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Nursing students' knowledge about biosafety in the hospital context during the pandemic: a qualitative approach

Conhecimento dos estudantes de enfermagem sobre biossegurança no contexto hospitalar na pandemia: abordagem qualitativa

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ABSTRACT

Objective: To describe Nursing students' knowledge about the biosafety measures in the hospital context in pandemic times. **Method:** A descriptive, exploratory and qualitative study conducted through interviews in a virtual environment between July and September 2021 with Nursing students from a public university in the coastal lowland of Rio de Janeiro, Brazil. *Interface de R pour Analyses Multidimensionnelles de Textes Et de Questionnaires* was used to process the text *corpus* and Thematic Content Analysis was employed to interpret the testimonies. **Results:** The participants were 29 students that recognize biosafety but are not confident enough to address it. For them, it is but a set of standards for the protection of workers and patients alike, associating it with PPE and with its use during the pandemic. **Conclusion:** Biosafety is not recognized in its entirety by the Nursing students who will enter the labor market in the near future. An expanded and cross-sectional perspective is required, especially in the academic disciplines of Nursing training cycle.
Descriptors: Students, Nursing; Containment of Biohazards; COVID-19.

RESUMO

Objetivo: Descrever o conhecimento dos estudantes de enfermagem sobre as medidas de biossegurança no contexto hospitalar em tempos de pandemia. **Método:** Estudo descritivo, exploratório, qualitativo, com estudantes de enfermagem de uma universidade pública da baixada litorânea do Rio de Janeiro, Brasil, através de entrevista em ambiente virtual, entre julho e setembro de 2021. Utilizou-se o *Interface de R pour Analyses Multidimensionnelles de Textes Et de Questionnaires* para processamento do corpus textual e Análise de Conteúdo Temática para interpretação das falas. **Resultados:** Participaram 29 estudantes que reconhecem a biossegurança, mas não possuem segurança ao abordá-la. Para eles, trata-se de normas para proteção do trabalhador e pacientes, associando-as aos EPIs e ao uso durante a pandemia. **Conclusão:** A biossegurança não é reconhecida na sua totalidade entre estudantes de enfermagem que estarão no mercado de trabalho futuramente. É necessário um olhar ampliado em perspectiva transversal, especialmente nas disciplinas do ciclo profissionalizante da enfermagem.
Descritores: Estudantes de Enfermagem; Contenção de Riscos Biológicos; COVID-19.

INTRODUCTION

Biosafety in the hospital context has been the focus of attention in studies prior to the pandemic; however, it gained prominence with the emergence, in December 2019, of the first cases of the infection by the new coronavirus, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), causative agent of the Coronavirus Disease (COVID-19), which further highlighted the importance of adherence to the biosafety measures, in addition to promoting the discussion on professional safety in health care, especially with regard to Nursing professionals, who totaled 63,414 cases of infections and 872 deaths due COVID-19 until May 18th, 2022[1,2].

Biosafety is defined by the National Health Surveillance Agency (*Agência Nacional de Vigilância Sanitária*, ANVISA) as a set of measures that prevent or control risk agents with potential harms to human health, animals and the environment. Among these, containment of biological risks is the focus of this research, as it addresses minimization of the exposure to risk agents

in the hospital context[3,4].

In the health area, the word "containment" refers specifically to the safety actions implemented while handling materials that are infected or may represent a biological risk. Among the main actions in a the hospital context are hand hygiene, use of personal protective equipment (PPE), minimization of exposure to biological risk, management of waste from health services and compliance with the provisions of Regulatory Standard No. 32 (*Norma Regulamentadora nº 32*, NR-32), which establishes basic guidelines for the implementation of measures to protect the safety and health of health service workers[3-5].

Hospitals are institutions in which, given the nature of the work performed, it is not possible to extinguish the biological risk, associating this aspect with the high infectivity of the new coronavirus and the increase in demand for hospital beds, accentuating work overload and, consequently, exposure to biological risk. In addition to that, even before the pandemic, the nurses' practice was already exposing them to risks due to direct contact with patients, to a large number of procedures and interventions in which sharp instruments are used, and to contact with body fluids during care[4,6,7].

Likewise, Nursing students are exposed to biological risks, as they are inserted in contexts and conditions close to the professional practice in their theoretical-practical learning, with the possibility of suffering accidents that differ little in relation to the causes of accidents among professionals. In addition, lack of safety increases exposure, especially in the handling of sharps and contact with body fluids. However, the students that are introduced to the biosafety measures in teaching laboratories show self-care improvements, becoming less vulnerable to biological risk accidents[8,9].

This research is justified by the scarcity of studies in the literature revealed through a previous integrative review carried out in different informational resources, which identified three studies on the theme with Nursing students, focusing on knowledge about NR-32, post-exposure behaviors to accidents with biological material and knowledge about risky practices. Considering the pandemic scenario, in which many Nursing students will be graduating and starting their professional practice, the following guiding question was formulated: "What do Nursing students know about biosafety in the hospital context during the pandemic period?"[8,10,11].

This study aims at describing Nursing students' knowledge about the biosecurity measures in the hospital context in pandemic times.

METHOD

A descriptive and exploratory study with a qualitative approach, developed with Nursing students from a Federal Public University in the coastal lowlands of the state of Rio de Janeiro, which followed the topics recommended in the Consolidated Criteria for Reporting Qualitative Research. The following inclusion criteria were used: being regularly enrolled in the undergraduate Nursing course and having attended the Semiology and Semiotechnics in Nursing I academic discipline, whose syllabus presents the topic of biosafety in the hospital context. The exclusion criteria were as follows: being a student under 18 years of age and not having access to any device that allows voice participation at the time of the interview[12].

The students were invited to the study by the research participants (professor and student) through a link shared on WhatsApp in several groups and on some students' private numbers. This link contained the Free and Informed Consent Form (FICF) available for download and, after accepting to participate and by checking the "I have read and agree" option, the participants were directed to a pre-scheduling form. After filling it out, they were contacted within 24 hours, booking date and time for the interviews. The sample was comprised by those who wished to participate respecting the inclusion criteria, following convenience sampling.

Data collection took place between July and September 2021 by means of individual interviews conducted online via the Google Meet platform. They lasted a mean of 15 minutes and were recorded in real-time. The interviews were in charge of a Nursing student that had no close relationships with the interviewees. It is noted that the student was trained by a researcher specialized in the interview and qualitative analysis technique, ensuring exemption of judgments or biases in the participants' answers.

The interviews were initiated by reading the FICF and, subsequently, the filter questions were asked ensuring adequacy to the study eligibility criteria. In case the participants did not meet any of the criteria, the interview was ended explaining the reason for their exclusion. Three exclusions were due to not having attended the Semiology and Semiotechnics in Nursing I academic discipline and to withdrawal before the interview.

A semi-structured script was used to characterize the sociodemographic and student profile with questions on the following topics: age; gender; marital status; whether the participant works or studies; if yes to the previous question: what is their occupation/profession; moved to the city after going to college; who do they live with when they attend face-to-face classes at college; ongoing period; year in which they studied the Semiology and Semiotechnics in Nursing I academic discipline; and having training in the health area prior to graduation, if so, whether they are working on the front line in the fight against COVID-19. In addition to the questions that would allow understanding the students' knowledge about the topic, the following was asked: What do you understand by biosafety? How does biosafety relate to Nursing in the hospital environment? Which biosafety measures do you consider adequate?

The participants' testimonies were constantly reviewed, identifying content recurrence and ensuring theoretical data saturation. Data collection was interrupted when there was repetition of answers without adding new relevant information that would change the meaning of the students' knowledge about biosafety in the hospital context in pandemic times[13].

Data referring to the participants' characterization were analyzed via basic statistics using the Statistical Package for the Social Sciences for Windows (IBM®SPSS), version 20.0, with central tendency (mean, minimum and maximum) and dispersion (standard deviation) measures). The Interface de R pour Analyses Multidimensionnelles de Textes Et de Questionnaires (IRAMUTEQ) software was used to process the text *corpus* arising from the students' testimonies[14].

In order to assemble the text *corpus*, the interviews' content was transcribed, removing language vices and onomatopoeias. In the analysis keys, the program's standard was maintained, except for the active form of nouns, supplementary nouns, adjectives and verbs; supplementary form of adverbs and supplementary verbs; and exclusion of conjunctions from the analyses. In the entire data processing by IRAMUTEQ, lemmatization was used to reduce the words to their base form by grouping different forms of the same word[14].

The data processing methods in IRAMUTEQ were the following: Similarity Analysis to identify the connection between the words of the text *corpus*, through co-occurrence of words and Descending Hierarchical Classification (CHD), grouping the words and text segments in order to correlate them, obtaining a hierarchical scheme of similar word classes. In DHC, the chi-square test (χ^2) is performed to reveal the associative strength between the words and their respective classes, a χ^2 value equal to or greater than 3.84 and $p<0.05$ denotes association of the word in the class, with emphasis for words with $p<0.0001$, which represents a very strong association, showing that this word could not be in a different class given the relevance it has in the class in question[14].

After data processing, the image generated by the similarity analysis and the classes generated by DHC were analyzed following the Thematic Analysis assumptions in the search for patterns of meaning and questions of possible interest for the research. The similarity analysis was interpreted through a search for meanings in the testimonies, highlighting the terms in the center of the structure and in the related branches. For the DHC analysis, the text segments were carefully read, seeking to attribute meaning to each class, observing homogeneity and coherent patterns. Based on the topics that emerged, it was possible to group them in two main axes, designated according to the meaning in common of the classes analyzed. The axes summarized key aspects of the data and described the data analyzed in depth and in a detailed manner[14,15].

The current study followed Resolution No. 466/2012 of the National Health Council (*Conselho Nacional de Saúde*, CNS) and the guidelines for research procedures with stages in virtual environments. It is noted that the study was initiated after approval by the Research Ethics Committee (*Comitê de Ética em Pesquisa*, CEP) of the Human Sciences School of the Federal University, under Protocol No. 4,806,719 and CAAE No. 47681321.3.0000.8160. After filling in the pre-scheduling form, the participants' names were coded, ensuring confidentiality and anonymity throughout the research process.

RESULTS

The participants were 29 (100.0%) Nursing students, 24 (82.8%) were female, 5 (17.2%) were male, 17 (58.6%) were attending from fourth to sixth period of the Nursing course and 12 (41.4%) were in seventh to tenth period, with a mean age of 23 years old (SD ± 1.6, Min: 21, Max: 28), 25 (86.2%) were single and 4 (13.8%) married. After entering college, 20 (69.0%) participants moved to another city and, during the

face-to-face classes, 10 (34.5%) lived with their parents and/or relatives, 8 (27.6%) lived alone, 7 (24.1%) in a students' dorm and 4 (13.8%) with their partners. Of all the participants, 9 (31.0%) worked and studied; however, only 1 (3.5%) was active in the health area as a caregiver of older adults.

It is noted that 3 (10.3%) students had training prior to their Nursing graduation, namely the Nursing Technician course; and none of them was active in the fight against COVID-19. Most (12 [41.4%]) of the interviewees attended the Semiology and Semiotechnics in Nursing I discipline in 2019, 9 (31.0%) did so in 2018, 7 (24.1%) in 2017 and 1 (3.5%) in 2016.

Processing of the data from the text *corpus* through Classical Text Statistics consisted of 29 texts, with 8,246 word occurrences, 1,277 different forms, and 664 (51.76%) words with only one occurrence.

In the similarity analysis, the relationship of the words uttered by the students to describe their knowledge about biosafety in the hospital context in pandemic times was inferred, considering a minimum recurrence of 10 times (Figure 1)

Through the similarity analysis, the central element was identified, which was the verb "believe", as well as the peripheral structures surrounding it. The figure indicates the relevant terms and their connections, whose analysis of the statements leads to understanding the students' conception of biosafety in this context. The six words that stood out the most (believe, biosafety, people, patient, PPE and being) were divided into six groups, from which other different branches emerged.

The students' statements showed that they had references about part of the biosafety process, although the conception that biosafety is associated with the minimization of biological risks, mainly through the use of PPE, is accompanied by uncertainties, according to the following text segments:

> *But I think that biosafety in Nursing is linked to infection and to minimizing all the risks that we deal with, chemical, physical and mainly biological, to prevent us, but also the patient and the population. I believe it's that. (I10)*

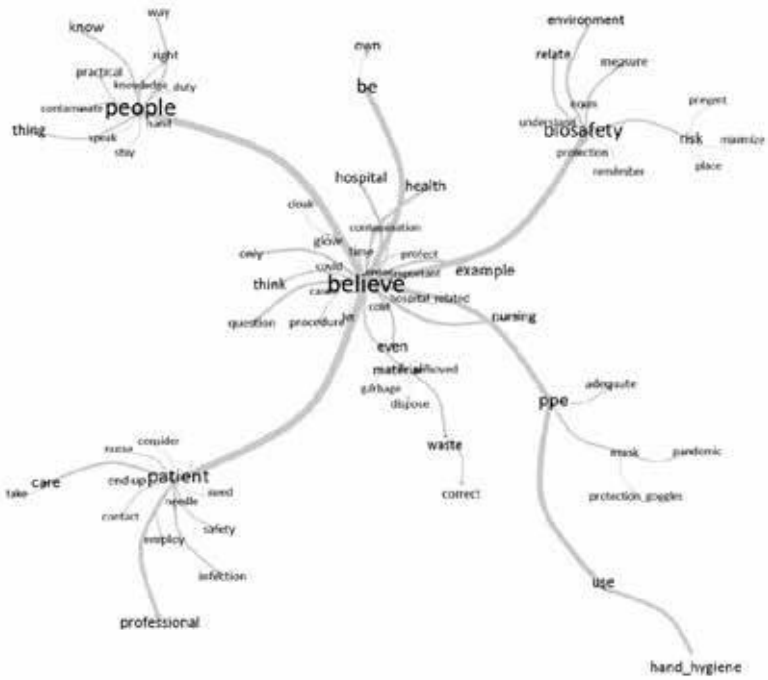

Figure 1 - Similarity analysis with the connectivity between the words and the links related to biosafety knowledge in the hospital context in pandemic times, as described by the Nursing students. Rio das Ostras, RJ, Brazil, 2022

Source: Prepared by the authors, 2022.

PPE; knowing how to do the practice properly, and I believe that training contributed a lot; also health surveillance, those things. I believe it's that, I sincerely don't know much. (I17)

From the text matrix, the DHC method was applied with simple classification on TSs, size of RTS1 "10", size of RTS2 "12" and number of terminal classes in phrase1 "8", which divided the text into 233 segments and, of these, 196 (84.12% leverage) were matched through DHC, obtaining five stable classes.

Figure 2 illustrates the interclass relationship generated by DHC, where it can be noticed that there was a division into two text *subcorpuses*: the first consisting of classes 2 in yellow and 3 in green and the second comprised by class 5 in purple and a second subdivision including classes 1 in red and 4 in blue (Figure 2).

After analyzing the most significant classes and words, the meanings were understood and grouped into two axes based on the emerging topics: The concept of biosafety and its importance for protection and for minimizing risks and Biosafety measures with emphasis on PPE in the hospital context in pandemic times.

The concept of biosafety and its importance for protection and for minimizing risks

This axis addressed the concept and importance of biosafety, comprised by classes 1, 4 and 5, respectively representing 17.9%, 25.5% and 14.8% of the text *corpus*. Class 1 deals with biosafety and with its importance from the Nursing students' perspective. The most significant words (those with $p<0.0001$) are as follows: relate, safety, patient, contaminated and professional.

Biosafety is everything related to our own safety, I understand it's PPE, actually our safety and then the patient's in the hospital environment, basically using PPE to prevent infections, transmission of bacteria from the patient to us and vice-versa. (I28)

I think for sure, in terms of being contaminated by the patient. I think that there are diseases in which contact itself can be harmful, contact, for example, the nurse without gloves, he arrives and touches a patient's wound, or a region that's infected, he can get contaminated. (I09)

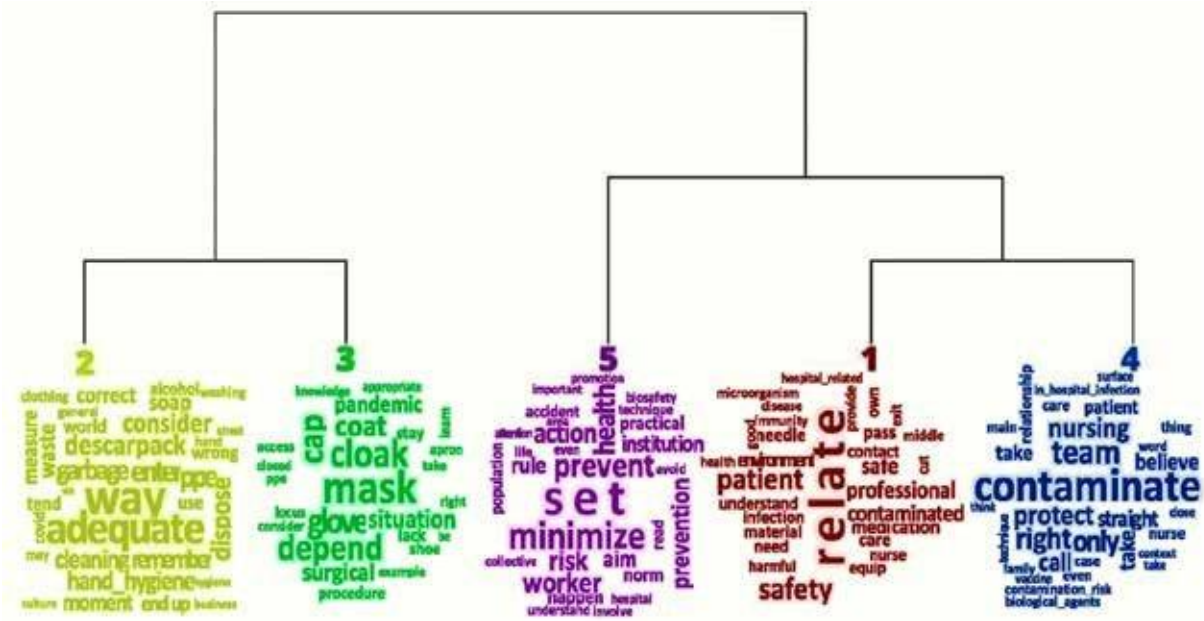

Figure 2 - Dendrogram corresponding to the Descending Hierarchical Classification of the text segments related to biosafety knowledge in the hospital context in pandemic times, as described by the Nursing students. Rio das Ostras, RJ, Brazil, 2022

Source: Prepared by the authors, 2022.

Despite the significant recurrence of the verb "believe", evidencing uncertainty regarding the topic, most of the students conceptualized the term "biosafety" adequately, emphasizing the main risks in relation to their future profession, even being capable of giving examples. However, those examples are mainly aimed at PPE use. The participants considered patient safety as part of the definition of biosafety in relation to the contamination risk.

Class 4 is strongly related to Class 1; it deals with the relationship between biosafety and protection of patients and professionals. The most important word ($p<0.0001$) was "contaminate".

> *I think that as Nursing is directly linked to the patients and we don't know what they have, which biological agents they may be exposing us to, biosafety is responsible for not letting us get contaminated. (I05)*

> *Biosafety, I think, is all the measures that we have to protect ourselves as professionals, the patients and the environment, not only me as a professional and the patient, but the hospital, in-hospital infection, things like that. (I20)*

This class reinforced the analysis that, for the students, biosafety is a set of measures aimed at protecting the health of workers and patients alike, especially prevention of healthcare-associated infections.

In Class 5, related to classes 1 and 4, the testimonies evoked the potential of complying with the biosafety measures regarding risk minimization. The most relevant words ($p<0.0001$) were as follows: set, minimize, prevent, risk, health, prevention, worker, action, rule, aim and institution.

> *[...] so these are actions that will prevent or minimize a risk of something happening to health, I think mainly because of what I've already said, the issue of avoiding common accidents, the issue of minimizing risk or often even trying to eliminate it, because nurses deal a lot with that. (I26)*

> *Biosafety represents standards that aim at preserving workers' health, they aim at minimizing risks, risks that may put a person's life at risk [...] (I12)*

> *It would be a set of standards and protocols, both global and from the institution, in this case here in the hospital, to reduce the risk of work-related accidents. (E13)*

Therefore, biosafety is understood as an effective measure capable of preventing the risks to the professionals' and patients' health. However, only three students highlighted the institution's role in supporting the biosafety measures. Although all the interviews were conducted during the pandemic period, the students did not relate the concept of biosafety to COVID-19.

Biosafety measures with emphasis on PPE in the hospital context in pandemic times

This axis addressed the biosafety measures in the hospital context and consisted of classes 2 and 3, respectively representing 24% and 17.8% of the text corpus. Class 2 represented the biosafety measures that the students considered adequate to protect their own health in the hospital context. Although the questions asked in the interview did not mention the COVID-19 pandemic, many students referred to the pandemic scenario in their testimonies. The most significant words ($p<0,0001$) were way, adequate, enter and descarpack.

> *[...] using PPE to prepare things, discarding the material where it needs to be discarded, in the descarpack or in the contaminated garbage, these are the measures that I consider adequate. (I06)*

> *I think that's it, PPE use, correct waste disposal, oh my God, I don't remember anymore, hand hygiene, in the case of COVID-19 you see that contamination among the professionals was fast, I think it was due to non-compliance or to doing it wrong [...] these biosafety measures [...] (I14)*

> *Even general cleaning precautions, getting home and not taking out the shoes, not entering the house with street shoes. (I15)*

The most cited biosafety measures among the students were PPE use, correct disposal of waste from health services and hand hygiene, in addition to greater concern in complying with these measures, especially in pandemic times. Only one participant mentioned not recapping needles as a biosafety measure.

Class 3 specifically addressed PPE items, which, from the students' perspective, are important for biosafety in the hospital context. The most significant words ($p<0.0001$) in this class were the following: mask, protection goggles, cloak, glove, depend, cap, coat, situation, surgical and pandemic.

> *[...] then I believe that it's those measures, using a coat, mask, cap, protection goggles and gloves mainly, I believe mainly after this post-pandemic [...] (I07)*

> *Currently, in this COVID-19 times, it would be a full PPE, I believe that our practices will never again be the same, that we get to the hospital wearing a lab coat, we'll always be wearing a coat, cap, in short, full PPE, the issue of waste disposal. (I08)*

By reading the text segments of this class, it was possible to perceive the emphasis given by the students in relation to the different types of PPE, highlighting the association between the need to use PPE items and the pandemic period.

DISCUSSION

The findings of this research reveal that most of the Nursing students consider the biosafety measures, in particular PPE use, hand hygiene and waste disposal, as important to protect the health of professionals and patients alike, as well as that of the environment and the general population. However, these students' speech is imbued with uncertainties in relation to the entire theme, which can be associated with the learning process and to lack of professional experience, as shown by a study carried out with Nursing students in a laboratory teaching practice, demonstrating the same uncertainties and doubts related to the biosafety measures[16].

Among the participants, practical and theoretical knowledge was mentioned as an essential biosafety measure, and its deficit was associated with the high numbers of professionals infected by COVID-19. Such findings are in line with the data from a survey, in which students in supervised internships identified the need to delve deeper into the topic; in addition, the importance of implementing safety measures aimed at staff shortages due to illness and at encouraging constant training of professionals to minimize their chances of contamination is highlighted[17,18].

It is also inferred that Nursing students associate PPE with the COVID-19 pandemic, as an indispensable measure for a safe practice, although these measures were essential even before the pandemic context, provided for in laws, standards and protocols. According to them, the pandemic made health professionals seek knowledge about PPE items to protect themselves, an aspect also described by three Nursing students in an experience report, during their internship in the pandemic context[19].

Most of the biosafety measures cited by the students included PPE items, with mask, cloak, glove and cap as the most frequent. Few mentioned protection goggles and face shields were not mentioned, which shows a gap in knowledge about biosafety, as both are indispensable for protecting the professionals, especially in the pandemic context. A study carried out with Nursing students from an institution specializing in health education presents similar results in relation to the most used PPE items, with coat, mask, cap and glove standing out[20].

In addition to hand hygiene, the students also emphasized management of waste from health services and its proper disposal as essential measures with regard to individual and collective protection, ratifying their own statements that biosafety is related to the prevention of biological risks not only for professionals, but also for the entire population. Although there are several biosafety measures, these findings converge with the results of a study carried out with graduate nurses in which it was found that, despite having extensive knowledge about hand hygiene and waste management, they had a superficial knowledge in terms of other biosafety measures[16].

Given the above, it is verified that biosafety measures in the hospital context still represent a challenge, with the need to expand, deepen and improve the existing knowledge beyond waste disposal, hand hygiene and PPE use. Thus, it is essential that the undergraduate Nursing program emphasizes biosafety measures that are rarely or not addressed, such as: proper gowning and degowning; and all aspects inherent to NR-32, such as immunization of the Nursing team and use of Collective Protection Equipment (CPE).

The findings of this research revealed a knowledge overview, evidencing weaknesses, as biosafety is partially recognized, but not in its entirety, among the Nursing students that will enter the job market and who, before that, will carry out practical activities in the field during and after the pandemic. It is worth emphasizing

that a broader view of biosafety in the hospital context is necessary, not only focused on a single discipline, but approached in a transversal perspective, especially in the professional cycle disciplines. In addition, all the issues involving biosafety must be present throughout academic training, not only for the Nursing students in the scenario researched, but also in other health area courses.

Memory bias was considered as a limitation, as the students interviewed had attended the academic discipline that addresses the theme at least two years ago. This further reinforces the need for a transversal approach to biosafety throughout training, in addition to new studies that seek to describe nursing students' knowledge at different moments and contexts of practice.

CONCLUSION

In view of the results, it became evident that the term "biosafety" is recognized by Nursing students as a set of rules aimed at protecting the health of workers and patients alike, with a close relationship to the Nursing practice. However, in relation to the description of these measures, the statements were mostly centered on the types of PPE, hand hygiene and waste management, showing superficial knowledge.

Probable gaps in Nursing training were identified, which could serve as subsidies and directions to consolidate the teaching of biosafety, a topic that permeates the entire professional life. Thus, such concepts and applications need to be very well-grounded, scientifically, so that there are no doubts in the choice of Nursing courses of action during care.

In addition, it is worth reinforcing the fundamental role that universities play in the training of future health professionals, capable of developing care in a safe way for themselves, for the patients under their care and for the population in general, stimulating new perspectives and encouraging discussions on the topic, reinforcing biosecurity measures in addition to PPE.

CONFLICT OF INTERESTS

The authors have declared that there is no conflict of interests.

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