



## Biological hazards that can affect the health of the workers handling hospital waste: a systematic review protocol

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### Abstract

Technological advances allow science development, with the creation of new materials / equipment and the offer of different products and services. Some of these materials, after use, are discarded, becoming waste. Mismanagement of these wastes and improper handling within the hospital environment can cause serious harm to workers' health. Comprehensive studies in hospital settings are essential to increase knowledge about the risks that workers are exposed to, including biological hazards. Under these circumstances, a systematic review is proposed to identify occupational biological hazards to which hospital workers are exposed when in direct or indirect contact with hospital waste produced in the hospital setting. Thus, following the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA-P), this systematic review protocol was developed with the objective of presenting suitable guidelines for the development of a research that can provide results to meet the goal sought. Five databases will be accessed (SCOPUS, PubMed, Science Direct, EBSCOhost and Web of Science) and a total of 9 keyword combinations will be used. This protocol is registered in PROSPERO under the code of PROSPERO CRD42019127145.

## 1. INTRODUCTION

Technological advancement allows great achievements in different fields of science, but new materials and different products can bring aggregate problems after use, especially when they become waste and it is necessary to discard them (Sousa *et al.*, 2016; Szczerbowski *et al.*, 2017).

Inappropriate management or even non-management of such waste has clear implications for human health and the environment (de Souza Araujo *et al.*, 2018). In this way, waste management aims to achieve excellence in all stages and processes involved, from the segregation and identification of waste, as well as adequate transportation, reaching the final destination. The need for attention with each specific action is clearly identified, resulting in the reduction of potential risk (Silva *et al.*, 2017; Castro *et al.*, 2017).

Health institutions (HIs) are institutions that provide health services, including counseling, clinical, surgical and / or psychiatric consultations and treatment services for the healthy, sick and injured people (Akagbo, Nortey, & Ackumey, 2017). The author considers that a HI has a highly heterogeneous floating population, being accessed by patients and their families, employees from many areas, sales representatives, technical assistants, outsourced employees, among others. Globally, HI employs more than 59 million workers, offers a variety of services to clients and patients, and is classified as a hazardous workplace (Monteiro *et al.*,

2017). HIs, like other high-risk workplaces, are characterized by a high level of exposure to hazardous agents, which significantly endangers the health and life of workers, patients and community members if they are not adequately treated (Prüss-Üstün *et al.*, 2014, Mendes *et al.*, 2018).

It is important to note that Health Care Waste (HCW), if not properly managed, can pose a greater threat and dangers than the original diseases (Patil *et al.*, 2005).

Among different classifications, HCWs can be classified as organic residues, sharp instruments, chemical and/or radioactive residues and pressurized gases and are a high priority because of their dangerous nature (Ciicero *et al.*, 2015). Within a health institution, waste is also produced and, according to the World Health Organization (WHO), about 10 to 25% are health waste and are hazardous because they affect human health as well as pollute the environment (Sodré *et al.*, 2017; Anozie *et al.*, 2017).

Occupational health and safety are important issues because of the high rates of morbidity and mortality associated with exposed workers (Awodele *et al.*, 2016). It is estimated that 100,000 people die from occupational diseases, while about 400,000 new cases of occupational diseases are diagnosed every year. This affects workers in various occupations as a result of their exposure to different types and varying degrees of hazards in the workplace. However, studies indicate that workers of agriculture, general contracting, steel, automobile, driving trucks and nursing sectors have the highest risk of exposure to high-risk occupational hazards (Anozie *et al.*, 2017).

The consequences of occupational accidents and injuries include physical, economic, and psychological harm to workers in health services and their dependents. The vulnerability of staff in HI is aggravated by inadequate facilities with equipment that could improve best practice in developing countries (Mbarki *et al.*, 2013).

The handling and careless disposal of HCW impact, directly and indirectly, the team, the patient, and the environment. This occurs because hospitals represent a single environment, providing medical care to patients and the working environment for doctors and other staff (Awodele *et al.*, 2016).

The practice of inadequate waste management has a direct and / or indirect impact on health teams, patients and the hospital environment (Gomes *et al.*, 2018). It is important to manage medical waste properly to avoid risks to human health and the environment (Anozie *et al.*, 2017).

Proper management of medical waste in a hospital depends on a dedicated team of waste management, good management, careful planning, solid organization, underlying legislation, adequate funding and full participation of trained staff. In fact, some authors have indicated the importance of other aspects, including the use of appropriate disposal techniques, an internal management system and training program for waste-related personnel (Mbarki *et al.*, 2013; Oliveira, 2017).

Until now, no systematic review has been conducted based on the parameters listed here. Therefore, this protocol aims to propose a methodology for a systematic review to identify the occupational hazards to which hospital workers are exposed when in direct or indirect contact with the hospital waste produced in the hospital setting.

## **2. METHODS**

### **2.1. Research structure**

This systematic review protocol follows the guidelines described in the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA-P) Statement (Shamseer *et al.*, 2015, Moher *et al.*, 2015).

### **2.2. Eligibility criteria**

#### *Type of studies*

Initially only published and peer-reviewed articles will be used. The authors will include experimental and theoretical studies, case studies, or field studies where information regarding occupational risks within the hospital environment is found. Articles that do not

contain relevant information will be excluded.

### *Context*

Eligible publications will include those that present investigations developed in the hospital environment, where the report of risks or biological accidents among hospital workers.

### *Type of participants*

The research will focus on staff actively working within the hospital setting. The study will include female and male samples, without age limitation, from various professional activities, and diverse formations. There will be no further restrictions.

### *Interventions*

Any result addressing biological occupational hazards within the hospital environment, related to the waste produced in the hospital will be considered. The researchers will also consider all types of accident analysis studies, reporting the type of accident and, where possible, the main causes.

### *Configuration*

Any setting from any country, in any type of hospital, will be taken into account.

### *Language*

The study will consider only articles written in English.

## **2.3. Information sources**

The research will include the following electronic databases: SCOPUS, PubMed, Science Direct, EBSCOhost and Web of Science. It will be conducted in articles since 2016. The year range is set to get relevant and recent results.

However, the study will also examine the references of articles collected to look for any additional relevant record to the objectives of this review. Similarly, authors with more articles on the subject and journals that appear frequently in searches will be analyzed in greater depth. This process will be repeated until no more related results can be found. In this case, publications older than the defined range can be used.

## **2.4. Search strategy**

The first step will involve researching and sorting the literature with the use of keywords, which will be combined into sentences and will include Boolean terms (AND, OR), in addition to the inclusion and exclusion criteria already foreseen in the search.

Combinations of keywords will be formed as follows:

[("Occupational health" or "Health worker" or "Occupational safety") **AND** ("Hospital waste management" or "Medical waste" or "Hospital waste disposal")]

- a. "Occupational health" **and** "Hospital waste management"
- b. "Occupational health" **and** "Medical waste"
- c. "Occupational health" **and** "medical waste disposal"
- d. "Health worker" **and** "Hospital waste management"
- e. "Health worker" **and** "Medical waste"
- f. "Health worker" **and** "medical waste disposal"

- g. "Occupational safety" **and** "Hospital waste management"
- h. "Occupational safety" **and** "Medical waste"
- i. "Occupational safety" **and** "medical waste disposal"

The appropriate search engines will be used, which will display all titles. In each database, the search will be performed by entering each combination (separated by the operator "AND") and selecting, where possible, "article title, abstract, keywords". All qualified literature for inclusion based on the titles will be loaded into Endnote. This step will be faithfully reproduced for each of the selected databases.

The articles included will be selected by two independent reviewers by using the eligibility and exclusion criteria. First, titles, keywords and abstracts will be analyzed; secondly, in addition to titles, keywords, and summary again, introduction and completion will be analyzed; and in the third step, the full texts will be read; then all the information found will be checked.

If divergences arise, a third reviewer must participate before a final decision is made. If an important data for review is absent or unclear, an attempt will be made to contact the corresponding study author to resolve or clarify the problem. Two independent reviewers will collect data from selected articles. Subsequently, the information retrieved will be crossed. Any disagreement will be discussed between them and the third reviewer. The following data will be extracted and recorded in duplicate by two reviewers for each study: author; year of publication; country, encountered risks; outcome measure (s); relevant results and conclusion (s).

In the next step, as the selected articles are analyzed, new potential keywords will be identified, and a new search will be conducted. Likewise, references will also be checked in order to find older articles that could provide supplementary information. This procedure will be repeated in the new identified articles until no more relevant results are obtained. In addition, other works developed by the authors of the primary studies included in the review will be consulted in order to find related investigations that meet the established inclusion criteria.

Finally, in the last step of the research, additional sources referenced in the articles analyzed will be identified and accessed. If many articles are published in the same journal, special attention should be given to this, and a more careful search should be carried out.

## 2.5. Study records

### *Data management*

After completing the search and registering the number of articles collected in Table 1 (see attachment), the selected articles from each database will be exported for duplicate sorting and removal. Title and abstracts will be reviewed. Then, after taking into account the established selection criteria, the full text of the resulting studies will be retrieved and evaluated.

The number of articles resulting from each filter phase will be recorded in [Table 1](#). This will allow keeping track of all studies of the first articles identified for the selected final publications along with the number of articles excluded from each applied criterion.

Records management will be done with "EndNote" software.

### *Selection process*

As each combination is inserted, three phases of exclusion will be applied:

- A.** Though search filters, the following criteria will be considered:
  - i. Date: Articles published since 2016. However, for the final stages mentioned earlier in the search process, no date constraints will be applied.
  - ii. Document type: Articles.
  - iii. Source Type: journal.
  - iv. Language: English.

- B.** Repeated articles will be removed.
- C.** Articles will be deleted if any of the following conditions are met:
  - i. Studies that are not applied in a hospital setting.
  - ii. Studies that do not consider occupational hazards.

#### *Data collection process*

From the final studies selected, the full-text will be retrieved in order to collect information of interest.

The extracted information will include:

1. General information: Authors, year of publication, country.
2. Sample characteristics: function exerted, gender distribution, risk.
3. Context: in a hospital setting and associated risks.
4. Study characteristics: objectives, risks considered, materials and equipment capable of producing risk, conclusions.
5. Main limitations of the study.
6. Quality assessment: The Quality assessment will be based on the possible risk of bias (selection, decision and information bias) (Higgins *et al.*, 2011)

#### **2.6. Data items**

Summary tables will be elaborated with information compiling the topics presented in the section above, mainly: reference and country, sample size, function exercised, gender distribution and average age range, study objectives, conclusions, assessed risks.

#### **2.7. Results and prioritization**

The main expected result of this research is to verify which are the most common risks that the workers are exposed in the handling of biological waste in the hospital environment.

#### **2.8. Risk of bias in individual studies**

For the systematic review, the risk of bias will be assessed individually. Two phases will take place throughout the evaluation. First, the general characteristics of each study will be identified and analyzed according to the intended objectives of this review. The parameters considered will include goals and objectives, evaluated variables, applied methods and equipment, evaluation procedure.

Subsequently, using the Cochrane collaboration tool (Higgins *et al.*, 2011) to assess risk of bias (Table 2), methodological issues will be addressed; compliance with ethical standards, justification of the sample, clear description of the experimental procedures and practical difficulties.

Each of the determined topics will be categorized by "Yes", "no" or "obscure", the latter indicating that there is insufficient information to determine compliance with the criteria.

Studies that present more positive responses to the established criteria will be considered the most adequate and reliable for the purposes of this review.

#### **2.9. Data synthesis**

The data synthesis will be carried out through a narrative, based on the data tables assembled (with information from the eligible documents). With this perspective, the bias will also be taken into consideration in the analysis of the data.

## 2.10. Protocol registration

This protocol is registered in The International Prospective Register of Systematic Reviews (PROSPERO) under the code CRD42019127145.

## 2.11. Authors' contributions

Design and development of the study: TFBXS. HC. MR. JCG

Title and abstract selection: TFBXS. HC. MR.

Full-text screening: TFBXS.

Data extraction: TFBXS.

Critical Rating: TFBXS.

Analysis and interpretation of the data: TFBXS.

Draft protocol: TFBXS. JCG

Support in project development: TFBXS. JCG

All authors have read and approved the final version.

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ANNEXES

**Table 1.** Form sheet summarizing the proposed rejection criteria

Summary of collected articles	Summary of selected articles	Summary of rejected articles	Summary of Total Rejected Items					Database	Keywords combination								
			Date	Type of document	Source type	Language	Other		Out of topic	n° of selected articles	n° of collected articles	n° of articles included after criteria					
												Date	Type of document	Source type	Language	Other	Out of topic
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	SCOPUS	0							
0	0	0	0	0	0	0	0	0	PUBMED	0							
0	0	0	0	0	0	0	0	0	SCIENCE DIRECT	0							
0	0	0	0	0	0	0	0	0	ACADEMIC SEARCH COMPLETE	0							
0	0	0	0	0	0	0	0	0	WEB OF SCIENCE	0							

**Table 2.** The Cochrane collaboration tool to assess the risk of bias.

Domain	Support for judgement	Review authors' judgement
<i>Selection bias.</i>		
<b>Random sequence generation.</b>	Describe the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups.	Selection bias (biased allocation to interventions) due to inadequate generation of a randomized sequence.
<b>Allocation concealment.</b>	Describe the method used to conceal the allocation sequence in sufficient detail to determine whether intervention allocations could have been foreseen in advance of, or during, enrolment.	Selection bias (biased allocation to interventions) due to inadequate concealment of allocations prior to assignment.
<i>Performance bias.</i>		
<b>Blinding of participants and personnel</b> <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe all measures used, if any, to blind study participants and personnel from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.	Performance bias due to knowledge of the allocated interventions by participants and personnel during the study.
<i>Detection bias.</i>		
<b>Blinding of outcome assessment</b> <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe all measures used, if any, to blind outcome assessors from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.	Detection bias due to knowledge of the allocated interventions by outcome assessors.
<i>Attrition bias.</i>		
<b>Incomplete outcome data</b> <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe the completeness of outcome data for each main outcome, including attrition and exclusions from the analysis. State whether attrition and exclusions were reported, the numbers in each intervention group (compared with total randomized participants), reasons for attrition/exclusions where reported, and any re-inclusions in analyses performed by the review authors.	Attrition bias due to amount, nature or handling of incomplete outcome data.
<i>Reporting bias.</i>		
<b>Selective reporting.</b>	State how the possibility of selective outcome reporting was examined by the review authors, and what was found.	Reporting bias due to selective outcome reporting.
<i>Other bias.</i>		
<b>Other sources of bias.</b>	State any important concerns about bias not addressed in the other domains in the tool. If questions/entries were pre-specified in the review's protocol, responses should be provided for each question/entry.	Bias due to problems not covered elsewhere in the table.

