

Biosafety in the face of biological risk in dental services: systematic review

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Abstract: Introduction: Biosafety is a fundamental pillar of dentistry. Objective: To describe biosafety in relation to biological risk in dental services. Method: A systematic review was conducted between January 2023 and May 2025, using the PRISMA flow diagram, 2020, and the Joanna Briggs method to evaluate the quality of the articles, using the PICO question: What is biosafety against biological risk in dental services, and can it be applied using protocols, guidelines or manuals? For the study, 180 articles that met the inclusion criteria were included. Results: Seventy-five articles were pre-selected, and only 10 were chosen, with Pubmed and Scielo predominating as databases with 30%. Peru was the predominant country (20.0%), 2019-2020 was the predominant year (50.0%), and original articles were the predominant type (40.0%). According to the journal group, group 1 prevailed, and five articles stood out in terms of relevant overall results. Most of the articles reviewed were classified as high quality. It was concluded that there are currently discrepancies and research gaps regarding biosafety standards in relation to biological risk in dental services.

Key words: biosafety; biological risk; dentistry; dental services

1 Introduction

Occupational hazards in dentistry have been defined by Bolivia's National Biosafety Standard for Dentistry (2021) [1] as any probability of bodily injury or functional disturbance caused by the sudden violent action of an external cause or by the effort made in the performance of work or as a consequence thereof. Specifically, exposure to living agents, i.e., microorganisms such as viruses, bacteria, and fungi, capable of causing any type of infection during dental care, although they can also cause allergies or toxicity, is considered a biological risk in dentistry [2,3,4].

According to WHO reports (2019-2024) [5,6] there are two million occupational accidents per year involving contaminated sharp instruments or contact with blood or fluids in the oral, ocular, nasal and skin mucosa, with a high risk of transmission of hepatitis B (30%), hepatitis C (2-3%) and HIV/AIDS (0.3%). By the end of 2022, these figures had increased by 40%. However, the specific number of dental workers affected by biological risk in their workplaces is still unknown, perhaps because it is relatively low in Latin American countries such as Cuba and Santiago de Cuba.

In this context, several authors have argued [4,7,8] that biosafety is a fundamental pillar of dentistry, whose purpose is to ensure safe practice through the prevention of cross-infections. That is why, both internationally and nationally, there are official documents (manuals, guidelines, protocols) based on dental biosafety standards.

In 2020, due to the COVID-19 pandemic, the WHO called for the urgent creation of new protocols, involving the Latin American Dental Federation (FDA) [9]. However, a consensus on the different proposals was not fully achieved, perhaps because they were created individually, according to the specialty that proposed them [10].

With regard to the structure and provision of dental care, in Cuba and in the province of Santiago de Cuba, there are dental services attached to polyclinics or hospitals which, for the purposes of their internal organization and the services they provide, perform the same functions as a dental clinic, but also provide primary care services [11]. Regardless the particularities of each one, workers are equally exposed to materials, biological agents and environments typical of the medical institutions to which they are attached, which facilitates the transmission of infectious diseases [12].

These dental services, depending on the context in which they are provided, adhere to relevant standards similar to those of nursing services, specific to the center to which they belong. However, this does not take into account that dental conditions are different from those of other medical specialties and that, therefore, biosafety standards must be adjusted to dental services.

These antecedents allowed for the identification of the following scientific problem: there are discrepancies in the biosafety measures assumed in the current context regarding biological risk, which hinders their compliance.

The presence of emerging and re-emerging infections, as well as their control during oral care, have demonstrated the need to re-evaluate the knowledge and actions already proposed in this field. It is therefore necessary to synthesize the scientific evidence on biosecurity against biological risk, applicable to dentistry. This motivated the present study, whose importance lies in the need to update biosafety protocols with specific, sustainable, easy-to-implement, and consciously adhered to measures that contribute to reducing cross-transmission infections. To this end, the present systematic review was conducted, with the aim of describing biosafety against biological risk in dental services.

2 Methods

A systematic review was conducted during the period from January 2023 to May 2025, using the PRISMA flow diagram, 2020 (Figure 1, Appendix 2) [13]. The quality of the articles was assessed using the Joanna Briggs method (Appendix 1), through the PICO question: How is biosafety addressed in relation to biological risks in dental services, and is it possible to implement it through protocols, guidelines, or manuals? The study included 180 articles that met the following criteria:

Inclusion criteria: articles related to biosafety against biological risk in dental or oral health services, knowledge of protocols, manuals or guidelines on dental biosafety, by title, abstract, keywords, without limitation to any country or language, and from the last 8 years. As well as complete books or summaries thereof, from the last 10 years. The expert researchers and the author decided to include updated theses from the last 8 years on the subject.

Exclusion criteria: expert opinions, case reports, letters to the editor, and brief communications. Studies conducted before 2018, not related to dental biosafety against biological risk (as they are outdated). Full texts not available to assess reliability when comparing them. And any disagreement that arises during the search evaluated and discussed with the tutor.

A sample of 10 articles was selected that met the above requirements. Figure 1 (Appendix 2) summarizes the selection of articles included in the sample.

The following variables were evaluated:

- Databases: these included Google Scholar, PubMed, Dialnet, Medigraphic, and Scielo.
- Journal name and group: based on the name of the journal and its indexing in the different databases.
- Type of articles: classification according to article type was taken into account, such as original articles, research

articles, literature reviews, systematic reviews, and protocols.

-General article data: including author(s), country or geographical area where the article was produced, year of publication, and general results.

-Article quality: based on its methodological design and the journal in which it was published. Classification as high, medium, or low.

Journal articles, original research articles, review articles, letters to the editor, and texts available in remote databases such as Scielo, MEDLINE-PUBMED, browsers such as Google Scholar, and websites were consulted in order to analyze all the indexed literature related to the topic. Health descriptors such as Biosafety, biological risk or biological hazard, dental services or dental clinic, and dental services (DecS) were used as a search strategy, applying an initial review of primary sources of information such as original scientific study publications and for each database, together with the use of Boolean operators "and," "or," and "in." The titles and abstracts of all articles were reviewed separately, followed by an evaluation of the full text to identify studies based on inclusion and exclusion criteria, such as direct relevance to the topic in question, level of updating within the last five years for original and review articles, and methodological quality. The parameters of each article were extracted and documented in Excel spreadsheets: type of article, authors, year of publication, countries, type of study, main results, and area of research.

The selected articles were evaluated independently using the Joanna Briggs Institute (JBI) critical appraisal checklist for analytical cross-sectional studies (Table 3, Appendix 3), assigning each domain as yes, no, unclear, or not applicable. The studies were then classified as included, excluded, or requiring further information. The GRADE (Grading of Recommendations Assessment, Development and Evaluation) system was used to establish the level of evidence for each study [14]. The SPSS 22.0 statistical package for Windows was used to analyze the data and obtain the variables to be analyzed. Single and double entry contingency tables and graphs were created in Microsoft Office Excel 2017. The distribution of results was shown in absolute and relative frequencies.

This study is part of a registered research project that was approved by the Scientific Council and Health Research Ethics Committee.

3 Results

Table 1 shows that the selected articles respond to the question outlined for the systematic review, with a total of 180 articles. Of these, 75 were pre-selected and only 10 were chosen (Figure 1, Annex 2). The most predominant database was Pubmed, followed by Scielo with 30%.

Table 1. Distribution of articles according to database

Database	Articles		Pre-selected articles		Selected article	
	No	%	No	%	No	%
Google Scholar	75	41.6	26	34.6	1	10.0
Pubmed	55	30.5	18	24.0	3	30.0
Dialnet	10	5.5	7	9.3	2	20.0
Scielo	25	13.8	15	20.0	3	30.0
Medigraphic	15	8.3	9	12.0	1	10.0
Total	180	100.0	75	100.0	10	100.0

Source: % calculated based on total columns

Table 2 shows that out of the total selected articles [10], the predominant country was Peru, 2019–2020 was the most prevalent year, and original articles were the most prevalent type of article, representing 20%, 50% and 40% respectively. According to the most frequent journal group, group 1 prevailed, and in terms of the most relevant overall results, five articles stood out. Most of the articles reviewed were classified as high quality.

Table 2. Distribution of selected articles according to general data, name, journal group, and quality

Identity (ID)	Author(s)/title/year/ country/type of article	Name/Group of the journal	Overall results	Quality
ID-1	Cayo Rojas, C, Briceño-Vergel, G, Córdova Limaylla, N, Huamani Echaccaya, J, et al (2023). Impact of a virtual educational intervention on knowledge and awareness of biomedical waste management among Peruvian dental professionals [15]. Peru/ research article.	Rev. (Sci Rep) Scientific reports Group 1	Dentistry uses various materials that create a substantial amount of waste capable of impacting the environment. However, the knowledge acquired about this was not retained after two weeks in professionals with less than 10 years of experience.	High
ID-2	Cazares León, F, Treviño Taméz, M., Soto Gámez, D. E, Sánchez Márquez, M. C. (2019). Magnitude of risk from accidents with sharp objects in dental practices/ [16]. Mexico /original article	Rev. Universidad Odontológica Group 2	Their study refers to the importance of dentists recognising the protocols to follow in the event of an accident, improving training and expanding their coverage in terms of biosafety and the handling of infectious biological waste.	Media
ID-3	Volgenant, CMC, Soet, JJ (2018). Cross-transmission in dental office: Does this make you ill? [17] Amsterdam (Netherlands) /research article	Rev. Current Oral Health Reports Group 1	They consider that the risk of pathogen transmission in dental offices is still unknown. In general, patients and dental healthcare professionals do not develop diseases after transmission. However, increased patient life expectancy and improvements in healthcare are leading to the growing virulence of microorganisms and the development of infectious diseases. Therefore, infection control in dental practices should be considered a complex and essential issue for healthcare professionals.	High
ID-4	Vila Sierra, LA, Hernández Fuentes MT (2020). Perception of patients with HIV/AIDS regarding dental consultations at IPS in Santa Marta, Colombia [18]. Colombia/ original	Rev, University and Health Group 2	Their study reports that dentists are considered to be at high risk of contracting infections due to their exposure to microorganisms, contaminated blood and oral secretions,	Media

	article		among other causes. Therefore, there is a need to address HIV/AIDS from a different perspective in order to dispel myths about its transmission and educate the general public and professionals.	
ID-5	Paz Betanco, MA (2019). Knowledge, attitudes and practices regarding biosafety and biological risk standards among private dentists in three cities in Nicaragua [19]. Nicaragua/original article	Rev. Odontología sanmarquina Group 2	It was found that 98.8% of dentists are familiar with the concept of biological risk, but not with the specific names of infectious agents and their routes of entry into the body (76.7%). They wash their hands frequently before and after each dental procedure (60.4%) and 48.8% have a basic understanding of how to respond to percutaneous accidents. Most respond to good attitudes towards disinfection and sterilization of instruments and equipment (78% and 68.6%), as well as personal biosecurity (98.8%).	Media
ID-6	Pérez, N, Diaz, C, Adorno C, Fretes, V, Escobar, J, Gamarra, J (2021). Evaluation of aerosol dispersion produced during the use of dental turbines using equipment ejectors and/or extraoral suction devices [20]/Paraguay/ research article	Rev. Ciencias Médicas de Paraguay Group 2	An in vitro study evaluated the dispersion of aerosols generated by high-speed dental instruments, an important factor in viral transmission. Within the dental practice, the use of mouthwashes before procedures and absolute isolation should be taken into account, as these will reduce the load of microorganisms present in the aerosol.	Media
ID-7	Alarcón, M; Sanz, I; Shibli, J; Treviño, A; Caram, S; Lanis, A; Jiménez, P.; et al (2021). Delphi project on the trends in implant dentistry in the COVID-19 era: perspectives from Latin America [21] /Perú- Spain/original article	Clinical Oral Implants Rese arch Group 1	International experts recommend the implementation of protocols to prevent the spread of infection, whereby patients must complete a questionnaire and undergo telephone triage prior to each appointment, as well as strict infection control during face-to-face consultations.	High
ID-8	Rodríguez-Aguilar, RM (2020). Dentistry: role in the transmission of SARS-CoV-2 through bioaerosols [22]/Panama/literature review article	Odontovs. Int. Journal Dental Sciences Group 1	The role of dentistry in the transmission of SARS-CoV-2 was determined in relation to the equipment used in essential treatments (turbines and ultrasound); this involves the aerodynamics of bioaerosols, with pathogens found in the air and on	High

			surfaces; saliva can contain a high pathogen load and, with the help of the air and water generated by the equipment, these are transported, extracted from carious cavities, blood, tissue cells, and nasopharyngeal secretions.	
ID-9	Herrera, P.; Enoki, E. & Ruiz, M (2020). Risks, contamination and prevention of COVID-19 in dental practice: a review [23]./Peru/ bibliographic review article	Rev. Salud Pública Paraguay Group 2	Dental biosafety must be extreme, where cleaning and disinfection of the environment and contact surfaces must be focused on the elimination of microorganisms. It is considered that SARS-CoV-2 remains on surfaces (steel and plastic) for longer than on others, from which it follows that the risk is greater because most dental equipment is made of metal.	Media
ID-10	Diaz Ronquillo, MA, OD- TNNV, Montece Ochoa, ER (2019). A look at biosafety and ergonomics in dental services [24]/. Cuba/bibliographic review article.	Rev. Científica Mundo (ReciMundo) Group 1	It is important to identify the hazards involved in dental procedures, calculating the combined effect of the consequences and probabilities of the risk materializing, which leads to the proportion of appropriate control and prevention strategies, including the design of procedures and methods to minimize risks and their consequences.	High

4 Discussion

Biosafety is a vital component of the quality assurance system; it is a doctrine aimed at achieving attitudes and behaviors that reduce the risk of workers acquiring infections in the workplace. In dentistry, biosafety is applied from the moment the patient arrives at reception, through the use of dental chairs and instruments, until they leave the clinic, in accordance with the main principles governing worker protection: universality, use of barriers and means of disposal of contaminated material.

Currently, due to the recent epidemiological situation, not only in Cuba but also worldwide, with regard to Covid-19, dental services are among the most vulnerable due to the area of work, the oral cavity. Therefore, a plan of measures has been implemented specifically to prevent the spread of the disease, and this has led to new concepts and attitudes for the protection of professionals.

In agreement with Barbieri (2019) [25], in Brazil, a literature review was conducted to recommend that knowledge, as well as evaluation, improvement of procedures and response attitudes in this context, requires investment in the aforementioned training and in strengthening biosafety, as this is the only way to address these health problems. According to Panda et al, 2020 [26], knowledge of the epidemiological characteristics of SARS-CoV-2 allows for the creation and modification of new concepts and measures to reduce the transmission of infection in dental services. It is necessary to

follow the maximum recommendations of biosafety standards in dental practice and, as far as possible, not to participate in the spread of infection, given that the work environment is the oral cavity.

The review showed that there is agreement on guidelines and attitudes in biosafety protocols, contextualized and restructured to a new reality of care, ranging from universal measures, disinfection, sterilization and waste management. Few authors refer to the need for training of personnel involved in dental care; however, it remains an important aspect because it determines whether biosafety is applied in dental consultations.

In agreement with Bedoya and Gutiérrez (2025) [27], biological accidents in institutions that provide health services constitute a real occupational health problem, where infectious diseases are a cause of high mortality rates in dentistry, and they recommend that biosafety regulations and their application are the future for the prevention of infectious diseases, although they do not refer to the training of dental staff to achieve better biosafety management in dental services.

Unlike Carrera et al (2024) [28], in their literature review article, they report that in dental practice, there are different occupational risks such as ergonomic, biological, and chemical risks. Even so, professionals are sometimes unaware of biological safety standards or do not comply with them, making them vulnerable to accidents or disease due to the high level of contamination in dental practices. Such continuous exposure to these occupational risk factors can affect stability and productivity, as well as the quality of services.

The databases such as PubMed/Medline and Scielo, where most of the searches were conducted and articles selected, are peer-reviewed and guarantee the reliability of the information obtained without risk of bias and quality. Together, they accounted for 100% of the types of studies evaluated.

To evaluate the quality of the studies, the authors of this research used the GRADE criteria to classify the quality of the evidence and strength of recommendation applicable to a wide range of interventions and contexts, giving value to the evidence for a particular measure or outcome based on several primary studies. They evaluated the balance between benefits and risks, the quality of the evidence, its application in specific circumstances, and the baseline risk situation in each article.

The grade is lowered if there is a major limitation (-1) or a very important limitation (-2) in the quality of the study; a major inconsistency (-1); uncertainty as to whether the evidence is direct or indirect: if it is either (-1) or if it is maximum (-2); imprecise or scarce information (-1) and a high probability of information bias (-1). The grade increases if: the evidence of association is strong with an RR (results) greater than 2 or less than 0.5 based on consistent evidence derived from two or more observational studies without plausible confounding factors (+1); or when the evidence of association is very strong with an RR greater than 5 or less than 0.2 based on direct evidence, with no significant threats to validity (+2); or when all possible potential confounding factors have been controlled for (+1) [14]. In the study, the high quality of the research allowed for the comparison of similarities and differences, with the aim of updating biosafety standards in the context of dental services.

The authors, as far as could be reviewed, found limitations and research gaps regarding the use of biosafety protocols and standards. Therefore, they propose the development and updating of a new dental biosafety protocol that would allow for the adoption and use of conscious and sustainable biosafety standards in the face of biological risk.

It is concluded that there are currently discrepancies and research gaps regarding biosafety standards in relation to biological risk in dental services; and an updated biosafety protocol is necessary in order to address possible infectious diseases.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix 1.

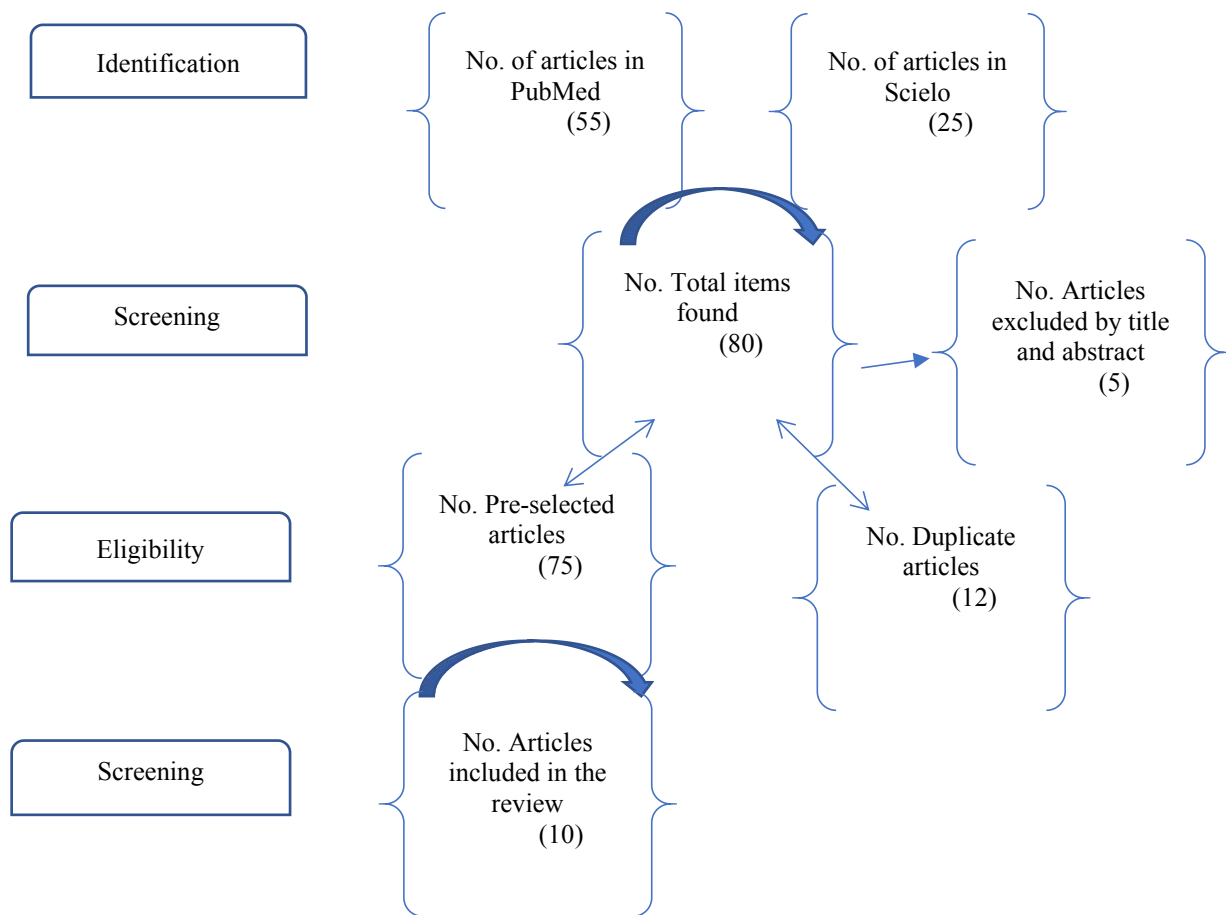


Figure 1. Prisma flowchart (2020). own work

Appendix 2.

Joanna Briggs' method for systematic reviews:

Reviewer _____

Cross-sectional studies: _____ Date _____

Authors (15,16,17,18,19,20,21,22,23,24) _____ Year_2020-2023

1. Were the inclusion criteria for the sample clearly defined?
2. Were the study subjects and setting described in detail?
3. Was exposure measured in a valid and reliable manner? Yes_ No_ Unclear_ Not applicable__
4. Were the objective and standard criteria used to measure the condition?
5. Were confounding factors identified?
6. Were the strategies to address confounding factors indicated?
7. Were the results measured in a valid and reliable manner?
8. Was an appropriate statistical analysis used?

Overall assessment: Include__ Exclude__ Seek further information__

Comments (Including _____ Reviewer reason for exclusion) _____ Systematic review:
_____ Date _____

Appendix 3.

Table 3. Methodological quality and risk of bias in analytical cross-sectional studies

Ítems	Yes	No	Unclear	Not applicable
	Article	Article	Article	Article
1. Were the inclusion criteria for the sample clearly defined?	ID-1,3,7,10	---	---	--
2. Were the study subjects and setting described in detail?	ID-1,3,7,10	---	---	--
3. Was exposure measured in a valid and reliable manner?	ID-1,3,7,10	---	---	--
4. Were objective and standard criteria used to measure the condition?	ID-1,3,7,10	---	---	--
5. Were confounding factors identified?	ID-1,3,7,10	---	---	--
6. Were strategies indicated to address confounding factors?	ID-1,3,7,10	---	---	--
7. Were the outcomes measured in a valid and reliable manner?	ID-1,3,7,10	---	---	--
8. Was an appropriate statistical analysis used?	ID-1,3,7,10	---	---	--