR, Huq MR, Chowdhury JA, et al. Role of personal protective measures in prevention of COVID-19 spread among physicians in Bangladesh: a multicenter cross-sectional comparative study. SN Compr Clin Med. 2020;2(10):1733-9.

35. Assis DC, Resende DV, Araújo GF. Acidentes de trabalho com material biológico entre trabalhadores de enfermagem de um hospital universitário. Res Society Development. 2022;11(8):e8611830524.