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Impacts for health and care workers of Covid-19 and other public health emergencies of international concern: living systematic review, meta-analysis and policy recommendations

Inês Fronteira[1,2*], Verona Mathews[3], Ranailla Lima Bandeira dos Santos[4], Karen Matsumoto[5], Woldekidan Amde[3], Alessandra Pereira[5], Ana Paula Cavalcante de Oliveira[5], Isabel Craveiro[1], Raphael Chança[6], Mathieu Boniol[7], Paulo Ferrinho[1†] and Mario Roberto Dal Poz[5†]

Abstract

Background Health and care workers (HCW) faced the double burden of the SARS-CoV-2 pandemic: as members of a society affected by a public health emergency and as HWC who experienced fear of becoming infected and of infecting others, stigma, violence, increased workloads, changes in scope of practice, among others. To understand the short and long-term impacts in terms of the COVID-19 pandemic and other public health emergencies of international concern (PHEICs) on HCW and relevant interventions to address them, we designed and conducted a living systematic review (LSR).

Methods We reviewed literature retrieved from MEDLINE—PubMed, Embase, SCOPUS, LILACS, the World Health Organization COVID-19 database, the ClinicalTrials.org and the ILO database, published from January 2000 until December 2021. We included quantitative observational studies, experimental studies, quasi-experimental, mixed methods or qualitative studies; addressing mental, physical health and well-being and quality of life. The review targeted HCW; and interventions and exposures, implemented during the COVID-19 pandemic or other PHEICs. To assess the risk of bias of included studies, we used the Johanna Briggs Institute (JBI) Critical Appraisal Tools. Data were qualitatively synthetized using meta-aggregation and meta-analysis was performed to estimate pooled prevalence of some of the outcomes.

Results The 1013 studies included in the review were mainly quantitative research, cross-sectional, with medium risk of bias/quality, addressing at least one of the following: mental health issue, violence, physical health and well-being, and quality of life. Additionally, interventions to address short- and long-term impact of PHEICs on HCW included in the review, although scarce, were mainly behavioral and individual oriented, aimed at improving mental health

†Paulo Ferrinho and Mario Roberto Dal Poz equally shared authorship position.

*Correspondence:
Inês Fronteira
ines.fronteira@ensp.unl.pt
Full list of author information is available at the end of the article

through the development of individual interventions. A lack of interventions addressing organizational or systemic bottlenecks was noted.

Discussion PHEICs impacted the mental and physical health of HCW with the greatest toll on mental health. The impact PHEICs are intricate and complex. The review revealed the consequences for health and care service delivery, with increased unplanned absenteeism, service disruption and occupation turnover that subvert the capacity to answer to the PHEICs, specifically challenging the resilience of health systems.

Keywords Public health emergencies of international concern, Health and care workers, Living systematic review, Meta-analysis, SARS-CoV-2, COVID-19, SARS, Influenza, MERS, Ebola, Mental health physical health

Background

The SARS-CoV-2 pandemic hit the world in a disruptive way, forcing stringent adaptation to a new reality, including ways of living, working, and communicating. All over the world, health and care systems were affected by the pandemic.

A strikingly high number of cases flooded health and care services with patients, many needing specialized and intensive care and demanding quick and often morally challenging decisions by health and care workers (HCW) [1, 2]. Patients with chronic conditions were "deviated" from the usual care pathways by either suspending care or reallocating them to other health units or health professionals.

HCW were inevitably involved in the turmoil of the pandemic and began to face a double burden of the pandemic [3–6]. As members of a society affected by a public health emergency, HCW faced the challenges of lockdowns, social distancing and other measures aimed at controlling the pandemic as well as its social and economic impacts, while experiencing fear of becoming infected and of infecting others [7–14], stigma, violence in the workplace and outside health facilities as they were the ones breaching the lockdown [15–17]. Many HCWs were overworked and under strenuous conditions with women more affected then men [18] and were asked to work more hours, to extend their scope of practice, to start working immediately after graduation without due guidance, subject to stigma, harassment, temporary contracts, and with no extra incentives [2].

Along with the numbers and figures of the pandemic, many media reports focused on the strain and problems that HCW were facing in terms of their mental and physical health. Some reports claimed anecdotal evidence on the absenteeism resulting from quarantines and the COVID-19 infection itself, and it was suggested that many HCWs started to miss work, suffered from burnout or/and exhaustion. Progressively, reports of some HCW leaving practice, and even the profession, emerged [19, 20].

Despite all the news, tweets and posts, and even scientific papers, there is a vacuum of knowledge on the health impacts of the COVID-19 pandemic but also of previous public health emergencies of international concern (PHEICs) [21] which is paramount to inform health and multisectoral decisions.

To systematize existing knowledge on this matter, we designed and conducted a living systematic review (LSR), "systematic review that is continually updated, incorporating relevant new evidence as it becomes available" [22] to answer to the review questions in Table 1. This is the first, comprehensive SLR to be conducted on the specific impacts of PHEIC on the health of HCW and its living nature can contribute to continuously monitor the evidence produced providing a "real-time" evidence base to support informed decisions.

In this paper, we report the baseline results of the LSR.

Methods

Protocol and registration

The protocol for this LSR has been registered in PROSPERO (registration PROSPERO 2022 CRD42022324006 (https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=324006).

Information sources

MEDLINE—PubMed, Embase, Latin American and Caribbean Health Sciences Literature; SCOPUS, World Health Organization COVID-19 database; ClinicalTrials.

Table 1 Review questions for the impacts for health and care workers of Covid-19

Review questions
1. What are the short and long-term impacts, in terms of morbidity, disability, mortality, violence against health care workers, attrition, performance and quality of life of COVID-19 pandemic and other public health emergencies of international concern (Severe Acute Respiratory Syndrome—SARS, Middle East Respiratory Syndrome SARS, Middle East Respiratory Syndrome—MERS, Ebola, Zika, Influenza A) on HCW?
2. What are the cost-effective and culturally relevant interventions to address short- and long-term morbidity, disability, mortality, violence against health care workers, attrition, performance, and quality of life of COVID-19 pandemic and other public health emergencies of international concern (SARS, MERS, Ebola, Zika, Influenza A) HCW?

org; and International Labour Office databases were searched in March 2022 with the last search conducted on the 4th of April 2022. The number of references detailed per database is mentioned in Fig. 1.

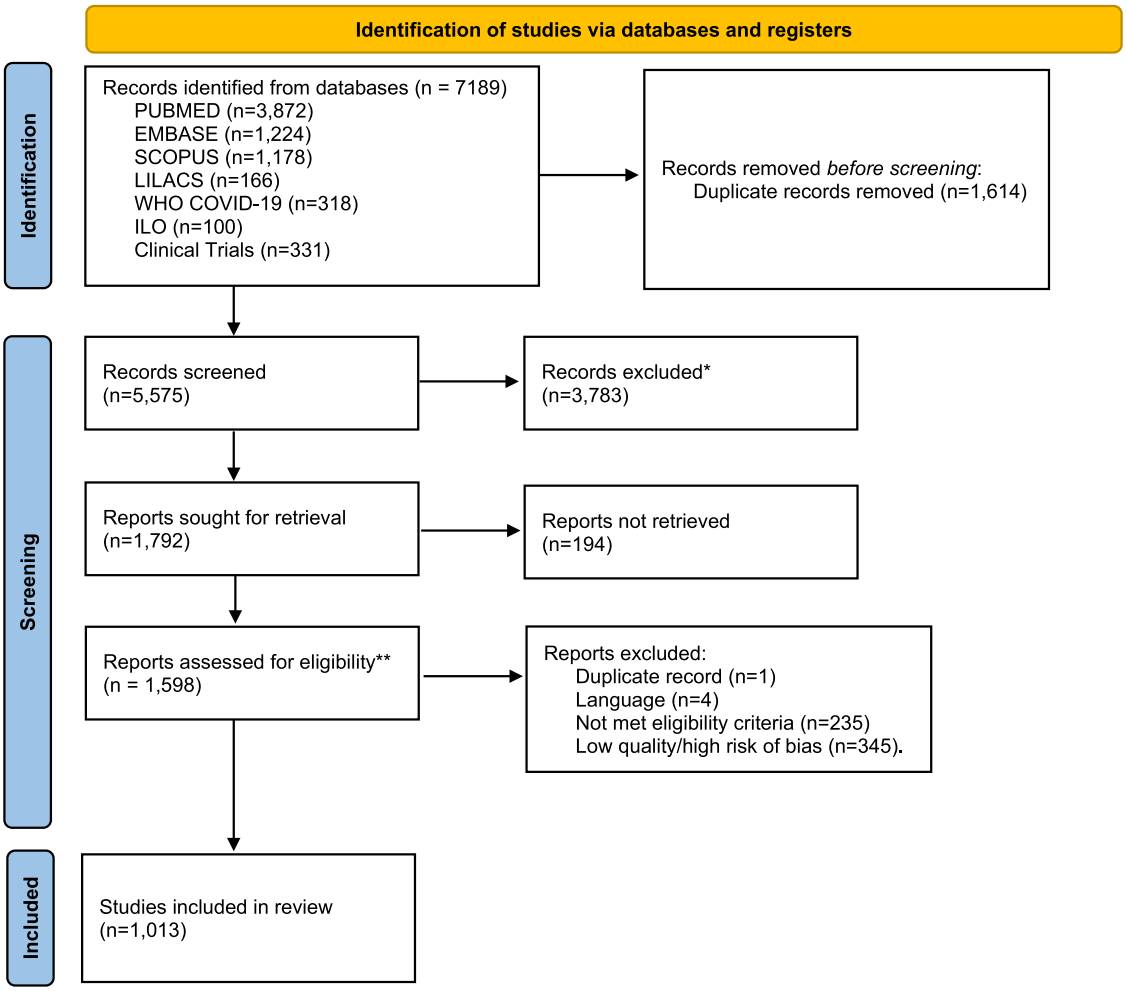
Search

The search strategy for each database is detailed in Additional file 1. The search of the LSR was limited to documents published from 1st of January 2000 to 31st December 2021 in English, French, Hindi, Portuguese, Italian or Spanish.

Selection process

The eligibility criteria for this LSR were:

- Type of study: quantitative observational studies (i.e., cohort, case–control, cross-sectional), experimental studies, quasi-experimental, mixed methods, and qualitative studies.
- Conditions studied: all studies addressing workplace hazards, physical and mental health (including stress, burnout, post-traumatic stress, suicide, and other mental health conditions), unplanned absenteeism, attrition, and intention to leave the profession, performance, violence, and quality of life were included.
- Participants/population: health and care workers as reported by the authors of the studies.
- Intervention(s), exposure(s): managerial, organizational and system strategies (i.e., environmental factors, health services, counselling, or screening)



* After assessment of titles and abstracts

** Fulltext analysis

Fig. 1 Flow diagram

targeting health care workers implemented during the COVID-19 pandemic or other PHEICs (SARS, MERS, Ebola, Zika and Influenza A); (1) targeting health systems; (2) targeting HCW and their families; (3) targeting health services users and the public.

To address the review questions, we used PICO (Population, Intervention, Comparison, Outcome) (Table 2).

The eligibility criteria were first applied to the title and abstract/executive summary or introduction of the studies and, if met, applied again to the full text of the studies. In cases where no abstract or equivalent was available, the full text was assessed for eligibility (Additional file 2).

The titles and the abstracts of the references retrieved from the databases were imported to Rayyan and assessed blindly by four reviewers (IF, VM, WA and RL), between mid-April and May 2022. The references were distributed between reviewers with overlap of references between at least two of the reviewers. The inclusion rate (number of included references/total references assessed) was 30% for IF, 32% for VM and WA and 47% for RL. The agreement between IF and VM, IF and WA, and VM and WA was almost perfect and between WA and RL substantial [23] (Additional file 3). A total of 294 (5.3%) conflicts were found between reviewers. These were resolved by a third reviewer.

Data collection process

The extraction of data was conducted by 5 reviewers (IF, VM, WA, RL, and KM). Each reviewer was given a list of the studies included after assessment of title and abstract. Reviewers assessed the risk of bias/quality of the study (see "Risk of bias assessment"). Studies with high risk of bias/low quality were excluded. Data were only collected for studies scored moderate to low risk of bias/moderate to high quality.

The JBI Qualitative and Qualitative Data Extraction Tools were adapted to extract data from qualitative and quantitative studies, respectively [24]. For mixed methods studies, data were retrieved using the data collection form for quantitative studies for the quantitative part and the data collection form for qualitative studies for the qualitative part of the study.

The forms for data collection were designed in REDCap [25, 26] and are available in Additional file 4.

Risk of bias assessment

The risk of bias/quality of each included study was assessed using the JBI critical appraisal tools (CAT) (https://jbi.global/critical-appraisal-tools): Checklists for Analytical Cross Sectional Studies, Case Control Studies, Cohort Studies, Prevalence Studies (used only when the aim as stated by the authors was to estimate/compute/describe the prevalence), Qualitative Research, Quasi-Experimental Studies, and Experimental Studies.

For all checklists, there were 4 options of answer (yes/no/unclear/not applicable). To compute a risk of bias/quality score for each study, each option of answer was given the following points:

- Yes—2 points.
- No—0 points.
- Unclear—1 point
- Not applicable—missing.

For each CAT checklist the maximum score was computed by multiplying the total number of items per the maximum score in each item (2 points per YES) as detailed in Additional file 5.

The Grading of Recommendations, Assessment, Development and Evaluations (GRADE) framework [27] was used to rate the body of evidence of the outcomes (Additional file 5). For that purpose, observational studies were considered low or very low quality of evidence, experimental studies, namely randomized clinical trials were considered very high quality of evidence, with non-randomized clinical studies as well as quasi-experimental studies being classified as high quality of evidence.

Table 2 PICO for impacts for health and care workers of Covid-19

Population	Health and care workers
Interventions	(1) Targeting health systems: managerial, organizational and system strategies (i.e., environmental factors, health services, counselling, or screening) targeting HCW implemented during the COVID-19 pandemic or other PHE; (2) targeting HCW and their families; (3) targeting health services users and the public
Comparison	General population, subsets of HCW, and other occupational groups
Outcomes	Workplace hazards, mental health (including stress, burnout, post-traumatic stress, suicide, and other mental health conditions), unplanned absenteeism, attrition, and intention to leave the occupation, performance, violence e quality of life

Qualitative studies were classified by default as very low quality of evidence. Then, for each outcome, and taking into consideration the number and type of studies, their limitations, inconsistency, indirectness, imprecision and publication bias, the quality of the evidence was determined as high, moderate, low, and very low. We present an overall qualitative assessment of the probability of publication bias (likely/very likely) for each of the outcomes considered in the meta-analysis and the graphical observation of funnel plots (Additional file 6).

Effect measures

We used the prevalence (present/absent) of the outcome as an effect measure. The prevalence was obtained through data provided by the authors either directly whenever the prevalence was presented in the text or by computation using the number of events divided by total population.

Synthesis methods

The data synthesis included a qualitative synthesis using a meta-aggregation approach pertaining to each research question and organized per outcome.

For each outcome we included a general summary of the context of studies, the outcomes assessed, the results and the results of the risk assessment bias. A summary of findings table is available in Additional file 7.

We conducted a maximum likelihood estimators' random effect inverse variance meta-analysis of binary outcomes with pre-calculated effect sizes using IBM SPSS v.29 to summarize the prevalence of the outcomes. We conducted subgroup analysis per World Bank Lending Regions (East Asia and Pacific; Europe and Central Asia; Latin America and the Caribbean; Middle East and North Africa; North America; South Asia; and sub-Saharan Africa) and multi-country studies. Whenever feasible, we further stratified the analysis per studies published before 2020 and after 2020, the year of the start of the COVID-19 pandemic.

Given the high methodological heterogeneity of the studies in terms of outcome measures and of reporting (e.g., prevalence and/or mean/median values) of the outcomes as well in study design and populations, we based the meta-analysis on the following assumptions:

- only quantitative studies or quantitative parts of mixed methods studies were included.
- all data collection instruments were equal in terms of identifying those with or without the outcome of interest.
- the source populations (HCW) were considered comparable (i.e., despite the definition used in the original research) considering solely that they worked as HCW, i.e., working in health and care system, no matter the nature of the occupation, the hierarchy, or other distinctive characteristics.
- only data on prevalence (yes/no) were considered (whenever needed this was computed by the researchers based on data from the studies)—all outcomes are nominal and dichotomous (yes/no) and only studies where this information was available or could be computed were included in the meta-analysis. Studies presenting only mean or median scores were not considered in the analysis. In studies reporting several degrees of the outcome (e.g., mild, severe, etc.) abnormal categories were categorized as yes and normal as no.
- studies comparing the outcome in different periods of time (e.g., first vs. second wave of the pandemic) were excluded since we were computing prevalence of the outcome and not considering the time of the pandemic.

The combined prevalence of the outcome and the 95% confidence interval (95CI), the I^2 statistics for homogeneity, the forest plot and the funnel plot are detailed in Table 3 and in Additional file 7.

This LSR did not require approval by an Ethics Committee, but ethical consideration pertaining to the use of secondary data was undertaken by the review team.

Results

A total of 1013 studies were included (Additional file 6) and 3783 were excluded after assessment of eligibility criteria in the title and abstract: 585 studies were excluded after reading the full text: 1 was a duplicate, 4 were in a language not considered in the LSR, for 194 it was not possible to access the full text or were abstracts from conferences or posters and 235 did not meet at least one for the four eligibility criteria. A total of 345 studies, presented high risk of bias/low quality and were, thus, also excluded (Fig. 1). A table of excluded studies is provided in Additional file 8.

The evidence of this LSR is derived from 1013 studies, mainly quantitative with a cross-sectional design, addressing the impacts of COVID-19 in HCW. In general, the quality of the evidence per outcome was very low, according to GRADE.

The majority of the studies were mostly concerned with the impact of PHEICs, especially the COVID-19 pandemic, on the health of HCW and, more specifically, on mental health. The studies covered a variety of countries and workplaces in all continents (with a bias to the Global North and with the vast majority of studies being published from 2020 onwards and focusing on the COVID-19 pandemic) (Fig. 2), as well as HCW in

Table 3 Effect size estimates of the outcomes (total and per region), test of homogeneity (I^2) and GRADE quality of the evidence (below the outcome is the total number of studies mentioning the outcome)

Outcome		Effect size estimates									I^2	GRADE quality of the evidence
		Included in meta-analysis	For subgroup analysis									
			East Asia and Pacific	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	North America	South Asia	Sub-Saharan Africa	Multi-country studies		
Anxiety[a] (*N* = 518)	*n*	350	106	83	23	44	38	32	13	11	1.00	Very low—346 cross-sectional studies, 3 cohorts and 1 case–control, 57% medium quality/risk of bias, 43% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	39%	31%	40%	44%	48%	37%	45%	49%	32%		
	95CI	[37; 41]	[27; 34]	[36; 45]	[36; 52]	[41; 54]	[31; 43]	[38; 52]	[35; 62]	[17; 47]		
Depression (*N* = 503)	*Before 2020*											
	n	3	–	–	–	–	–	–	–	–	0.98	Very low—3 cross-sectional studies, 1 medium quality/risk of bias, 2 high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	21%	–	–	–	–	–	–	–	–		
	95CI	[5; 37]	–	–	–	–	–	–	–	–		
	From 2020 onwards											
	n	370	108	90	22	48	45	34	13	10	1.00	Very low—367 cross-sectional studies, 2 cohorts and 1 case–control, 55% medium quality/risk of bias, 45% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	35%	32%	35%	34%	44%	31%	39%	41%	20%		
	95CI	[33; 37]	[29; 35]	[31; 39]	[26; 42]	[39; 50]	[26; 36]	[32; 45]	[31; 51]	[11; 29]		
Stress[b] (*N* = 486)	*Before 2020*											
	n	2	–	–	–	–	–	–	–	–	1.00	Very low—2 cross-sectional studies, 1 medium quality/risk of bias, 1 high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	40%	–	–	–	–	–	–	–	–		
	95CI	[0; 79]	–	–	–	–	–	–	–	–		
	From 2020 onwards											
	n	158	41	38	9	25	11	23	7	4	1.00	Very low—157 cross-sectional studies and 1 case–control, 63% medium quality/risk of bias, 37% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	44%	39%	46%	34%	50%	38%	48%	51%	35%		
	95CI	[40; 48]	[32; 46]	[38; 54]	[22; 47]	[41; 60]	[25; 50]	[37; 59]	[39; 63]	[3; 67]		
Burnout[a] (*N* = 235)	*n*	94	24	23	8	12	20	1	4	2	1.00	Very low—90 cross-sectional studies and 4 cohort, 52% medium quality/risk of bias, 48% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	46%	52%	46%	34%	55%	42%	–	41%	46%		
	95CI	[42; 51]	[43; 61]	[38; 55]	[18; 49]	[43; 66]	[32; 51]	–	[16; 67]	[18; 75]		

Table 3 (continued)

Outcome		Effect size estimates									I^2	GRADE quality of the evidence
		Included in meta-analysis	For subgroup analysis									
			East Asia and Pacific	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	North America	South Asia	Sub-Saharan Africa	Multi-country studies		
PTSD[a] (*N* = 84)	*n*	53	12	23	4	2	8	1	2	1	1.00	Very low—52 cross-sectional, 1 cohort, 89% medium quality/risk of bias, 43% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	26%	26%	25%	22%	44%	24%	–	56%	–		
	95CI	[22; 31]	[16; 36]	[18; 31]	[6; 38]	[16; 72]	[15; 32]	–	[52; 59]	–		
Suicidal ideation[a] (*N* = 18)	*n*	15	4	7	1	–	3	–	–	–	0.98	Very low—12 cross-sectional, 60% medium quality/risk of bias, 40% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	7%	9%	5%	–	–	8%	–	–	–		
	95CI	[5; 8]	[6; 12]	[3; 7]	–	–	[8; 9]	–	–	–		
Headaches[a,c] (*N* = 12)	*n*	12	2	2	1	–	1	5	–	1	0.99	Very low—12 cross-sectional studies, 92% medium quality/risk of bias, 8% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	53%	43%	36%	–	–	–	53%	–	–		
	95CI	[38; 67]	NA	[23; 49]	–	–	–	[39; 77]	–	–		
Sleep disorders (*N* = 90)	*n*	54	13	9	3	12	6	4	5	2	0.99	Very low—54 cross-sectional studies, 52% medium quality/risk of bias, 48% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	36%	40%	31%	33%	38%	50%	34%	24%	32%		
	95CI	[31; 41]	[30; 50]	[21; 41]	NA	[29; 46]	[33; 67]	[17; 51]	[12; 37]	[12; 52]		
Skin-related morbidity (*N* = 19)	*n*	14	4	6	1	1	1	1	–	–	1.00	Very low—14 cross-sectional studies, 86% medium quality/risk of bias, 14% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	51%	48%	64%	–	–	–	–	–	–		
	95CI	[39; 64]	[43; 53]	[43; 84]	–	–	–	–	–	–		
Violence (*N* = 32)	*n*	11	1	2	3	2	–	2	–	1	1.00	Very low—11 cross-sectional studies, 64% medium quality/risk of bias, 36% high quality/low risk of bias, very serious inconsistency, very serious imprecision, unlikely publication bias, no large effect, no evidence of a dose–response gradient, all plausible confounding would suggest a spurious effect
	P	48%	–	30%	58%	81%	–	19	–	–		
	95CI	[32; 64]	–	[28; 32]	[31; 84]	NA	–	[17; 21]	–	–		

N total number of studies included in the LSR for a given outcome, *n* studies included in the meta-analysis, *P* prevalence of the outcome in percentage, *95CI* 95% confidence interval for the prevalence, *NA* not available

[a] None of the included studies in the meta-analysis were published before 2020

[b] Only studies measuring stress were considered for meta-analysis

[c] Only data on the prevalence of de novo headaches are included in the meta-analysis

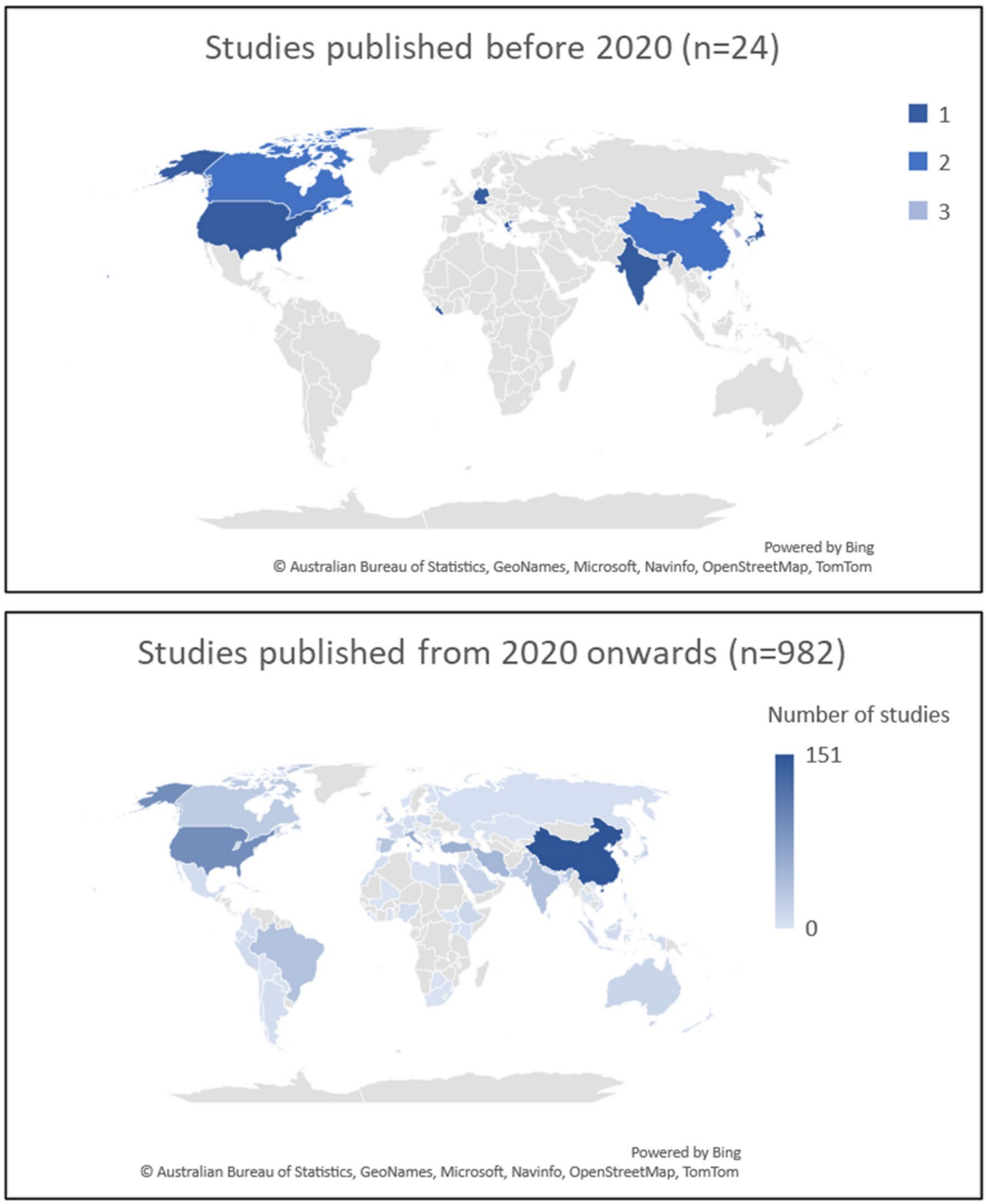


Fig. 2 Geographical distribution of the studies included in the LSR

general or per type of occupation (with a greater focus on nurses and physicians), thus allowing to have a comprehensive glimpse of the health and care workforce. Much of the social rejection or other negative experiences that HCW experienced due to a disproportionate exposure to PHEIC and high risk of infection were often associated with mental health conditions [28] and these often resulted in somatization [29]. The conditions under which HCW were forced to work (e.g., with PPE, during extended working periods, with changes in the organization of work), and faced with insufficient or inadequate coping strategies or resilience [30–34], impacted their

physical health with reports of PPE-related skin injuries and headaches or sleep disturbances. All these factors negatively impacted the performance of HCW, leading, for instance to absenteeism [35], financial problems (that backlashed on mental health) [36] and inevitably resulted in regret about choosing the profession or even intention to resign or change career [37–39].

One of the most mentioned impacts of the PHEIC was on mental health, namely stress/distress, anxiety, depression, burnout, post-traumatic stress disorder (PTSD) and suicidal ideation (thoughts), among others.

Anxiety

Contrary to other mental health outcomes, such as burnout, suicide, depression or psychological well-being in general [40–47], anxiety in HCW did not seem to be a major concern reflected in the published literature before 2020 [44, 48], although its relevance became evident with the COVID-19 pandemic. Anxiety was frequently reported in the studies included in the LSR ($N=518$), either as the sole outcome or measured along with depression and/or stress, among other mental health outcomes. The overall prevalence of anxiety in HCW was 39% (95CI = [37; 41]) with low variation between regions 31% (95CI = [27; 34]) in East Asia and Pacific and 49% (95CI = [35; 62]) in sub-Saharan Africa (Table 3 and Additional file 6). This prevalence was related only with the SARS-CoV-2 pandemic.

Generally, there were higher levels of anxiety in HCW when compared to the general population [38, 49–51], in healthcare providers vs non-healthcare providers [52, 53], in frontline HCW compared to non-frontliners [54–60], in those working in high incidence areas [61–63], with infected patients [52–54] and in relation to the pre-PHEIC period [64]. Anxiety was also frequently reported in female HCW [5, 51, 57, 63, 65–87].

Anxiety was frequently associated with depression and stress [88–92], sharing some of its determinants. Anxiety and depression were commonly either the result or the drivers for burnout, stress, distress and PTSD and poor well-being [31, 65, 93–97]. All tended to relate to sleep quality and sleep disorders [98–102]. Some resulted from or in somatization [103].

Anxiety emerged as an early consequence of the PHEIC that would: (i) either resolve by itself (improvement in symptoms of anxiety between the start the of the PHEIC and subsequent periods, even in HCW who had contracted the disease [104–112] but much dependent on overall incidence of the infection [113]; (ii) or evolve to more serious presentations of mental health conditions such as depression [66], PTSD or suicidal ideation [114]. Nevertheless, the levels of anxiety tended to remain high for long periods of time [105, 106] (Additional file 9).

Depression

Depression was the second outcome most frequently addressed ($N=503$). With a prevalence of 21% (95CI = [5; 37]) before 2020 and 35% (95CI = [33; 37]) after 2020 (Table 3 and Additional file 6), depression, as anxiety, seemed to be more prevalent in HCW compared to the overall population [115, 116], among frontliners [5, 55, 74, 77, 117–124], those caring for patients [81, 125–127], especially for COVID-19 patients, and even on HCW that had become infected [50, 67, 77, 88, 88, 98, 109, 125, 128–130]. Female gender was also mentioned to be related with depression [51, 66, 71, 74, 80, 86–88, 88, 93, 98, 122, 128, 129, 131–136].

The changes in clinical and operational practices and the level of PHEICs' preparedness of health and care services along with adjustments in professional roles [93, 98, 137–141] were associated with depression. PHEIC seemed to exacerbate or add to existing mental conditions [67, 69, 87, 119, 131, 140, 142–145] (Table 3). High levels of anxiety and depression prevented health professionals from psychologically detaching from work [8] leading to burnout [146] and stress [147].

Health and care occupations are considered very stressful with long work hours, frequent night work, and shift duties. Hence, when compared to the with general population, HCW even in non-PHEIC situations, face high risk of stress, poor sleep patterns, fatigue and burnout [148]. Not surprisingly, as a result of the PHEICs [149–152], 40% (95CI = [0; 70%]) of HCW reported experiencing some level of stress before 2020 with the prevalence increasing after 2020 to 44% (95CI = [40; 48%]) (Table 3 and Additional file 6). Usually stress is higher in HCW than the general population [153, 154] and, despite the manifestations being more frequently psychological than physical [155, 156], few sought professional mental health support [157]. Stress resulted mainly from working conditions like the complexity of patients and concerns about transmitting the disease [155, 158], disruption of familiar and social networks, exposure to disease [159] but also from workload and levels of perceived anxiety and depression [160] (Additional file 9). Several studies mentioned stress to be related with female gender in HCW [67, 70, 74, 80, 87, 111, 122, 123, 131, 133, 139, 160–166].

Burnout

Job stress, staff and resource adequacy, interprofessional relationships in healthcare practice, fear of infection and anxiety related to work during the PHEIC largely contributed to emotional and mental exhaustion of HCW often leading to burnout [167, 168]. Burnout addressed in 235 of the included studies, had a prevalence of 46% (95CI = [42; 51]) and was mainly reported after 2020 with

studies conducted on East Asia and Pacific Region showing higher prevalence than in other regions (Table 3 and Additional file 6). Burnout seems to be higher during PHEICs in relation to the pre-PHEIC period [169–172], evolved over time [173] and manifested through physical (chronic fatigue, extreme exhaustion, reduced energy, and sleep disturbances), emotional (frustration, irritability, anger and fear), cognitive (mental fatigue, difficulty in decisions) and behavioral (negativism, emotional outbursts, cynicism, rudeness) symptoms [169]. Its negative impact is far reaching and includes not only harm to the burnt out HCW, but also to patients, co-workers, family members, close friends, and healthcare organizations [174]. Similarly, burnout was frequently more reported in female HCW [63, 66, 77, 135, 167, 175–185].

Burnout and other mental health conditions, more frequent in women, together with feelings of dehumanization of self and/or of others can potentiate PTSD [186–188]. A total of 84 studies addressed PTSD. The pooled prevalence of PTSD, after 2020, was 26% (95CI = [22; 31]) (Table 3 and Additional file 6). The studies point to an excess of PTSD in HCW when compared to general population [50], before the declaration of PHEIC [108] and in frontliners [66, 215]. Previous mental health conditions, especially stress, work in frontline services, high workload and access and use of PPE were the main determinants referred by the literature. PTSD seemed to be linked to suicidal thoughts [186, 189] (Additional file 9).

A total of 18 studies addressed suicidal ideation in HCW. The pooled prevalence of suicidal ideation and/or attempt was 7% (95CI = [5; 8]). Thoughts of suicide or self-harm were frequently related with depression and other previous mental health conditions [156, 157]. Young, male, living alone HCW were the most frequently affected (Additional file 9).

Sleep disorders, headaches and migraines, skin-related morbidity and other health issues. In this LSR we also found sleep disorders (pooled prevalence of 36%; 95CI = [31; 41]), headaches/migraines (pooled prevalence of de novo headaches 53%; 95CI = [38; 67]) and skin-related morbidity (pooled prevalence of 51%; 95CI = [39; 64]) to be frequently reported physical health impacts of PHEIC (Table 3 and Additional file 6). Other less frequent PHEICs-related morbidity studied in HCW included musculoskeletal disorders, erectile dysfunction, eye strain, weight gain, constipation and risk of infection [159, 190–194].

PHEICS often require HCW to use sophisticated PPE (e.g., gloves, respirators, eye protection, face shields masks, full body suites) more frequently and for prolonged periods of time, which seemed to be associated with dermatitis, pressure injuries, excessive heating and sweating, headaches and/or migraines, breathing difficulties, itching, cracking, burning, flaking, peeling and/or rash [195–203], although complaints varied greatly with the equipment used. Actually, the use of PPE tended to induce de novo headaches and migraines or worsen pre-existing ones, a couple of hours after the end of the shift [204, 205].

Workplace violence

In the context of a PHEICS, workplace violence emerged also as a relevant impact, with a pooled prevalence of 48% (95CI = [32; 64]) among HCW, from 2020 onwards (Table 3 and Additional file 6). Known in their communities as HCW, during PHEICs these professionals cannot escape scrutiny and face stigma and violent episodes, even if they are working remotely [206]. HCW continue to move freely even in curfews and lockdowns and have often to quarantine even if not infected, which places them at risk of extortion and other violent acts [207]. The determinants of violence in PHEICs do not seem to differ from those identified in non-PHEIC periods and include, among others, unsupportive environment and lack of guidelines or appropriate measures to implement necessary health protocols (399 402) (Additional file 9). Also in the case of PHEICs, violence [208, 209] and stigma [120, 140, 142] seem to contribute to poor mental health.

HCW and the impact that their work has on their health has been studied in the past, in particular throughout the developed world where markedly high rates of sickness absence, sickness presenteeism, burnout, and distress compared to what has been described for other sectors [210, 211].

Unplanned absenteeism

PHEICs are inevitably linked to unplanned absenteeism. This results from HCW becoming infected, bearing the burden of working in services directly linked to the management of the PHEIC, increased physical and mental morbidity, having to assist relatives or due to non-pharmacological measures such as quarantine [212]. Other recognized determinants of absenteeism in HCW include organizational aspects, inadequate working conditions, long hours, task overload, interpersonal conflicts, low autonomy and remuneration, associated with psychological, cognitive and physical professional overload [213], all aggravated during a PHEIC. Sometimes, HCW might opt to work even if not feeling well, a practice known as sickness presenteeism which as deleterious effects such as increased risk of burnout or loss of productivity [211, 214].

Attrition

Leaving or intention to leave the occupation emerged as a relevant impact of PHEICs [215, 216]. Contrary to

unplanned absenteeism, it is more definitive and represents a peril for the sustainability of provision of care during the PHEIC and afterwards. Sometimes, it is preceded by department or institution turnover [217–219]. Besides, working conditions like understaffing or increased work hours [20, 37, 220], mental health issues seemed to be the most relevant determinants [37, 38, 221] (Additional file 9).

Among the included studies, we only identified 9 interventions that included behavioral and organizational approaches directed at individual HCW. The timing and relative novelty and somewhat rapid resolution of most of the PHEICs might explain the lack of studies to address interventions to tackle their effects. In this LSR, all but one, which addressed workplace violence, aimed at the impacts of PHEICs on mental health. Behavioral interventions were based on therapies to increase HCW capacity to deal with stressors, building resilience and acquire and developing coping strategies [222–227]. Organizational interventions were designed to strengthen the health and care service capacity to address the challenges imposed by the PHEIC [228, 229]. Nevertheless, the overall evidence on this matter was very weak (Additional file 10).

Discussion

Included studies were assessed in terms of risk of bias/quality of the study with those with low quality being excluded from the evidence synthesis. If on one hand this decision might have left out studies focusing on, for instance, less frequent outcomes, or those for which there is no standardized instruments for their measure, on the other hand was essential to base conclusions on less biased results.

Throughout the analysis a publication bias (i.e., tendency to include study that conform to their preconceived notions or outcomes) was not detected, since studies demonstrating effects and those not demonstrating that same effects were published and included in the analysis. Nevertheless, the large number of studies on mental health and more specifically on some of its outcomes need to be considered carefully, especially when considering pooled effect estimates—all presented very high heterogeneity. They might result from a publicity/media bias (i.e., tendency to publish "hot" topics) as these issues became more and more relevant during the pandemic.

HWC are not isolated islands. They integrate societies that also suffered the impacts of the pandemic, thus holding a double burden that it is not easy to measure.

Often, the measurement of the exposure to the PHEIC (i.e., direct contact with infected patients, nature of the contact, including duration, use of PPE, among others) was not considered in the studies which made it difficult to conclude if the changes observed in the outcomes resulted from a specific, more intense, work-related exposure or if it was restrained to that of the lay citizen (this was particularly evident in the case of the studies conducted during the COVID-19 pandemic).

Some gender differences have emerged, namely in terms of mental health outcomes. However, and because we did not consider this perspective since the design of the LSR, we cannot draw conclusions on the relevance of these studies in adding to existing evidence that reports important gender inequities between genders in HCW.

Access to and demand from HCW of in-service supportive interventions where not properly addressed in the literature. PHEICs are often associated with an intensification of work, with higher demand for care, ambiguous roles and unfamiliar work content but also to a halt on career development and increased industrial action, attrition and absences from work [230, 231].

During PHEICs, including the most recent pandemic, there was an evident concern with HCW health and well-being and the impact that PHEICs was having on their lives. The concern was mainly as professionals essential and paramount to guarantee front-line response to the challenges posed by the situation.

During PHEICs, HCW suffer stigma, divergent healthcare hero perception, added responsibilities, fear and uncertainty, worry about infecting others, broader social grief, professional exhaustion, work–life imbalance, leadership challenges and challenged performance to name a few, that negatively influence their well-being and quality of life [232–236]. The hero narrative may be detrimental to the mental well-being of HCW as it risks stifling the debate about their scope of practice and the ethical limits of duty [237].

PHEICs are opportunities to learn, to develop new skills, to improve inter and intradisciplinary collaboration and team work, and to gain the ability to balance work and life [228, 232, 234]. However, the final balance of this score card appears to remain negative as HCW tend to present poorer well-being and quality of life during the PHEIC when compared to other professionals and with the general population [238–240] with well-being stabilizing at a lower level [152].

The evidence on the impacts of PHEICs are still weak and based on cross-sectional studies.

We recommend the implementation of continuing monitoring of the health of HCW, besides the practice of traditional occupational health, in all health and care services, but specially in those more subject to PHEICs-related strain (e.g., emergency departments, intensive care units, pre-hospital emergency services). The monitoring should include extended physical health (to

problems often ascertained in studies but sometimes forgotten in terms of occupational health services like sleep disorders), mental health (in general and specific prevalent problems like stress, burnout, anxiety, among others) and workplace violence screening and gender perspective. The continuous monitoring of the health and well-being of HCW should not be restricted to PHEIC periods as information on pre-PHEIC and post-PHEIC is as crucial as during PHEIC.

The LSR included a wide number of references, mostly published after the inception of the COVID-19 pandemic. Despite having included other PHEIC, such as SARS, MERS, or Ebola, most of the studies retrieved and included focused on the impact of the COVID-19 pandemic and, as such, had been published from 2020 onwards. Accordingly, the geographical distribution of the studies reflects the geographical distribution and intensity of the pandemic.

No matter the year of publication, most of the studies adopted a cross-sectional design which makes difficult to establish a timeline between PHEICs and the occurrence of the outcomes. Despite an overall consistency in the results of the studies, cross-sectional studies are weak in terms of strength of the evidence. Given that the majority of the studies included addressed the impacts of COVID-19, additional time and research is need to fully grasp the impacts of this pandemic that was still ongoing when searches were conducted in the databases. Several cohorts of HCW were created during the pandemic to monitor its impacts in the short, medium, and long term. Only 2 years have passed. This is not enough epidemiological time or even scientific time to study and publish the results.

The research gaps identified during the review require future research to address longitudinal data on the health and well-being of HCW no matter the period under consideration (in relation to PHEICs). We recommend the creation of a global, multi-country, multicenter cohort of HCW from whose observation good quality evidence can be derived. This cohort should include multiple contexts (e.g., high/middle/low income, rural/urban, underserved), different health and care services (e.g., hospital, primary health care, long-term) and departments (e.g., wards, emergency department, laboratories) and should focus on a broader understanding of the concept of HCW (similar to that adopted in this report). It should also foresee a sex-disaggregated data collection. PHEICs have shown not to spare anyone who is working in health and care services—from physicians and nurses to the auxiliary and maintenance personnel.

Although interventions aimed at HCW are relevant and seem to produce positive effects on individuals (e.g., mindfulness-based interventions appear to improve the well-being), helping them to cope and effectively manage the psychological and individual burden imposed by PHEICs, some literature suggests that interventions targeting the workplace at a system-level (including organizational, cultural, social, physical aspects) can also improve health and well-being of healthcare staff [210]. These interventions need to continue and to be expanded to cover more HCW. But they should also be complemented with initiatives to incorporate input from staff regarding their local needs and contexts and the involvement of management staff at all levels of the organization. As such, we recommend the implementation of system-level interventions that address the determinants of the impacts of the PHEIC on HCW. We also recommend that interventions can be a part of the follow-up of the HCW so that can provide in-time evidence to support the impacts of PHEIC.

Addressing the impacts of PHEIC on HCW, being able to minimize them and having a healthy, motivated, and resilient HCW is paramount to ensure universal health coverage even during crisis.

Limitations of the study

Given the heterogeneity of HCW we have only considered as a proxy to exposure to PHEICs, being or not HCW. We acknowledge that the exposure and putative impacts of PHEICs largely depend on the occupation, type of service, etc. As such, the results of this LSR should be interpreted bearing this in mind. As should also the results that point gender differences as the gendered impacts of COVID-19 and other PHEICs were not considered in the definition of our search strategy. However, we recognize that there are critical gender imbalances and inequities in the health workforce that should be accounted for in future research on the topic."

Despite the large number of studies on the impacts of PHEIC in the health and performance of HCWs, the majority adopt a cross-sectional design which makes difficult to establish a timeline between PHEICs and the occurrence of the outcomes, presenting a traditional example of reverse causality.

The measurement of the exposure to the PHEIC (i.e., direct contact with infected patients, nature of the contact, including duration, use of PPE, among others) is often not considered which makes it difficult to conclude if the changes observed in the frequency of studied outcomes resulted from a specific, more intense, work-related exposure or if it is restrained to that of the lay citizen (this was particularly evident in the case of the studies conducted during the COVID-19 pandemic).

Abbreviations

COVID-19	Coronavirus disease 19
HCW	Health and care workers

LSR	Living systematic review
PHEIC	Public health emergencies of international concern
PPE	Personal protective equipment
PTSD	Post-traumatic stress disorder
SARS	Severe acute respiratory syndrome
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
MERS	Middle East respiratory syndrome
WHO	World Health Organization

Supplementary Information

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Additional file 1. Search strategy.

Additional file 2. Flow for assessing eligibility criteria.

Additional file 3. Interrater agreement.

Additional file 4. Data collection forms.

Additional file 5. Critical appraisal tools, score coding and GRADE.

Additional file 6. Forest plots and funnel plots for meta-analysis of the outcomes.

Additional file 7. Included studies.

Additional file 8. Excluded studies.

Additional file 9. Impact of PHEICs on HCW.

Additional file 10. Cost-effective and culturally relevant interventions to address short- and long-term impact of COVID-19 pandemic and other PHEICs on HCW.

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Author contributions
IF, PF, MDP, APCO, AP, IC and MB designed the LSR. RC defined the search strategies and conducted the database base search. IF, VM, WA, RL and KM assessed studies regarding eligibility and collected data. IF conducted the meta-analysis and meta-aggregation. IF, PF and MDP produced the first version of the manuscript. All authors read and approved the final manuscript.

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Author details
[1]Global Health and Tropical Medicine, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Rua da Junqueira, 100, 1349-008 Lisbon, Portugal. [2]National School of Public Health, Public Health Research Centre, Comprehensive Health Research Center, NOVA University of Lisbon, Avenida Padre Cruz, 1600-560 Lisbon, Portugal. [3]School of Public, Health University of the Western Cape, South Africa, Private Bag X17, Bellville 7535, Republic of South Africa. [4]Escola Nacional de Saúde Pública Sérgio Arouca, Fundação Osvaldo Cruz, Rua Leopoldo Bulhões, 1480 - Manguinhos, Rio de Janeiro, Brazil. [5]Instituto de Medicina Social, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524 – 7º andar, Blocos D e E – Maracanã, Rio de Janeiro, RJ 20550-013, Brazil. [6]Instituto Nacional de Cancer, Ministério da Saúde, Rua Marquês de Pombal, 125, Centro, Rio de Janeiro, RJ 20230240, Brazil. [7]Health Workforce Department, World Health Organization, Av. Appia 20, 1202 Geneva, Switzerland.

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