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Protocol of a scoping review assessing injury rate and determinants among healthcare workers in Western countries

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ABSTRACT

Introduction: Healthcare workers (HCWs) are subject to different risk factors and risky behaviors that can have a serious impact on their health and work capability. The aim of this protocol is to detail the steps for carrying out a scoping review assessing the prevalence of injuries among these workers category.

Methods and analysis: The study will be carried out following the Preferred Reporting Items For Systematic Reviews and Meta-analysis (PRISMA) guidelines. Studies will be selected according the following PICO: P (HCWs), E (exposure to injuries), C (different types of HCWs) and O (prevalence and determinants of injuries). Time filter has been set considering literature between 2000 and 2018 to enable a direct comparison of the findings with the epidemiological figures available at national and local INAIL centers in Italy. On the other hand, no language restriction will be applied. Study quality will be assessed using the Effective Public Health Practice Project (EPHPP) "Quality Assessment Tool for Quantitative Studies" checklist. Heterogeneity and sensitivity analysis, as well as publication bias assessment, will be performed.

Ethics and dissemination: Formal ethical approval is not required as primary data will not be collected. The results will be disseminated through a peer-reviewed publication, conference presentation and the popular press.

Study protocol registration number: Currently, the "International Prospective Register for Systematic Reviews" (PROSPERO) does not accept to register scoping review protocols.

Key terms: healthcare workers; injuries; scoping review protocol

Strengths and limitations of this study

- This scoping review concerning injuries among HCWs is the most comprehensive and broadest review, of studies performed in Western Countries, existing in the literature.
- Stratifying according to the work tasks and type of injuries could add meaningful information.
- The paucity of found results, especially those concerning some kinds of injuries, could limit generalization and interpretation of the research results.
- Another limitation is given by time filters, which, on the other hand, enable a direct comparison of the findings with the epidemiological figures available at national and local INAIL centers.

BACKGROUND

Healthcare system represents the fastest growing sector of the economy of Western countries, in that it employs million workers, over 18 millions in the United States and more than 59 millions worldwide.[1] Healthcare workers (HCWs) is an umbrella term, which includes "all people engaged in the promotion, protection or improvement of the health of the population", that is to say a variety of different figures, ranging from medical doctors (like specialists, pediatricians, general practitioners), to midwives and nurses, other health allied professionals, central supply workers and technicians, cleaners and porters, administrative professionals, as well as residents and students.[2-4]

Different variables, including the characteristics of the HCW (i.e., age, gender, education, smoking status, and other lifestyle habits), the features of the patient under care (namely, socio-demographic characteristics of the patient and type of disease) and of the hospital setting (for example, organization, workload, or night shifts) may act as risk factors and impact on HCW's health and safety, leading to injuries or disorders. As other working settings, hospitals are not, indeed, completely safe workplace environments for professionals. HCWs can be exposed to several occupational health hazards, resulting in a relevant clinical, economic and humanistic burden. Injury rates among HCWs constitute the highest injury rates, among all type of workers, in Western countries. Occupational hazards include biological ones (such as infections like, HAV, HBV, HCV, influenza, HIV/AIDS, measles, mumps, rubella, varicella, tuberculosis, pertussis or meningitis, among others),[5-13]. They represent an important occupational health problem: most of them are blood-borne diseases, which can be acquired through needle-stick or sharp injuries. HCWs have contact with infected patients and their body fluids. A particularly important factor is repeated performance of exposure prone procedures (EPPs) that may cause injuries to employees, such as surgeons, midwives, microbiologists, pathologists, blood bank and dialysis staff. According to a recent review by Cooke and Stephens, in 2015 a needle-stick injury generated a cost of 747 dollars (range 199-1,691 dollars).[14] Prüss-Ustün and collaborators, using mathematical modeling, estimated the global burden of infections due to percutaneous injuries among HCWs, on the basis of the probability of injury, the prevalence of infection, the susceptibility of the worker and the percutaneous transmission potential. In Western countries 1,510 HCV, 360 HBV and 11 HIV cases occurred in the year 2000, ranging from 8-27%, 1-8% and 0,5-3,1% of infections, respectively.[15] Incidence rates of sharps injuries range from 1.4 to 9.5 per 100 HCWs, with a weighted mean of 3.7/100 HCWs per year and a related societal mean cost of €272.[16] According to Deuffic-Burban and colleagues, the risk of transmission of blood-borne pathogens infections is estimated to be 30% in susceptible HCWs without post-exposure prophylaxis (PEP) or adequate hepatitis B vaccination,

0-0.5%, and <0.3%, for HBV, HCV and HIV, respectively. Adopting preventive measures such as following standard precautions, or undertaking training sessions targeted for both long-term HCWs, students and residents at risk, can lead to reduction in the incidence of occupational exposure, and therefore of percutaneous injuries (PIs). For instance, in France, the proportion of PIs preventable by taking standard precautions decreased from 52.5% in 2004 to 45.8% in 2008.[17]

Other hazards are ergonomic/physical. Musculoskeletal injuries are a leading category of accidents among HCWs, due to patient handling and overexertion. Musculoskeletal injuries can involve body structures such as muscles, nerves, tendons and ligaments, joints and cartilage, due to factors like repetition, force, awkward postures, contact stress or vibration. Healthcare personnel members dedicated to patient care, as well as to hospital housekeeping, laundry, and food service, maintenance, central supply and office, are susceptible to such injuries. Patient-handling injuries are caused by manually lifting patients, who are generally more overweight and obese than in the past. As such a "Safe Patient Handling--No Manual Lift" policy should be adopted in order to prevent such accidents, especially given the actual shortage of HCWs and, in particular of nurses, and the importance of early mobilizing patients and assisting them with physical activities.[18,19] According to some epidemiological surveys, up to two thirds of nurses have suffered from musculoskeletal disorders at least once time in their working life for at least 14 days.[20] Other HCWs with direct patient contact at high risk for developing musculoskeletal disorders are physical therapists. According to a recent comprehensive narrative review, their lifetime and yearly prevalence rates are 55-91%, and 40-91.3%, respectively. Injuries generally affect lower back, neck, upper back and shoulders.[21]

Physical violence represents another occupational hazard, which severely impacts on HCWs well-being, and job motivation, affecting health-care provision and quality.[22] According to the World Health Organization (WHO) estimates, from 8% to 38% of HCWs have suffered from assaults perpetrated by patients or visitors at least once at some point in their careers. Recently, the WHO, the International Labor Organization (ILO), the International Council of Nurses (ICN) and the Public Services International (PSI) have jointly developed a guideline entitled "Framework guidelines for addressing workplace violence in the health sector". Physical violence represents a major source of injuries among HCWs, especially those working in psychiatric wards. According to a recent review of the literature, in acute psychiatric units lifetime of physical, verbal, threats and sexual harassment are 24-80%, 46-78.6%, 43-78.6% and 9.5-37.2%, respectively. Sequelae of such episodes include fractures, eye injuries, and permanent disability, as well as psychological symptoms, such as anxiety, depression, post-traumatic disorder stress, or avoidance behavior.[23] Another hospital ward in which violence/assault can be experienced is the emergency department

(ED): according to a recent qualitative meta-synthesis, ED staff perceives aggression as unavoidable and feels isolated in its management.[24] Aggressors usually suffer from psychiatric disorders, have a history of drug and alcohol use, possess weapons, are a victim of violence and are unable to rationally cope with situational crises.[25] In the last years a rise in the number of assault episodes against HCWs has been observed: for example, in a University teaching hospital in the northern part of Italy, non-fatal violence events increased from 20.65/10,000 in 2012 to 22.81/10,000 in 2014, resulting in 431 days of absence from work and generating a direct cost of € 64,170. Up to 75% of violent episodes occurred in emergency room, intermediate care, psychiatry and geriatrics wards.[26]

Less common sources of injuries among HCWs are given by chemical exposure (inhalation of anesthetics, solvents, detergents or reagents)[27] or exposure to physical agents (such as ionizing and non ionizing radiations).

A particular type of injuries is given by commuting injuries. Some investigations conducted among shift and non shift workers found a strict significant relationship between shift-work condition and the presence of excess daytime sleepiness.[28,29] Due to workforce shortage, high workloads, and night shifts, 32% of HCWs report not to get enough sleep.[30]

Systematically identifying and then intervening to alter workplace conditions associated with exposure to health hazards may be an important tool for primary prevention.[31]

METHODS

Study design

In order to properly address the research questions, a scoping review will be performed using the 6-stage methodological framework initially proposed by Arksey and O'Malley.[32] This framework comprises 6 steps: namely, i) identifying the research question; ii) identifying relevant studies; iii) study selection; iv) charting the data; v) collating, summarizing and reporting the results; and vi) consultation exercise.[32] The conceptual scheme has been made more detailed and explicit by Levac, Colquhoun and O'Brien,[33] further refined by Colquhoun and collaborators,[34] and subsequently modified by the Joanna Briggs Institute (JBI) in the "JBI scoping review methods" manual.[35-37]

Scoping review is one of the fourteen kinds of literature synthesis identified by the Search, Appraisal, Synthesis and Analysis (SALSA) analytical.[38] In details, it is a review whose *"aim* [is] *to map rapidly the key concepts underpinning a research area and the main sources and types of evidence available, and can be undertaken as stand-alone projects in their own right, especially where an area is complex or has not been reviewed comprehensively before*".[39] This specifies a

literature search conducted with one or more broad research questions, and performed in an iterative way to familiarize with the entire literature, to gain a sense of it and to map it properly. Search restrictive/selective parameters are, indeed, set *a posteriori*. The results are obtained specifying inclusion and exclusion criteria and, thus, delimiting the outcome(s) of the literature search, similarly to systematic review, but also time constraints and space filters are allowed, for example, utilizing deadlines for searching and inclusion/exclusion criteria for study retention. Data are, then, abstracted and reported in a synthetic format (tables, charts, etc.).

The specific methodology of the scoping review was chosen taking into account both the nature and the specific requests of a national project co-funded and performed in collaboration between the Department of Health Sciences (DISSAL), Occupational Medicine - University of Genoa, Italy, and the "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institution for Insurance Against Accidents at Work, INAIL). This required a quick assessment of a diverse amount of scholarly literature, aiming more for breadth rather than for depth. As such, other types of review identified by the SALSA were not deemed methodologically effective, such as systematic reviews or rapid reviews.

As maintained by Arksey and O'Malley,[32] scoping review may be utilized to assess the topology of a vast body of literature, and to critically appraise it, in terms of current gaps of knowledge and future prospects. These aims corresponded to the objectives of our project.

More in detail, this scoping review is intended as one of the first step of our research plan: once "mapped" the extant literature concerning injuries among HCWs, each major topic will be further developed by in-depth systematic review and/or meta-analysis.

Review title

The current review protocol is titled "Protocol of a scoping review assessing injury prevalence and determinants among healthcare workers in Western countries". The title was guided by the so-called 'PCC' mnemonic (namely, Population, Concept and Context) used by the JBI. Structuring the title according to the PCC mnemonic enables to clearly reflect and incorporate the core information about the focus and scope of the review to potential impending readers.

Review objective

The study aim will be to map the extant literature concerning injury rate among HCWs in Western countries and their determinants.

Review questions

The main broad research question will be to evaluate the epidemiology of injuries among HCWs in Western countries carrying out a scoping review, in such a way to provide the health decision- and

policy-makers and the stakeholders with an updated synthesis of relevant studies in order to plan proper preventive strategies and interventions.

In details, all the sub-questions are: i) Which is the incidence/prevalence rate of injuries among HCWs in Western countries? ii) Which are the determinants of injuries among HCWs in Western countries? iii) Which is the type of injury most commonly occurring among HCWs in Western countries? iv) Among the different professional figures within the umbrella term of HCWs, which one(s) is/are the most affected by injuries in Western countries? v) Which is the burden imposed by injuries among HCWs in terms of related disabilities, residual working capability, absence from work and generated direct/indirect costs? vi) Which are the state-of-art preventive measures that can be adopted in order to effectively reduce injuries among HCWs in Western countries?

Drafting and registration of the study protocol

This *a priori* protocol is reported in such a way that the objectives and methods of the scoping review are clearly stated and pre-defined, according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis - Protocols (PRISMA-P) guidelines.[40] In accordance with these guidelines, the scoping review protocol has been submitted to the International Prospective Register of Systematic Reviews (PROSPERO).[41] However, currently, PROSPERO does not accept to register scoping review protocols.

The results of the study will be reported in line with the PRISMA guidelines (Figure 1).[42]

Data sources and Search strategy

A systematic literature search will be performed in the MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded and Social Sciences Citation Index from ISI/Web of Science, ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform databases.

This will include all studies reporting epidemiological figures of injuries among HCWs in Western countries in terms of prevalence/incidence rates. The search will be performed using a proper string of search terms (**Table 1**). The search strategy will be adapted for the other databases. Additionally, we will search reference lists of the chosen studies and prior reviews. When it will not be possible to make a decision on a study's inclusion or exclusion based on the abstract, the full text of the study will be examined.

We would like to emphasize that, as maintained by Arksey and O'Malley, scoping reviews, differently from systematic reviews, do not set *a priori* inclusion/exclusion criteria and data

extraction strategies in that these are better defined *post hoc*, that is to say after familiarizing with the extant literature.[32]

Study screening and selection

The studies will be independently screened by seven authors (NLB, GD, VP, FB, EM, BD, and AM) looking at study titles and abstracts for potential eligibility. Screening questions will be developed and pilot tested with a subset of records before implementation. Disagreement will be assessed using κ statistics and will be resolved through discussion; an eighth reviewer (PD) will be involved if necessary. We will provide a table with characteristics of included studies and another table of excluded studies with reasons for their exclusion, in our published final review.

Studies meeting the following criteria will be considered for inclusion:

- Population: HCWs
- Exposure: Injuries
- Design: original articles, prevalence/incidence studies, case series
- Languages: all languages available.

Appraisal of Study quality

The Effective Public Health Practice Project (EPHPP) "Quality Assessment Tool for Quantitative Studies" checklist will be used in order to critically appraise the quality of included studies.[43] This tool has been specifically developed for dealing with topics related to the field of public health, including injuries and their prevention. It comprises seven domains: namely, question formulation, literature *search* and retrieval, determining relevance criteria, assessment of literature for relevance and quality, data extraction and synthesis, peer review of the report, and dissemination.

Five reviewers are contents experts (GD, AT, CB, RL, ND) and one reviewer (NLB) is an experienced biostatistician/epidemiologist. The contents experts will only assess potential publications with respect to the appropriateness of the research questions tested. The biostatistician will only evaluate the appropriateness of methods employed. Disagreements will be resolved by consensus or involving VM and PD as final referees.

Statistical analysis

For the planned meta-analysis, data will be extracted from the studies using a standardized documentation form. The parameters will be the number of employees examined and the proportion

of employees who reported injuries. Prevalence ratios will be calculated as effect estimates. The 95% CIs will be generated. Additional analyses will be performed after stratification by type of study region, publication period, gender and professional group, as well as considering all the other variables listed in Table 2. Meta-analyses will be carried out using the commercial software Comprehensive Meta-Analysis version 3 (CMA v3). This analysis will include different HCWs professional areas.

Heterogeneity and sensitivity analysis

We will assess statistical heterogeneity in our meta-analysis, using the I^2 statistics. In details, if the I^2 is >50%, we will regard this as substantial heterogeneity.[44,45]

To identify sources of variation, further stratification will be performed relative to study quality and to performance of confirmatory tests. In addition, for the sensitivity analyses, the stability of the pooled estimate with respect to each study will be investigated by excluding individual studies from the analysis.

Publication bias

Possible publication bias will be visually inspected with a funnel plot, looking at asymmetry of the graph.[46] If asymmetry is present based on visual assessment, we will perform exploratory analyses to investigate and adjust this using trim and/or fill analysis.[47] In addition, the probability of publication bias will be tested using Egger's linear regression.[48]

Confidence in cumulative evidence

The strength of the body of evidence will be assessed using the "Grading of Recommendations Assessment, Development and Evaluation" (GRADE) tool.[49]

DISCUSSION

Implications

This scoping review with planned subsequent systematic review(s) with meta-analysis will provide the first rigorous analytical synthesis of primary research data concerning the epidemiology of injuries among HCWs in Western countries. This will be useful for decision makers in order to develop, design and implement adequate policies for primary prevention.

Ethics and dissemination

No ethical clearance is required for the present scoping review protocol as well as for its subsequent implementation steps, in that it will undertake a secondary analysis of data already collected and published. The findings of the scoping review as well as of its planned systematic review(s) and meta-analysis will be submitted to peer-reviewed journals for potential publication(s) and will be the object of *ad hoc* oral/poster communications in relevant national/international scientific congresses, conferences, as well as will be used to inform the development and implementation of courses for continuous medical learning.

References

1) World Health Organization. Working Together for Health: World Health Report 2006. Geneva, Switzerland, 2006.
2) Joseph B, Joseph M. The health of the healthcare workers. Indian J Occup Environ Med. 2016 May-Aug; 20(2): 71–72.
3) Adams BO, Dal Poz MR, Shengelia B, et al. Human, Physical, and Intellectual Resource Generation: Proposals for Monitoring. In Murray, C.J.L and Evans, D. (eds) Health Systems Performance Assessment: Debates, Methods and Empiricism. Geneva: World Health Organization: 273-287, 2003.
4) Diallo K, Zurn P, Gupta N, et al. Monitoring and evaluation of human resources for health: an international perspective. Hum Resour Health. 2003 Apr 14;1(1):3.
5) Young TN, Arens FJ, Kennedy GE, et al. Antiretroviral post-exposure prophylaxis (PEP) for occupational HIV exposure. Cochrane Database Syst Rev. 2007 Jan 24;(1):CD002835.
6) Rischitelli G, Harris J, McCauley L, et al. The risk of acquiring hepatitis B or C among public safety workers: a systematic review. Am J Prev Med. 2001 May;20(4):299-306.
7) Westermann C, Peters C, Lisiak B, et al. The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. Occup Environ Med. 2015 Dec;72(12):880-8.
8) Dini G, Toletone A, Sticchi L, et al. Influenza vaccination in healthcare workers: A comprehensive critical appraisal of the literature. Hum Vaccin Immunother. 2017 Aug 8:1-18.
9) Uden L, Barber E, Ford N, et al. Risk of Tuberculosis Infection and Disease for Health Care Workers: An Updated Meta-Analysis. Open Forum Infect Dis. 2017 Aug 29;4(3):ofx137.
10) Placidi D, Tonozzi B, Alessio L, Porru S. Tuberculin skin test (TST) survey among healthcare workers (HCWs) in hospital: a systematic review of the literature. G Ital Med Lav Ergon. 2007 Jul-Sep;29(3 Suppl):409-11.
11) Riccò M, Vezzosi L, Odone A, Signorelli C. Invasive Meningococcal Disease on the Workplaces: a systematic review. Acta Biomed. 2017 Oct 23;88(3):337-351.
12) van den Hoogen A, Duijn JM, Bode LGM, et al. Systematic review found that there was moderate evidence that vaccinating healthcare workers prevented pertussis in infants. Acta Paediatr. 2017, in press.
13) Leone Roberti Maggiore U, Scala C, et al. Susceptibility to vaccine-preventable diseases and vaccination adherence among healthcare workers in Italy: A cross-sectional survey at a

regional acute-care university hospital and a systematic review. Hum Vaccin Immunother. 2017 Feb;13(2):470-476.

14) Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. Med Devices (Auckl). 2017 Sep 29;10:225-235.

15) Prüss-Ustün A, Rapiti E, Hutin Y. Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers. Am J Ind Med. 2005; 48(6): 482.

16) Elseviers MM, Arias-Guillén M, Gorke A, Arens HJ. Sharps injuries amongst healthcare workers: review of incidence, transmissions and costs. J Ren Care. 2014 Sep;40(3):150-6.

17) Deuffic-Burban S, Delarocque-Astagneau E, Abiteboul D, et al. Blood-borne viruses in health care workers: prevention and management. J Clin Virol. 2011 Sep;52(1):4-10.

18) Edlich RF, Hudson MA, Buschbacher RM, et al. Devastating injuries in healthcare workers: description of the crisis and legislative solution to the epidemic of back injury from patient lifting. J Long Term Eff Med Implants. 2005;15(2):225-41.

19) Nelson AL, Collin J, Knibbe H, et al. Safer patient handling. Nurs Manage 2007 Mar;38(3):26−32.

20) Delloiacono N. Musculoskeletal safety for older adults in the workplace: review of current best practice evidence. Workplace Health Saf. 2015 Feb;63(2):48-53.

21) Milhem M, Kalichman L, Ezra D, Alperovitch-Najenson D. Work-related musculoskeletal disorders among physical therapists: A comprehensive narrative review. Int J Occup Med Environ Health. 2016;29(5):735-47.

22) Dillon BL. Workplace violence: impact, causes, and prevention. Work. 2012;42(1):15-20.

23) d'Ettorre G, Pellicani V. Workplace Violence Toward Mental Healthcare Workers Employed in Psychiatric Wards. Saf Health Work. 2017 Dec;8(4):337-342.

24) Ashton RA, Morris L, Smith I. A qualitative meta-synthesis of emergency department staff experiences of violence and aggression. Int Emerg Nurs. 2018, in press.

25) Gillespie GL, Gates DM, Miller M, et al. Workplace violence in healthcare settings: risk factors and protective strategies. Rehabil Nurs. 2010 Sep-Oct;35(5):177-84.

26) Sossai D, Molina FS, Amore M, et al. Analysis of incidents of violence in a large italian hospital. Med Lav. 2017 Oct 27;108(5):6005.

27) Molina Aragonés JM, Ayora Ayora A, Barbara Ribalta A, et al. Occupational exposure to volatile anaesthetics: a systematic review. Occup Med (Lond). 2016 Apr;66(3):202-7.

28) Garbarino S, Traversa F, Spigno F, et al. Sleepiness, sleep disorders and risk of occupational accidents. G Ital Med Lav Ergon. 2011 Jul-Sep;33(3 Suppl):207-11.

29) Garbarino S, Repice AM, Traversa F, et al. Commuting accidents: the influence of excessive daytime sleepiness. A review of an Italian Police officers population. G Ital Med Lav Ergon. 2007 Jul-Sep;29(3 Suppl):324-6.

30) Caruso CC. Negative impacts of shiftwork and long work hours. Rehabil Nurs. 2014 Jan-Feb;39(1):16-25.

31) Copello F, Garbarino S, Messineo A, et al.. Occupational Medicine and Hygiene: applied research in Italy. J Prev Med Hyg. 2015;56(2):E102-10.

32) Arksey H, O'Malley L. Scoping studies: Towards a Methodological Framework. Int J Soc Res Methodol. 2005;8:19–32.

33) Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. Implement Sci. 2010 Sep 20;5:69.

34) Colquhoun HL, Levac D, O'Brien KK, et al. Scoping reviews: time for clarity in definition, methods, and reporting. J Clin Epidemiol. 2014 Dec;67(12):1291-4.

35) Tricco AC, Lillie E, Zarin W, et al. A scoping review on the conduct and reporting of scoping reviews. BMC Med Res Methodol. 2016 Feb 9;16:15.

36) Khalil H, Peters M, Godfrey CM, et al. An Evidence-Based Approach to Scoping Reviews. Worldviews Evid Based Nurs. 2016 Apr;13(2):118-23.

37) Peters MD, Godfrey CM, Khalil H, et al. Guidance for conducting systematic scoping reviews. International journal of evidence-based healthcare. 2015;13(3):141-146.

38) Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. Health Info Libr J. 2009 Jun;26(2):91-108.

39) Mays N, Roberts E, Popay J. (2001). Synthesising research evidence. In N. Fulop, P. Allen, A. Clarke, & N. Black (Eds.), Studying the organisation and delivery of health services: Research methods (pp. 188-219). London: Routledge.

40) Shamseer L, Moher D, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015;349(jan02 1):g7647.

41) Chien PF, Khan KS, Siassakos D. Registration of systematic reviews: PROSPERO. BJOG. 2012 Jul;119(8):903-5.

42) Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. Open Med. 2009;3(3):e123-30. Epub 2009 Jul 21.

43) Armijo-Olivo S, Stiles CR, Hagen NA, et al. Assessment of study quality for systematic reviews: a comparison of the Cochrane Collaboration Risk of Bias Tool and the Effective

Public Health Practice Project Quality Assessment Tool: methodological research. J Eval Clin Pract. 2012 Feb;18(1):12-8.

44) Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Stat Med. 2002;21(11):1539-58.

45) Huedo-Medina TB, Sánchez-Meca J, Marín-Martínez F, et al. Assessing heterogeneity in meta-analysis: Q statistic or I2 index? Psychol Methods. 2006;11(2):193-206.

46) Sterne JA, Egger M. Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. J Clin Epidemiol. 2001 Oct;54(10):1046-55.

47) Duval S, Tweedie R. Trim and fill: a simple funnel-plot–based method of testing and adjusting for publication bias in meta-analysis. Biometrics. 2000;56:455–63.

48) Egger M, Davey Smith G, Schneider M, et al. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997;315(7109):629-34.

49) Dijkers M. Introducing GRADE: a systematic approach to rating evidence in systematic reviews and to guideline development. 2016. Available at http://ktdrr.org/products/update/v1n5/dijkers_grade_ktupdatev1n5.html

Tables.

Table 1.

SEARCH STRATEGY ITEM	SEARCH STRATEGY
Databases	PubMed/MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded and Social Sciences Citation Index from ISI/Web of Science, ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform
Language filter	None
Time filter	2000-2018
Spatial filter	Western countries
Keywords	1. “healthcare worker” OR “healthcare workers” OR “healthcare personnel” OR “healthcare staff” OR “health worker” OR “health workers” OR “health personnel” OR “health staff” OR physicians OR physician OR doctors OR doctor OR nurses OR nurse OR practitioners OR practitioner OR "medical students" OR "medical residents" OR "attending residents" OR "hospital technician" OR "hospital technicians" OR "paramedical personnel" OR "paramedical staff" OR " hospital support personnel" 2. injury OR injuries OR incident OR incidents OR "occupational injury" OR "occupational injuries" OR "occupational incident" OR "occupational incidents" OR "work related injury" OR "work related injuries" OR "work related incident" OR "work related incidents" OR "workplace-induced injury" OR "workplace-induced injuries" OR "workplace-induced incident" OR "workplace-induced incidents" OR "occupational health hazard" OR "occupational health hazards" 3. "exposure incidents" OR "splash exposures" OR "splash exposure" OR needle-sticks OR "sharp objects" OR sharps OR "percutaneous injuries" OR "percutaneous injury" 4. "manual handling injury" OR "manual handling injuries" OR "musculoskeletal injury" OR "musculoskeletal injuries" 5. "chemical occupational exposure" OR "exposure to inhaled anesthetic" OR "reagent exposure" OR "exposure to reagent" OR "exposure to solvents" OR "solvent exposure" OR "exposure to detergents" OR "detergent exposure" 6. "slips, trips and falls" OR "slipping, tripping and falling accidents" OR "accidental fall" OR "same-level fall" OR "same-surface fall" OR stump-and-fall OR step-and-fall OR "forced-rotation-type fall" OR "fall from elevation" 7. "violent events" OR violence OR assault OR assaults 8. "cuts and wounds" OR "burns" 9. "motor vehicle accidents" OR "motor vehicle accident" OR "motor

	vehicle collisions" OR "motor vehicle collision" OR "motor vehicle crash" OR "motor vehicle crashes" OR "motor vehicle near crash" OR "motor vehicle near crashes" 10. "exposure to ionizing radiation" OR "radiation exposure" 1. AND 2. OR 3. OR 4. OR 5. OR 6. OR 7. OR 8. OR 9. OR 10.
Inclusion criteria	P: medical/paramedical students and residents, doctors and nurses, cleaners and porters E: exposure to biological, chemical, physical/ergonomic risk and hazard C: medical versus nursing or dental students; students versus residents; medical versus nursing or dental trainees/residents; before and after a preventive program O: prevalence/incidence of injuries and their determinants among healthcare workers in Western countries, related disabilities and absence from work, and generated economic burden (direct/indirect costs) S: primary research
Exclusion criteria	Editorial, letter to the editor, commentary, review
Target journals	Occupational and public health journals

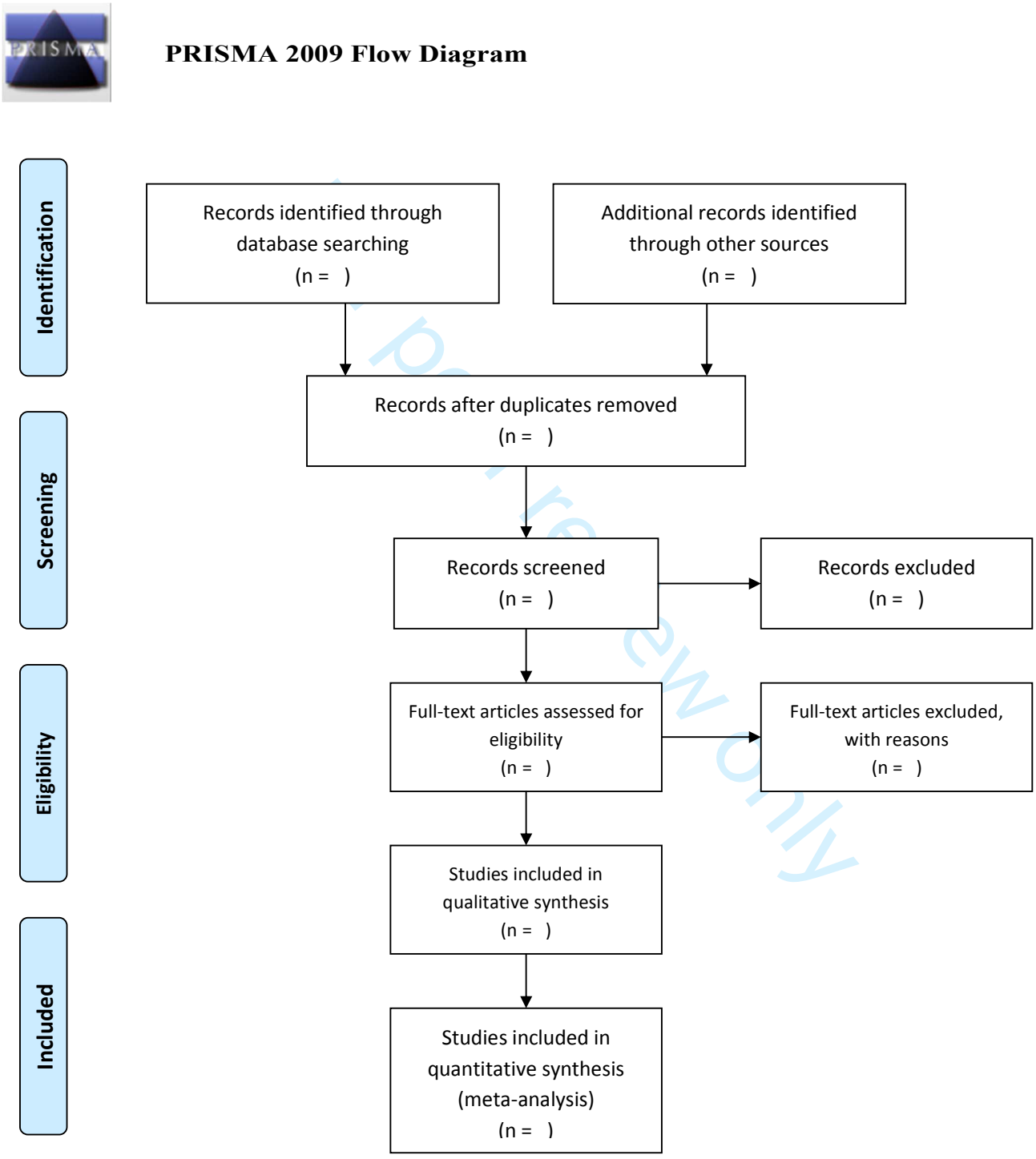
Table 2.

EXTRACTED DATA	DETAILS
Study Reference	Names and surnames of authors, year of publication
Study population	Physicians, doctors, nurses, medical students, residents, cleaners, porters
Country	Country or countries in which the study or studies was or were carried out
Study design	Type of recruitment
M%	Percentage of male healthcare workers
Age	Mean age of healthcare workers sample
Sample number, attrition rate	Number of healthcare workers who took part into the survey, number of non responders
Professional/experience years	Years spent in profession by healthcare workers included in the study
Working setting	Hospital ward where the injury occurred (for example, emergency room, obstetrics department, surgery department, operating room, outpatient clinic, department of Internal Medicine, patients' room, CCU/ICU)
Injury prevalence/incidence rate	Prevalence/incidence rates stratified according to the kind of injury
Method	Questionnaire (validated, not validated)
Following standard procedures	Prevalence/incidence rates stratified according to the compliance to procedures and guidelines among the different types of healthcare workers
Knowledge, attitudes and practices about PEP	Prevalence/incidence rates stratified according to the knowledge, attitudes and practices concerning PEP, among the different types of healthcare workers
Clerkship abroad	Periods of training abroad; type of task(s) the healthcare worker was involved in during the training period abroad
Reporting/non-reporting to Occupational Departement	Prevalence/incidence rates stratified according

	to the determinants of the reporting/non-reporting, among the different types of healthcare workers
Injuries-related burden	Number of days of absence from work, disabilities and economic direct/indirect costs due to injuries

Figures.

Figure 1. Flowchart of selection of studies according to the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.



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All authors participated in drafting the article or revising it critically for important intellectual content; all authors gave final approval of the version to be submitted and any revised version.

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Competing interests statement:

The authors report no conflicts of interest in this work.

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page of the documents and details
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	Protocol of a scoping review assessing injury rate and determinants among healthcare workers in Western countries (page 1)
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	In accordance with these guidelines, the scoping review protocol has been submitted to the International Prospective Register of Systematic Reviews (PROSPERO). However, currently, PROSPERO does not accept to register scoping review protocols (page 8).
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	Page 1 and page 21. Furthermore, role of each author is outlined in the protocol.
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	The present protocol is not an amendment.
Support:			Sources and the role of the sponsor are indicated at page 7 and at page 21.
Sources	5a	Indicate sources of financial or other support for the review	
Sponsor	5b	Provide name for the review funder and/or sponsor	
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	Rationale is provided in the background (pages 4-6).
Objectives	7	Provide an explicit statement of the question(s) the review will	Page 7.

		address with reference to participants, interventions, comparators, and outcomes (PICO)	
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	Page 8 and table 1.
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	Page 8 and table 1.
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Page 8 and table 1.
Study records: Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	Pages 8-9.

Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	Pages 8-9
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	Pages 8-9
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	Table 2.
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with Rationale	Table 2.
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	Pages 8-10
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	Pages 8-10
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	Pages 8-10
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	Page 10

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

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Protocol of a scoping review assessing injury rate and its determinants among healthcare workers in Western countries

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Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Epidemiology
Keywords:	healthcare workers, injuries, scoping review protocol

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Protocol of a scoping review assessing injury rate and its determinants among healthcare workers in Western countries

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ABSTRACT

Introduction: Healthcare workers (HCWs) are subject to different risk factors and risky behaviors that can have a serious impact on their health and work capability. The aim of this protocol is to detail the steps for carrying out a scoping review assessing the prevalence/incidence of injuries among HCWs.

Methods and analysis: The study will be carried out following the "Preferred Reporting Items for Systematic reviews and Meta-Analysis" (PRISMA) guidelines. Studies will be selected according to the following PECO criteria: P (HCWs), E (exposure to injuries), C (different types of HCWs) and O (prevalence/incidence and determinants of injuries). Time filter has been set considering literature between 2000 and 2018 to enable a direct comparison of the findings with the epidemiological figures available at national and local "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institute for Insurance Against Accidents at Work, INAIL) centers in Italy. No language restriction will be applied.

Ethics and dissemination: Formal ethical approval is not required as primary data will not be collected, being already published. The results will be disseminated through peer-reviewed publication(s), conference presentation(s) and the popular press.

Key terms: healthcare workers; injuries; scoping review protocol

Strengths and limitations of this study

- In the existing scholarly literature, there is not a comprehensive and broad review of studies performed in Western Countries concerning injuries among healthcare workers .
- Stratifying according to the work tasks and type of injuries could add meaningful information.
- A major limitation of the study may be the paucity of found results, especially those concerning certain kinds of injuries.
- Another limitation concerns time filter, which, on the other hand, enables a direct comparison of the findings with the epidemiological figures available at national and local "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institute for Insurance Against Accidents at Work, INAIL) centers.

BACKGROUND

The healthcare system represents the fastest growing sector in Western economy and employs millions of workers, over 18 million in the United States and more than 59 million worldwide.[1] Healthcare workers (HCWs) is an umbrella term, which refers to all people engaged in the promotion, protection or improvement of the health of the population. This term includes a variety of different figures, ranging from medical doctors (like specialists, pediatricians, and general practitioners), to midwives and nurses, other health allied professionals, central supply workers and technicians, as well as residents.[2-4]

Different variables may act as risk factors and impact on HCWs' health and safety, which could, in turn, lead to injuries or disorders. These include: the characteristics of the HCWs (age, gender, education, smoking status, and other lifestyle habits), as well as the features of the patient under care (namely, socio-demographic characteristics of the patient and type of disease) and of the hospital setting (for example, organization, workload, or night shifts).

As with other working settings, hospitals are not completely safe workplace environments for professionals. HCWs can be exposed to several occupational health hazards, resulting in a relevant clinical, economic and humanistic burden. Injury rates among HCWs constitute the highest injury rates, among all type of workers, in Western countries.[5,6] Occupational hazards include biological ones (such as infections, like HAV, HBV, HCV, influenza, HIV/AIDS, measles, mumps, rubella, varicella, tuberculosis, pertussis or meningitis, among others).[7-15] They represent an important occupational health problem, as most of them are blood-borne diseases, which can be acquired through needle-stick or sharp injuries. HCWs have contact with infected patients and their body fluids. An important factor is that HCWs are at risk for repeated performance of exposure prone procedures (EPPs) that may cause injuries to employees. These include surgeons, midwives, microbiologists, pathologists, blood bank and dialysis staff. According to a recent review by Cooke and Stephens, in 2015, a needle-stick injury generated a cost of 747 dollars (range 199-1,691 dollars).[16] Prüss-Ustün and collaborators, using mathematical modeling, estimated the global burden of infections due to percutaneous injuries among HCWs. More in detail, this was done on the probability of injury, the prevalence of infection, the susceptibility of the worker and the percutaneous transmission potential. In Western countries, 1,510 HCV, 360 HBV and 11 HIV cases occurred in the year 2000, ranging from 8-27%, 1-8% and 0,5-3,1% of infections, respectively.[17] Incidence rates of sharps injuries ranged from 1.4 to 9.5 per 100 HCWs, with a weighted mean of 3.7/100 HCWs *per* year and a related societal mean cost of €272.[18] According to Deuffic-Burban and colleagues, the risk of transmission of blood-borne pathogens infections is estimated to be 30% in susceptible HCWs without post-exposure prophylaxis (PEP) or adequate hepatitis B vaccination,

0-0.5%, and <0.3%, for HBV, HCV and HIV, respectively. Adopting preventive measures such as following standard precautions or undertaking training sessions targeted for both long-term HCWs, students and residents at risk can lead to a reduction in the incidence of occupational exposure, and, therefore, of percutaneous injuries (PIs). For instance, in France, the proportion of PIs preventable by taking standard precautions decreased from 52.5% in 2004 to 45.8% in 2008.[19]

Other hazards are ergonomic/physical. The category of musculoskeletal injuries represents one of the highest categories of accidents among HCWs, due to patient handling and overexertion. Musculoskeletal injuries can involve body structures, such as muscles, nerves, tendons and ligaments, joints and cartilage, due to factors like repetition, force, awkward postures, contact stress or vibration. Healthcare personnel members dedicated to patient care, as well as to hospital housekeeping, laundry, and food service, maintenance, central supply and office, are susceptible to such injuries. Patient-handling injuries are caused by manually lifting patients, who are generally more overweight and obese than in the past. As such, a "Safe Patient Handling – No Manual Lift" policy should be adopted in order to prevent such accidents. This is especially of value, given the actual shortage of HCWs and, in particular, of nurses, and the importance of early mobilizing patients and assisting them with physical activities.[20,21] According to some epidemiological surveys, up to two thirds of nurses have suffered from musculoskeletal disorders at least once in their working life for at least 14 days.[22] Physical therapists are another type of HCWs with direct patient contact at high risk for developing musculoskeletal disorders. According to a recent comprehensive narrative review, their lifetime and yearly prevalence rates are 55-91% and 40-91.3%, respectively. Injuries generally affect lower back, neck, upper back and shoulders.[23]

Physical violence represents another occupational hazard, which severely impacts on HCWs' well-being and job motivation, affecting health-care provision and quality.[24] According to the World Health Organization (WHO) estimates, from 8% to 38% of HCWs have suffered from assaults perpetrated by patients or visitors at least once, at some point in their careers. Recently, the WHO, the "International Labor Organization" (ILO), the "International Council of Nurses" (ICN) and the "Public Services International" (PSI) have jointly developed a guideline entitled "Framework guidelines for addressing workplace violence in the health sector".[25] Physical violence represents a major source of injuries among HCWs, especially those working in psychiatric wards.[26] According to a recent review of the literature, in acute psychiatric units, lifetime rates of overall assaults, physical and verbal threats and sexual harassment are 24-80%, 46-78.6%, 43-78.6% and 9.5-37.2%, respectively. Complications of such episodes include fractures, eye injuries, and permanent disability, as well as psychological symptoms, such as anxiety, depression, post-traumatic stress disorder (PTSD), or avoidance behavior.[27,28] Another hospital ward in which violence/assault can be

experienced is the emergency department (ED): according to a recent qualitative meta-synthesis, ED staff perceives aggression as unavoidable and feels isolated in its management.[29] Aggressors usually suffer from psychiatric disorders, have a history of drug and alcohol use, possess weapons, are victims of violence and are unable to rationally cope with situational crises.[30] In recent years, a rise in the number of assault episodes against HCWs has been observed: for example, in a University teaching hospital in the northern part of Italy, non-fatal violence events increased from 20.65/10,000 in 2012 to 22.81/10,000 in 2014, resulting in 431 days of absence from work and generating a direct cost of € 64,170. Up to 75% of violent episodes occurred in emergency room, intermediate care, psychiatry and geriatrics wards.[31]

Less common sources of injuries among HCWs are represented by chemical exposure (inhalation of anesthetics, solvents, detergents or reagents)[32] or exposure to physical agents (such as ionizing and non ionizing radiations).[33]

A particular type of injury is also known to occur among commuters. Some scholars conducted research among shift and non-shift workers and found a strict, statistically significant relationship between shift-work condition and the presence of excess daytime sleepiness.[34-37] Due to workforce shortage, high workloads, and night shifts, 32% of HCWs report not to get enough sleep.[36]

Systematically identifying and, then, intervening to alter workplace conditions associated with exposure to health hazards may be an important tool for primary prevention.[38]

METHODS

Review title

The current review protocol is titled "Protocol of a scoping review assessing injury rate and its determinants among healthcare workers in Western countries". The title was guided by the so-called 'PCC' mnemonic (namely, Population, Concept and Context) used by the Joanna Briggs Institute (JBI). Structuring the title according to the PCC mnemonic enables to clearly reflect and incorporate the core information about the focus and scope of the review.

Review questions

The main broad research question will be to evaluate the epidemiology of injuries among HCWs in Western countries by carrying out a scoping review. This is expected to provide the health decision- and policy-makers and all the involved stakeholders with an updated synthesis of relevant studies, in order to plan proper *ad hoc* preventive strategies and interventions.

More in detail, all the sub-questions are: i) What is the incidence/prevalence rate of injuries among HCWs in Western countries? ii) What are the determinants of injuries among HCWs in Western

countries? iii) What is the type of injury most commonly occurring among HCWs in Western countries? iv) Among the different professional figures within the umbrella term of HCWs, which one(s) is/are the most affected by injuries in Western countries? v) What is the burden imposed by injuries among HCWs in terms of related disabilities, residual working capability, absence from work and generated direct/indirect costs? vi) What are the state-of-art preventive measures that can be adopted in order to effectively reduce injuries among HCWs in Western countries?

Review objective

The study aim will be to map the existing literature concerning injury rate among HCWs in Western countries and its determinants. As such, the main "*end product ...* [will be] *… a narrative presentation, with minimal or limited statistical information*".[39] Secondary objective will be to verify the feasibility of performing systematic review(s) and meta-analysis.

Study design

In order to properly address the research questions, a scoping review will be performed using the 6-stage methodological framework initially proposed by Arksey and O'Malley.[40] This framework comprises 6 steps: namely, i) identifying the research question; ii) identifying relevant studies; iii) study selection; iv) charting the data; v) collating, summarizing and reporting the results; and vi) consultation exercise.[41] The conceptual scheme has been made more detailed and explicit by Levac, Colquhoun and O'Brien,[42] further refined by Colquhoun and collaborators,[43] and subsequently modified by the JBI in the "JBI scoping review methods" manual.[39,44]

Scoping review is one of the fourteen kinds of literature synthesis, according to the "Search, Appraisal, Synthesis and Analysis" (SALSA) framework.[45] In detail, it is a review whose *"aim* [is] *to map rapidly the key concepts underpinning a research area and the main sources and types of evidence available, and can be undertaken as stand-alone projects in their own right, especially where an area is complex or has not been reviewed comprehensively before*".[46] This specifies a literature search conducted with one or more broad research questions, and performed in an iterative way to familiarize with the entire literature, to gain a sense of it and to map it properly. Search restrictive/selective parameters can be set *a posteriori*. The results are obtained specifying inclusion and exclusion criteria and, thus, delimiting the outcome(s) of the literature search, similarly to systematic review, but also time constraints and space filters are allowed, for example, utilizing deadlines for searching and inclusion/exclusion criteria for study retention. Data are, then, abstracted and reported in a synthetic format (tables, charts, etc.).

The specific methodology of the scoping review was chosen to take into account both the nature and the specific requests of a national project co-funded and performed in collaboration between the Department of Health Sciences (DISSAL), Occupational Medicine - University of Genoa, Italy, and

the "*Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro*" (in Italian, "National Institute for Insurance Against Accidents at Work", INAIL). This required a quick assessment of a diverse amount of scholarly literature, aiming more for breadth rather than for depth. As such, other types of review identified by the SALSA framework were not deemed methodologically effective, such as systematic reviews, umbrella reviews or rapid reviews.

As maintained by Arksey and O'Malley,[40] scoping reviews may be utilized to assess the topology of a vast body of literature, and to critically appraise it, in terms of current gaps of knowledge and future prospects. These aims corresponded to the objectives (both primary and secondary) of our project.

Drafting and registration of the study protocol

This *a priori* protocol is reported in such a way that the objectives and methods of the scoping review are clearly stated and pre-defined, according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis – Protocols (PRISMA-P) guidelines.[47] However, despite the recommendation of these guidelines, it was not possible to register the scoping review protocol in the "International Prospective Register of Systematic Reviews" (PROSPERO),[48] in that it, currently, does not accept scoping review protocols.

The results of the study will be reported in line with the PRISMA guidelines (Figure 1).[49]

Data sources and Search strategy

A systematic literature search will be performed in the MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded and Social Sciences Citation Index from ISI/Web of Science, ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform databases.

This will include all studies reporting epidemiological figures of injuries among HCWs in Western countries in terms of prevalence/incidence rates. The search will be performed using a proper string of search terms (**Table 1**). The search strategy will be adapted for the other databases. Additionally, we will search reference lists of the chosen studies and prior reviews. When it will not be possible to make a decision on a study's inclusion or exclusion based on the abstract, the full text of the study will be examined.

We would like to emphasize that, as maintained by Arksey and O'Malley, scoping reviews, differ from systematic reviews and do not set *a priori* inclusion/exclusion criteria and data extraction strategies. These are better defined *post hoc*, that is to say after familiarizing with the existing

literature.[40] We have carried out a preliminary literature search on the topic of interest in order to preliminarily clarify inclusion/exclusion criteria.

Study screening and selection

The studies will be independently screened by two authors (NLB and GD), looking at study titles and abstracts for potential eligibility. Screening questions will be developed and pilot tested with a subset of records before implementation. The inter-rater agreement will be assessed using κ statistics and will be resolved through discussion; a third reviewer (PD), acting as a final referee, will be involved if necessary. We will provide a table with characteristics of included studies and another table of excluded studies with reasons for their exclusion, in our published final scoping review.

Studies meeting the following PECO criteria will be considered for inclusion:[50]

- P (patient, problem or population): HCWs;
- E (exposure): injuries;
- C (comparison, control or comparator): different types of HCWs;
- O (outcome/outcomes of interest): prevalence/incidence and determinants of injuries.

Furthermore, the following criteria will be taken into consideration:

- Study design/characteristics: original articles, prevalence/incidence studies, case series;
- Languages: no language filter/restraint (that is to say, all the full complement of Western languages available).

Appraisal of Study quality

In the drafting of the scoping review, we will not critically appraise the methodological quality or risk of bias of the included articles, as this will be done in the next steps, once verified the feasibility of performing systematic review(s) and meta-analysis.

In case of feasibility, the “Effective Public Health Practice Project” (EPHPP) "Quality Assessment Tool for Quantitative Studies" checklist will be used in order to critically appraise the quality of included studies.[51] This tool has been specifically developed for dealing with topics related to the field of public health. This includes injuries and their prevention. It comprises seven domains: namely, i) question formulation, ii) literature search and retrieval, iii) determining relevance criteria, iv) assessment of literature for relevance and quality, v) data extraction and synthesis, vi) peer review of the report, and vii) dissemination.

Two reviewers are contents experts (GD and AT) and one reviewer (NLB) is an experienced biostatistician/epidemiologist. The contents experts will only assess potential publications with respect to the appropriateness of the research questions tested. The biostatistician will only evaluate the appropriateness of methods employed. Disagreements will be resolved by consensus or involving VM and PD (mentors and supervisors of the scientific research project), who will act as final referees. PD is an occupational physician, coming from academic setting, whereas VM is an occupational physician with expertise in the field of social security and insurance.

Statistical analysis

For the planned systematic review(s) and meta-analysis, once feasibility has been verified, data will be extracted from the studies using a standardized documentation form. The parameters will be the number of employees examined and the proportion of employees who reported injuries. Prevalence/incidence ratios will be calculated as effect size estimates. The 95% confidence intervals (CIs) will be generated.

Additional analyses will be performed after stratification by type of study region, publication period, gender and professional group, as well as considering all the other variables listed in **Table 2**. Meta-analyses will be carried out using the commercial software Comprehensive Meta-Analysis version 3 (CMA v3). This analysis will include different HCWs' professional areas.

Heterogeneity and sensitivity analysis

Once verified the feasibility of conducting systematic review(s) and meta-analysis, we will assess statistical heterogeneity in our meta-analysis, using the I^2 statistics. In details, if the I^2 is >50%, we will regard this as substantial, statistically significant heterogeneity.[52,53]

To identify sources of variation, further stratification will be performed based on study quality. In addition, for the sensitivity analyses, the stability of the pooled estimate with respect to each study will be investigated by excluding individual studies from the analysis.

Publication bias

Once verified the feasibility of conducting systematic review(s) and meta-analysis, possible publication bias will be visually inspected with a funnel plot, looking at asymmetry of the graph.[54] If asymmetry is present based on visual assessment, we will perform exploratory analyses to investigate it and adjust the pooled estimate using the trim and/or fill analysis.[55] In addition, the probability of publication bias will be tested using the Egger's linear regression.[56]

Confidence in cumulative evidence

Once the feasibility of carrying out systematic review(s) and meta-analysis has been verified, the strength of the body of evidence will be assessed using the "Grading of Recommendations Assessment, Development and Evaluation" (GRADE) tool.[57]

Patient and public involvement

There was no specific patient and public involvement in the development of this scoping review.

DISCUSSION

Implications

This scoping review with planned subsequent systematic review(s) with meta-analysis will provide the first rigorous analytical synthesis of primary research data concerning the epidemiology of injuries among HCWs in Western countries. This will be useful for decision- and policy-makers in order to develop, design and implement *ad hoc* adequate policies for primary prevention.

Ethics and dissemination

No ethical clearance is required for the present scoping review protocol and for its subsequent implementation steps, in that it will undertake a knowledge synthesis and an analysis of data that have been already collected and published. The findings of the scoping review as well as of its potentially planned systematic review(s) and meta-analysis will be submitted to peer-reviewed journals for potential publication(s) and will be the object of *ad hoc* oral/poster communications in relevant national/international scientific congresses, conferences, and will be used to inform the development and implementation of courses for continuous medical learning.

References

1) World Health Organization. Working Together for Health: World Health Report 2006. Geneva: Switzerland, 2006.
2) Joseph B, Joseph M. The health of the healthcare workers. *Indian J Occup Environ Med* 2016;20(2):71–72.
3) Adams BO, Dal Poz MR, Shengelia B, *et al*. Human, Physical, and Intellectual Resource Generation: Proposals for Monitoring. In Murray, C.J.L and Evans, D. (eds) Health Systems Performance Assessment: Debates, Methods and Empiricism. Geneva: World Health Organization: 273-287, 2003.
4) Diallo K, Zurn P, Gupta N, *et al*. Monitoring and evaluation of human resources for health: an international perspective. *Hum Resour Health* 2003;1(1):3.
5) Dressner MA. Hospital workers: an assessment of occupational injuries and illnesses. Monthly Labor Review, U.S. Bureau of Labor Statistics, June 2017.
6) Miller K. Risk factors and impacts of occupational injury in healthcare workers: A critical review. OA Musculoskeletal Medicine 2013 Mar 01;1(1):4.
7) Young TN, Arens FJ, Kennedy GE, *et al*. Antiretroviral post-exposure prophylaxis (PEP) for occupational HIV exposure. *Cochrane Database Syst Rev* 2007;(1):CD002835.
8) Rischitelli G, Harris J, McCauley L, et al. The risk of acquiring hepatitis B or C among public safety workers: a systematic review. Am J Prev Med. 2001 May;20(4):299-306.
9) Westermann C, Peters C, Lisiak B, et al. The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. Occup Environ Med. 2015 Dec;72(12):880-8.
10) Dini G, Toletone A, Sticchi L, et al. Influenza vaccination in healthcare workers: A comprehensive critical appraisal of the literature. Hum Vaccin Immunother. 2017 Aug 8:1-18.
11) Uden L, Barber E, Ford N, et al. Risk of Tuberculosis Infection and Disease for Health Care Workers: An Updated Meta-Analysis. Open Forum Infect Dis. 2017 Aug 29;4(3):ofx137.
12) Placidi D, Tonozzi B, Alessio L, Porru S. Tuberculin skin test (TST) survey among healthcare workers (HCWs) in hospital: a systematic review of the literature. G Ital Med Lav Ergon. 2007 Jul-Sep;29(3 Suppl):409-11.
13) Riccò M, Vezzosi L, Odone A, et al. Invasive Meningococcal Disease on the Workplaces: a systematic review. Acta Biomed. 2017 Oct 23;88(3):337-351.

14) van den Hoogen A, Duijn JM, Bode LGM, *et al*. Systematic review found that there was moderate evidence that vaccinating healthcare workers prevented pertussis in infants. Acta Paediatr. 2017, in press.

15) Leone Roberti Maggiore U, Scala C, et al. Susceptibility to vaccine-preventable diseases and vaccination adherence among healthcare workers in Italy: A cross-sectional survey at a regional acute-care university hospital and a systematic review. Hum Vaccin Immunother. 2017 Feb;13(2):470-476.

16) Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. *Med Devices (Auckl)* 2017;10:225-235.

17) Prüss-Ustün A, Rapiti E, Hutin Y. Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers. *Am J Ind Med* 2005;48(6):482.

18) Elseviers MM, Arias-Guillén M, Gorke A, *et al*. Sharps injuries amongst healthcare workers: review of incidence, transmissions and costs. *J Ren Care* 2014 Sep;40(3):150-6.

19) Deuffic-Burban S, Delarocque-Astagneau E, Abiteboul D, *et al*. Blood-borne viruses in health care workers: prevention and management. *J Clin Virol* 2011;52(1):4-10.

20) Edlich RF, Hudson MA, Buschbacher RM, *et al*. Devastating injuries in healthcare workers: description of the crisis and legislative solution to the epidemic of back injury from patient lifting. *J Long Term Eff Med Implants* 2005;15(2):225-41.

21) Nelson AL, Collin J, Knibbe H, *et al*. Safer patient handling. *Nurs Manage* 2007;38(3):26−32.

22) Delloiacono N. Musculoskeletal safety for older adults in the workplace: review of current best practice evidence. *Workplace Health Saf* 2015;63(2):48-53.

23) Milhem M, Kalichman L, Ezra D, *et al*. Work-related musculoskeletal disorders among physical therapists: A comprehensive narrative review. Int J Occup Med Environ Health. 2016;29(5):735-47.

24) Dillon BL. Workplace violence: impact, causes, and prevention. *Work* 2012;42(1):15-20.

25) International Labour Office (ILO), International Council of Nurses (ICN), World Health Organization (WHO), Public Services International (PSI). Joint Programme on Workplace Violence in the Health Sector. Geneva, 2002.

26) Spaducci G, Stubbs B, McNeill A, Stewart D, Robson D. Violence in mental health settings: A systematic review. Int J Ment Health Nurs. 2018 Feb;27(1):33-45.

27) d'Ettorre G, Pellicani V. Workplace Violence Toward Mental Healthcare Workers Employed in Psychiatric Wards. *Saf Health Work* 2017;8(4):337-342.

28) Luftman K, Aydelotte J, Rix K, et al. PTSD in those who care for the injured. Injury. 2017 Feb;48(2):293-296.

29) Ashton RA, Morris L, Smith I. A qualitative meta-synthesis of emergency department staff experiences of violence and aggression. Int Emerg Nurs. 2018, in press.

30) Gillespie GL, Gates DM, Miller M, *et al*. Workplace violence in healthcare settings: risk factors and protective strategies. *Rehabil Nurs* 2010;35(5):177-84.

31) Sossai D, Molina FS, Amore M, et al. Analysis of incidents of violence in a large italian hospital. Med Lav. 2017 Oct 27;108(5):6005.

32) Molina Aragonés JM, Ayora Ayora A, Barbara Ribalta A, et al. Occupational exposure to volatile anaesthetics: a systematic review. Occup Med (Lond). 2016 Apr;66(3):202-7.

33) Caciari T, Capozzella A, Tomei F, et al. Professional exposure to ionizing radiations in health workers and white blood cells. Ann Ig. 2012 Nov-Dec;24(6):465-74.

34) Garbarino S, Traversa F, Spigno F, et al. Sleepiness, sleep disorders and risk of occupational accidents. G Ital Med Lav Ergon. 2011 Jul-Sep;33(3 Suppl):207-11.

35) Garbarino S, Repice AM, Traversa F, *et al*. Commuting accidents: the influence of excessive daytime sleepiness. A review of an Italian Police officers population. *G Ital Med Lav Ergon* 2007;29(3 Suppl):324-6.

36) Caruso CC. Negative impacts of shiftwork and long work hours. Rehabil Nurs. 2014 Jan-Feb;39(1):16-25.

37) Booker LA, Magee M, Rajaratnam SMW, et al. Individual vulnerability to insomnia, excessive sleepiness and shift work disorder amongst healthcare shift workers. A systematic review. Sleep Med Rev. 2018

38) Copello F, Garbarino S, Messineo A, *et al*. Occupational Medicine and Hygiene: applied research in Italy. *J Prev Med Hyg* 2015;56(2):E102-10.

39) Khalil H, Peters M, Godfrey CM, et al. An Evidence-Based Approach to Scoping Reviews. *Worldviews Evid Based Nurs* 2016;13(2):118-23.

40) Arksey H, O'Malley L. Scoping studies: Towards a Methodological Framework. *Int J Soc Res Methodol* 2005;8:19–32.

41) Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:69.

42) Colquhoun HL, Levac D, O'Brien KK, *et al*. Scoping reviews: time for clarity in definition, methods, and reporting. *J Clin Epidemiol*. 2014 Dec;67(12):1291-4.

43) Tricco AC, Lillie E, Zarin W, *et al*. A scoping review on the conduct and reporting of scoping reviews. *BMC Med Res Methodol* 2016;16:15.

44) Peters MD, Godfrey CM, Khalil H, *et al*. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc* 2015;13(3):141-146.

45) Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J* 2009;26(2):91-108.

46) Mays N, Roberts E, Popay J. Synthesising research evidence. In N. Fulop, P. Allen, A. Clarke, & N. Black (Eds.), Studying the organisation and delivery of health services: Research methods (pp. 188-219). London: Routledge, 2001.

47) Peterson J, Pearce PF, Ferguson LA, *et al*. Understanding scoping reviews: Definition, purpose, and process. *J Am Assoc Nurse Pract* 2017;29(1):12-16.

48) Shamseer L, Moher D, Clarke M, *et al*. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;349(jan02 1):g7647.

49) Chien PF, Khan KS, Siassakos D. Registration of systematic reviews: PROSPERO. *BJOG* 2012;119(8):903-5.

50) Moher D, Liberati A, Tetzlaff J, *et al*. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. *Open Med* 2009;3(3):e123-30.

51) Schaefer HR, Myers JL. Guidelines for performing systematic reviews in the development oftoxicity factors. Regulatory Toxicology and Pharmacology. 2017;91:124-141.

52) Armijo-Olivo S, Stiles CR, Hagen NA, et al. Assessment of study quality for systematic reviews: a comparison of the Cochrane Collaboration Risk of Bias Tool and the Effective Public Health Practice Project Quality Assessment Tool: methodological research. J Eval Clin Pract. 2012 Feb;18(1):12-8.

53) Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Stat Med. 2002;21(11):1539-58.

54) Huedo-Medina TB, Sánchez-Meca J, Marín-Martínez F, et al. Assessing heterogeneity in meta-analysis: Q statistic or I2 index? Psychol Methods. 2006;11(2):193-206.

55) Sterne JA, Egger M. Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. J Clin Epidemiol. 2001 Oct;54(10):1046-55.

56) Duval S, Tweedie R. Trim and fill: a simple funnel-plot–based method of testing and adjusting for publication bias in meta-analysis. Biometrics. 2000;56:455–63.

57) Egger M, Davey Smith G, Schneider M, et al. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997;315(7109):629-34.

Tables.

Table 1. Planned search strategy.

SEARCH STRATEGY ITEM	SEARCH STRATEGY
Databases	PubMed/MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded and Social Sciences Citation Index from ISI/Web of Science, ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform
Language filter	None
Time filter	2000-2018
Spatial filter	Western countries
Keywords	1. “healthcare worker” OR “healthcare workers” OR “healthcare personnel” OR “healthcare staff” OR “health worker” OR “health workers” OR “health personnel” OR “health staff” OR physicians OR physician OR doctors OR doctor OR nurses OR nurse OR practitioners OR practitioner OR "medical students" OR "medical residents" OR "attending residents" OR "hospital technician" OR "hospital technicians" OR "paramedical personnel" OR "paramedical staff" OR " hospital support personnel" 2. injury OR injuries OR incident OR incidents OR "occupational injury" OR "occupational injuries" OR "occupational incident" OR "occupational incidents" OR "work related injury" OR "work related injuries" OR "work related incident" OR "work related incidents" OR "workplace-induced injury" OR "workplace-induced injuries" OR "workplace-induced incident" OR "workplace-induced incidents" OR "occupational health hazard" OR "occupational health hazards" 3. "exposure incidents" OR "splash exposures" OR "splash exposure" OR needle-sticks OR "sharp objects" OR sharps OR "percutaneous injuries" OR "percutaneous injury" 4. "manual handling injury" OR "manual handling injuries" OR "musculoskeletal injury" OR "musculoskeletal injuries" 5. "chemical occupational exposure" OR "exposure to inhaled anesthetic" OR "reagent exposure" OR "exposure to reagent" OR "exposure to solvents" OR "solvent exposure" OR "exposure to detergents" OR "detergent exposure" 6. "slips, trips and falls" OR "slipping, tripping and falling accidents" OR "accidental fall" OR "same-level fall" OR "same-surface fall" OR stump-and-fall OR step-and-fall OR "forced-rotation-type fall" OR "fall from elevation" 7. "violent events" OR violence OR assault OR assaults 8. "cuts and wounds" OR "burns"

	9. "motor vehicle accidents" OR "motor vehicle accident" OR "motor vehicle collisions" OR "motor vehicle collision" OR "motor vehicle crash" OR "motor vehicle crashes" OR "motor vehicle near crash" OR "motor vehicle near crashes" 10. "exposure to ionizing radiation" OR "radiation exposure" 1. AND 2. OR 3. OR 4. OR 5. OR 6. OR 7. OR 8. OR 9. OR 10.
Inclusion criteria	P: medical/paramedical students and residents, doctors and nurses, cleaners and porters E: exposure to biological, chemical, physical/ergonomic risk and hazard C: medical versus nursing or dental students; students versus residents; medical versus nursing or dental trainees/residents; before and after a preventive program O: prevalence/incidence of injuries and their determinants among healthcare workers in Western countries, related disabilities and absence from work, and generated economic burden (direct/indirect costs) S: primary research
Exclusion criteria	Editorial, letter to the editor, commentary, review
Target journals	Occupational and public health journals

Table 2. Data planned to be extracted and details/explanations.

EXTRACTED DATA	DETAILS
Study Reference	Names and surnames of authors, year of publication
Study population	Physicians, doctors, nurses, medical students, residents, cleaners, porters
Country	Country or countries in which the study or studies was or were carried out
Study design	Type of recruitment
M%	Percentage of male healthcare workers
Age	Mean age of healthcare workers sample
Sample number, attrition rate	Number of healthcare workers who took part into the survey, number of non responders
Professional/experience years	Years spent in profession by healthcare workers included in the study
Working setting	Hospital ward where the injury occurred (for example, emergency room, obstetrics department, surgery department, operating room, outpatient clinic, department of Internal Medicine, patients' room, CCU/ICU)
Injury prevalence/incidence rate	Prevalence/incidence rates stratified according to the kind of injury
Method	Questionnaire (validated, not validated)
Following standard procedures	Prevalence/incidence rates stratified according to the compliance to procedures and guidelines among the different types of healthcare workers
Knowledge, attitudes and practices about PEP	Prevalence/incidence rates stratified according to the knowledge, attitudes and practices concerning PEP, among the different types of healthcare workers
Clerkship abroad	Periods of training abroad; type of task(s) the healthcare worker was involved in during the training period abroad
Reporting/non-reporting to Occupational Departement	Prevalence/incidence rates stratified according

	to the determinants of the reporting/non-reporting, among the different types of healthcare workers
Injuries-related burden	Number of days of absence from work, disabilities and economic direct/indirect costs due to injuries

Figures.

Figure 1. Flowchart of selection of studies according to the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.

Contributors

NLB, GD, VP, CB, RL, VM, AT, FB, BDA, EM, AM, ND, and PD conceived the idea. NLB, GD, VM, AT, and PD developed the research questions. NLB, GD, and PD developed the study methods. VP, CB, RL, FB, BDA, EM, AM, and ND aided in developing the research question and study methods. All authors participated in drafting the article, editing or revising it critically for important intellectual content; all authors gave final approval of the version to be submitted and any revised version.

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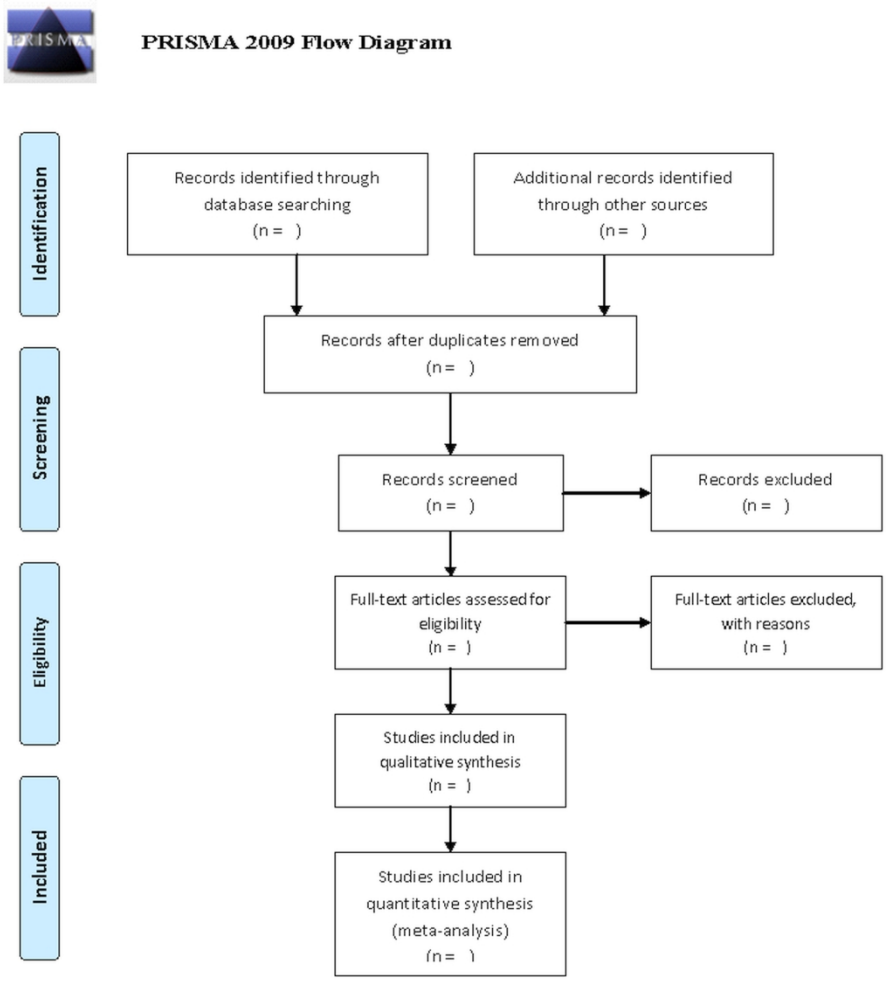
Competing interests

None declared.

Patient consent

Not required.



Flowchart of selection of studies according to the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.

226x236mm (300 x 300 DPI)

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page of the documents and details
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	Protocol of a scoping review assessing injury rate and determinants among healthcare workers in Western countries (page 1)
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	In accordance with these guidelines, the scoping review protocol has been submitted to the International Prospective Register of Systematic Reviews (PROSPERO). However, currently, PROSPERO does not accept to register scoping review protocols (page 8).
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	Page 1 and page 21. Furthermore, role of each author is outlined in the protocol.
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	The present protocol is not an amendment.
Support:			Sources and the role of the sponsor are indicated at page 7 and at page 21.
Sources	5a	Indicate sources of financial or other support for the review	
Sponsor	5b	Provide name for the review funder and/or sponsor	
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	Rationale is provided in the background (pages 4-6).
Objectives	7	Provide an explicit statement of the question(s) the review will	Page 7.

		address with reference to participants, interventions, comparators, and outcomes (PICO)	
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	Page 8 and table 1.
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	Page 8 and table 1.
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Page 8 and table 1.
Study records: Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	Pages 8-9.

Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	Pages 8-9
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	Pages 8-9
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	Table 2.
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with Rationale	Table 2.
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	Pages 8-10
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	Pages 8-10
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	Pages 8-10
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	Page 10

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

BMJ Open

Protocol of a scoping review assessing injury rate and its determinants among healthcare workers in Western countries

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Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Epidemiology
Keywords:	healthcare workers, injuries, scoping review protocol

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Protocol of a scoping review assessing injury rate and its determinants among healthcare workers in Western countries

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ABSTRACT

Introduction: Healthcare workers (HCWs) are subject to different risk factors and risky behaviors that can have a serious impact on their health and work capability. The aim of this protocol is to detail the steps for carrying out a scoping review assessing the prevalence/incidence of injuries among HCWs.

Methods and analysis: The study will be carried out following the "Preferred Reporting Items for Systematic reviews and Meta-Analysis" (PRISMA) guidelines. Studies will be selected according to the following PECO criteria: P (HCWs), E (exposure to injuries), C (different types of HCWs) and O (prevalence/incidence and determinants of injuries). Time filter has been set considering literature between 2000 and 2018 to enable a direct comparison of the findings with the epidemiological figures available at national and local "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institute for Insurance Against Accidents at Work, INAIL) centers in Italy. No language restriction will be applied.

Ethics and dissemination: Formal ethical approval is not required as primary data will not be collected, being already published. The results will be disseminated through peer-reviewed publication(s), conference presentation(s) and the popular press.

Key terms: healthcare workers; injuries; scoping review protocol

Strengths and limitations of this study

- In the existing scholarly literature, there is not a comprehensive and broad review of studies performed in Western Countries concerning injuries among healthcare workers .
- Stratifying according to the work tasks and type of injuries could add meaningful information.
- A further strength is the lack of any language filter..
- A major limitation concerns time filter, which, on the other hand, enables a direct comparison of the findings with the epidemiological figures available at national and local "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institute for Insurance Against Accidents at Work, INAIL) centers.

BACKGROUND

The healthcare system represents the fastest growing sector in Western economy and employs millions of workers, over 18 million in the United States and more than 59 million worldwide.[1] Healthcare workers (HCWs) is an umbrella term, which refers to all people engaged in the promotion, protection or improvement of the health of the population. This term includes a variety of different figures, ranging from medical doctors (like specialists, pediatricians, and general practitioners), to midwives and nurses, other health allied professionals, central supply workers and technicians, as well as residents.[2-4]

Different variables may act as risk factors and impact on HCWs' health and safety, which could, in turn, lead to injuries or disorders. These include: the characteristics of the HCWs (age, gender, education, smoking status, and other lifestyle habits), as well as the features of the patient under care (namely, socio-demographic characteristics of the patient and type of disease) and of the hospital setting (for example, organization, workload, or night shifts).

As with other working settings, hospitals are not completely safe workplace environments for professionals. HCWs can be exposed to several occupational health hazards, resulting in a relevant clinical, economic and humanistic burden. Injury rates among HCWs constitute the highest injury rates, among all type of workers, in Western countries.[5,6] Occupational hazards include biological ones (such as infections, like HAV, HBV, HCV, influenza, HIV/AIDS, measles, mumps, rubella, varicella, tuberculosis, pertussis or meningitis, among others).[7-15] They represent an important occupational health problem, as most of them are blood-borne diseases, which can be acquired through needle-stick or sharp injuries. HCWs have contact with infected patients and their body fluids. An important factor is that HCWs are at risk for repeated performance of exposure prone procedures (EPPs) that may cause injuries to employees. These include surgeons, midwives, microbiologists, pathologists, blood bank and dialysis staff. According to a recent review by Cooke and Stephens, in 2015, a needle-stick injury generated a cost of 747 dollars (range 199-1,691 dollars).[16] Prüss-Ustün and collaborators, using mathematical modeling, estimated the global burden of infections due to percutaneous injuries among HCWs. More in detail, this was done on the probability of injury, the prevalence of infection, the susceptibility of the worker and the percutaneous transmission potential. In Western countries, 1,510 HCV, 360 HBV and 11 HIV cases occurred in the year 2000, ranging from 8-27%, 1-8% and 0,5-3,1% of infections, respectively.[17] Incidence rates of sharps injuries ranged from 1.4 to 9.5 per 100 HCWs, with a weighted mean of 3.7/100 HCWs *per* year and a related societal mean cost of €272.[18] According to Deuffic-Burban and colleagues, the risk of transmission of blood-borne pathogens infections is

estimated to be 30% in susceptible HCWs without post-exposure prophylaxis (PEP) or adequate hepatitis B vaccination, 0-0.5%, and <0.3%, for HBV, HCV and HIV, respectively. Adopting preventive measures such as following standard precautions or undertaking training sessions targeted for both long-term HCWs, students and residents at risk can lead to a reduction in the incidence of occupational exposure, and, therefore, of percutaneous injuries (PIs). For instance, in France, the proportion of PIs preventable by taking standard precautions decreased from 52.5% in 2004 to 45.8% in 2008.[19]

Other hazards are ergonomic/physical. The category of musculoskeletal injuries represents one of the highest categories of accidents among HCWs, due to patient handling and overexertion. Musculoskeletal injuries can involve body structures, such as muscles, nerves, tendons and ligaments, joints and cartilage, due to factors like repetition, force, awkward postures, contact stress or vibration. Healthcare personnel members dedicated to patient care, as well as to hospital housekeeping, laundry, and food service, maintenance, central supply and office, are susceptible to such injuries. Patient-handling injuries are caused by manually lifting patients, who are generally more overweight and obese than in the past. As such, a "Safe Patient Handling – No Manual Lift" policy should be adopted in order to prevent such accidents. This is especially of value, given the actual shortage of HCWs and, in particular, of nurses, and the importance of early mobilizing patients and assisting them with physical activities.[20,21] According to some epidemiological surveys, up to two thirds of nurses have suffered from musculoskeletal disorders at least once in their working life for at least 14 days.[22] Physical therapists are another type of HCWs with direct patient contact at high risk for developing musculoskeletal disorders. According to a recent comprehensive narrative review, their lifetime and yearly prevalence rates are 55-91% and 40-91.3%, respectively. Injuries generally affect lower back, neck, upper back and shoulders.[23]

Physical violence represents another occupational hazard, which severely impacts on HCWs' well-being and job motivation, affecting health-care provision and quality.[24] According to the World Health Organization (WHO) estimates, from 8% to 38% of HCWs have suffered from assaults perpetrated by patients or visitors at least once, at some point in their careers. Recently, the WHO, the "International Labor Organization" (ILO), the "International Council of Nurses" (ICN) and the "Public Services International" (PSI) have jointly developed a guideline entitled "Framework guidelines for addressing workplace violence in the health sector".[25] Physical violence represents a major source of injuries among HCWs, especially those working in psychiatric wards.[26] According to a recent review of the literature, in acute psychiatric units, lifetime rates of overall assaults, physical and verbal threats and

sexual harassment are 24-80%, 46-78.6%, 43-78.6% and 9.5-37.2%, respectively. Complications of such episodes include fractures, eye injuries, and permanent disability, as well as psychological symptoms, such as anxiety, depression, post-traumatic stress disorder (PTSD), or avoidance behavior.[27,28] Another hospital ward in which violence/assault can be experienced is the emergency department (ED): according to a recent qualitative meta-synthesis, ED staff perceives aggression as unavoidable and feels isolated in its management.[29] Aggressors usually suffer from psychiatric disorders, have a history of drug and alcohol use, possess weapons, are victims of violence and are unable to rationally cope with situational crises.[30] In recent years, a rise in the number of assault episodes against HCWs has been observed: for example, in a University teaching hospital in the northern part of Italy, non-fatal violence events increased from 20.65/10,000 in 2012 to 22.81/10,000 in 2014, resulting in 431 days of absence from work and generating a direct cost of € 64,170. Up to 75% of violent episodes occurred in emergency room, intermediate care, psychiatry and geriatrics wards.[31]

Less common sources of injuries among HCWs are represented by chemical exposure (inhalation of anesthetics, solvents, detergents or reagents)[32] or exposure to physical agents (such as ionizing and non ionizing radiations).[33]

A particular type of injury is also known to occur among commuters. Some scholars conducted research among shift and non-shift workers and found a strict, statistically significant relationship between shift-work condition and the presence of excess daytime sleepiness.[34-37] Due to workforce shortage, high workloads, and night shifts, 32% of HCWs report not to get enough sleep.[36]

Systematically identifying and, then, intervening to alter workplace conditions associated with exposure to health hazards may be an important tool for primary prevention.[38]

METHODS

Review title

The current review protocol is titled "Protocol of a scoping review assessing injury rate and its determinants among healthcare workers in Western countries". The title was guided by the so-called ‘PCC’ mnemonic (namely, Population, Concept and Context) used by the Joanna Briggs Institute (JBI). Structuring the title according to the PCC mnemonic enables to clearly reflect and incorporate the core information about the focus and scope of the review.

Review questions

The review questions are: i) What is the incidence/prevalence rate of injuries among HCWs in Western countries? ii) What are the determinants of injuries among HCWs in Western countries? iii) What is the type of injury most commonly occurring among HCWs in Western countries? iv) Among the different professional figures within the umbrella term of HCWs, which one(s) is/are the most affected by injuries in Western countries? v) What is the burden imposed by injuries among HCWs in terms of related disabilities, residual working capability, absence from work and generated direct/indirect costs? vi) What are the state-of-art preventive measures that can be adopted in order to effectively reduce injuries among HCWs in Western countries?

Review objective

The study aim will be to map the existing literature concerning injury rate among HCWs in Western countries and its determinants. As such, the main "*end product* ... [will be] … *a narrative presentation, with minimal or limited statistical information*".[39]

Study design

In order to properly address the research questions, a scoping review will be performed using the 6-stage methodological framework initially proposed by Arksey and O'Malley.[40] This framework comprises 6 steps: namely, i) identifying the research question(s); ii) identifying relevant studies; iii) study selection; iv) charting the data; v) collating, summarizing and reporting the results; and vi) consultation exercise.[41] The conceptual scheme has been made more detailed and explicit by Levac, Colquhoun and O'Brien,[42] further refined by Colquhoun and collaborators,[43] and subsequently modified by the JBI in the "JBI scoping review methods" manual.[39,44]

Scoping review is one of the fourteen kinds of literature synthesis, according to the "Search, Appraisal, Synthesis and Analysis" (SALSA) framework.[45] In detail, it is a review whose *"aim* [is] *to map rapidly the key concepts underpinning a research area and the main sources and types of evidence available, and can be undertaken as stand-alone projects in their own right, especially where an area is complex or has not been reviewed comprehensively before*".[46] This specifies a literature search conducted with one or more broad research questions, and performed in an iterative way to familiarize with the entire literature, to gain a sense of it and to map it properly. Search restrictive/selective parameters can be preliminarily set. The results are obtained specifying inclusion and exclusion criteria and, thus, delimiting the outcome(s) of the literature search, similarly to systematic review, but also time constraints and space filters are allowed, for example, utilizing deadlines for searching and inclusion/exclusion criteria for study retention. Data are, then, abstracted and reported in a synthetic format (tables, charts, etc.).

The specific methodology of the scoping review was chosen to take into account both the nature and the specific requests of a national project co-funded and performed in collaboration between the Department of Health Sciences (DISSAL), Occupational Medicine - University of Genoa, Italy, and the "*Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro*" (in Italian, "National Institute for Insurance Against Accidents at Work", INAIL). This required a quick assessment of a diverse amount of scholarly literature, aiming more for breadth rather than for depth. As such, other types of review identified by the SALSA framework were not deemed methodologically effective, such as systematic reviews, umbrella reviews or rapid reviews.

As maintained by Arksey and O'Malley,[40] scoping reviews may be utilized to assess the topology of a vast body of literature, in terms of current gaps of knowledge and future prospects. These aims corresponded to the objective of our project.

Drafting and registration of the study protocol

This *a priori* protocol is reported in such a way that the objectives and methods of the scoping review are clearly stated and pre-defined, according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis – Protocols (PRISMA-P) guidelines.[47] However, despite the recommendation of these guidelines, it was not possible to register the scoping review protocol in the "International Prospective Register of Systematic Reviews" (PROSPERO),[48] in that it, currently, does not accept scoping review protocols.

The results of the study will be reported in line with the PRISMA guidelines (Figure 1).[49]

Identifying the research question(s)

The research questions and objective have been formulated and shaped as they are stated in the previous sections "Review questions" and "Review objective".

Identifying relevant studies

A systematic literature search will be performed in the MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded and Social Sciences Citation Index from ISI/Web of Science, ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform databases.

This will include all studies reporting epidemiological figures of injuries among HCWs in Western countries in terms of prevalence/incidence rates. The search will be performed using a proper string of

search terms (**Table 1**). The search strategy will be adapted for the other databases. Additionally, we will search reference lists of the chosen studies and prior reviews. When it will not be possible to make a decision on a study's inclusion or exclusion based on the abstract, the full text of the study will be examined.

We have carried out a preliminary literature search on the topic of interest in order to preliminarily clarify inclusion/exclusion criteria. After familiarizing with the literature, we could further implement/expand and/or modify/refine the targeted search strategy, with the help of an expert research librarian

Study selection

The studies will be independently screened by two authors (NLB and GD), looking at study titles and abstracts for potential eligibility. Screening questions will be developed and pilot tested with a subset of records before implementation. The inter-rater agreement will be assessed using κ statistics and will be resolved through discussion; a third reviewer (PD), acting as a final referee, will be involved if necessary.

Studies meeting the following PECO criteria will be considered for inclusion:[50]

- P (patient, problem or population): HCWs;
- E (exposure): injuries;
- C (comparison, control or comparator): different types of HCWs;
- O (outcome/outcomes of interest): prevalence/incidence and determinants of injuries.

Furthermore, the following criteria will be taken into consideration:

- Study design/characteristics: original articles, prevalence/incidence studies, case series;
- Languages: no language filter/restraint (that is to say, all the full complement of Western languages available). Included non-English articles will be acquired in full-text and translated by expert translators with expertise in the field of medicine and related health-allied disciplines.

Charting the data

Data presented in Table 2 will be abstracted from included studies. The data abstraction process will be performed independently by two authors (NLB and GD) and will be pilot-tested on a small sample of studies, until consensus is reached.

Collating, summarizing and reporting the results

Besides the narrative review, we will provide a table with characteristics of included studies and another table of excluded studies with reasons for their exclusion, in our published final scoping review.

Patient and public involvement

There will be no specific patient and public involvement in the development of this scoping review.

DISCUSSION

Implications

The proposed scoping review is expected to contribute to the existing scholarly literature with the potential to influence and inform health practice, education, policy, and future research in the field.

Currently, there is not a comprehensive and broad review of studies performed in Western Countries concerning injuries among HCWs. Stratifying according to the work tasks and type of injuries could add meaningful information.

Briefly, this scoping review will provide the first rigorous analytical, updated synthesis of primary research data concerning the epidemiology of injuries among HCWs in Western countries. This will be useful for health decision- and policy-makers in order to develop, design and implement *ad hoc* adequate policies for primary prevention.

However, we have to anticipate also some shortcomings. The major limitation concerns time filter, which, on the other hand, enables a direct comparison of the findings with the epidemiological figures available at national and local INAIL centers. Moreover, as the process of scoping reviews does not include a formal critical quality assessment and appraisal of included studies, reported findings may lack confidence and validity.

Ethics

No ethical clearance is required for the present scoping review protocol and for its subsequent implementation steps, in that it will undertake a knowledge synthesis and an analysis of data that have been already collected and published.

Disssemination

The findings of the scoping review will be submitted to peer-reviewed journals for potential publication(s) and will be the object of *ad hoc* oral/poster communications in relevant national/international scientific congresses, and conferences.

Often, knowledge synthesis studies develop and provide recommendations based on the results obtained. We will not be able to provide any recommendations, since the selected studies will not be critically and formally appraised for methodological quality. However, we will able to develop recommendations for future research on injuries among HCWs, their burden and their prevention. The findings of this scoping review could be used to guide the education of HCWs (for example, to inform the development and implementation of courses for continuous medical learning). and the health policy- and decision-making process.

References

1) World Health Organization. Working Together for Health: World Health Report 2006. Geneva: Switzerland, 2006.
2) Joseph B, Joseph M. The health of the healthcare workers. *Indian J Occup Environ Med* 2016;20(2):71–72.
3) Adams BO, Dal Poz MR, Shengelia B, *et al*. Human, Physical, and Intellectual Resource Generation: Proposals for Monitoring. In Murray, C.J.L and Evans, D. (eds) Health Systems Performance Assessment: Debates, Methods and Empiricism. Geneva: World Health Organization: 273-287, 2003.
4) Diallo K, Zurn P, Gupta N, *et al*. Monitoring and evaluation of human resources for health: an international perspective. *Hum Resour Health* 2003;1(1):3.
5) Dressner MA. Hospital workers: an assessment of occupational injuries and illnesses. Monthly Labor Review, U.S. Bureau of Labor Statistics, June 2017.
6) Miller K. Risk factors and impacts of occupational injury in healthcare workers: A critical review. OA Musculoskeletal Medicine 2013 Mar 01;1(1):4.
7) Young TN, Arens FJ, Kennedy GE, *et al*. Antiretroviral post-exposure prophylaxis (PEP) for occupational HIV exposure. *Cochrane Database Syst Rev* 2007;(1):CD002835.
8) Rischitelli G, Harris J, McCauley L, et al. The risk of acquiring hepatitis B or C among public safety workers: a systematic review. Am J Prev Med. 2001 May;20(4):299-306.
9) Westermann C, Peters C, Lisiak B, et al. The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. Occup Environ Med. 2015 Dec;72(12):880-8.
10) Dini G, Toletone A, Sticchi L, et al. Influenza vaccination in healthcare workers: A comprehensive critical appraisal of the literature. Hum Vaccin Immunother. 2017 Aug 8:1-18.
11) Uden L, Barber E, Ford N, et al. Risk of Tuberculosis Infection and Disease for Health Care Workers: An Updated Meta-Analysis. Open Forum Infect Dis. 2017 Aug 29;4(3):ofx137.
12) Placidi D, Tonozzi B, Alessio L, Porru S. Tuberculin skin test (TST) survey among healthcare workers (HCWs) in hospital: a systematic review of the literature. G Ital Med Lav Ergon. 2007 Jul-Sep;29(3 Suppl):409-11.
13) Riccò M, Vezzosi L, Odone A, et al. Invasive Meningococcal Disease on the Workplaces: a systematic review. Acta Biomed. 2017 Oct 23;88(3):337-351.

14) van den Hoogen A, Duijn JM, Bode LGM, *et al*. Systematic review found that there was moderate evidence that vaccinating healthcare workers prevented pertussis in infants. Acta Paediatr. 2017, in press.

15) Leone Roberti Maggiore U, Scala C, et al. Susceptibility to vaccine-preventable diseases and vaccination adherence among healthcare workers in Italy: A cross-sectional survey at a regional acute-care university hospital and a systematic review. Hum Vaccin Immunother. 2017 Feb;13(2):470-476.

16) Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. *Med Devices (Auckl)* 2017;10:225-235.

17) Prüss-Ustün A, Rapiti E, Hutin Y. Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers. *Am J Ind Med* 2005;48(6):482.

18) Elseviers MM, Arias-Guillén M, Gorke A, *et al*. Sharps injuries amongst healthcare workers: review of incidence, transmissions and costs. *J Ren Care* 2014 Sep;40(3):150-6.

19) Deuffic-Burban S, Delarocque-Astagneau E, Abiteboul D, *et al*. Blood-borne viruses in health care workers: prevention and management. *J Clin Virol* 2011;52(1):4-10.

20) Edlich RF, Hudson MA, Buschbacher RM, *et al*. Devastating injuries in healthcare workers: description of the crisis and legislative solution to the epidemic of back injury from patient lifting. *J Long Term Eff Med Implants* 2005;15(2):225-41.

21) Nelson AL, Collin J, Knibbe H, *et al*. Safer patient handling. *Nurs Manage* 2007;38(3):26−32.

22) Delloiacono N. Musculoskeletal safety for older adults in the workplace: review of current best practice evidence. *Workplace Health Saf* 2015;63(2):48-53.

23) Milhem M, Kalichman L, Ezra D, *et al*. Work-related musculoskeletal disorders among physical therapists: A comprehensive narrative review. *Int J Occup Med Environ Health*. 2016;29(5):735-47.

24) Dillon BL. Workplace violence: impact, causes, and prevention. *Work* 2012;42(1):15-20.

25) International Labour Office (ILO), International Council of Nurses (ICN), World Health Organization (WHO), Public Services International (PSI). Joint Programme on Workplace Violence in the Health Sector. Geneva, 2002.

26) Spaducci G, Stubbs B, McNeill A, Stewart D, Robson D. Violence in mental health settings: A systematic review. Int J Ment Health Nurs. 2018 Feb;27(1):33-45.

27) d'Ettorre G, Pellicani V. Workplace Violence Toward Mental Healthcare Workers Employed in Psychiatric Wards. *Saf Health Work* 2017;8(4):337-342.

28) Luftman K, Aydelotte J, Rix K, et al. PTSD in those who care for the injured. Injury. 2017 Feb;48(2):293-296.

29) Ashton RA, Morris L, Smith I. A qualitative meta-synthesis of emergency department staff experiences of violence and aggression. Int Emerg Nurs. 2018, in press.

30) Gillespie GL, Gates DM, Miller M, *et al*. Workplace violence in healthcare settings: risk factors and protective strategies. *Rehabil Nurs* 2010;35(5):177-84.

31) Sossai D, Molina FS, Amore M, et al. Analysis of incidents of violence in a large italian hospital. Med Lav. 2017 Oct 27;108(5):6005.

32) Molina Aragonés JM, Ayora Ayora A, Barbara Ribalta A, et al. Occupational exposure to volatile anaesthetics: a systematic review. Occup Med (Lond). 2016 Apr;66(3):202-7.

33) Caciari T, Capozzella A, Tomei F, et al. Professional exposure to ionizing radiations in health workers and white blood cells. Ann Ig. 2012 Nov-Dec;24(6):465-74.

34) Garbarino S, Traversa F, Spigno F, et al. Sleepiness, sleep disorders and risk of occupational accidents. G Ital Med Lav Ergon. 2011 Jul-Sep;33(3 Suppl):207-11.

35) Garbarino S, Repice AM, Traversa F, *et al*. Commuting accidents: the influence of excessive daytime sleepiness. A review of an Italian Police officers population. *G Ital Med Lav Ergon* 2007;29(3 Suppl):324-6.

36) Caruso CC. Negative impacts of shiftwork and long work hours. Rehabil Nurs. 2014 Jan-Feb;39(1):16-25.

37) Booker LA, Magee M, Rajaratnam SMW, et al. Individual vulnerability to insomnia, excessive sleepiness and shift work disorder amongst healthcare shift workers. A systematic review. Sleep Med Rev. 2018

38) Copello F, Garbarino S, Messineo A, *et al*. Occupational Medicine and Hygiene: applied research in Italy. *J Prev Med Hyg* 2015;56(2):E102-10.

39) Khalil H, Peters M, Godfrey CM, et al. An Evidence-Based Approach to Scoping Reviews. *Worldviews Evid Based Nurs* 2016;13(2):118-23.

40) Arksey H, O'Malley L. Scoping studies: Towards a Methodological Framework. *Int J Soc Res Methodol* 2005;8:19–32.

41) Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:69.

42) Colquhoun HL, Levac D, O'Brien KK, *et al*. Scoping reviews: time for clarity in definition, methods, and reporting. *J Clin Epidemiol*. 2014 Dec;67(12):1291-4.

43) Tricco AC, Lillie E, Zarin W, *et al*. A scoping review on the conduct and reporting of scoping reviews. *BMC Med Res Methodol* 2016;16:15.

44) Peters MD, Godfrey CM, Khalil H, *et al*. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc* 2015;13(3):141-146.

45) Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J* 2009;26(2):91-108.

46) Mays N, Roberts E, Popay J. Synthesising research evidence. In N. Fulop, P. Allen, A. Clarke, & N. Black (Eds.), Studying the organisation and delivery of health services: Research methods (pp. 188-219). London: Routledge, 2001.

47) Peterson J, Pearce PF, Ferguson LA, *et al*. Understanding scoping reviews: Definition, purpose, and process. *J Am Assoc Nurse Pract* 2017;29(1):12-16.

48) Shamseer L, Moher D, Clarke M, *et al*. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;349(jan02 1):g7647.

49) Chien PF, Khan KS, Siassakos D. Registration of systematic reviews: PROSPERO. *BJOG* 2012;119(8):903-5.

50) Moher D, Liberati A, Tetzlaff J, *et al*. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. *Open Med* 2009;3(3):e123-30.

Tables.

Table 1. Planned search strategy.

SEARCH STRATEGY ITEM	SEARCH STRATEGY
Databases	PubMed/MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded and Social Sciences Citation Index from ISI/Web of Science, ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform
Language filter	None
Time filter	2000-2018
Spatial filter	Western countries
Keywords	1. “healthcare worker” OR “healthcare workers” OR “healthcare personnel” OR “healthcare staff” OR “health worker” OR “health workers” OR “health personnel” OR “health staff” OR physicians OR physician OR doctors OR doctor OR nurses OR nurse OR practitioners OR practitioner OR "medical students" OR "medical residents" OR "attending residents" OR "hospital technician" OR "hospital technicians" OR "paramedical personnel" OR "paramedical staff" OR " hospital support personnel" 2. injury OR injuries OR incident OR incidents OR "occupational injury" OR "occupational injuries" OR "occupational incident" OR "occupational incidents" OR "work related injury" OR "work related injuries" OR "work related incident" OR "work related incidents" OR "workplace-induced injury" OR "workplace-induced injuries" OR "workplace-induced incident" OR "workplace-induced incidents" OR "occupational health hazard" OR "occupational health hazards" 3. "exposure incidents" OR "splash exposures" OR "splash exposure" OR needle-sticks OR "sharp objects" OR sharps OR "percutaneous injuries" OR "percutaneous injury" 4. "manual handling injury" OR "manual handling injuries" OR "musculoskeletal injury" OR "musculoskeletal injuries" 5. "chemical occupational exposure" OR "exposure to inhaled anesthetic" OR "reagent exposure" OR "exposure to reagent" OR "exposure to solvents" OR "solvent exposure" OR "exposure to detergents" OR "detergent exposure" 6. "slips, trips and falls" OR "slipping, tripping and falling accidents" OR "accidental fall" OR "same-level fall" OR "same-surface fall" OR stump-and-fall OR step-and-fall OR "forced-rotation-type fall" OR "fall from elevation" 7. "violent events" OR violence OR assault OR assaults

	8. "cuts and wounds" OR "burns" 9. "motor vehicle accidents" OR "motor vehicle accident" OR "motor vehicle collisions" OR "motor vehicle collision" OR "motor vehicle crash" OR "motor vehicle crashes" OR "motor vehicle near crash" OR "motor vehicle near crashes" 10. "exposure to ionizing radiation" OR "radiation exposure" 1. AND 2. OR 3. OR 4. OR 5. OR 6. OR 7. OR 8. OR 9. OR 10.
Inclusion criteria	P: medical/paramedical students and residents, doctors and nurses, cleaners and porters E: exposure to biological, chemical, physical/ergonomic risk and hazard C: medical versus nursing or dental students; students versus residents; medical versus nursing or dental trainees/residents; before and after a preventive program O: prevalence/incidence of injuries and their determinants among healthcare workers in Western countries, related disabilities and absence from work, and generated economic burden (direct/indirect costs) S: primary research
Exclusion criteria	Editorial, letter to the editor, commentary, review
Target journals	Occupational and public health journals

Table 2. Data planned to be extracted and details/explanations.

EXTRACTED DATA	DETAILS
Study Reference	Names and surnames of authors, year of publication
Study population	Physicians, doctors, nurses, medical students, residents, cleaners, porters
Country	Country or countries in which the study or studies was or were carried out
Study design	Type of recruitment
M%	Percentage of male healthcare workers
Age	Mean age of healthcare workers sample
Sample number, attrition rate	Number of healthcare workers who took part into the survey, number of non responders
Professional/experience years	Years spent in profession by healthcare workers included in the study
Working setting	Hospital ward where the injury occurred (for example, emergency room, obstetrics department, surgery department, operating room, outpatient clinic, department of Internal Medicine, patients' room, CCU/ICU)
Injury prevalence/incidence rate	Prevalence/incidence rates stratified according to the kind of injury
Method	Questionnaire (validated, not validated)
Following standard procedures	Prevalence/incidence rates stratified according to the compliance to procedures and guidelines among the different types of healthcare workers
Knowledge, attitudes and practices about PEP	Prevalence/incidence rates stratified according to the knowledge, attitudes and practices concerning PEP, among the different types of healthcare workers
Clerkship abroad	Periods of training abroad; type of task(s) the healthcare worker was involved in during the

	training period abroad
Reporting/non-reporting to Occupational Departement	Prevalence/incidence rates stratified according to the determinants of the reporting/non-reporting, among the different types of healthcare workers
Injuries-related burden	Number of days of absence from work, disabilities and economic direct/indirect costs due to injuries

Figures.

Figure 1. Flowchart of selection of studies according to the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.

Contributors

NLB, GD, VP, CB, RL, VM, AT, FB, BDA, EM, AM, ND, and PD conceived the idea. NLB, GD, VM, AT, and PD developed the research questions. NLB, GD, and PD developed the study methods. VP, CB, RL, FB, BDA, EM, AM, and ND aided in developing the research question and study methods. All authors participated in drafting the article, editing or revising it critically for important intellectual content; all authors gave final approval of the version to be submitted and any revised version.

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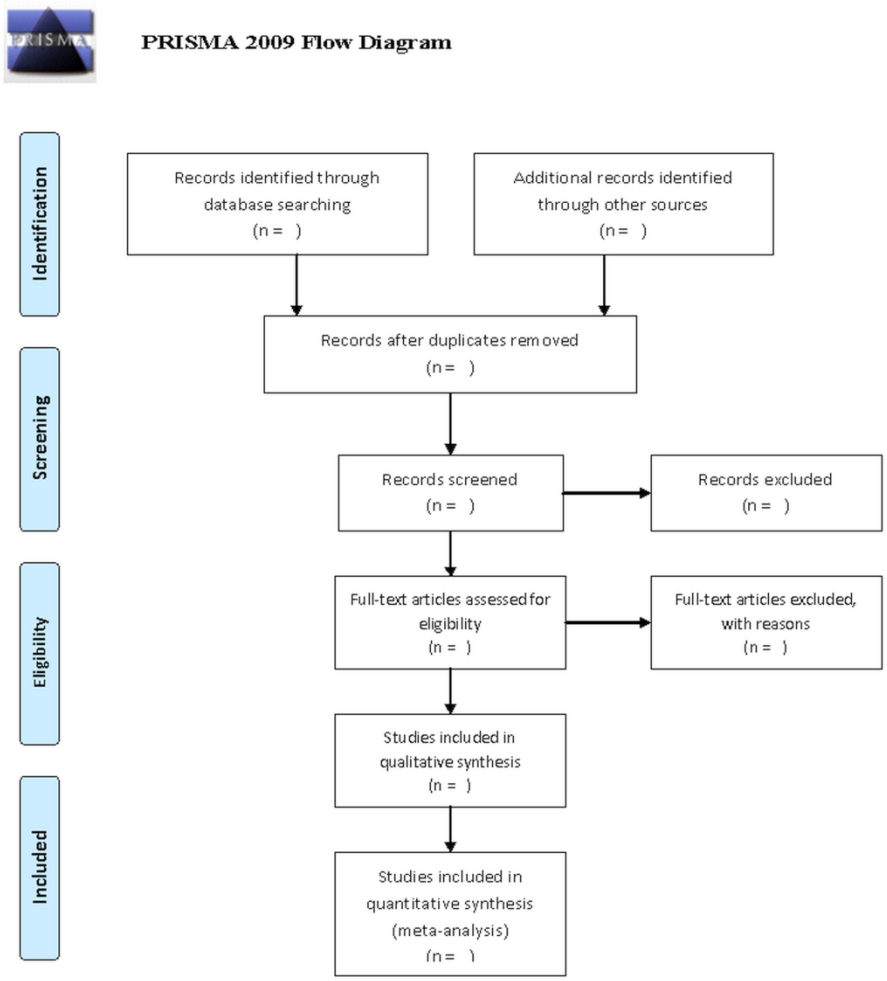
Competing interests

None declared.

Patient consent

Not required.



Flowchart of selection of studies according to the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.

226x236mm (300 x 300 DPI)

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page of the documents and details
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	Protocol of a scoping review assessing injury rate and determinants among healthcare workers in Western countries (page 1)
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	In accordance with these guidelines, the scoping review protocol has been submitted to the International Prospective Register of Systematic Reviews (PROSPERO). However, currently, PROSPERO does not accept to register scoping review protocols (page 8).
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	Page 1 and page 21. Furthermore, role of each author is outlined in the protocol.
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	The present protocol is not an amendment.
Support:			Sources and the role of the sponsor are indicated at page 7 and at page 21.
Sources	5a	Indicate sources of financial or other support for the review	
Sponsor	5b	Provide name for the review funder and/or sponsor	
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	Rationale is provided in the background (pages 4-6).
Objectives	7	Provide an explicit statement of the question(s) the review will	Page 7.

		address with reference to participants, interventions, comparators, and outcomes (PICO)	
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	Page 8 and table 1.
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	Page 8 and table 1.
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Page 8 and table 1.
Study records: Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	Pages 8-9.

Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	Pages 8-9
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	Pages 8-9
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	Table 2.
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with Rationale	Table 2.
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	Pages 8-10
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	Pages 8-10
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	Pages 8-10
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	Page 10

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

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Protocol of a scoping review assessing injury rate and its determinants among healthcare workers in Western countries

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ABSTRACT

Introduction: Healthcare workers (HCWs) are subject to different risk factors and risky behaviors that can have a serious impact on their health and work capability. The aim of this protocol is to detail the steps for carrying out a scoping review assessing the prevalence/incidence of injuries among HCWs.

Methods and analysis: The study will be carried out following the "Preferred Reporting Items for Systematic reviews and Meta-Analysis – Protocols" (PRISMA-P) guidelines. Studies will be selected according to the following Population/Exposure/Comparator/Outcomes (PICO) criteria: P (HCWs), I (exposure to injuries), C (different types of exposure and different categories of HCWs) and O (prevalence/incidence and determinants of injuries). Time filter has been set considering literature between 2000 and 2018 to enable an updated, direct comparison of the findings with the epidemiological figures available at national and local "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institute for Insurance Against Accidents at Work, INAIL) Centers in Italy. No language restriction will be applied.

Ethics and dissemination: Formal ethical approval is not required as primary data will not be collected, being already published. The results will be disseminated through peer-reviewed publication(s), conference presentation(s) and the popular press.

Key terms: healthcare workers; injuries; scoping review protocol

Strengths and limitations of this study

- In the existing scholarly literature, there is not a review of studies performed in Western Countries concerning injuries among healthcare workers .
- Stratifying according to the work tasks and type of injuries could add meaningful information.
- A major limitation concerns time filter (studies published between 2000 and 2018), which, on the other hand, enables an updated, direct comparison of the findings with the epidemiological figures available at national and local "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institute for Insurance Against Accidents at Work, INAIL) Centers.

BACKGROUND

The healthcare system represents the fastest growing sector in Western economy and employs millions of workers, over 18 million in the United States and more than 59 million worldwide.[1] Healthcare workers (HCWs) is an umbrella term, which refers to all people engaged in the promotion, protection, care or improvement of the health of the population. This term includes a variety of different figures, ranging from medical doctors (like specialists, pediatricians, and general practitioners) to midwives and nurses, other health allied professionals, central supply workers and technicians, as well as residents.[2-4]

Different variables may act as risk factors and impact on HCWs' health and safety, which could, in turn, lead to occupational injuries and disorders. These include: the individual characteristics of the HCWs (age, gender, education, smoking status, and other lifestyle habits), as well as the features of the patient under care (namely, socio-demographic characteristics of the patient and type of disease) and of the healthcare settings (for example, organization, workload, or night shifts) and procedures (such as invasive treatment).

As with other working settings, hospitals and other healthcare facilities are not completely safe workplace environments for professionals. HCWs can be exposed to several occupational health hazards, resulting in a relevant clinical, economic and humanistic burden. Injury rates among HCWs constitute the highest injury rates, among all type of workers, in Western countries.[5,6] Some classical occupational hazards seem to re-emerge due to societal changes, including biological ones (such as infections, like HBV, HCV, HIV, measles, influenza, varicella, tuberculosis, among others).[7-15] They represent an important occupational health problem, as most of them are blood-borne diseases, which can be acquired through needle-stick or sharp injuries (NSSI). HCWs have contact with infected patients and their body fluids. An important factor is that HCWs are at risk for repeated performance of exposure prone procedures (EPPs) that may cause injuries to employees. These include surgeons, midwives, microbiologists, pathologists, blood bank and dialysis staff. According to a recent review by Cooke and Stephens, in 2015, a needle-stick injury generated a cost of 747 dollars (range 199-1,691 dollars).[16] Prüss-Ustün and collaborators, using mathematical modeling, estimated the global burden of infections due to percutaneous injuries (PIs) among HCWs. More in detail, this was done on the probability of injury, the prevalence of infection, the susceptibility of the worker and the percutaneous transmission potential. In Western countries, 1,510 HCV, 360 HBV and 11 HIV cases occurred in the year 2000, ranging from 8-27%, 1-8% and 0,5-3,1% of infections, respectively.[17] A recently published systematic review and meta-analysis of the literature performed by Auta and coworkers[18] has computed a global one-year prevalence of PIs of 36.4% [95% confidence interval or CI 32.9–40.0], ranging from 9.5% [95%CI 6.7–12.4] in

Australasia to 15.7% [95%CI 12.1–19.3] in North America and to 31.8% [95%CI 25.0–38.5] in Europe. Incidence rates of sharps injuries ranged from 1.4 to 9.5 per 100 HCWs, with a weighted mean of 3.7/100 HCWs *per* year and a related societal mean cost of €272.[19] According to Deuffic-Burban and colleagues,[20] the risk of transmission of blood-borne pathogens infections is estimated to be 30% in susceptible HCWs without post-exposure prophylaxis (PEP) or adequate hepatitis B vaccination, 0-0.5%, and <0.3%, for HBV, HCV and HIV, respectively. Recently, in the last years, large measles outbreaks with nosocomial transmission among HCWs have been documented, in countries like Italy and the UK.[21,22]

Adopting preventive measures such as following standard precautions or undertaking training sessions targeted for both long-term HCWs, students and residents at risk can lead to a reduction in the incidence of occupational exposure, and, therefore, of PIs. For instance, in France, the proportion of PIs preventable by taking standard precautions decreased from 52.5% in 2004 to 45.8% in 2008.[20]

Other hazards are ergonomic/physical. The category of musculoskeletal injuries represents one of the highest categories of accidents among HCWs, due to patient handling and overexertion. Musculoskeletal injuries can involve body structures, such as muscles, nerves, tendons and ligaments, joints and cartilage, due to factors like repetition, force, awkward postures, contact stress or vibration. Healthcare personnel members dedicated to patient care, as well as to hospital housekeeping, laundry, and food service, maintenance, central supply and office, are susceptible to such injuries. Patient-handling injuries are caused by manually lifting patients, who are generally more overweight and obese than in the past. As such, a "Safe Patient Handling – No Manual Lift" policy should be adopted in order to prevent such accidents. This is especially of value, given the actual shortage of HCWs and, in particular, of nurses, and the importance of early mobilizing patients and assisting them with physical activities.[23,24] According to some epidemiological surveys, up to two thirds of nurses have suffered from musculoskeletal disorders at least once in their working life for at least 14 days.[25] Physical therapists are another type of HCWs with direct patient contact at high risk for developing musculoskeletal disorders: according to a recent comprehensive narrative review, their lifetime and yearly prevalence rates are 55-91% and 40-91.3%, respectively. Injuries generally affect lower back, neck, upper back and shoulders.[26]

Physical violence represents another occupational hazard, which severely impacts on HCWs' well-being and job motivation, affecting health-care provision and quality.[27] According to the World Health Organization (WHO) estimates, from 8% to 38% of HCWs have suffered from assaults perpetrated by patients or visitors at least once, at some point in their careers. Recently, the WHO, the "International Labor Organization" (ILO), the "International Council of Nurses" (ICN) and the

"Public Services International" (PSI) have jointly developed a guideline entitled "Framework guidelines for addressing workplace violence in the health sector".[28] Physical violence represents a major source of injuries among HCWs, especially those working in psychiatric wards.[29] According to a recent review of the literature, in acute psychiatric units, lifetime rates of overall assaults, physical and verbal threats and sexual harassment are 24-80%, 46-78.6%, 43-78.6% and 9.5-37.2%, respectively. Complications of such episodes include fractures, eye injuries, and permanent disability, as well as psychological symptoms, such as anxiety, depression, post-traumatic stress disorder (PTSD), or avoidance behavior.[30,31] Another hospital ward in which violence/assault can be experienced is the emergency department (ED): according to a recent qualitative meta-synthesis, ED staff perceives aggression as unavoidable and feels isolated in its management.[32] Aggressors usually suffer from psychiatric disorders, have a history of drug and alcohol use, possess weapons, are victims of violence and are unable to rationally cope with situational crises.[33] In recent years, a rise in the number of assault episodes against HCWs has been observed: for example, in a University teaching hospital in the northern part of Italy, non-fatal violence events increased from 20.65/10,000 in 2012 to 22.81/10,000 in 2014, resulting in 431 days of absence from work and generating a direct cost of € 64,170. Up to 75% of violent episodes occurred in emergency room, intermediate care, psychiatry and geriatrics wards.[34]

Less common sources of injuries among HCWs are represented by chemical exposure (inhalation of anesthetics, solvents, detergents or reagents)[35] or exposure to physical agents (such as ionizing and non ionizing radiations).[36]

A particular type of injury is also known to occur among commuters. Some scholars conducted research among shift and non-shift workers and found a strict, statistically significant relationship between shift-work condition and the presence of excess daytime sleepiness.[37-40] Due to workforce shortage, high workloads, and night shifts, 32% of HCWs report not to get enough sleep.[40]

Systematically identifying and, then, intervening to alter workplace conditions associated with exposure to health hazards may be an important tool for primary prevention.[41]

PURPOSES AND OBJECTIVES

Review aims

The study aims will be to i) identify and map the existing literature concerning injury rate among HCWs in Western countries in terms of incidence/prevalence and its determinants, the occupational and economic burden generated by injuries and the preventive measures and strategies that can be adopted to curb injury rate, and to ii) establish the breadth of the relevant scholarly literature.

Review objectives

Review objectives will be to i) provide a comprehensive overview of any study focusing on injuries among HCWs in Western countries; ii) identify the most frequent kind of injuries among HCWs, iii) identify the type(s) of HWCs more prone to injuries, iv) identify which variable(s) impact(s) on injuries occurrence among HCWs, v) quantify the burden of injuries among HCWs in terms of related disabilities, residual working capability, absence from work and generated direct/indirect costs, vi) identify the preventive measures that can effectively curb the occurrence of injuries among HCWs, and vii) disseminate review findings on the published literature about injuries among HCWs.

METHODS

Review questions

The review questions are: i) What is the incidence/prevalence rate of injuries among HCWs in Western countries? ii) What are the determinants of injuries among HCWs in Western countries? iii) What is the type of injury most commonly occurring among HCWs in Western countries? iv) Among the different professional figures within the umbrella term of HCWs, which one(s) is/are the most affected by injuries in Western countries? v) What is the burden imposed by injuries among HCWs in terms of related disabilities, residual working capability, absence from work and generated direct/indirect costs? vi) What are the state-of-art preventive measures that can be adopted in order to effectively reduce injuries among HCWs in Western countries?

Study design

In order to properly address the research questions, a scoping review will be performed using the 6-stage methodological framework initially proposed by Arksey and O'Malley.[42] This framework comprises 6 steps: namely, i) identifying the research question(s); ii) identifying relevant studies; iii) study selection; iv) charting the data; v) collating, summarizing and reporting the results; and vi) consultation exercise.[43] The conceptual scheme has been made more detailed and explicit by Levac, Colquhoun and O'Brien,[44] further refined by Colquhoun and collaborators,[45] and subsequently modified by the JBI in the "JBI scoping review methods" manual.[46]

The specific methodology of the scoping review[46,47] was chosen to take into account both the nature and the specific requests of a national project co-funded and performed in collaboration between the Department of Health Sciences (DISSAL), Occupational Medicine - University of Genoa, Italy, and the "*Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro*" (in Italian, "National Institute for Insurance Against Accidents at Work", INAIL). This required a quick assessment of a diverse amount of scholarly literature, aiming more for breadth rather than for depth. As such, other

types of review, such as systematic reviews, umbrella reviews or rapid reviews,[48] were not deemed methodologically effective,.

As maintained by Arksey and O'Malley,[42] scoping reviews may be utilized to assess the topology of a vast body of literature, in terms of current gaps of knowledge and future prospects.[42,49,50] These aims corresponded to the objectives of our project.

Drafting and registration of the study protocol

This protocol is reported according to the "Preferred Reporting Items for Systematic Reviews and Meta-Analysis – Protocols" (PRISMA – P) guidelines.[51] However, despite the recommendation of these guidelines, it was not possible to register the scoping review protocol in the "International Prospective Register of Systematic Reviews" (PROSPERO),[52] in that it, currently, does not accept scoping review protocols.

Stage I: Identifying the research question(s)

Five authors (NLB, GD, VM, AT, and PD) developed the research questions, whereas the other authors (VP, CB, RL, FB, BDA, EM, AM, and ND) aided in developing the research questions. The research objectives and questions have been formulated and shaped as they are stated in the previous sections "Purposes and objectives" and "Review questions".

Stage II: Identifying relevant studies

The identification of relevant studies will follow the three-step process recommended by the JBI: namely, i) first step or preliminary search conducted at least on two databases, ii) preparation of a list of search terms and words to guide the subsequent process and run of the search on a larger number of databases using previously identified keywords, and iii) eventual additional searches (cross-checking/cross-referencing of reference lists of potentially eligible studies, hand-searching in target journals relevant to the topic, etc.).

Preliminary literature search

We have carried out a preliminary literature search on the topic of interest in order to preliminarily clarify inclusion/exclusion criteria. After familiarizing with the literature, we could further implement/expand and/or modify/refine the targeted search strategy, with the help of an expert and qualified research librarian.

The preliminary literature search was undertaken for two widely used scholarly databases (PubMed/MEDLINE and Scopus), using "healthcare injuries" as keywords and adopting the time filter, resulting in 27,844 and 139,073 studies, respectively. In the second step, the research team

has inspected titles and abstracts of potentially relevant articles and has prepared a list of pertinent words and index terms to inform the subsequent search strategy process.

Structured search strategy

Based on the previously prepared list of key terms, a systematic literature search will be performed in several scholarly database, including PubMed/MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded (SCIE) and Social Sciences Citation Index (SSCI) from the ISI/Web of Science (WoS), ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform databases.

This will include all studies reporting epidemiological figures of injuries among HCWs in Western countries in terms of prevalence/incidence rates. The search will be performed using a proper string of relevant search terms based on controlled vocabulary and Boolean connectors (**Table 1**). For PubMed/MEDLINE, for instance, Medical Subject Headings (MeSH) key terms and wild card option (truncated key terms) will be utilized. This structured search strategy will be adapted for the other databases, in order to obtain database-specific search strategies. When it will not be possible to make a decision on a study's inclusion or exclusion based on the abstract, the full text of the study will be examined. During this process, we will utilize the "Peer Review of Electronic Search Strategies (PRESS) 2015 Guideline statement" as a guide.[53]

In the third step of the search strategy, we will scan reference lists of the chosen studies and prior reviews. Additionally, we will hand-search in target journals relevant to the topic under study.

Five authors (NLB, GD, VM, AT, and PD) will contribute to the identification of relevant studies, helped by the other authors (VP, CB, RL, FB, BDA, EM, AM, and ND).

Stage III: Study selection

Once the search strategy is successfully completed, search results will be collated and exported to EndNote V.X7 (Clarivate Analytics). Duplicates will be automatically removed before the file containing a set of unique records is provided to reviewers for further processing (i.e., study screening and selection).

The studies will be independently screened by two authors (NLB and GD), looking at study titles and abstracts for potential eligibility. Screening questions will be developed and pilot-tested with a subset of records randomly chosen before implementation. The inter-rater agreement will be assessed using the κ statistics and will be resolved through discussion; a third reviewer (PD), acting as a final referee, will be involved if necessary.

Inclusion criteria

Studies meeting the following PICO criteria will be considered for inclusion:[54]

- P (patient, problem or population): HCWs (of any type, medical, nursing or dental practitioners, trainees/residents, other health allied professionals, central supply workers and technicians) working in Western countries;
- I (exposure or phenomenon of interest): injuries (of any type, due to exposure to biological, chemical, physical/ergonomic risks and hazards);
- C (comparison, control or comparator): different types of HCWs (medical *versus* nursing or dental practitioners, trainees or residents); exposed HCWs *versus* non exposed; before and after a preventive program;
- O (outcome/outcomes of interest): prevalence/incidence and determinants of injuries, occupational burden (in terms of related disabilities and absence from work), and generated economic burden (in terms of direct and indirect costs).

Furthermore, the following criteria will be taken into consideration:

- Study design/characteristics: original articles, prevalence/incidence studies;
- Time: a time filter/restraint will be applied. Only papers written between 2000 and 2008 will be considered;
- Languages: no language filter/restraint will be applied. Included non-English articles will be acquired in full-text and translated by expert translators of the University of Genoa, Italy.

Exclusion criteria

Investigations not meeting with the above-stated PICO criteria or with insufficient information and studies designed as editorials, letters to editor, commentaries, expert opinions, case reports, case series, and reviews will be excluded.

Selected study reporting

Details of the literature search and screening results will be both summarized narratively and pictorially presented using the "Preferred Reporting Items for Systematic reviews and Meta-Analyses" (PRISMA) flow diagram (Figure 1).[55] Besides this, we will provide a table of excluded studies with reasons for their exclusion, in our published final scoping review.

Stage IV: Charting the data

An *ad hoc* data extraction template will be developed that reflects the research questions, the purposes/objectives and the aims of the review. It will be used both for confirming study relevance and for data abstraction. More in detail, it will include gathering information regarding the key characteristics of the studies, such as study authors, year of publication, study population – type(s) of HCWs recruited – and study country, study design, percentage of male HCWs, mean age, sample size, attrition rate, professional experience years, working setting, injury prevalence/incidence rate, knowledge, attitudes and practices concerning the adoption of standard procedures, and injuries-related burden (Table 2) These *a priori* data items have been individuated and developed through a preliminary exercise by all the research team.

The data abstraction process will be performed independently by two authors (NLB and GD) and will be pilot-tested on a small sample of studies randomly selected, until consensus is reached. Based on this pilot test, if deemed necessary by the research team, the data extraction form will be reviewed and revised, in order to capture any relevant information of the included studies. Any change to the data collection form will be documented and explained. To assist this process of the scoping review, the "Covidence" software (Cochrane) for systematic review management will be used.

Stage V: Collating, summarizing and reporting the results

While the stage V aims at providing a summary and synthesis of the findings, Levac et al.[44] have suggested breaking this review step into the following three smaller and distinct phases: namely, a) data collation and analysis; b) report of the results and outcome(s) delivery in such a way to guide and inform the overall study purposes/objectives, aims and research questions; and c) taking into account the meaning of the findings in relation to the study aims, purposes/objectives and research questions and discussion of the potential, practical implications that findings may have on future research, practice and policy.

The data collected during the stage IV will be stored in an Excel electronic database. Besides the narrative review describing how the results relate to the review aims, purposes/objectives and questions, we will provide a table with the main characteristics of the studies included in the scoping review. We will also assess the frequency of the number of studies investigating i) the type(s) of HCWs recruited, ii) the types of injuries, as well as iii) the outcome studied (injury rate and determinants; burden generated by the injuries; and preventive measures that can be adopted to curb the injury rate).

Findings will be reported according to the PRISMA Extension for Scoping Reviews (PRISMA – ScR) checklist.[56]

Stage VI: Consultation exercise and stakeholder involvement

Both Arksey and O'Malley[42] and Levac et al.[44] have suggested that the consultation exercise stage could provide opportunities for the involvement of key stakeholders, providing insights beyond what can be found in the scholarly literature. In the development of our planned scoping review, there will be an ongoing involvement of the relevant scientific societies, such as the Italian Society of Occupational Medicine ("Società Italiana di Medicina del Lavoro", SIML) and of the national and international networks of occupational physicians. Prior to publication and dissemination of the findings, we will once again consult with these stakeholders in order to receive their feedback and to ensure that the data have been clearly and accurately presented.

Patient and public involvement

In the development of the planned scoping review, there will be no specific patient and public involvement.

DISCUSSION

Implications

HCWs are subject to different risk factors and risky behaviors that may have a serious impact on their health and safety, consequently imposing an economic burden for all non-fatal and fatal work-related injuries and illnesses.[57,58] From this viewpoint, a major challenge for Western Countries is to promote health and wellbeing of individuals both at the occupational and community level in order to enable workforce to stay at work longer and healthier.[59,60] Mapping the existing literature on the relevant topic related to injuries in the healthcare setting enables to understand both the traditional and the emerging health problems at work (such as the impact of ageing, musculoskeletal and psychosocial problems, shift working, gender perspectives, re-emergent infectious diseases), providing useful insights to better interpret them and their determinants, within the actual transition phase to the service sector. This approach underpins the planning and implementation of high-quality occupational health interventions in the currently changing world of work.[61]

The proposed scoping review is expected to contribute to the existing scholarly literature with the potential to influence and inform health practice, education, policy, and future research in the field.

Currently, there is not a review of studies performed in Western Countries concerning injuries among HCWs. As such, this scoping review will provide the first rigorous analytical, updated synthesis of primary research data concerning the epidemiology and the economic and occupational burden of injuries among HCWs in Western countries. Stratifying according to the work tasks and type of injuries could add meaningful information and increase the understanding of the determinants of injuries among HCWs.

Due to the changing conditions of our society and of healthcare settings, together with classical occupational risk factors, new hazardous factors are emerging and ensuring health protection in the workplace is mandatory. Acquiring good evidence concerning the epidemiology of injuries and associated determinants among HCWs in Western countries is the scientific basis for implementing programs and properly orienting the activities of occupational health services and policies. This would bring considerable benefits not only to workers but to the entire organizations and societies, matching the objective of occupational and public health programs.

Furthermore, this scoping review will allow to assess the scholarly literature for knowledge gaps that researchers could be able to address, focusing their future research activities on. Being conducted in partnership with the INAIL and the national and international networks of occupational physicians, the planned scoping review will be useful as well for health decision- and policy-makers in order to develop, design, implement and foster *ad hoc* adequate, cost-effective policies and practices for primary prevention and educational programs.

Strengths and limitations

The major strength is given by the rigor, transparency, and reproducibility of our review approach. The scoping review will be, indeed, based on the present scoping review protocol, which has been submitted separately for review and publication, in order to ensure high methodological standards. Any amendments to the present scoping review protocol will be precisely documented, listed and explained in the final review publication(s).

Another strength is given by our multi-disciplinary team, which comprises an experienced epidemiologist and research methodologist (NLB), a biologist with a background in the field of public health (VP), occupational physicians, coming from academic setting (GD, AT, FB, BDA, EM, AM, ND, and PD), and occupational physicians with expertise in the field of social security and insurance (CB, RL, and VM).

However, we have to anticipate also some shortcomings. The major limitation concerns time filter (studies published between 2000 and 2018 will be included in the scoping review), which, on the other hand, enables an updated, direct comparison of the findings with the epidemiological figures available at national and local INAIL Centers. Moreover, as the process of scoping reviews does not include a formal critical quality assessment and appraisal of included studies, reported findings may lack confidence and validity.

Ethics

No ethical clearance is required for the present scoping review protocol and for its subsequent implementation steps, in that it will undertake a knowledge synthesis and an analysis of data that have been already collected and published.

Dissemination

Following the successful completion of the scoping review, its findings will be submitted to peer-reviewed journals for potential publication(s) and will be the object of *ad hoc* oral/poster communication(s) in relevant national and international scientific congresses, and conferences. All members of the research team have established relationships with national and international occupational medicine networks, which will also be used to further disseminate the review findings.

We will not be able to provide any recommendations, since the selected studies will not be critically and formally appraised for methodological quality. The findings of this scoping review could be used to guide the education of HCWs (for example, to inform the development and implementation of courses for continuous medical learning) and the health policy- and decision-making process.

References

1) World Health Organization. Working Together for Health: World Health Report 2006. Geneva: Switzerland, 2006.
2) Joseph B, Joseph M. The health of the healthcare workers. *Indian J Occup Environ Med* 2016;20(2):71–72.
3) Adams BO, Dal Poz MR, Shengelia B, *et al*. Human, Physical, and Intellectual Resource Generation: Proposals for Monitoring. In Murray, C.J.L and Evans, D. (eds) Health Systems Performance Assessment: Debates, Methods and Empiricism. Geneva: World Health Organization: 273-287, 2003.
4) Diallo K, Zurn P, Gupta N, *et al*. Monitoring and evaluation of human resources for health: an international perspective. *Hum Resour Health* 2003;1(1):3.
5) Dressner MA. Hospital workers: an assessment of occupational injuries and illnesses. Monthly Labor Review, U.S. Bureau of Labor Statistics, June 2017.
6) Miller K. Risk factors and impacts of occupational injury in healthcare workers: A critical review. OA Musculoskeletal Medicine 2013 Mar 01;1(1):4.
7) Young TN, Arens FJ, Kennedy GE, *et al*. Antiretroviral post-exposure prophylaxis (PEP) for occupational HIV exposure. *Cochrane Database Syst Rev* 2007;(1):CD002835.
8) Rischitelli G, Harris J, McCauley L, et al. The risk of acquiring hepatitis B or C among public safety workers: a systematic review. Am J Prev Med. 2001 May;20(4):299-306.
9) Westermann C, Peters C, Lisiak B, et al. The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. Occup Environ Med. 2015 Dec;72(12):880-8.
10) Dini G, Toletone A, Sticchi L, et al. Influenza vaccination in healthcare workers: A comprehensive critical appraisal of the literature. Hum Vaccin Immunother. 2017 Aug 8:1-18.
11) Uden L, Barber E, Ford N, et al. Risk of Tuberculosis Infection and Disease for Health Care Workers: An Updated Meta-Analysis. Open Forum Infect Dis. 2017 Aug 29;4(3):ofx137.
12) Placidi D, Tonozzi B, Alessio L, Porru S. Tuberculin skin test (TST) survey among healthcare workers (HCWs) in hospital: a systematic review of the literature. G Ital Med Lav Ergon. 2007 Jul-Sep;29(3 Suppl):409-11.
13) Riccò M, Vezzosi L, Odone A, et al. Invasive Meningococcal Disease on the Workplaces: a systematic review. Acta Biomed. 2017 Oct 23;88(3):337-351.

14) van den Hoogen A, Duijn JM, Bode LGM, *et al*. Systematic review found that there was moderate evidence that vaccinating healthcare workers prevented pertussis in infants. Acta Paediatr. 2017, in press.

15) Leone Roberti Maggiore U, Scala C, et al. Susceptibility to vaccine-preventable diseases and vaccination adherence among healthcare workers in Italy: A cross-sectional survey at a regional acute-care university hospital and a systematic review. Hum Vaccin Immunother. 2017 Feb;13(2):470-476.

16) Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. *Med Devices (Auckl)* 2017;10:225-235.

17) Prüss-Ustün A, Rapiti E, Hutin Y. Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers. *Am J Ind Med* 2005;48(6):482.

18) Auta A, Adewuyi EO, Tor-Anyiin A, *et al*. Global prevalence of percutaneous injuries among healthcare workers: a systematic review and meta-analysis. *Int J Epidemiol* 2018, in press..

19) Elseviers MM, Arias-Guillén M, Gorke A, *et al*. Sharps injuries amongst healthcare workers: review of incidence, transmissions and costs. *J Ren Care* 2014 Sep;40(3):150-6.

20) Deuffic-Burban S, Delarocque-Astagneau E, Abiteboul D, *et al*. Blood-borne viruses in health care workers: prevention and management. *J Clin Virol* 2011;52(1):4-10.

21) Baxi R, Mytton OT, Abid M, *et al*. Outbreak report: nosocomial transmission of measles through an unvaccinated healthcare worker-implications for public health. *J Public Health (Oxf)* 2014 Sep;36(3):375-81.

22) Amendola A, Bianchi S, Frati ER, *et al*. Ongoing large measles outbreak with nosocomial transmission in Milan, northern Italy, March-August 2017. *Euro Surveill* 2017 Aug 17;22(33).

23) Edlich RF, Hudson MA, Buschbacher RM, *et al*. Devastating injuries in healthcare workers: description of the crisis and legislative solution to the epidemic of back injury from patient lifting. *J Long Term Eff Med Implants* 2005;15(2):225-41.

24) Nelson AL, Collin J, Knibbe H, *et al*. Safer patient handling. *Nurs Manage* 2007;38(3):26−32.

25) Delloiacono N. Musculoskeletal safety for older adults in the workplace: review of current best practice evidence. *Workplace Health Saf* 2015;63(2):48-53.

26) Milhem M, Kalichman L, Ezra D, *et al*. Work-related musculoskeletal disorders among physical therapists: A comprehensive narrative review. *Int J Occup Med Environ Health*. 2016;29(5):735-47.

27) Dillon BL. Workplace violence: impact, causes, and prevention. *Work* 2012;42(1):15-20.
28) International Labour Office (ILO), International Council of Nurses (ICN), World Health Organization (WHO), Public Services International (PSI). Joint Programme on Workplace Violence in the Health Sector. Geneva, 2002.
29) Spaducci G, Stubbs B, McNeill A, Stewart D, Robson D. Violence in mental health settings: A systematic review. Int J Ment Health Nurs. 2018 Feb;27(1):33-45.
30) d'Ettorre G, Pellicani V. Workplace Violence Toward Mental Healthcare Workers Employed in Psychiatric Wards. *Saf Health Work* 2017;8(4):337-342.
31) Luftman K, Aydelotte J, Rix K, et al. PTSD in those who care for the injured. Injury. 2017 Feb;48(2):293-296.
32) Ashton RA, Morris L, Smith I. A qualitative meta-synthesis of emergency department staff experiences of violence and aggression. *Int Emerg Nurs*. 2018, in press.
33) Gillespie GL, Gates DM, Miller M, *et al*. Workplace violence in healthcare settings: risk factors and protective strategies. *Rehabil Nurs* 2010;35(5):177-84.
34) Sossai D, Molina FS, Amore M, et al. Analysis of incidents of violence in a large italian hospital. *Med Lav*. 2017 Oct 27;108(5):6005.
35) Molina Aragonés JM, Ayora Ayora A, Barbara Ribalta A, et al. Occupational exposure to volatile anaesthetics: a systematic review. Occup Med (Lond). 2016 Apr;66(3):202-7.
36) Caciari T, Capozzella A, Tomei F, et al. Professional exposure to ionizing radiations in health workers and white blood cells. Ann Ig. 2012 Nov-Dec;24(6):465-74.
37) Garbarino S, Traversa F, Spigno F, et al. Sleepiness, sleep disorders and risk of occupational accidents. G Ital Med Lav Ergon. 2011 Jul-Sep;33(3 Suppl):207-11.
38) Garbarino S, Repice AM, Traversa F, *et al*. Commuting accidents: the influence of excessive daytime sleepiness. A review of an Italian Police officers population. *G Ital Med Lav Ergon* 2007;29(3 Suppl):324-6.
39) Caruso CC. Negative impacts of shiftwork and long work hours. Rehabil Nurs. 2014 Jan-Feb;39(1):16-25.
40) Booker LA, Magee M, Rajaratnam SMW, et al. Individual vulnerability to insomnia, excessive sleepiness and shift work disorder amongst healthcare shift workers. A systematic review. Sleep Med Rev. 2018
41) Copello F, Garbarino S, Messineo A, *et al*. Occupational Medicine and Hygiene: applied research in Italy. *J Prev Med Hyg* 2015;56(2):E102-10.
42) Arksey H, O'Malley L. Scoping studies: Towards a Methodological Framework. *Int J Soc Res Methodol* 2005;8:19–32.

43) Khalil H, Peters M, Godfrey CM, et al. An Evidence-Based Approach to Scoping Reviews. *Worldviews Evid Based Nurs* 2016;13(2):118-23.Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:69.

44) Colquhoun HL, Levac D, O'Brien KK, *et al*. Scoping reviews: time for clarity in definition, methods, and reporting. *J Clin Epidemiol*. 2014 Dec;67(12):1291-4.

45) Tricco AC, Lillie E, Zarin W, *et al*. A scoping review on the conduct and reporting of scoping reviews. *BMC Med Res Methodol* 2016;16:15.

46) Peters MD, Godfrey CM, Khalil H, *et al*. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc* 2015;13(3):141-146.

47) Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J* 2009;26(2):91-108.

48) Mays N, Roberts E, Popay J. Synthesising research evidence. In N. Fulop, P. Allen, A. Clarke, & N. Black (Eds.), Studying the organisation and delivery of health services: Research methods (pp. 188-219). London: Routledge, 2001.

49) Peterson J, Pearce PF, Ferguson LA, *et al*. Understanding scoping reviews: Definition, purpose, and process. *J Am Assoc Nurse Pract* 2017;29(1):12-16.

50) Shamseer L, Moher D, Clarke M, *et al*. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;349(jan02 1):g7647.

51) Chien PF, Khan KS, Siassakos D. Registration of systematic reviews: PROSPERO. *BJOG* 2012;119(8):903-5.

52) McGowan J, Sampson M, Salzwedel DM, et al. PRESS Peer Review of Electronic Search Strategies: 2015 Guideline Statement. J Clin Epidemiol. 2016 Jul;75:40-6.

53) Thabane L, Thomas T, Ye C, Paul J. Posing the research question: Not so simple. Can J Anaesth. 2009;56:71–9.

54) Moher D, Liberati A, Tetzlaff J, *et al*. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. *Open Med* 2009;3(3):e123-30.

55) Tricco AC, Lillie E, Zarin W, *et al*. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018 Oct 2;169(7):467-473.

56) European Agency for Safety and Health at Work (EU-OSHA). The economics of occupational safety and health - the value of OSH to society. 2017. Available from: https://visualisation. osha.europa.eu/osh-costs#!/

57) Heuvel S, Zwaan L, Dam Lv, *et al*. Estimating the costs of work-related accidents and ill-health: An analysis of European data sources. Luxembourg: European Agency for Safety and Health at Work (EU-OSHA), 2017.

58) Burton J. WHO Healthy workplace framework and model: Background and supporting literature and practices. World Health Organization, 2010.

59) Westerholm P, Walters D. Supporting Health at Work: International Perspectives on Occupational Health Services. IOSH Services, 2007.

60) Leijon O, Lindahl E, Torén K, et al. First-time decisions regarding work injury annuity due to occupational disease: a gender perspective. *Occup Environ Med* 2014 Feb;71(2):147-53.)

61) Steel J, Luyten J, Godderis L. Occupational Health: The Global Evidence and Value. Society of Occupational Medicine, International SOS Foundation, KU Leuven University, 2018.

Tables.

Table 1. Planned search strategy.

SEARCH STRATEGY ITEM	SEARCH STRATEGY
Databases	PubMed/MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded and Social Sciences Citation Index from ISI/Web of Science, ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform
Language filter	None
Time filter	2000-2018
Spatial filter	Western countries
Keywords	1. “healthcare worker” OR “healthcare workers” OR “healthcare personnel” OR “healthcare staff” OR “health worker” OR “health workers” OR “health personnel” OR “health staff” OR physicians OR physician OR doctors OR doctor OR nurses OR nurse OR practitioners OR practitioner OR "medical students" OR "medical residents" OR "attending residents" OR "hospital technician" OR "hospital technicians" OR "paramedical personnel" OR "paramedical staff" OR " hospital support personnel" 2. injury OR injuries OR incident OR incidents OR "occupational injury" OR "occupational injuries" OR "occupational incident" OR "occupational incidents" OR "work related injury" OR "work related injuries" OR "work related incident" OR "work related incidents" OR "workplace-induced injury" OR "workplace-induced injuries" OR "workplace-induced incident" OR "workplace-induced incidents" OR "occupational health hazard" OR "occupational health hazards" 3. "exposure incidents" OR "splash exposures" OR "splash exposure" OR needle-sticks OR "sharp objects" OR sharps OR "percutaneous injuries" OR "percutaneous injury" 4. "manual handling injury" OR "manual handling injuries" OR "musculoskeletal injury" OR "musculoskeletal injuries" 5. "chemical occupational exposure" OR "exposure to inhaled anesthetic" OR "reagent exposure" OR "exposure to reagent" OR "exposure to solvents" OR "solvent exposure" OR "exposure to detergents" OR "detergent exposure" 6. "slips, trips and falls" OR "slipping, tripping and falling accidents" OR "accidental fall" OR "same-level fall" OR "same-surface fall" OR stump-and-fall OR step-and-fall OR "forced-rotation-type fall" OR "fall from elevation" 7. "violent events" OR violence OR assault OR assaults 8. "cuts and wounds" OR "burns"

	9. "motor vehicle accidents" OR "motor vehicle accident" OR "motor vehicle collisions" OR "motor vehicle collision" OR "motor vehicle crash" OR "motor vehicle crashes" OR "motor vehicle near crash" OR "motor vehicle near crashes" 10. "exposure to ionizing radiation" OR "radiation exposure" 1. AND 2. OR 3. OR 4. OR 5. OR 6. OR 7. OR 8. OR 9. OR 10.
Inclusion criteria	P: medical/paramedical students and residents, doctors and nurses, cleaners and porters I: exposure to biological, chemical, physical/ergonomic risk and hazard C: medical versus nursing or dental students; students versus residents; medical versus nursing or dental trainees/residents; exposed HCWs versus non exposed; before and after a preventive program O: prevalence/incidence of injuries and their determinants among healthcare workers in Western countries, related disabilities and absence from work, and generated economic burden (direct/indirect costs) Study design: primary research
Exclusion criteria	Studies not meeting with the above-stated PICO criteria Study design: editorial, letter to the editor, commentary, case report, case series, review
Target journals	Occupational and public health journals

Table 2. Data planned to be extracted and details/explanations.

EXTRACTED DATA	DETAILS
Study Reference	Names and surnames of authors, year of publication
Study population	Physicians, doctors, nurses, medical students, residents, cleaners, porters
Country	Country or countries in which the study or studies was or were carried out
Study design	Type of recruitment
M%	Percentage of male healthcare workers
Age	Mean age of healthcare workers sample
Sample number, attrition rate	Number of healthcare workers who took part into the survey, number of non responders
Professional/experience years	Years spent in profession by healthcare workers included in the study
Working setting	Hospital ward where the injury occurred (for example, emergency room, obstetrics department, surgery department, operating room, outpatient clinic, department of Internal Medicine, patients' room, CCU/ICU)
Injury prevalence/incidence rate	Prevalence/incidence rates stratified according to the kind of injury
Method	Questionnaire (validated, not validated)
Following standard procedures	Prevalence/incidence rates stratified according to the compliance to procedures and guidelines among the different types of healthcare workers
Knowledge, attitudes and practices about PEP	Prevalence/incidence rates stratified according to the knowledge, attitudes and practices concerning PEP, among the different types of healthcare workers
Clerkship abroad	Periods of training abroad; type of task(s) the healthcare worker was involved in during the training period abroad
Reporting/non-reporting to Occupational Departement	Prevalence/incidence rates stratified according

	to the determinants of the reporting/non-reporting, among the different types of healthcare workers
Injuries-related burden	Number of days of absence from work, disabilities and economic direct/indirect costs due to injuries

Figures.

Figure 1. Flowchart of selection of studies according to the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.

Contributors

NLB, GD, VP, CB, RL, VM, AT, FB, BDA, EM, AM, ND, and PD conceived the idea. NLB, GD, VM, AT, and PD developed the research questions. NLB, GD, and PD developed the study methods. VP, CB, RL, FB, BDA, EM, AM, and ND aided in developing the research question and study methods. All authors participated in drafting the article, editing or revising it critically for important intellectual content; all authors gave final approval of the version to be submitted and any revised version.

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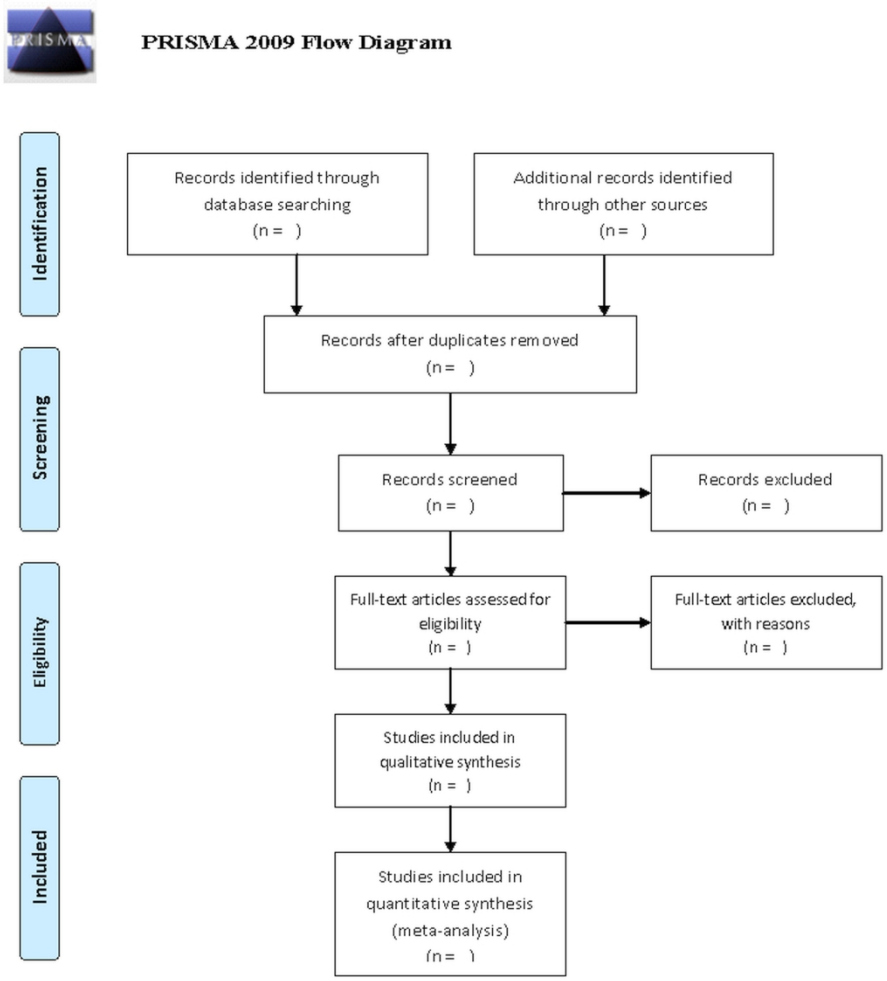
Competing interests

None declared.

Patient consent

Not required.



Flowchart of selection of studies according to the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.

226x236mm (300 x 300 DPI)

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page of the documents and details
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	Protocol of a scoping review assessing injury rate and determinants among healthcare workers in Western countries (page 1)
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	In accordance with these guidelines, the scoping review protocol has been submitted to the International Prospective Register of Systematic Reviews (PROSPERO). However, currently, PROSPERO does not accept to register scoping review protocols (page 8).
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	Page 1 and page 21. Furthermore, role of each author is outlined in the protocol.
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	The present protocol is not an amendment.
Support:			Sources and the role of the sponsor are indicated at page 7 and at page 21.
Sources	5a	Indicate sources of financial or other support for the review	
Sponsor	5b	Provide name for the review funder and/or sponsor	
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	Rationale is provided in the background (pages 4-6).
Objectives	7	Provide an explicit statement of the question(s) the review will	Page 7.

		address with reference to participants, interventions, comparators, and outcomes (PICO)	
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	Page 8 and table 1.
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	Page 8 and table 1.
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Page 8 and table 1.
Study records: Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	Pages 8-9.

Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	Pages 8-9
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	Pages 8-9
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	Table 2.
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with Rationale	Table 2.
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	Pages 8-10
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	Pages 8-10
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	Pages 8-10
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	Page 10

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

BMJ Open

Protocol of a scoping review assessing injury rates and their determinants among healthcare workers in Western countries

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Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Epidemiology
Keywords:	healthcare workers, injuries, scoping review protocol

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Protocol of a scoping review assessing injury rates and their determinants among healthcare workers in Western countries

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ABSTRACT

Introduction: Healthcare workers (HCWs) are exposed to various risk factors and risky behaviors that may seriously affect their health and ability to work. The aim of this protocol is to detail the steps to follow in order to carry out a scoping review to assess the prevalence/incidence of injuries among HCWs.

Methods and analysis: The study will be carried out in accordance with the "Preferred Reporting Items for Systematic reviews and Meta-Analysis – Protocols" (PRISMA-P) guidelines. Studies will be selected according to the following criteria: P (HCWs), E (exposure to injuries), C (different types of exposure and different categories of HCWs) and O (prevalence/incidence and determinants of injuries). A time filter has been set (literature between 2000 and 2018) to enable updated, direct comparison between the findings and the epidemiological data available at national and local "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institute for Insurance Against Accidents at Work, INAIL) Centers in Italy. No language restriction will be applied.

Ethics and dissemination: Formal ethical approval is not required; primary data will not be collected, as they have already been published. The results will be disseminated through peer-reviewed publication(s), conference presentation(s) and the press.

Key terms: healthcare workers; injuries; scoping review protocol

Strengths and limitations of this study

- Current literature reports no reviews of studies performed in Western countries concerning injuries among healthcare workers.
- Stratifying injuries according to type and the work tasks involved could add meaningful information.
- A major limitation concerns the time filter (studies published between 2000 and 2018). However, this enables updated, direct comparison between the findings and the epidemiological data available at national and local "Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro" (National Institute for Insurance Against Accidents at Work, INAIL) Centers.

BACKGROUND

The healthcare system is the fastest-growing sector in Western countries and employs millions of workers: over 18 million in the United States and more than 59 million worldwide.[1] "Healthcare workers" (HCWs) is an umbrella term, which refers to all people engaged in the promotion, protection, care or improvement of the health of the population. This term includes a variety of different figures, ranging from medical doctors (such as specialists, pediatricians and general practitioners) to midwives and nurses, other allied health professionals, central supply workers and technicians, and residents.[2-4]

Several variables may constitute risk factors and impact on HCWs' health and safety, potentially leading to occupational injuries and diseases. These include: the individual characteristics of the HCWs (age, gender, education, smoking status, and other lifestyle habits) and the features of the patient under care (socio-demographic characteristics and type of disease) and of the healthcare setting (e.g. organization, workload, or night shifts) and procedures (such as invasive treatment).

Like other working environments, hospitals and other healthcare facilities are not completely safe workplaces for professionals. HCWs may be exposed to several occupational health hazards, which may impose a considerable clinical, economic and human burden. In Western countries, injury rates are higher among HCWs than among workers in any other field.[5,6] Some classic occupational hazards seem to re-emerge owing to societal changes, including biological hazards (such as HBV, HCV, HIV, measles, influenza, varicella and tuberculosis infections, among others).[7-15] These constitute a major occupational health problem, as most of them are blood-borne diseases, which can be acquired through needle-stick or sharps injuries (NSSI). HCWs have contact with infected patients and their body fluids. Moreover, they frequently perform exposure-prone procedures (EPPs) that may cause injury. This risk involves surgeons, midwives, microbiologists, pathologists, and blood bank and dialysis staff, among others. According to a recent review by Cooke and Stephens, in 2015 a needle-stick injury generated a cost of $747 (range $199-1,691).[16] Prüss-Ustün and collaborators used mathematical modeling to estimate the global burden of infections due to percutaneous injuries (PIs) among HCWs. Their model was based on the probability of injury, the prevalence of infection, the susceptibility of the worker and the potential of percutaneous transmission. In Western countries, 1,510 cases of HCV, 360 cases of HBV and 11 cases of HIV occurred in the year 2000, accounting for 8-27%, 1-8% and 0.5-3.1% of infections, respectively.[17] A recently published systematic review and meta-analysis of the literature performed by Auta and coworkers[18] computed a global one-year prevalence of PIs of 36.4% [95% confidence interval (CI) 32.9–40.0], ranging from 9.5% [95%CI 6.7–12.4] in Australasia to 15.7% [95%CI 12.1–19.3] in North America and to 31.8% [95%CI 25.0–38.5] in Europe. Incidence rates of sharps injuries

ranged from 1.4 to 9.5 per 100 HCWs, with a weighted mean of 3.7/100 HCWs *per* year and a related mean societal cost of €272.[19] According to Deuffic-Burban and colleagues,[20] the risk of transmission of blood-borne pathogen infections in susceptible HCWs – i.e. without post-exposure prophylaxis (PEP) or adequate hepatitis B vaccination - is estimated to be 30%, 0-0.5%, and <0.3% for HBV, HCV and HIV, respectively. In recent years, large measles outbreaks, with nosocomial transmission among HCWs, have been documented in Italy and the UK.[21,22]

The incidence of occupational exposure, and, therefore, of PIs can be reduced by adopting preventive measures, such as taking standard precautions or implementing training sessions targeting both long-term HCWs and students and residents at risk. For instance, in France, the proportion of PIs preventable by means of standard precautions decreased from 52.5% in 2004 to 45.8% in 2008.[20]

Other hazards are ergonomic/physical. Musculoskeletal injuries caused by patient handling and overexertion are among the most frequent traumas sustained by HCWs. Musculoskeletal injuries, which may involve muscles, nerves, tendons and ligaments, joints and cartilage, are due to such factors as repetitive movements, force, awkward postures, contact stress or vibration. Personnel assigned to hospital housekeeping, laundry and food services, maintenance, central supply and office tasks, as well as those involved in patient care, are susceptible to such injuries. Patient-handling injuries may be caused by manually lifting patients, who are generally more overweight or obese than in the past. Consequently, a "Safe Patient Handling – No Manual Lifting" policy should be adopted. This is especially important today, given the current shortage of HCWs, particularly of nurses, and the need to mobilize patients early and to assist them with physical activities.[23,24] According to some epidemiological surveys, up to two thirds of nurses have suffered from musculoskeletal disorders for at least 14 days at least once in their working lives.[25] Physiotherapists are also at high risk of developing musculoskeletal disorders: according to a recent comprehensive narrative review, their lifetime and yearly prevalence rates are 55-91% and 40-91.3%, respectively. Injuries generally affect the lower back, neck, upper back and shoulders.[26]

Physical violence is another occupational hazard, and severely impacts on HCWs' well-being and job motivation, affecting health-care provision and quality.[27] According to World Health Organization (WHO) estimates, from 8% to 38% of HCWs have been assaulted by patients or visitors at least once in their careers. Recently, the WHO, the "International Labor Organization" (ILO), the "International Council of Nurses" (ICN) and the "Public Services International" (PSI) jointly drafted a document entitled "Framework guidelines for addressing workplace violence in the health sector".[28] The risk of physical violence is particularly high among HCWs working in psychiatric wards.[29] Indeed, according to a recent review of the literature, lifetime rates of overall

assaults, physical and verbal threats and sexual harassment in acute psychiatric units are 24-80%, 46-78.6%, 43-78.6% and 9.5-37.2%, respectively. The complications of such episodes include fractures, eye injuries and permanent disability, as well as psychological symptoms such as anxiety, depression, post-traumatic stress disorder (PTSD) or avoidance behavior.[30,31] Another environment in which the risk of violence/assault is high is the emergency department (ED): according to a recent qualitative meta-synthesis, ED staff members perceive aggression as unavoidable and feel that they are too often left to handle it alone.[32] Aggressors typically suffer from psychiatric disorders, have a history of drug or alcohol use, carry weapons, are themselves victims of violence, and are unable to cope rationally with situational crises.[33] In recent years, the number of assaults against HCWs has risen. For example, in one university teaching hospital in northern Italy, non-fatal violent events increased from 20.65/10,000 in 2012 to 22.81/10,000 in 2014, resulting in 431 days of absence from work and generating a direct cost of € 64,170. Up to 75% of violent episodes occurred in the ED, intermediate care, psychiatry and geriatrics wards.[34]

A less common source of injury among HCWs is exposure to chemicals (inhalation of anesthetics, solvents, detergents or reagents)[35] or physical agents (such as ionizing and non-ionizing radiations).[36]

A particular type of disorder is also known to affect shift workers. Research among shift and non-shift workers has revealed a strict, statistically significant relationship between shift work and excess daytime sleepiness.[37-40] Owing to workforce shortages, high workloads and the need to work at night, 32% of HCWs report not getting enough sleep.[40]

Systematically identifying working conditions associated with exposure to health hazards and subsequently taking remedial action can play a major role in primary prevention.[41]

Review objectives

The objectives of our planned study will be to: i) provide a comprehensive overview of all studies dealing with injuries among HCWs in Western countries; ii) identify the most frequent kinds of injuries among HCWs; iii) identify the type(s) of HWCs most prone to injuries; iv) identify which variable(s) impact(s) on the occurrence of injuries among HCWs; v) quantify the burden of injuries among HCWs in terms of related disabilities, residual working capability, absence from work and direct/indirect costs generated; vi) identify preventive measures that can effectively curb the occurrence of injuries among HCWs; and vii) disseminate review findings in the published literature on injuries among HCWs.

Review questions

The review questions of our planned study are: i) What is the incidence/prevalence rate of injuries among HCWs in Western countries? ii) What are the determinants of injuries among HCWs in Western countries? iii) What type of injury most commonly occurs among HCWs in Western countries? iv) Among the different professional figures within the umbrella term of HCWs, which one(s) is/are the most affected by injuries in Western countries? v) What is the burden imposed by injuries among HCWs in terms of related disabilities, residual working capability, absence from work and direct/indirect costs generated? vi) What are the state-of-art preventive measures that can be adopted in order to effectively reduce injuries among HCWs in Western countries?

METHODS

Study design

In order to properly address the research questions, a scoping review will be performed by means of the 6-stage methodological framework initially proposed by Arksey and O'Malley.[42] This framework comprises 6 steps: namely, i) identifying the research question(s); ii) identifying relevant studies; iii) study selection; iv) charting the data; v) collating, summarizing and reporting the results; and vi) consultation exercise.[43] This conceptual scheme has been made more detailed and explicit by Levac, Colquhoun and O'Brien,[44] further refined by Colquhoun and collaborators,[45] and subsequently modified by the Joanna Briggs Institute (JBI) in the "JBI scoping review methods" manual.[46]

The specific methodology of the scoping review[46,47] was chosen in order to take into account both the nature and the specific requests of a national project co-funded and performed in collaboration between the Department of Health Sciences (DISSAL), Occupational Medicine - University of Genoa, Italy, and the National Institute for Insurance Against Accidents at Work (in Italian, "*Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro*", INAIL). This objective requires the rapid assessment of a large amount of diverse scholarly literature, the aim being to achieve breadth rather than depth. For this reason, other types of review, such as systematic reviews, umbrella reviews or rapid reviews,[48] were not deemed methodologically effective.

As maintained by Arksey and O'Malley,[42] scoping reviews may be utilized to assess the topology of a vast body of literature, in order to identify current gaps of knowledge and future prospects.[42,49,50] These aims corresponded to the objectives of our project.

Drafting and registration of the study protocol

This protocol is reported in accordance with the "Preferred Reporting Items for Systematic Reviews and Meta-Analysis – Protocols" (PRISMA – P) guidelines.[51] However, despite the recommendation of these guidelines, it was not possible to register the scoping review protocol in the "International

Prospective Register of Systematic Reviews" (PROSPERO),[52] in that this register does not currently accept scoping review protocols.

Stage I: Identifying the research question(s)

Five authors (NLB, GD, VM, AT, and PD) drafted the research questions; the other authors (VP, CB, RL, FB, BDA, EM, AM, and ND) helped to develop these questions. The research objectives and questions have been formulated as they are stated in the previous sections "Review objectives" and "Review questions".

Stage II: Identifying relevant studies

The identification of relevant studies will follow the three-step process recommended by the JBI: namely, i) preliminary search conducted on at least two databases; ii) preparation of a list of search terms and words to be used in the subsequent running of the search on a larger number of databases; and iii) possible additional searches (cross-checking/cross-referencing of reference lists of potentially eligible studies, hand-searching in target journals relevant to the topic, etc.).

Preliminary literature search

We carried out a preliminary literature search on the topic of interest in order to clarify inclusion/exclusion criteria. After familiarizing ourselves with the literature, we were able to further expand and/or modify/refine the search strategy with the help of an expert, qualified research librarian.

The preliminary literature search was carried out on two widely used scholarly databases (PubMed/MEDLINE and Scopus), using "healthcare injuries" as keywords and adopting a time filter; this yielded 27,844 and 139,073 studies, respectively. In the second stage, the research team inspected titles and abstracts of potentially relevant articles and prepared a list of pertinent words and index terms to inform the subsequent search process.

Structured search strategy

Based on the previously prepared list of key terms, a systematic literature search will be carried out on several scholarly databases, namely PubMed/MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded (SCIE) and Social Sciences Citation Index (SSCI) from the ISI/Web of Science (WoS), ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform databases.

We will include all studies reporting epidemiological figures of injuries among HCWs in Western countries in terms of prevalence/incidence rates. The search will be performed by using an appropriate string of relevant search terms based on controlled vocabulary and Boolean connectors (Table 1). For PubMed/MEDLINE, for instance, Medical Subject Headings (MeSH) key terms and wild card option (truncated key terms) will be utilized. This structured search strategy will be adapted to the other databases, in order to obtain database-specific search strategies. If a decision on the inclusion or exclusion of a study cannot be made on the basis of the abstract, the full text of the article will be examined. During this process, we will utilize the "Peer Review of Electronic Search Strategies (PRESS) 2015 Guideline statement" as a guide.[53]

In the third phase of the search strategy, we will scan reference lists of the studies chosen and prior reviews. Additionally, we will hand-search target journals relevant to the topic under study.

Five authors (NLB, GD, VM, AT and PD) will identify relevant studies, with the aid of the other authors (VP, CB, RL, FB, BDA, EM, AM, and ND).

Stage III: Study selection

Once the search strategy has been successfully completed, search results will be collated and exported to EndNote V.X7 (Clarivate Analytics). Duplicates will be automatically removed before the file containing a set of unique records is made available to reviewers for further processing (i.e., study screening and selection).

The studies will be independently screened by two authors (NLB and GD), who will read study titles and abstracts for potential eligibility. Screening questions will be drafted and pilot-tested on a subset of records randomly chosen before implementation. Inter-rater agreement will be assessed by means of the κ statistic and any disagreement will be resolved through discussion; a third reviewer (PD), acting as a final referee, will be involved if necessary.

Inclusion criteria

Studies meeting the following PECO criteria will be considered for inclusion:[54]

- P (patient, problem or population): HCWs (of any type, medical, nursing or dental practitioners, trainees/residents, other allied health professionals, central supply workers and technicians) working in Western countries;
- E (exposure): injuries (of any type, due to exposure to biological, chemical, physical/ergonomic risks and hazards);

- C (comparison, control or comparator): different types of HCWs (medical *versus* nursing or dental practitioners, trainees or residents); exposed HCWs *versus* non-exposed; before and after a preventive program;
- O (outcome/outcomes of interest): prevalence/incidence and determinants of injuries, occupational burden (in terms of related disabilities and absence from work), and economic burden generated (in terms of direct and indirect costs).

Furthermore, the following criteria will be taken into consideration:

- Study design/characteristics: original articles, prevalence/incidence studies;
- Time: a time filter/restraint will be applied. Only papers written between 2000 and 2008 will be considered;
- Languages: no language filter/restraint will be applied. Non-English articles that are included will be acquired in full text and translated by expert translators from the University of Genoa, Italy.

Exclusion criteria

Articles that do not meet the above-stated PECO criteria, or which provide insufficient information, and studies designed as editorials, letters to the editor, commentaries, expert opinions, case reports, case series, and reviews will be excluded.

Reporting the studies selected

Details of the literature search and screening results will be both summarized narratively and presented graphically by means of the "Preferred Reporting Items for Systematic reviews and Meta-Analyses" (PRISMA) flow diagram (Figure 1).[55] In addition, we will provide a table of excluded studies, with reasons for their exclusion, in our published final scoping review.

Stage IV: Charting the data

An *ad hoc* data-extraction template reflecting the research questions and the purposes/objectives of the review will be created. This will be used both to confirm study relevance and to extract the data. In detail, the template will gather information regarding the key characteristics of the studies, such as study authors, year of publication, study population – type(s) of HCWs recruited – and study country, study design, percentage of male HCWs, mean age, sample size, attrition rate, years of professional experience, working setting, prevalence/incidence rate of injuries, knowledge, attitudes and practices concerning the adoption of standard procedures, and injury-related burden (Table 2)

These *a priori* data items have been individuated and developed through a preliminary exercise by all the research team.

The data-extraction process will be performed independently by two authors (NLB and GD) and will be pilot-tested on a small sample of randomly selected studies, until consensus is reached. On the basis of this pilot test, if deemed necessary by the research team, the data-extraction form will be reviewed and revised, in order to capture any relevant information contained in the studies included. Any change to the data-collection form will be documented and explained. To assist this process of the scoping review, the "Covidence" software (Cochrane) for systematic review management will be used.

Stage V: Collating, summarizing and reporting the results

Stage V is aimed at providing a summary and synthesis of the findings. However, Levac et al.[44] have suggested breaking down this review step into the following three smaller and distinct phases: namely, a) data collation and analysis; b) reporting of the results and outcome(s) in such a way as to guide and inform the overall study purposes/objectives, and research questions; and c) taking into account the meaning of the findings in relation to the study purposes/objectives and research questions, and discussion of the potential, practical implications that the findings may have on future research, practice and policy.

The data collected during stage IV will be stored in an Excel electronic database. In addition to the narrative review describing how the results relate to the review purposes/objectives and questions, we will provide a table showing the main characteristics of the studies included in the scoping review. We will also assess the frequency of studies investigating: i) the type(s) of HCWs recruited, ii) the types of injuries, and iii) the outcome studied (injury rate and determinants; burden generated by the injuries; and preventive measures that can be adopted to curb the injury rate).

Findings will be reported according to the PRISMA Extension for Scoping Reviews (PRISMA – ScR) checklist.[56]

Stage VI: Consultation exercise and stakeholder involvement

Both Arksey and O'Malley[42] and Levac et al.[44] have suggested that the consultation exercise stage can provide opportunities to involve key stakeholders, providing insights beyond those that can be found in the scholarly literature. The development of our planned scoping review will include the ongoing involvement of relevant scientific societies, such as the Italian Society of Occupational Medicine ("Società Italiana di Medicina del Lavoro", SIML), and of the national and international

networks of occupational physicians. Prior to publication and dissemination of the findings, we will once again consult with these stakeholders in order to receive their feedback and to ensure that the data have been clearly and accurately presented.

Patient and public involvement

In the development of the planned scoping review, there will be no specific involvement of patients or the public.

DISCUSSION

Implications

HCWs are subject to various risk factors and risky behaviors, which may have a serious impact on their health and safety. Moreover, both non-fatal and fatal work-related injuries and illnesses impose an economic burden on society.[57,58] Thus, a major challenge for Western countries is to promote the health and well-being of individuals at both the occupational and community levels, in order to enable workers to stay at work longer and in good health.[59,60] Mapping the existing literature on injuries in the healthcare setting enables us to understand both traditional and emerging health problems at work (such as the impact of aging, musculoskeletal and psychosocial problems, shift work, gender perspectives, re-emergent infectious diseases) and provides useful insights into their determinants. This approach underpins the planning and implementation of high-quality occupational health interventions in the currently changing world of work.[61]

The proposed scoping review is expected to contribute to the existing scholarly literature through its potential to inform and influence healthcare practice, education and policy, and to guide future research in the field.

As yet, no reviews of studies conducted in Western countries concerning injuries among HCWs have been carried out. As such, this scoping review will provide the first rigorous analytical, updated synthesis of primary research data on the epidemiology and the economic and occupational burden of injuries among HCWs in Western countries. Stratifying injuries according to type and the work tasks involved could add meaningful information and increase our understanding of the determinants of injuries among HCWs.

Owing to the changing conditions of our society and of healthcare settings, new hazards are emerging alongside classic occupational risk factors, and ensuring health protection in the workplace is mandatory. Acquiring good evidence concerning the epidemiology of injuries and

associated determinants among HCWs in Western countries is the scientific basis for implementing programs and properly orienting the activities of occupational health services and policies. This would bring considerable benefits not only to workers but to entire organizations and societies, which is an objective of occupational and public health programs.

Furthermore, this scoping review will allow us to assess the scholarly literature for knowledge gaps that researchers will be able to address in their future research. Being conducted in partnership with the INAIL and the national and international networks of occupational physicians, the planned scoping review will also be useful to decision- and policy-makers, in order to design, develop, implement and foster adequate, cost-effective *ad hoc* policies and practices for primary prevention and educational programs.

Strengths and limitations

The main strength of this scoping review lies in the rigor, transparency and reproducibility of our approach. Indeed, it will be based on the present scoping review protocol, which has been submitted separately for review and publication, in order to ensure high methodological standards. Any amendments to the present scoping review protocol will be precisely documented, listed and explained in the final review publication(s).

Another strength is the multi-disciplinary nature of our team, which comprises an experienced epidemiologist and research methodologist (NLB), a biologist with a background in the field of public health (VP), occupational physicians from the academic setting (GD, AT, FB, BDA, EM, AM, ND, and PD), and occupational physicians with expertise in the field of social security and insurance (CB, RL, and VM).

However, some shortcomings must also be mentioned. The main limitation concerns the time filter (studies published between 2000 and 2018 will be included in the scoping review). However, this will enable us to make an updated, direct comparison of the findings with the epidemiological figures available at national and local INAIL Centers. Moreover, as the process of scoping reviews does not include formal critical quality assessment and appraisal of the studies included, the findings reported may lack reliability and validity.

Ethics

No ethical clearance is required for the present scoping review protocol and for its subsequent implementation, in that it will summarize knowledge and analyze data that have been already collected and published.

Dissemination

Following the successful completion of the scoping review, its findings will be submitted to peer-reviewed journals for potential publication(s) and will be the subject of *ad hoc* oral/poster communication(s) in relevant national and international scientific congresses and conferences. All members of the research team have established relationships with national and international occupational medicine networks, which will also be used to further disseminate the review findings.

We will not be able to provide any recommendations, since the studies selected will not be critically and formally appraised for methodological quality. The findings of this scoping review could be used to guide the education of HCWs (for example, to inform the development and implementation of courses for continuous medical learning) and the health policy- and decision-making process.

References

1) World Health Organization. Working Together for Health: World Health Report 2006. Geneva: Switzerland, 2006.
2) Joseph B, Joseph M. The health of the healthcare workers. *Indian J Occup Environ Med* 2016;20(2):71–72.
3) Adams BO, Dal Poz MR, Shengelia B, *et al*. Human, Physical, and Intellectual Resource Generation: Proposals for Monitoring. In Murray, C.J.L and Evans, D. (eds) Health Systems Performance Assessment: Debates, Methods and Empiricism. Geneva: World Health Organization: 273-287, 2003.
4) Diallo K, Zurn P, Gupta N, *et al*. Monitoring and evaluation of human resources for health: an international perspective. *Hum Resour Health* 2003;1(1):3.
5) Dressner MA. Hospital workers: an assessment of occupational injuries and illnesses. Monthly Labor Review, U.S. Bureau of Labor Statistics, June 2017.
6) Miller K. Risk factors and impacts of occupational injury in healthcare workers: A critical review. OA Musculoskeletal Medicine 2013 Mar 01;1(1):4.
7) Young TN, Arens FJ, Kennedy GE, *et al*. Antiretroviral post-exposure prophylaxis (PEP) for occupational HIV exposure. *Cochrane Database Syst Rev* 2007;(1):CD002835.
8) Rischitelli G, Harris J, McCauley L, et al. The risk of acquiring hepatitis B or C among public safety workers: a systematic review. Am J Prev Med. 2001 May;20(4):299-306.
9) Westermann C, Peters C, Lisiak B, et al. The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. Occup Environ Med. 2015 Dec;72(12):880-8.
10) Dini G, Toletone A, Sticchi L, et al. Influenza vaccination in healthcare workers: A comprehensive critical appraisal of the literature. Hum Vaccin Immunother. 2017 Aug 8:1-18.
11) Uden L, Barber E, Ford N, et al. Risk of Tuberculosis Infection and Disease for Health Care Workers: An Updated Meta-Analysis. Open Forum Infect Dis. 2017 Aug 29;4(3):ofx137.
12) Placidi D, Tonozzi B, Alessio L, Porru S. Tuberculin skin test (TST) survey among healthcare workers (HCWs) in hospital: a systematic review of the literature. G Ital Med Lav Ergon. 2007 Jul-Sep;29(3 Suppl):409-11.
13) Riccò M, Vezzosi L, Odone A, et al. Invasive Meningococcal Disease on the Workplaces: a systematic review. Acta Biomed. 2017 Oct 23;88(3):337-351.

14) van den Hoogen A, Duijn JM, Bode LGM, *et al*. Systematic review found that there was moderate evidence that vaccinating healthcare workers prevented pertussis in infants. Acta Paediatr. 2017, in press.

15) Leone Roberti Maggiore U, Scala C, et al. Susceptibility to vaccine-preventable diseases and vaccination adherence among healthcare workers in Italy: A cross-sectional survey at a regional acute-care university hospital and a systematic review. Hum Vaccin Immunother. 2017 Feb;13(2):470-476.

16) Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. *Med Devices (Auckl)* 2017;10:225-235.

17) Prüss-Ustün A, Rapiti E, Hutin Y. Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers. *Am J Ind Med* 2005;48(6):482.

18) Auta A, Adewuyi EO, Tor-Anyiin A, *et al*. Global prevalence of percutaneous injuries among healthcare workers: a systematic review and meta-analysis. *Int J Epidemiol* 2018, in press..

19) Elseviers MM, Arias-Guillén M, Gorke A, *et al*. Sharps injuries amongst healthcare workers: review of incidence, transmissions and costs. *J Ren Care* 2014 Sep;40(3):150-6.

20) Deuffic-Burban S, Delarocque-Astagneau E, Abiteboul D, *et al*. Blood-borne viruses in health care workers: prevention and management. *J Clin Virol* 2011;52(1):4-10.

21) Baxi R, Mytton OT, Abid M, *et al*. Outbreak report: nosocomial transmission of measles through an unvaccinated healthcare worker-implications for public health. *J Public Health (Oxf)* 2014 Sep;36(3):375-81.

22) Amendola A, Bianchi S, Frati ER, *et al*. Ongoing large measles outbreak with nosocomial transmission in Milan, northern Italy, March-August 2017. *Euro Surveill* 2017 Aug 17;22(33).

23) Edlich RF, Hudson MA, Buschbacher RM, *et al*. Devastating injuries in healthcare workers: description of the crisis and legislative solution to the epidemic of back injury from patient lifting. *J Long Term Eff Med Implants* 2005;15(2):225-41.

24) Nelson AL, Collin J, Knibbe H, *et al*. Safer patient handling. *Nurs Manage* 2007;38(3):26−32.

25) Delloiacono N. Musculoskeletal safety for older adults in the workplace: review of current best practice evidence. *Workplace Health Saf* 2015;63(2):48-53.

26) Milhem M, Kalichman L, Ezra D, *et al*. Work-related musculoskeletal disorders among physical therapists: A comprehensive narrative review. *Int J Occup Med Environ Health*. 2016;29(5):735-47.

27) Dillon BL. Workplace violence: impact, causes, and prevention. *Work* 2012;42(1):15-20.
28) International Labour Office (ILO), International Council of Nurses (ICN), World Health Organization (WHO), Public Services International (PSI). Joint Programme on Workplace Violence in the Health Sector. Geneva, 2002.
29) Spaducci G, Stubbs B, McNeill A, Stewart D, Robson D. Violence in mental health settings: A systematic review. Int J Ment Health Nurs. 2018 Feb;27(1):33-45.
30) d'Ettorre G, Pellicani V. Workplace Violence Toward Mental Healthcare Workers Employed in Psychiatric Wards. *Saf Health Work* 2017;8(4):337-342.
31) Luftman K, Aydelotte J, Rix K, et al. PTSD in those who care for the injured. Injury. 2017 Feb;48(2):293-296.
32) Ashton RA, Morris L, Smith I. A qualitative meta-synthesis of emergency department staff experiences of violence and aggression. *Int Emerg Nurs*. 2018, in press.
33) Gillespie GL, Gates DM, Miller M, *et al*. Workplace violence in healthcare settings: risk factors and protective strategies. *Rehabil Nurs* 2010;35(5):177-84.
34) Sossai D, Molina FS, Amore M, *et al*. Analysis of incidents of violence in a large italian hospital. *Med Lav*. 2017 Oct 27;108(5):6005.
35) Molina Aragonés JM, Ayora Ayora A, Barbara Ribalta A, et al. Occupational exposure to volatile anaesthetics: a systematic review. Occup Med (Lond). 2016 Apr;66(3):202-7.
36) Caciari T, Capozzella A, Tomei F, *et al*. Professional exposure to ionizing radiations in health workers and white blood cells. Ann Ig. 2012 Nov-Dec;24(6):465-74.
37) Garbarino S, Traversa F, Spigno F, *et al*. Sleepiness, sleep disorders and risk of occupational accidents. G Ital Med Lav Ergon. 2011 Jul-Sep;33(3 Suppl):207-11.
38) Garbarino S, Repice AM, Traversa F, *et al*. Commuting accidents: the influence of excessive daytime sleepiness. A review of an Italian Police officers population. *G Ital Med Lav Ergon* 2007;29(3 Suppl):324-6.
39) Caruso CC. Negative impacts of shiftwork and long work hours. *Rehabil Nurs* 2014 Jan-Feb;39(1):16-25.
40) Booker LA, Magee M, Rajaratnam SMW, et al. Individual vulnerability to insomnia, excessive sleepiness and shift work disorder amongst healthcare shift workers. A systematic review. Sleep Med Rev. 2018
41) Copello F, Garbarino S, Messineo A, *et al*. Occupational Medicine and Hygiene: applied research in Italy. *J Prev Med Hyg* 2015;56(2):E102-10.
42) Arksey H, O'Malley L. Scoping studies: Towards a Methodological Framework. *Int J Soc Res Methodol* 2005;8:19–32.

43) Khalil H, Peters M, Godfrey CM, et al. An Evidence-Based Approach to Scoping Reviews. *Worldviews Evid Based Nurs* 2016;13(2):118-23.Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:69.

44) Colquhoun HL, Levac D, O'Brien KK, *et al*. Scoping reviews: time for clarity in definition, methods, and reporting. *J Clin Epidemiol*. 2014 Dec;67(12):1291-4.

45) Tricco AC, Lillie E, Zarin W, *et al*. A scoping review on the conduct and reporting of scoping reviews. *BMC Med Res Methodol* 2016;16:15.

46) Peters MD, Godfrey CM, Khalil H, *et al*. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc* 2015;13(3):141-146.

47) Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J* 2009;26(2):91-108.

48) Mays N, Roberts E, Popay J. Synthesising research evidence. In N. Fulop, P. Allen, A. Clarke, & N. Black (Eds.), Studying the organisation and delivery of health services: Research methods (pp. 188-219). London: Routledge, 2001.

49) Peterson J, Pearce PF, Ferguson LA, *et al*. Understanding scoping reviews: Definition, purpose, and process. *J Am Assoc Nurse Pract* 2017;29(1):12-16.

50) Shamseer L, Moher D, Clarke M, *et al*. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;349(jan02 1):g7647.

51) Chien PF, Khan KS, Siassakos D. Registration of systematic reviews: PROSPERO. *BJOG* 2012;119(8):903-5.

52) McGowan J, Sampson M, Salzwedel DM, et al. PRESS Peer Review of Electronic Search Strategies: 2015 Guideline Statement. J Clin Epidemiol. 2016 Jul;75:40-6.

53) Thabane L, Thomas T, Ye C, Paul J. Posing the research question: Not so simple. Can J Anaesth. 2009;56:71–9.

54) Moher D, Liberati A, Tetzlaff J, *et al*. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. *Open Med* 2009;3(3):e123-30.

55) Tricco AC, Lillie E, Zarin W, *et al*. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018 Oct 2;169(7):467-473.

56) European Agency for Safety and Health at Work (EU-OSHA). The economics of occupational safety and health - the value of OSH to society. 2017. Available from: https://visualisation. osha.europa.eu/osh-costs#!/

57) Heuvel S, Zwaan L, Dam Lv, *et al*. Estimating the costs of work-related accidents and ill-health: An analysis of European data sources. Luxembourg: European Agency for Safety and Health at Work (EU-OSHA), 2017.

58) Burton J. WHO Healthy workplace framework and model: Background and supporting literature and practices. World Health Organization, 2010.

59) Westerholm P, Walters D. Supporting Health at Work: International Perspectives on Occupational Health Services. IOSH Services, 2007.

60) Leijon O, Lindahl E, Torén K, et al. First-time decisions regarding work injury annuity due to occupational disease: a gender perspective. *Occup Environ Med* 2014 Feb;71(2):147-53.)

61) Steel J, Luyten J, Godderis L. Occupational Health: The Global Evidence and Value. Society of Occupational Medicine, International SOS Foundation, KU Leuven University, 2018.

Tables.

Table 1. Planned search strategy.

SEARCH STRATEGY ITEM	SEARCH STRATEGY
Databases	PubMed/MEDLINE (NLM), Scopus, SciVerse ScienceDirect, Science Citation Index Expanded and Social Sciences Citation Index from ISI/Web of Science, ProQuest Research Library, ABI/INFORM, CBCA, *via* the UNO per TUTTI Primo Central (Ex Libris) platform
Language filter	None
Time filter	2000-2018
Spatial filter	Western countries
Keywords	1. “healthcare worker” OR “healthcare workers” OR “healthcare personnel” OR “healthcare staff” OR “health worker” OR “health workers” OR “health personnel” OR “health staff” OR physicians OR physician OR doctors OR doctor OR nurses OR nurse OR practitioners OR practitioner OR "medical students" OR "medical residents" OR "attending residents" OR "hospital technician" OR "hospital technicians" OR "paramedical personnel" OR "paramedical staff" OR " hospital support personnel" 2. injury OR injuries OR incident OR incidents OR "occupational injury" OR "occupational injuries" OR "occupational incident" OR "occupational incidents" OR "work related injury" OR "work related injuries" OR "work related incident" OR "work related incidents" OR "workplace-induced injury" OR "workplace-induced injuries" OR "workplace-induced incident" OR "workplace-induced incidents" OR "occupational health hazard" OR "occupational health hazards" 3. "exposure incidents" OR "splash exposures" OR "splash exposure" OR “needle-sticks” OR "sharp objects" OR “sharps” OR "percutaneous injuries" OR "percutaneous injury" 4. "manual handling injury" OR "manual handling injuries" OR "musculoskeletal injury" OR "musculoskeletal injuries" 5. "chemical occupational exposure" OR "exposure to inhaled anesthetic" OR "reagent exposure" OR "exposure to reagent" OR "exposure to solvents" OR "solvent exposure" OR "exposure to detergents" OR "detergent exposure" 6. "slips, trips and falls" OR "slipping, tripping and falling accidents" OR "accidental fall" OR "same-level fall" OR "same-surface fall" OR “stump-and-fall” OR “step-and-fall” OR "forced-rotation-type fall" OR "fall from elevation" 7. "violent events" OR “violence” OR “assault” OR “assaults” 8. "cuts and wounds" OR "burns"

	9. "motor vehicle accidents" OR "motor vehicle accident" OR "motor vehicle collisions" OR "motor vehicle collision" OR "motor vehicle crash" OR "motor vehicle crashes" OR "motor vehicle near crash" OR "motor vehicle near crashes"
	10. "exposure to ionizing radiation" OR "radiation exposure"
	1. AND 2. OR 3. OR 4. OR 5. OR 6. OR 7. OR 8. OR 9. OR 10.
Inclusion criteria	P: medical/paramedical students and residents, doctors and nurses, cleaners and porters E: exposure to biological, chemical, physical/ergonomic risk and hazard C: medical versus nursing or dental students; students versus residents; medical versus nursing or dental trainees/residents; exposed HCWs versus non-exposed; before and after a preventive program O: prevalence/incidence of injuries and their determinants among healthcare workers in Western countries, related disabilities and absence from work, and economic burden generated (direct/indirect costs) Study design: primary research
Exclusion criteria	Studies not meeting the above-stated PECO criteria Study design: editorial, letter to the editor, commentary, case report, case series, review
Target journals	Occupational and public health journals

Table 2. Data to be extracted and details/explanations.

EXTRACTED DATA	DETAILS
Study Reference	Names and surnames of authors, year of publication
Study population	Physicians, doctors, nurses, medical students, residents, cleaners, porters
Country	Country or countries in which the study or studies was or were carried out
Study design	Type of recruitment
M%	Percentage of male healthcare workers
Age	Mean age of healthcare worker sample
Sample number, attrition rate	Number of healthcare workers who took part in the survey, number of non-responders
Professional/experience years	Years spent in profession by healthcare workers included in the study
Working setting	Hospital ward where the injury occurred (e.g., emergency room, obstetrics department, surgery department, operating room, outpatient clinic, department of Internal Medicine, patient's room, CCU/ICU)
Injury prevalence/incidence rate	Prevalence/incidence rates stratified according to the kind of injury
Method	Questionnaire (validated, not validated)
Compliance with standard procedures	Prevalence/incidence rates stratified according to the compliance with procedures and guidelines among the different types of healthcare workers
Knowledge, attitudes and practices regarding PEP	Prevalence/incidence rates stratified according to knowledge, attitudes and practices concerning PEP, among the different types of healthcare workers
Clerkship abroad	Periods of training abroad; type of task(s) the healthcare worker was involved in during the training period abroad

Reporting/non-reporting to Occupational Department	Prevalence/incidence rates stratified according to the determinants of reporting/non-reporting, among the different types of healthcare workers
Injury-related burden	Number of days of absence from work, disabilities and direct/indirect economic costs due to injuries

Abbreviations: CCU (critical care unit), ICU (intensive care unit), PEP (post-exposure prophylaxis).

Figures.

Figure 1. Flowchart of study selection in accordance with the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.

Contributors

NLB, GD, VP, CB, RL, VM, AT, FB, BDA, EM, AM, ND and PD conceived the idea. NLB, GD, VM, AT and PD drafted the research questions. NLB, GD and PD developed the study methods. VP, CB, RL, FB, BDA, EM, AM and ND aided in developing the research questions and study methods. All authors participated in drafting the article and in editing or revising it critically for important intellectual content; all authors gave final approval of the version to be submitted and any revised version.

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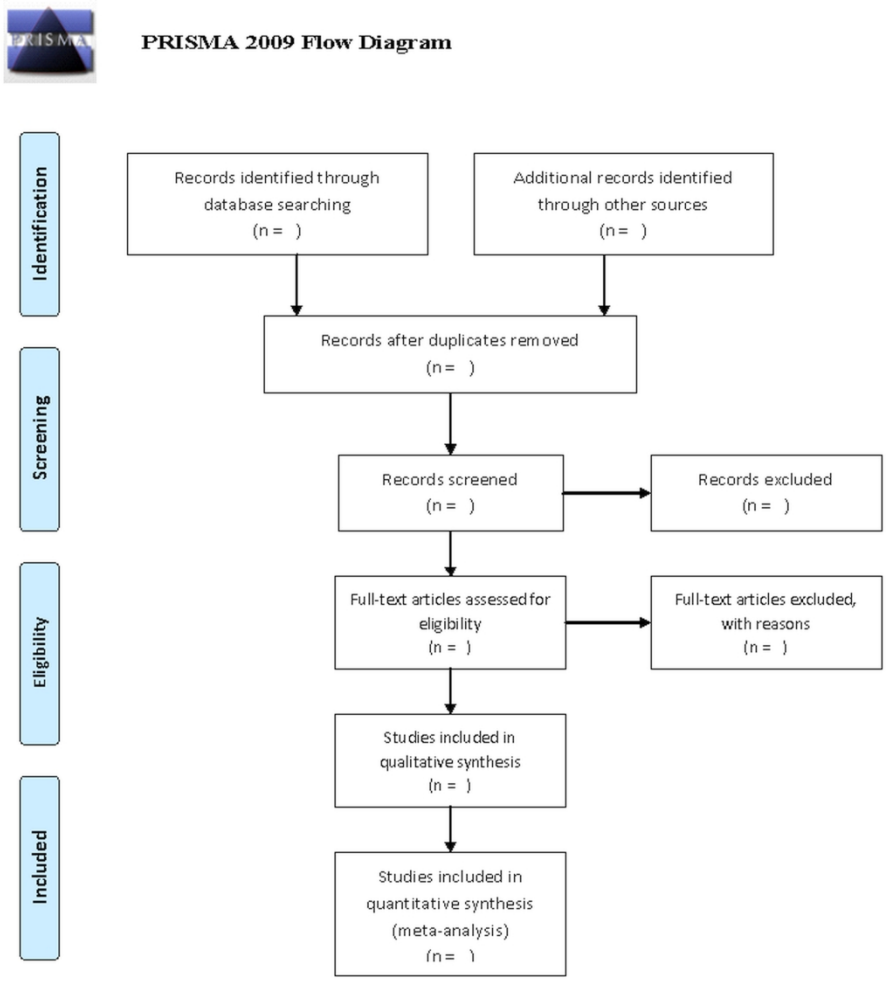
Competing interests

None declared.

Patient consent

Not required.



Flowchart of selection of studies according to the "Preferred Reporting Items for Systematic Reviews and Meta-analyses" (PRISMA) guidelines.

226x236mm (300 x 300 DPI)

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page of the documents and details
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	Protocol of a scoping review assessing injury rate and determinants among healthcare workers in Western countries (page 1)
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	In accordance with these guidelines, the scoping review protocol has been submitted to the International Prospective Register of Systematic Reviews (PROSPERO). However, currently, PROSPERO does not accept to register scoping review protocols (page 8).
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	Page 1 and page 21. Furthermore, role of each author is outlined in the protocol.
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	The present protocol is not an amendment.
Support:			Sources and the role of the sponsor are indicated at page 7 and at page 21.
Sources	5a	Indicate sources of financial or other support for the review	
Sponsor	5b	Provide name for the review funder and/or sponsor	
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	Rationale is provided in the background (pages 4-6).
Objectives	7	Provide an explicit statement of the question(s) the review will	Page 7.

		address with reference to participants, interventions, comparators, and outcomes (PICO)	
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	Page 8 and table 1.
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	Page 8 and table 1.
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Page 8 and table 1.
Study records: Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	Pages 8-9.

Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	Pages 8-9
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	Pages 8-9
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	Table 2.
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with Rationale	Table 2.
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	Pages 8-10
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	Pages 8-10
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	Pages 8-10
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	Page 10

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

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