IMPACT OF VIRAL EPIDEMIC OUTBREAKS ON MENTAL HEALTH OF HEALTHCARE WORKERS: A RAPID SYSTEMATIC REVIEW

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Content:

ABSTRACT

Objectives: To examine the impact of providing healthcare during or after health emergencies caused by viral epidemic outbreaks on healthcare workers´(HCWs) mental health, and to assess the available evidence base regarding interventions to reduce such impact.

Design: Systematic rapid review and meta-analysis.

Data sources: MEDLINE, Embase, and PsycINFO, searched up to 23 March 2020.

Method: We selected observational and experimental studies examining the impact on mental health of epidemic outbreaks on HCWs. One reviewer screened titles and abstracts, and two reviewers independently reviewed full texts. We extracted study characteristics, symptoms, prevalence of mental health problems, risk factors, mental health interventions, and its impact. We assessed risk of bias for each individual study and used GRADE to ascertain the certainty of the evidence. We conducted a narrative and tabulated synthesis of the results. We pooled data using random-effects meta-analyses to estimate the prevalence of specific mental health problems.

Results: We included 61 studies (56 examining impact on mental health and five about interventions to reduce such impact). Most were conducted in Asia (59%), in the hospital setting (79%), and examined the impact of the SARS epidemic (69%). The pooled prevalence was higher for anxiety (45%, 95% CI 21 to 69%; 6 studies, 3,373 participants), followed by depression (38%, 95% CI 15 to 60%; 7 studies, 3,636 participants), acute stress disorder (31%, 95% CI 0 to 82%, 3 studies , 2,587 participants), burnout (29%, 95% CI 25 to 32%; 3 studies; 1,168 participants), and post-traumatic stress disorder (19%, 95% CI 11 to 26%, 10 studies, 3,121 participants). Based on 37 studies, we identified factors associated with the likelihood of developing those problems, including sociodemographic (younger age and female gender), social (lack of social support, social rejection or isolation, stigmatization), and occupational (working in a high risk environment (frontline staff), specific occupational roles (e.g., nurse), and lower levels of specialised training, preparedness and job experience) factors. Five studies reported interventions for frontline HCW, two of which were educational and aimed to prevent mental health problems by increasing HCWs´ resilience. These interventions increased confidence in support and training, pandemic self-efficacy, and interpersonal problems solving (very low certainty). One multifaceted intervention implemented training and organisational changes) targeted at hospital nurses during the SARS epidemic, reporting improvements in

anxiety, depression, and sleep quality (very low certainty). The two remaining interventions, which were multifaceted and based on psychotherapy provision, did not assess their impact.

Conclusion: The prevalence of anxiety, depression, acute and post-traumatic stress disorder, and burnout, was high both during and after the outbreaks. These problems not only have a long-lasting effect on the mental health of HCWs, but also hinder the urgent response to the current COVID-19 pandemic, by jeopardising attention and decision-making. Governments and healthcare authorities should take urgent actions to protect the mental health of HCWs. In light of the limited evidence regarding the impact of interventions to tackle mental health problems in HCWs, the risk factors identified in this study, more so when they are modifiable, represent important targets for future interventions.

SUMARY BOX

1: What is already known on this topic?

- Previous studies showed that healthcare workers involved providing frontline care during viral epidemic outbreaks are at high risk of developing mental health problems.
- Given the current COVID-19 pandemic, there is an urgent need to synthesize the evidence regarding the impact of viral epidemic outbreaks on mental health of healthcare workers.

2: What does this study add?

- This timely systematic rapid review offers for the first time pooled estimations of the prevalence of the most common mental health problems experienced by HCWs during and after viral epidemic outbreaks, namely anxiety (45%), depression (38%), and acute stress disorder (31%), among others.
- Our study also identifies a broad number of factors associated with these conditions, including sociodemographic factors such as younger age and female gender, social factors such as lack of social support, social rejection or isolation, stigmatization, and occupational factors such as working in a high risk environment, specific occupational roles, and having lower levels of specialised training, preparedness and job experience.
- Our study shows that, although educational and multifaceted interventions might mitigate the development of mental health problems, the certainty on the evidence is very low - therefore indicating that further high quality research is urgently needed to inform evidence-based policies for viral pandemics.

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INTRODUCTION

Infectious disease outbreaks are relatively common,[1] often prompting an international response involving thousands of healthcare workers (HCWs).[2] Providing frontline healthcare during infectious outbreaks increases the risk of HCWs developing mental health problems, both short and long-term.[3] It has been suggested that specific occupational factors are associated with psychological outcomes of HCWs during an infectious disease outbreak.[2] Working in a high-risk environment, adhering to quarantine, job-related stress, and belonging to a specific cadre were all considered to aggravate psychological outcomes. Perceived safety, namely through access to protective equipment, and specialised training, mitigated those outcomes.[2]

During December 2019 a new infectious disease outbreak was reported in Wuhan, Hubei province, China,[4] which was named COVID-19.[5]The World Health Organization (WHO) declared COVID-19 a pandemic by March 11th 2020, and by 30 March 2020 it had spread to most countries and territories, with more than 693,000 known cases and a death toll of over 33,000 people.[6] Early anecdotal evidence from Wuhan showed how this unprecedented situation impacted the mental health of frontline HCWs, who reported mental problems such as anxiety, depressive symptoms, anger, and fear.[7] These problems cannot only have a long-lasting effect on the mental health of HCWs,[3] but also hinder the urgent response to COVID-19, by jeopardising attention and decision-making.[7] Tackling the mental health of HCWs during this pandemic is essential, and will strengthen healthcare systems' capacity.[8]

Previous systematic reviews have explored social and occupational factors associated with psychological outcomes in HCW during an infectious disease outbreak,[2] and their perceptions of risk and use of coping strategies towards emerging respiratory infectious diseases.[9] However, to date, the impact of viral disease outbreaks on specific mental health problems and the effectiveness of interventions to ameliorate such impact have not been systematically reported.

The aim of this rapid systematic literature review is twofold: i) to examine the impact of health emergencies caused by a viral pandemic or epidemic on HCWs mental health; and ii) to assess the effectiveness of interventions to reduce such impact.

METHODS

We conducted a rapid systematic review following WHO guidelines[10] and Cochrane's recommendations for Rapid Reviews in response to COVID-19.[11] We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for planning, conducting and reporting this study.[12]

Data Sources and Searches

We designed specific search strategies for biomedical databases (MEDLINE/Ovid, EMBASE/Elsevier, and PsycInfo/EBSCO), combining MeSH terms and free-text keywords (Online Appendix 1). We searched databases from inception to 23rd March 2020, and checked the list of included studies of relevant systematic reviews.[9 13 14] We used EndNote X8™ to create a bibliographical database, and Rayyan to screen relevant records.[15]

Selection criteria

We included empirical studies examining the impact on mental health of epidemic outbreaks on HCWs, and studies about interventions to reduce such impact. We included observational (cross-sectional, case-control, and cohort studies), and experimental studies (non-controlled before-after studies, controlled before-after studies, non-randomised controlled trials, and randomised controlled trials).

We included studies on any type of health emergency caused by a viral epidemic or pandemic, and examining its impact on HCWs mental health during or after the crisis. For intervention studies, we included also those that examined interventions to protect mental health of healthcare workers prior, during or after the outbreak onset. All types of settings and healthcare professionals were accepted for inclusion. We included studies measuring any type of mental health problem or psychiatric morbidity. We excluded narrative reviews, thesis, editorials, protocols, letters to the editor, and studies published in languages other than English, Spanish or Portuguese.

Study Selection

One reviewer (of IRC, MJSR, MAFR, RZC, DGB) screened the retrieved references at title and abstract against the selection criteria. Two reviewers (of those aforementioned) independently and blinded against the others' judgements assessed full-text eligibility. We solved disagreements by consensus or by involving a third reviewer, if needed.

Data Extraction and Quality Assessment

We used structured forms to extract relevant data, such as country, health emergency, setting, population, epidemiological design, number of participants, mental health conditions, clinical outcomes and their measurement tools, and main study results. For observational studies addressing the impact of health emergencies on HCWs mental health, we extracted the prevalence rate of the mental conditions examined in terms of the number of professionals suffering the condition (numerator) out of the total number of study participants (denominator). If available, we extracted information about the risk factors. For intervention studies (i.e., randomised and non-randomised trials), we extracted data about the characteristics of the intervention as well as that reported also for observational studies.

We assessed the risk of bias of observational studies (i.e., cross-sectional, case-control, and cohort studies) by using the set of tools developed by Evidence Partners (McMaster University) [16]; whereas ROBINS I [17] was applied to uncontrolled trials, and AMSTAR [18]for systematic reviews.

One reviewer (of MJSR, MAFR, AC, DF, JM, GP, RZ) extracted all the data and assessed the risk of bias, while a second reviewer cross-checked the information for accuracy and completeness.

Data Synthesis and Analysis

We conducted a narrative and tabulated synthesis of the results, classifying the studies according to the type of study (i.e., impact of infectious disease outbreaks on HCWs mental health, or interventions to reduce such impact), and timing (i.e., before, during, or after the outbreak). We adapted a taxonomy proposed in a previous study [14] to classify risk factors as social, occupational and sociodemographic.

For studies about the impact of outbreaks on mental health, we conducted random-effects meta-analyses to estimate the prevalence and 95% confidence interval (CI) of each type of mental health condition, using the STATA command “metaprop”. We conducted subgroup analyses to explore potential differences in the prevalence of mental health disorders during vs. after the outbreak. Heterogeneity was quantified by the I^2 statistic, where I^2>50% was deemed as substantial heterogeneity.[19] Publication bias was examined with funnel plots and presence of asymmetry tested with Begg[20] and Egger tests.[21] We used Stata, version 12.0 to conduct meta-analyses.

GRADE and 'Summary of findings' tables

We used the GRADE approach[22] to assess the quality of evidence related to the outcomes included in this rapid review. We used GRADEpro 2011 [23] software to create 'Summary of findings' tables. For assessments of the overall quality of evidence for each outcome that included pooled data, we downgraded the evidence from 'high quality' by one level for serious, or by two levels for very serious, study limitations (risk of bias), indirectness of evidence, inconsistency, imprecision of effect estimates, or potential publication bias.[22]

Patient and public involvement

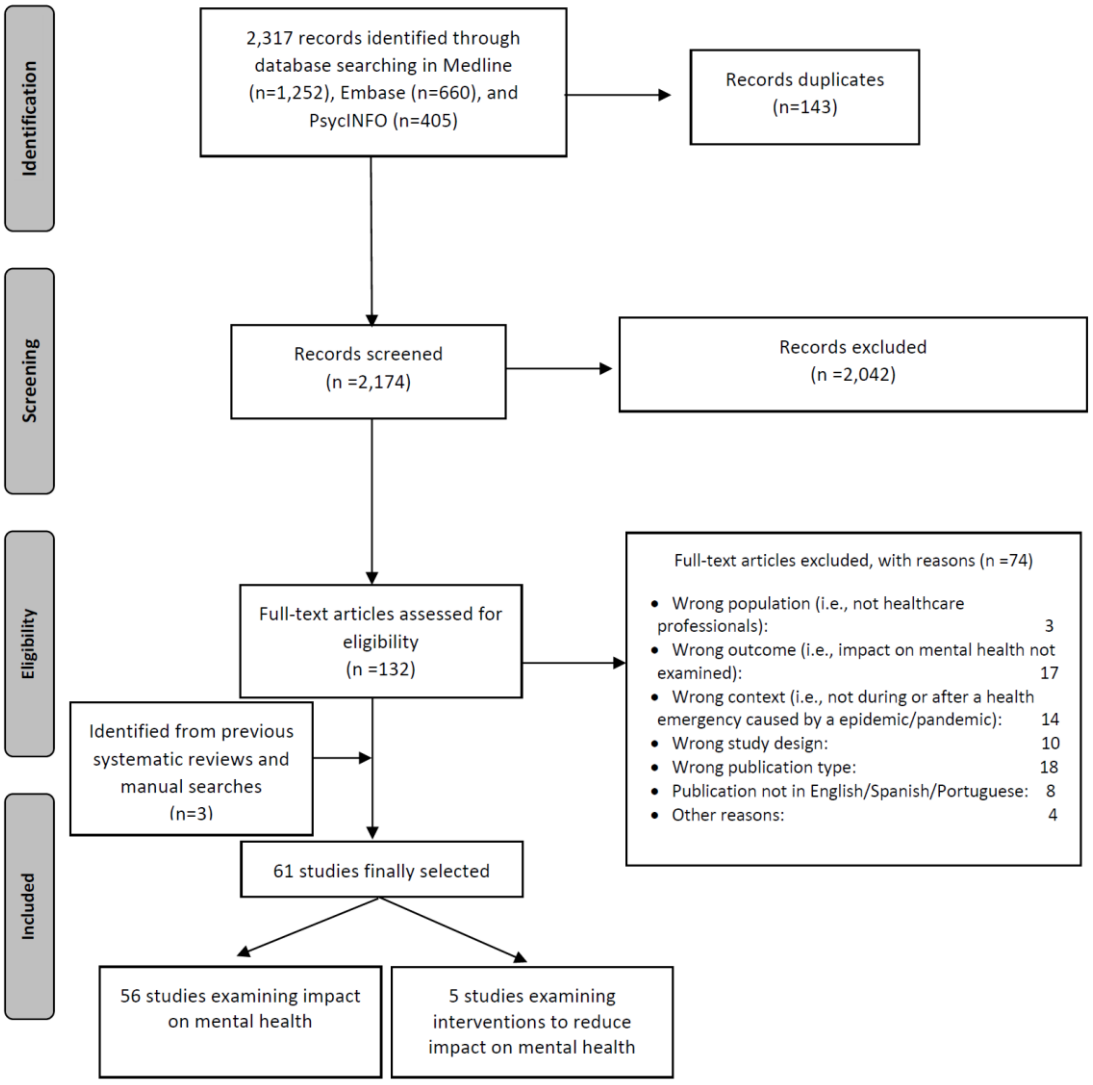
We have invited HCW frontline to promote the dissemination of these results, alongside members of the author team who are also frontline HCWs.

RESULTS

Search results

The search resulted in a total of 2,317 records. After 143 duplicates were removed, 2,174 records remained to be screened. We excluded 2,042 records based on title and abstract screening. We assessed full-text 132 articles in full-text, of which we excluded 74. After including three additional studies identified from manual searches, sixty-one published studies met the inclusion criteria for this systematic rapid review.[13 24-83] Figure 1 illustrates the selection process of the included studies. Online Appendix 2 presents the excluded studies.

Figure 1. PRISMA flow diagram



Characteristics of the studies

This systematic rapid review included 38,415 participants (total). Most of the studies (59%) were conducted in Asian countries, including China (30%), South Korea (18%), Taiwan (15%) or Singapore (12%). The mean number of participants was 612 (range 26 to 10,511). More than two-thirds (69%) examined the impact of Severe acute respiratory syndrome (SARS epidemic), followed by Middle East respiratory syndrome coronavirus (MERS-CoV) (11%). Three studies examined the impact of COVID-19.[46 53 83] Most studies were conducted during or after the infectious outbreak (92%). Around three quarters took place in the hospital setting. General HCWs was the most common group (70%), followed by nurses (20%) and physicians (10%). Post-traumatic stress disorder (PTSD) (38%), anxiety (36%), depression (28%) and stress/distress symptoms (28%) were the mental health conditions most frequently examined. The majority followed a cross-sectional design (82%). The characteristics of the included studies are summarised in Table 1.

Risk of bias assessment

In general, main risks of bias in the 50 cross-sectional studies were the lack of use of reliable and valid instruments to measure mental health outcomes (high risk of bias in 22% of the studies) and selection bias (12%). The main sources of bias across the seven cohort studies were selection bias (43%) and inadequate follow-up of the cohorts (29%). Main sources of bias of the two uncontrolled before-after studies were bias in selection of participants, and bias in outcome measurement. The case-control and the systematic review identified did not present serious risks of bias. Results of the risk of bias assessment are provided in Online Appendix 3.

Table 1. Features of the studies selected (N=61)

		N	%
Year of the study publication			
	2001-2005	22	36
	2006-2010	19	31
	2011-2015	5	8
	2016-2020	15	25
Epidemiologic design			
	Cross-sectional	50	82
	Cohort study	7	11
	Quasi-experimental	2	3
	Case-control	1	2
	Systematic literature reviews	1	2
Number of participants *		612	(26 - 10,511)
Mental health problems⸸			
	Post-traumatic stress disorder	23	38
	Anxiety	22	36
	Depression	17	28
	Stress/distress	17	28
	Burnout	8	13
	Acute stress disorder	7	11
	Mental health status (overall assessment)	20	33
	Others	15	25
Country⸸			
	China	18	30
	Canada	12	20
	South Korea	11	18
	Taiwan	9	15
	Singapore	7	12
	Saudi Arabia	3	5
	Others	11	18
Study timing			
	After outbreak	28	46
	During outbreak	28	46
	Both during and after outbreak	2	3
	Prior, during and after outbreak	2	3
	Prior outbreak onset	1	2
Type of health emergency			
	SARS	42	69
	MERS-COV	7	11
	H1N1 influenza virus	4	7
	Ebola	4	7
	COVID-19	3	5
	H7N9 influenza virus	1	2
Population			
	Health care workers in general	43	70
	Nurses	12	20
	Doctors	6	10
Setting			
	Hospital	48	79
	Healthcare facilities in general	8	13
	Primary Care centre	3	5
	Non specified	2	3

* mean and range, ⸸ percentages exceeding 100% as categories are not mutually exclusive.

Prevalence of mental health problems in HCWs during and after infectious disease outbreaks

Fifty-six studies examined the mental health problems among frontline HCWs during and/or after an infectious disease outbreak (Online Appendix 4). The great majority of them reported clinically significant mental health symptoms, most frequently PTSD, anxiety, depression, and burnout. For clinically significant symptoms of mental health disorders, the pooled prevalence was higher for anxiety (45%, 95% CI 21 to 69%, I*2* 99.7%; 6 studies, 3,373 participants), followed by depression (38%, 95% CI 15 to 60%, *I2* 99.6%; 7 studies , 3,636 participants), and PTSD (19%, 95% CI 11 to 26%, *I2* 97.6%; 10 studies, 3,121 participants). Three studies reported the prevalence of burnout (29%, 95% CI 25 to 32%; 1,168 participants), and three reported the prevalence of acute stress disorder (31%, 95% CI 0 to 82%, 2,587 participants). Subgroup analyses found little or no differences in prevalence during vs. after the outbreaks (Online Appendix 5). Begg's and Egger's tests suggested the absence of publication bias for all the meta-analyses conducted.

Risk factors for mental health problems in HCWs during and after infectious disease outbreaks

Thirty-seven studies examined a large number of occupational, sociodemographic and social factors associated with the likelihood of developing mental health problems while providing frontline healthcare during an infectious disease outbreak (Online Appendix 4).

The main occupational factors were working in a high risk environment, higher perception of threat and risk, specialised training received, and specific occupational role. Working in a high risk environment was associated with different mental health problems, namely depression,[46] anxiety,[46 52 60 77] PTSD,[28 72 75 81 82] and burnout.[76] The definition of *high risk environment* varied across studies, but usually included being in direct contact with infected patients, either providing care,[28 77] or being responsible for cleaning and disinfection.[52]

Likewise, higher perception of threat and risk was also associated with a higher prevalence of a number of different mental health problems, including depression,[55] anxiety,[25] and PTSD.[63 72 81] Lack of specialised training was a risk factor for anxiety,[60 79] PTSD,[75] and burnout.[63]

Some of the studies that recruited more than one cadre reported that specific HCWs were at higher risk of developing mental health problems. One study each found that nurses were more likely to develop PTSD [75] and burnout,[76] whereas one study [26] reported that resident pulmonologists were at higher risk of burnout.

Other occupational risk factors for PTSD were job stress,[63] and less job experience,[75] whereas lower levels of organisational support increased the risk of burnout.[59]

Studies addressing sociodemographic and social risk factors focused on PTSD and burnout. Younger age was a risk factor for both PTSD [75] and burnout,[26] while female gender was associated with higher levels of PTSD in HCWs.[75] Feelings of social rejection or isolation,[63] and higher impact of the outbreak on daily life [72] increased the likelihood of developing PTSD, whereas lack of family and friends support were associated with burnout.[43] In addition, stigmatisation,[44] social rejection,[67] and lower levels of social support were identified as risk factors for stress.[83]

Interventions to reduce the mental health impact of viral outbreaks in HCWs

Five studies [24 33 40 62 70] described five different interventions to reduce the mental health impact of viral outbreaks in HCWs (Online Appendix). Two studies implemented in Canada evaluated two educational interventions for improving HCWs mental health by increasing resilience.[24 62] Aiello and colleagues[24] described an educational intervention targeted to HCWs during the SARS epidemic, which consisted of a face-to-face group training session based on Folkman and Greer's model of coping.[84] The session focused on stressors associated with pandemic influenza and on organisational and individual approaches to building resilience and reducing stress. While most participants did not feel prepared to deal confidently with the pandemic before the session (35%), there was a higher proportion of participants who felt better able to cope after the session (76%).

Maunder and colleagues explored the impact of a computer-assisted resilience training to prepare HCWs for a potential pandemic influenza.[62] The course consisted of modules incorporating different modalities of learning (knowledge-based modules, relaxation skills, and self-assessment modules using questionnaires to characterize interpersonal problem and coping style). The intervention improved confidence in support and training, pandemic self-efficacy and interpersonal problems ($p<0.05$). We have very low confidence on the evidence of educational interventions for preventing the psychological impact of infectious epidemic outbreaks in HCWs (detailed in Online Appendix 7) due to the study design (uncontrolled before-after studies) and very serious risk of bias with regard to confounding and measurement of outcomes.

Two studies examined two multifaceted interventions combining training and implementation of organizational changes.[33 70] A study in Taiwan [33] evaluated the effects of a multifaceted intervention to prevent depression and anxiety in hospital nurses during the SARS epidemic. The intervention included in-service training, manpower allocation, gathering sufficient protective equipment, and establishment of a mental health team. The authors observed statistically significant improvements in nurses' anxiety and depression along with sleep quality at two weeks follow-up. Another study described a multifaceted intervention to improve resilience and prevent PTSD in HCWs during the Ebola epidemic in the USA, Philippines, and West Africa.[70] The intervention, based on the Anticipate, Plan and Deter Responder Risk and Resilience model, included pre-deployment development of an individualized resilience plan and an in-theatre, real-time self-triage system, to allow HCWs to assess and manage the full range of psychological risk and resilience for themselves and their families. The potential effectiveness of this intervention was not studied. Our confidence on the evidence for multifaceted interventions for preventing the psychological impact during infectious epidemic outbreaks in HCWs was very low (Online Appendix 7) due to limitations in the study design (uncontrolled before after studies) and very serious risk of bias (high risk of selection bias and high risk of bias in measurement of outcomes).

Finally, Khee et al. 2004 reported an intervention in 188 hospital nurses in Singapore, consisted in the provision of psychological support during the SARS outbreak.[40] The intervention, not based on any specific psychotherapeutic model, comprised multiple sessions (75 minutes per session) and was aimed at preserving their mental health. The primary goal of therapy was to externalise all their emotions, and bring support to each other. The effectiveness of this intervention was not studied.

DISCUSSION

Summary of findings

In this timely systematic rapid review we synthesized evidence from 61 studies examining the impact on mental health of providing frontline healthcare during infectious disease outbreaks. Results showed that HCWs commonly present high levels of anxiety, depression, PTSD, acute disorder and burnout, both during and after the outbreaks. We identified a broad number of risk factors for these conditions, including sociodemographic factors such as younger age and female gender, and social factors such as lack of social support, social rejection or isolation, stigmatization. Occupational factors entailed working in a high risk environment (frontline staff), specific occupational roles (e.g., nurse), and having lower levels of specialized training, preparedness and job experience. In contrast with the high number of studies examining impact on mental health, there is limited evidence regarding the impact of interventions to reduce mental health problems in this particularly vulnerable population, and overall its certainty is very low, mainly due to study design and serious risk of bias.

Strengths and limitations of the review

This is a timely and comprehensive rapid review of the current literature on the impact of infectious disease outbreaks on the mental health of HCWs. We examined three relevant areas, namely the prevalence of mental health problems, factors associated with an increased likelihood of developing those problems, and the effects of interventions to improve mental health of HCWs. We followed the highest methodological standards when undertaking the current rapid review,[10] and we used the GRADE approach to evaluate the certainty of the evidence, in order to facilitate evidence-informed decision making processes. Our review team is also a strength, as it included experts in evidence synthesis, Cochrane authors, members of the GRADE Working Group, physicians, nurses, editors, psychologists, and psychiatrists. There were also some limitations underlying this work. Despite searching three major databases and manually searching references of previously published systematic reviews, we did not examine gray literature; hence, we cannot discard that relevant references may have been missed out. We observed high heterogeneity when pooling data, which could be partially attributed to the high variability across studies in terms of study population (e.g. occupational role), context (e.g. magnitude of the health emergency caused by epidemic) and outcome measures. In light of this, our results should be interpreted with caution.

Discussion of the main findings

Some of the risk factors associated with mental health problems while providing frontline care during infectious disease outbreaks cannot be modified. In this way, working in a high risk environment increases the risk of developing clinically significant symptoms, namely depression,[46] anxiety,[46 52 60 77] PTSD,[28 72 75 81 82] and burnout.[76] Likewise, it seems like specific cadres are more likely to report mental health problems, namely PTSD,[75] and burnout.[26 76]

However this review also identified specific modifiable factors that can be addressed in advance and mitigate the risk brought by the aforementioned factors. Lack of specialized training was associated with anxiety, [60 79] PTSD,[75] and burnout,[63] and higher perception of threat and risk was associated with depression,[55] anxiety,[25] and PTSD [38 63 72 81]. Long-term institutional preparedness is possible for both factors, through the development and implementation of specialized training that includes infection prevention, diagnostics, patient care, staff, and communication.[85]

Continuous communication between HCWs and managers, including the provision of up-to-date facts about the progression of the outbreak, can convey institutional support,[59] and promote the acquisition of knowledge and confidence for those HCWs who have less job experience.[75] Likewise, managers are essential to mitigate feelings of social isolation [50 63] and stigmatization, [44] especially among those HCWs who have to be quarantined.[13] The proliferation of online mobile-based technologies will play an essential role in promoting connectedness and decrease the feelings of isolation and stigmatization,[86] and can also be used for informal contacts between HCWs who are quarantined.

Although limited, evidence from intervention studies indicates that educational interventions have the potential to increase knowledge and resilience, [24 62] even when implemented during an outbreak.[33]

Limitations of available evidence and future research needs

We identified 56 studies reporting on the impact on mental health of providing frontline healthcare during an infectious disease outbreak, however most of the studies did not use validated methods to assess mental health, which limits the generalizability of our findings. Furthermore, only a handful of studies assessed the efficacy of interventions to ameliorate the impact of health emergencies on mental health of HCWs.

It is expected the proliferation of a large volume of studies examining the impact of COVID-19 on HCWs´ mental health during the near future. To make progress in this area, future studies should address these limitations of the available literature. The use of validated measurement tools and more representative sample sizes are warranted in order to strengthen the quality of the evidence in this area. Intervention studies should also adhere to international reporting standards such as CONSORT [85] and TIDieR.[87]

Conclusions

As we demonstrated in our review, the mental health burden for HCWs during pandemics is especially high both during and after the outbreak. Of note for its similarity to the current COVID-19 crisis, are the experiences gained from the previous SARS outbreak. This time, given the size, scale and importance of the current pandemic, these trends could be much worse.

We urge governments, policy makers and relevant stakeholders to monitor and follow these outcomes and conduct scientifically sound interventional research, in order to mitigate mental health impact on HCWs.

The physical health of HCWs is already at stake from the virus, and once we tackle the current pandemic, we will need to heal the healers, not only for the sake of having a prepared and resilient work-force, but as we owe them from the tremendous sacrifices they are doing. If we want to address these concerns and be able to mitigate its impact, we need to act soon.

Contributors: IRC, IRP and MJSR had the idea for the study. IRC designed the search strategy. IRC, MJSR, MAFR, RZC, DGB screened abstracts and full texts. MJSR, MAFR, AC, DFN, JM, GP, RZ, DGB acquired data, and assessed risk of bias in studies. IRC did the data analysis. All authors interpreted the data analysis. IRC and DGB wrote the manuscript, with revisions from all authors. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. IRC is the guarantor.

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Ethical approval: Not required

Data sharing: No additional data available.

Transparency: The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained**.**

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Online Appendix 1. Search strategies

Medline (Ovid): 23 March 2020

	Searches	Hits
1	exp Health Personnel/ or ((health or health care or healthcare) adj2 (personnel or worker* or provider* or employee* or staff or professional*)).tw. or ((medical or hospital) adj2 (staff or employee* or personnel or worker*)).tw. or (doctor* or physician* or clinician*).tw. or (allied health adj2 (staff or personnel or worker*)).tw. or paramedic*.tw. or nurse*.tw. or (nursing adj2 (staff or personnel or auxiliar*)).tw.	1379427
2	mental disorders/ or exp adjustment disorders/ or exp anxiety disorders/ or exp mood disorders/ or neurotic disorders/ or mental health.mp.	466605
3	(anxi* or depress* or melancholi* or neuros* or neurotic or psychoneuro* or stress* or distress* or emotion*).tw.	1614503
4	affective symptom*.mp.	14631
5	2 or 3 or 4	1882229
6	Disease Outbreaks.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	80952
7	exp *Disease Outbreaks/	61132
8	pandemic*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	24932
9	epidemic.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	89450
10	exp *Coronaviridae Infections/ or exp *Coronaviridae/	14403
11	exp *Coronavirus/	9573
12	covid 19.mp.	993
13	covid-19.mp.	993
14	exp *SARS Virus/	2321
15	exp *Hemorrhagic Fever, Ebola/	4618
16	exp *Influenza, Human/ or exp *Influenza A Virus, H1N1 Subtype/ or exp *Influenza A virus/	59684

17	health crisis.mp.	2070
18	emergency crisis.mp.	44
19	6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18	228659
20	1 and 5 and 19	1252

PsycINFO (EBSCO): 23 March 2020

	Searches	Hits
1	TI (healthcare professionals or healthcare workers or healthcare providers or physician or nurse or doctor) OR AB (healthcare professionals or healthcare workers or healthcare providers or physician or nurse or doctor)	163,295
2	DE mental health	70,131
3	TI (mental health or mental illness or mental disorder or psychiatric illness) OR AB (mental health or mental illness or mental disorder or psychiatric illness)	250,928
4	DE depression	44,673
5	DE anxiety	78,469
6	TI (depression or depressive disorder or depressive symptoms or major depressive disorder) OR AB (depression or depressive disorder or depressive symptoms or major depressive disorder)	265,842
7	TI (anxiety disorders or anxiety or generalized anxiety disorder) OR AB (anxiety disorders or anxiety or generalized anxiety disorder)	191,246
8	S2 OR S3 OR S4 OR S5 OR S6 OR S7	607,016
9	DE disease outbreaks	904
10	TI (disease outbreaks or pandemic or epidemic or health emergency) OR AB (disease outbreaks or pandemic or epidemic or health emergency)	16,032
11	DE coronavirus	9
12	TI (coronavirus or covid-19 or sars or mers or pandemic or outbreak) OR AB (coronavirus or covid-19 or sars or mers or pandemic or outbreak)	3,213
13	S9 OR S10 OR S11 OR S12	18,427
14	S1 AND S8 AND S13	405

Embase (Elsevier): 23 March 2020

	Searches	Hits
1	'health care personnel'/exp OR 'health care personnel'	1,538,012
2	health NEXT/2 (personnel OR worker* OR provider* OR employee* OR staff OR professional*)	399,604
3	'health care' NEXT/2 (personnel OR worker* OR provider* OR employee* OR staff OR professional*)	217,126
4	healthcare NEXT/2 (personnel OR worker* OR provider* OR employee* OR staff OR professional*)	85,747
5	medical NEAR/2 (staff OR employee* OR personnel OR worker*)	68,132
6	hospital NEAR/2 (staff OR employee* OR personnel OR worker*)	37,505
7	doctor* OR physician* OR clinician*	1,432,241
8	'allied health' NEAR/2 (staff OR personnel OR worker*)	978
9	paramedic* OR nurse*	542,98
10	nursing NEAR/2 (staff OR personnel OR auxiliar*)	82,598
11	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10	2,845,394
12	'mental health'/exp OR 'mental health'	460,848
13	'mental disease'/exp OR 'mental disease'	2,284,001
14	anxi* OR depress* OR melancholi* OR neuros* OR neurotic OR psychoneuro* OR stress* OR distress* OR emotion*	3,662,310
15	'affective symptom*'	3,096
16	#12 OR #13 OR #14 OR #15	5,081,304
17	'epidemic'/exp OR 'epidemic'	177,563
18	'pandemic'/exp OR 'pandemic'	30,568
19	'coronavirus infection'/exp OR 'coronavirus infection'	11,65
20	covid AND 19 OR covid19 OR 'covid 19'	378
21	'sars-related coronavirus'/exp OR 'sars-related coronavirus'	4,657
22	'ebolavirus'/exp OR 'ebolavirus'	5,873
23	'influenza'/exp OR 'influenza'	155,881
24	'health crisis' OR 'emergency crisis'	3,215
25	#17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24	339,775

26	#11 AND #16 AND #25	5,981
27	#26 AND [embase]/lim NOT ([embase]/lim AND [medline]/lim) AND 'human'/de AND ('article'/it OR 'article in press'/it OR 'review'/it)	660

Online Appendix 2. List of excluded papers after full-text screening

❖ Excluded due to wrong study population (i.e., not healthcare professionals)

1. Gardner PJ, Moallef P. Psychological impact on SARS survivors: Critical review of the English language literature. Canadian Psychology/Psychologie canadienne. 2015;56(1):123-35.
2. Sipos ML, Kim PY, Thomas SJ, Adler AB. U.S. Service Member Deployment in Response to the Ebola Crisis: The Psychological Perspective. Military medicine. 2018;183(3):e171-e8.
3. Wong TW, Gao Y, San Tam WW. Anxiety among university students during the SARS epidemic in Hong Kong. Stress Health. 2007;23(1):31-5.

❖ Excluded due to wrong outcome (i.e., impact on mental health not examined)

1. Alsahafi AJ, Cheng AC. Knowledge, Attitudes and Behaviours of Healthcare Workers in the Kingdom of Saudi Arabia to MERS Coronavirus and Other Emerging Infectious Diseases. International journal of environmental research and public health. 2016;13(12).
2. Bar-Dayan Y, Boldor N, Kremer I, London M, Levy R, Barak MI, et al. Who is willing to risk his life for a patient with a potentially fatal, communicable disease during the peak of A/H1N1 pandemic in Israel? Journal of emergencies, trauma, and shock. 2011;4(2):184-7.
3. Chang CS, Du PL, Huang IC. Nurses' perceptions of severe acute respiratory syndrome: relationship between commitment and intention to leave nursing. Journal of advanced nursing. 2006;54(2):171-9.
4. Cohen MA, Cohen SC. AIDS education and a volunteer training program for medical students. Psychosomatics: Journal of Consultation and Liaison Psychiatry. 1991;32(2):187-90.
5. Considine J, Shaban RZ, Patrick J, Holzhauser K, Aitken P, Clark M, et al. Pandemic (H1N1) 2009 Influenza in Australia: Absenteeism and redeployment of emergency medicine and nursing staff. Emergency medicine Australasia : EMA. 2011;23(5):615-23.
6. El Gaafary MM, Abd Elaziz KM, Abdel-Rahman AG, Allam MF. Concerns, perceived impacts and preparedness of health care workers in a referral hospital in Egypt in facing influenza (H1N1) epidemic. Journal of preventive medicine and hygiene. 2010;51(3):105-9.
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9. Imai H, Matsuishi K, Ito A, Mouri K, Kitamura N, Akimoto K, et al. Factors associated with motivation and hesitation to work among health professionals during a public crisis: a cross sectional study of hospital workers in Japan during the pandemic (H1N1) 2009. BMC public health. 2010;10(100968562):672.
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11. de Saxe Zerden L, Zerden ML, Billinghurst KG. Caring for home-based care workers. Understanding the needs, fears and motivations of front-line care workers in South Africa. South Afr J HIV Med. 2006(24):38-43.
12. Lateef F, Lim SH, Tan EH. New paradigm for protection: the emergency ambulance services in the time of severe acute respiratory syndrome. Prehospital emergency care : official journal of the National Association of EMS Physicians and the National Association of State EMS Directors. 2004;8(3):304-7.

13. Pratt M, Kerr M, Wong C. The impact of ERI, burnout, and caring for SARS patients on hospital nurses' self-reported compliance with infection control. The Canadian journal of infection control : the official journal of the Community & Hospital Infection Control Association-Canada = Revue canadienne de prevention des infections. 2009;24(3):167-74.
14. Vinck L, Isken L, Hooiveld M, Trompenaars M, Ijzermans J, Timen A. Impact of the 2009 influenza A(H1N1) pandemic on public health workers in the Netherlands. Euro surveillance : bulletin Europeen sur les maladies transmissibles = European communicable disease bulletin. 2011;16(7).
15. von Strauss E, Paillard-Borg S, Holmgren J, Saaristo P. Global nursing in an Ebola viral haemorrhagic fever outbreak: before, during and after deployment. Global health action. 2017;10(1):1371427.
16. Wong TY, Koh GC, Cheong SK, Lee HY, Fong YT, Sundram M, et al. Concerns, perceived impact and preparedness in an avian influenza pandemic--a comparative study between healthcare workers in primary and tertiary care. Annals of the Academy of Medicine, Singapore. 2008;37(2):96-102.
17. Wong TY, Koh GCH, Cheong SK, Sundram M, Koh K, Chia SE, et al. A cross-sectional study of primary-care physicians in Singapore on their concerns and preparedness for an avian influenza outbreak. Annals of the Academy of Medicine, Singapore. 2008;37(6):458-64.

❖ Excluded due to wrong context (i.e., not during or after a health emergency caused by an epidemic/pandemic).

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Online Appendix 3. Risk of bias assessment

A. Risk of bias of cross-sectional, assessed with the "Risk of Bias Instrument for Cross-Sectional Surveys of Attitudes and Practices" (Evidence Partners)

	Population representativenness	Response rate	Missing data	Survey clinically sensible	Reliability and validity of the instruments
Lai 2020	?	+	?	+	?
Li 2020	?	?	?	+	+
Xiao 2020	+	+	+	+	+
Alsubaie 2019	?	+	+	?	?
Schreiber 2019	-	+	?	?	-
Park 2018	-	?	?	?	+
Oh 2017	?	+	+	?	+
Tang 2017	-	?	+	?	+
Bukhari 2016	?	+	?	+	+
Khalid 2016	-	+	+	+	+
Kim 2016	+	+	+	+	+
Lehmann 2016	?	?	?	+	+
Li 2015	?	?	+	+	+
Liu 2012	?	+	+	+	+
Matsuishi 2012	?	?	+	+	+
Aiello 2011	?	+	?	-	-
Austria Corrales 2011	?	+	+	?	+
Goulia 2010	?	?	?	?	?
Imai 2010	+	+	-	-	-
Lancee 2008	+	?	?	+	+
Styra 2008	+	?	?	+	+
Wu 2008	+	+	+	+	+
Chen 2007	+	?	?	+	+
Lin 2007	+	+	+	+	+
Marjanovic 2007	?	?	?	-	+
Wong 2007	+	?	?	?	-
Fiksenbaum 2006	?	?	+	-	+
Loh 2006	?	+	+	?	-
Lu 2006	-	+	+	-	+
Maunder 2006	+	+	?	+	+
Grace 2005	+	?	?	?	-
Ho 2005	?	?	+	+	+
Koh 2005	+	+	?	+	+
Lee 2005	+	+	?	?	?
Phua 2005	?	+	?	+	+
Tham 2005	?	+	?	+	+
Tolomiczenko 2005	-	-	?	-	-
Wong 2005	?	?	?	+	?
Bai 2004	?	+	?	?	-
Chan 2004	?	+	?	+	+
Chong 2004	+	+	+	+	+
Chua 2004	+	+	+	+	+
Khee 2004	?	?	?	-	-
Maunder 2004	?	-	+	+	+
Nickell 2004	+	?	?	+	+
Poon 2004	?	?	+	+	+
Sim 2004	+	+	?	+	+
Tam 2004	+	-	?	+	?
Verma 2004	+	-	+	+	+
Wong 2004	?	+	+	-	-

+ Low risk
? Some concerns
- High risk

B. Risk of bias of uncontrolled before-after studies (assess with ROBINS - I)

	Bias due to confounding		Bias in selection of participants into the study		Bias in classification of interventions		Bias due to deviations from intended interventions		Bias due to missing data		Bias in measurement of outcomes		Bias in selection of the reported result		Overall bias
	Rating	Comments	Rating	Comments	Rating	Comments	Rating	Comments	Rating	Comments	Rating	Comments	Rating	Comments	
Chen 2006	Low	GEE analysis for confounding factors and time-varying analysis. The negative side is the factors were self-reported.	Serious	Nurses volunteered to participate in the study (participation probably related to intervention/outcome). No preliminary analysis or assessment.	Moderate	(i) Intervention status is well defined; and (ii) Some aspects of the assignments of intervention status were determined retrospectively (participation was voluntary and knowledge of the prevention program may have affected the intervention).	No information	Not applicable. It is not possible to observe any differences from the intended intervention.	Low	-	Serious	Subjective measures. Team was aware of allocation status.	Moderate	GEE analysis is presented later in the results, not in the methods.	Serious
Maunder 2010	Critical	No adjusted analysis of confounding factors	Serious		Moderate	(i) Intervention status is well defined; and (ii) Some aspects of the assignments of intervention	No information	Not applicable. It is not possible to observe any differences from the intended	Serious	Proportions of missing participants differ substantially across interventions: Attrition was 12% in short	Serious	Subjective measures. Team was aware of allocation status.	Low	All outcomes listed in the methods are also reported in the results. Do not	Critical

						status were determined retrospectively (participation was voluntary and knowledge of the prevention program may have affected the intervention).		interventio n.		courses and 28% in long courses. The authors state a ITT in the methods, but no results were provided.				expect selective reporting.	

C. Risk of bias of the systematic review identified (Brooks 2018), assessed with AMSTAR.

	Brooks 2018
PICO question	+
Following the protocol and methodology	-
Selection of the study designs for inclusion	+
Comprehensive literature search strategy	+
Study selection in duplicate performed	-
Data extraction in duplicate performed	-
List of excluded studies and justification provided	-
Included studies described in detail	+
Risk of bias (RoB) assessed	+
Sources of funding reported	-
Meta-analysis performed with appropriate statistical combination of results	-
Potential impact of RoB in individual studies	-
RoB idiscussed in the results	+
Discussion of any heterogeneity	+
Investigation and discussion of publication bias	-
Conflict of interest reported	+

+ Yes
- No

D. Risk of bias of cohort studies, assessed with the "Tool to Assess Risk of Bias in Cohort Studies" (Evidence Partners)

	Exposed and non-exposed cohorts drawn from the same population	Confidence in the assessment of exposure	Outcome not present at start of study	Associated or prognostic variables analyzed	Assessment of prognostic factors	Assessment of outcome	Follow up of cohorts	Co-interventions similar between groups
Lee 2018	-	+	?	+	+	?	?	?
Ji 2017	-	+	?	+	+	+	-	?
Lung 2009	+	+	-	+	+	+	?	?
Wu 2009	?	-	+	+	+	+	+	?
Lee 2007	+	+	?	+	+	+	?	?
McAlonan 2007	+	+	?	+	?	+	?	?
Su 2007	+	+	-	+	+	+	+	+

+ Low risk
? Some concerns
- High risk

E. Risk of bias of case control studies, assessed with the "Tool to Assess Risk of Bias in Case Control Studies" (Evidence Partners)

	Chen 2005
Confidence in the assessment of exposure	+
Cases develope the outcome but not controls	?
Cases selection	?
Controls selection	?
Associated or prognostic variables analyzed	+

+ Low risk
? Some concerns
- High risk

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Online Appendix 4. Summary of Findings table of studies examining the impact on mental health problems in healthcare workers during and after viral epidemics

A. **Summary of Findings table of studies examining the impact on mental health problems in healthcare workers during viral epidemics (N= 27)**

Author/ year/health emergency/ country/	**Setting** **Type of healthcare professionals**	**Sample size (N)**	**Mental health problem (**tool**)**	**Main results**
Cross-sectional studies				
Lai 2020 (1) COVID-19 China	Hospitals HCWs	N=1,257	Depression (PHQ-9), anxiety (GAD-7), insomnia-(7-item Insomnia Severity Index), distress (IES-R)	Participants reported symptoms of depression (634 [50.4%]), anxiety (560 [44.6%]), insomnia (427 [34.0%]), and distress (899 [71.5%]). Nurses, women, frontline HCWs, and those working in Wuhan, China, reported more severe degrees of all measurements of mental health symptoms than other HCWs. Frontline HCWs engaged in direct diagnosis, treatment, and care of patients with COVID-19 were associated (P<0.05) with a higher risk of symptoms of depression (OR=1.52), anxiety (OR=1.57), insomnia (OR=2.97), and distress (OR=1.60).
Li 2020(2) COVID-19 China	Hospitals Nurses	N=526	Vicarious traumatization (Chinese version of the vicarious traumatization questionnaire)	Vicarious traumatization scores for front-line nurses were significantly lower than those of non-front-line nurses (P<0.001). The vicarious traumatization scores of the general public were significantly higher than those of the front-line nurses (P<0.001); however, no statistical difference was observed compared to the scores of non- front-line nurses (P>0.05).
Xiao 2020(3)	Several facilities: departments of	N=180	Anxiety (SAS), PTSD (SASR), self-efficacy	Levels of social support for medical staff were significantly associated with self-efficacy and sleep quality and negatively associated with the degree of

COVID-19 China	respiratory medicine, fever clinics, or the ICU Physicians and nurses		(GSES), sleep quality (PSQI), and social support (SSRS)	anxiety and stress. Levels of anxiety were significantly associated with the levels of stress, which negatively impacted self-efficacy and sleep quality. Anxiety, stress, and self-efficacy were mediating variables associated with social support and sleep quality.
Alsubaie 2019 (4) MERS-CoV Saudi Arabia	Tertiary care teaching hospital Physicians, nurses, and technicians	N=284	Anxiety (unclear)	The mean anxiety score was similar for physicians and other HCWs (3/5); however, non-physicians expressed higher levels of anxiety toward the risk of transmitting MERS-CoV to their families, with an anxiety mean score of 4/5.
Bukhari 2016(5) MERS-Cov Saudi Arabia	Hospital Medical staff (HCWs and administrative personnel)	N=386	Perception of exposure to SARS, perceived risk of infection, and impact of the SARS outbreak on personal and work life (88 questions comprising single choice, multiple choice, and open-ended question) and intrusion and avoidance (IES)	Significant difference in the ”worry and fear” scale of contracting the MERS-CoV infection between participants who worked in isolation areas, ICUs, and emergency rooms (mean: 3.01 ± 1.1) compared to participants who worked in areas that are less likely to admit and have MERS-CoV suspected or positive cases (mean: 2.77 ± 1.1; P=0.031). Females were significantly more worried and fearful of contracting the virus compared to males (mean: 2.92 ± 1.1 versus 2.61 ± 1.0, respectively; P=0.045).
Khalid 2016(6)	Tertiary care hospital	N=117	Emotions, perceived stressors, factors that reduced their stress,	The main sentiments centered upon fear of personal safety and well-being of colleagues and family. Positive attitudes in the workplace, clinical improvement of infected colleagues, and stoppage of disease transmission

MERS-CoV Saudi Arabia	HCWs		coping strategies, and motivators to work during future outbreaks (MERS-CoV staff questionnaire)	among HCWs after adopting strict protective measures alleviated their fear and drove them through the epidemic. HCWs appreciated recognition of their efforts by hospital management and expected similar acknowledgment, infection control guidance, and equipment would entice them to work during future epidemics.
Kim 2016(7) MERS-CoV South Korea	Hospitals designated for treating MERS-CoV-infected patients Emergency department nurses	N=215	Burnout (OLBI), stress (Parker and DeCotiis scale)	The emergency department nurses' burnout was affected by job stress (β=0.59, P <0.001), poor hospital resources for the treatment of MERS-CoV (β=0.19, P <0.001) and poor support from family and friends β= 0.14, P < 0.05). These three variables explained 47.3% of the variance in burnout.
Li 2015(8) Ebola Liberia	China Ebola Treatment Unit HCWs	N=52	General psychological status (SCL-90-R)	Mean General Severity Index, Positive Symptom Total and Positive Symptom Distress Index was 0.42 ± 0.42, 24.15 ± 18.27, and 1.31 ± 0.51, respectively. Mental distress among participants was not very serious; only Positive Symptom Distress Index paranoid ideation and interpersonal sensitivity numerically increased relative to changes in other categories. While male physicians and those responsible for cleaning and disinfection showed significant increases in scores for psychological dimensions, such as obsessive-compulsive, anxiety, phobic anxiety, interpersonal sensitivity, paranoid ideation and positive symptom total.
Austria Corrales 2011(9)	Hospital	N=99	Burnout (MBIQ)	36 medical residents (3.4%) meet the criteria for medium to high burnout. The highest proportion of medical residents with burnout syndrome was those in their second year of specialization in the area of pneumology

H1N1 Mexico	Medical residents with different fields of specialization related to respiratory medicine			(n=11; 52.4%). Medical residents under 30 years of age had a higher probability of presenting burnout syndrome (X^2=4.000; P=0.046).
Goulia 2010(10) H1N1 Greece	Hospital HCWs	N=469	20-item questionnaire, Cassileth's Information Styles Questionnaire (part-I) and GHQ-28.	56.7% reported being worried about A/H1N1 influenza pandemic. The level of anxiety was moderately high (median 6/9). The most frequent concern was infection of family and friends and the health consequences of the disease (54.9%). The perceived risk of being infected was moderately high (median 6/9). Few HCWs (6.6%) had restricted their social contacts and fewer (3.8%) felt isolated by their family members and friends because of their hospital work, while a low percentage (4.3%) intended to take a leave to avoid infection. Worry and degree of worry were significantly associated with intended absenteeism (P<0.0005), restriction of social contacts (P<0.0005), and psychological distress P= 0.036).
Styra 2008(11) SARS Canada	Clinical units at tertiary care healthcare institution HCWs	N=248	PTSD (IES)	Factors that increased post-traumatic stress symptoms were: working in a high-risk unit, [B=0.76, SE 0.37, OR=2.2 (1.0 to4.4); P=0.04]; attending only one SARS patient [B=1.27, SE 0.50, OR=3.5 (1.3 to9.5); P=0.01; perception of risk to self [B=0.67, SE 0.19, OR=2.0 (1.4 to 2.8); P<0.001]; impact on work life [B=0.62, SE 0.19, OR=1.9 (1.3 to 2.7); P=0.001]; depressive affect [B=0.79, SE 0.23, OR=2.2 (1.4 to3.5); P<0.001].

Loh 2006(12) SARS Malaysia	Medical School Medical students	N=204	Anxiety (unclear)	Phase 1 students expressed significantly a higher level of anxiety compared to Phase II in relation to attendance and personal protection in hospitals, and in meeting people coughing in public places.
Chan 2005(13) SARS China	Hospital Nurses	N=1470	Stress (SARS Nurses' Survey Questionnaire)	Nurses in moderate-risk areas appeared to have more stress symptoms than those working in high-risk areas.
Grace 2005(14) SARS Canada	Hospital Physicians	N=193	Psychological distress (unclear)	The rate of psychological distress was significantly higher among physicians providing direct care to SARS patients (45.7%, N=16) than among physicians not providing direct care (17.7%, N=28) (P<0.001).
Koh 2005(15) SARS Singapore	Healthcare centers HCWs	N=10511	Intrusion and avoidance (IES)	More than half of the participants reported increased work stress (56%) and workload (53%). Many experienced social stigmatization (49%) and ostracism by family members (31%), but most (77%) felt appreciated by society.

Lee 2005(16) SARS Taiwan	Hospitals Nurses	N=26	Depression and anxiety (SARS Team Questionnaire)	12–31% reported experiencing a mixture of various negative feelings, such as anxiety, fear, depression and loss of control.
Tolomiczenko 2005 (17) SARS Canada	Community hospital HCWs and administrative personnel	N=300	Burnout (unclear)	Statistically significant differences were found in burnout for gender (73.9% women), nurses (24.7%) vs. others, physicians (20.3%) vs. others, older (40 years or older, 60.0%) vs. younger persons, emergency or ICU workers (8.0%) vs. others, and those employed fewer years at the hospital (less than 5 years: 46.2%) vs. five or more years. While all groups found SARS stressful, nurses reported a greater impact on morale and job satisfaction.
Bai 2004(18) SARS Taiwan	Psychiatric teaching hospital Hospital staff members (HCWs and administrative personnel)	N=338	Depression, anxiety and stress (SARS-related stress reactions questionnaire)	17 staff members (5%) suffered acute stress disorder, 44 (11,2%) presented depressed mood and 44 (13%) presented anxiety.
Chan 2004(19) SARS Singapore	Regional general hospital	N=661	Depression (GHQ-28), anxiety (GHQ-28) and PTSD (IES)	177 (27%) participants had a GHQ 28 score ≥5 , indicating the presence of psychiatric symptoms . GHQ-28-depression means (SD) were 0.6 (1.1) for group A doctor (HCWs who were first-generation contacts or who had direct contact with suspect or probable SARS patients), 0.4 (0.9) for group B doctor (HCWs who did not have direct contact with any suspect or probable SARS patients), 0.3 (0.6) for Group A nurse and 0.4 (1.0) for group

	Physicians and nurses			B nurse. GHQ-28- anxiety means and SD were 0.9 (1.8) for group A doctor, 0.8 (1.4) for group B doctor, 0.7 (1.1) for group A nurse and 0.6 (1.2) for group B nurse. Physicians [P= 0.026, OR = 1.6 and 95% CI = 1.1 to 2.5] and single HCWs were at higher risk (P= 0.048, OR = 1.4 and 95% CI = 1.02 to2.0) compared to nurses and those who were married. Approximately, 20% of the participants had IES scores ≥ 30, indicating the presence of PTSD.
Maunder 2004(20) SARS Canada	Hospital HCWs	N=1557	Psychological Stress (IES)	Higher IES scores were observed in nurses and HCWs having contact with patients with SARS. The relationship of these groups to the IES score was mediated by three factors: health fear, social isolation, and job stress.
Nickell 2004(21) SARS Canada	Tertiary hospital HCWs	N=2001	Emotional distress (GHQ-12)	29% of the respondents scored above the threshold point on the GHQ-12, indicating probable emotional distress; the rate among nurses was 45%.
Poon 2004(22) SARS China	Hospital	N=1926	Anxiety (State-Trait Anxiety Inventory), burnout (unclear)	Anxiety scores ranged from 20 to 80 and mean (SD) scores were higher among staff who had had contact with patients with severe SARS than among those who had not (52.6 [10.5] versus 49.8 [10.1], respectively; (P<0.01). Mean anxiety levels were higher among workmen, healthcare assistants, and nurses than among administrative staff controls or doctors (P<0.01).

	HCWs and administrative personnel			
Sim 2004(23) SARS Singapore	Primary healthcare center Physicians and nurses	N=277	PTSD (IES-R), psychiatric morbidity (GHQ-28)	The prevalence of psychiatric morbidity was 20.6%, and of PTSD was 9.4%. Psychiatric morbidity was associated with a high level of PTSD [OR= 3.38 (1.17 to 9.73); P=0.02] and the use of denial as a way of coping [OR= 1.69 (1.06 to 2.69); P=0.03] Posttraumatic morbidity was associated with younger age [OR= 0.94 (0.89 to 0.98); P=0.007]; being married [OR=11.63 (1.41 to 100); P = 0.02), psychiatric morbidity [OR= 4.31 (1.28 to 14.6); P = 0.02], self-distraction [OR= 1.75 (1.09 to 2.80); P = 0.02], behavioral disengagement [OR= 2.85 (1.25 to 6.47) P = 0.01], religion [OR= 1.70 (1.20 to 2.39); P=0 .003], less venting [OR= 0.51 (0.26 to 0.97); P= 0.04], less humor [OR= 0.45 (0.21 to 0.97);p = 0.04), and less acceptance [OR= 0.53 (0.32 to 0.89); P= 0.02]
Cohort (prospective) studies				
Lee 2018(24) MERS-CoV South Korea	Hospital HCWs	N=359	PTSD (IES-R)	The mean IES-R score was 26.3 ± 19.09. Of all respondents, 230 (64.1%) received a score of 18 or higher, indicating the presence of PTSD-like symptoms, while 183 respondents (51.5%) exceeded the cut-off score of 25 for a diagnosis of PTSD.

Ji 2017(25) Ebola Sierra Leone / China	Hospital N=161 Sierra Leone (SL) medical staff (n= 59), SL logistic staff (n= 21), SL medical students (n= 22), and Chinese medical staff (n = 41), the other group consisted of 18 EVD survivors.	N=161	Psychological symptoms (SCL-90-R)	The mean of General Severity Index in EVD survivors, SL medical staff, SL logistic staff, SL medical students, and Chinese medical staff were 2.31 ± 0.57, 1.92 ± 0.62, 1.88 ± 0.68, 1.68 ± 0.73, and 1.25 ± 0.23; Positive Symptom Total (PST) were 62.00 ± 18.93, 43.83 ± 22.87, 38.43 ± 24.25, 34.95 ± 28.10, and 16.76 ± 10.79; Positive Symptom Distress Index (PSDI) were 3.43 ± 0.47, 5.07 ± 2.64, 6.85 ± 5.47, 7.79 ± 7.00, and 11.85 ± 6.79, respectively. The order of total general severity index (GSI) scores from high to low was EVD survivors, SL medical staff, SL logistic staff, SL medical students, and Chinese medical staff. There were 5 dimensions (obsession-compulsion, anxiety, hostility, phobic anxiety, and paranoid ideation) extremely high in EVD survivors. GSI was inversely associated with university education.
Su 2007(26) SARS Taiwan	Hospital (structured SARS caring unit) Nurses	N=102	Depression (BDI), anxiety (Spielberger trait anxiety inventory), PTSD (Chinese version of the Davidson trauma scale), sleep disturbance (PSQI)	Depression (38.5% vs. 3.1%) and insomnia (37% vs. 9.7%) were greater in the SARS unit nurses than the non-SARS unit nurses. No difference was found in the prevalence of PTSD symptoms (33% vs. 18.7%), yet, three unit subjects (SARS ICU, SARS regular and Neurology) had significantly higher rate than those in CCU (29.7% vs. 11.8%, respectively) ($P< 0.05$). For the SARS unit nurses, significant reduction in mood ratings, insomnia rate and perceived negative feelings as well as increasing knowledge and understanding of SARS at the end of the study (all $P< 0.001$) indicated that a gradual psychological adaptation had occurred.

Case-control study				
Chen 2005(27) Taiwan SARS	Wards or emergency units Nurses	N=128	Depression (SCR), anxiety (SCR), PTSD (IES), intrusion and avoidance (IES), somatization, interpersonal sensitivity, hostility, psychoticism (SCR)	11% of the nurses had stress reaction syndrome. The symptoms of psychological stress reactions included anxiety, depression, hostility, and somatization. The highest rate of stress reaction syndrome was observed in the group that originally worked in a high-risk unit, and the conscripted group experienced the most severe distress on average.

BDI= Beck Depression Inventory; CI= confidence Interval; COVID-19= Coronavirus disease; EVD= Ebola Virus Disease; GAD-7= Generalized Anxiety Disorder 7-item; GHQ= General Health Questionnaire; GSES= General Self-Efficacy Scale; H1N1= H1N1 influenza virus; HCWs= healthcare workers ; ICU= intensive care unit; IES= Impact of Event Scale; MBIQ= Maslach Burnout Inventory questionnaire; MERS-CoV= Middle East respiratory syndrome coronavirus; N= sample size; OLBI= Oldenburg Burnout Inventory; OR= odds ratio; PHQ-9= Patient Health Questionnaire-9; PSQI= Pittsburgh Sleep Quality Index ; PTSD= Post-Traumatic Stress Disorder; SARS= Severe acute respiratory syndrome; SAS= Self-Rating Anxiety Scale; SASR= Stanford Acute Stress Reaction; SCL-90-R= Symptom Checklist 90 Revised; SCR= Symptom Checklist–Revised; SD= standard deviation; SE= standard error; SSRS= Social Support Rate Scale.

B. **Summary of Findings table of studies examining the impact on mental health problems in healthcare workers after viral epidemics (N= 27)**

Author/ year/health emergency/ country/	**Setting** **Type of healthcare professionals**	**Sample size (N)**	**Mental health problem (**tool**)**	**Main results**
Cross-sectional studies				
Park 2018(28) MERS-Cov South Korea	Hospital Nurses	N=187	Mental Health (SF-36); Stress (PSS-10); Hardiness (DSR-15); Stigma (new scale for study)	Mental Health: a significant direct effect of stigma on mental health when controlling for hardiness and stress (β = –0.306, t = –7.2376, P <0.001) Hardiness exerted a significant direct effect on mental health when the other variables were kept constant (β=0.487, t=4.8692, P<0.001) The indirect effect of stigma on mental health was 19.9% of its direct effect on mental health, while the indirect effect of hardiness was 51.6% of its direct effect
Oh 2017(29) MERS-Cov South Korea	Hospital Nurses	N=313	Stress (12 questions based on a trauma appraisal questionnaire and questionnaire developed by the Korean Neuro-Psychiatric Association for medical	The overall mean stress score of total study participants was 32.91. Nurses who provided either inpatient nursing care or screening services of suspected or confirmed case (first hand): overall stress= 33.72

			workers who experienced the MERS outbreak)	Nurses who participated in medical care of the general population with no suspected MERS symptom (second hand): overall stress= 32.25 (There was no statistically significant difference between the groups) The regression estimate between stress and nursing intention was B (SE)= -0.08 (0.02) β= -0.21 P<0.01.
Tang 2017(30) H7N9 influenza China	Departments admitting H7N9 patients HCWs	N=102	PTSD (PCL-C)	20.59% showed PTSD symptoms. The sample had a mean PCL-C score of 30±9.95. The differences in the scores of doctors and nurses with different genders, ages, professional titles, contact frequencies, trainings, and experiences were statistically significant (P<0.05, P<0.01). Moreover, t-tests and one-way analysis of variance showed that nurses received higher scores than doctors, female participants received higher scores than male participants, and the participants with low professional title and high contact frequency, aged between 20 years and30 years, with less than five years of work experience, having not received related training and with no related experience obtained higher PCL-C scores than the others (P<0.05, P<0.01).
Lehmann 2016(31) Ebola Germany	Hospital and research institute HCWs, and general staff	N=86	Depression (PHQ-9), anxiety (GAD-7), general mental health (SF12)	Ebola patient treatment group experienced significantly higher levels of social isolation than both other groups. The best predictors of poor physical and mental HrQoL were perceived lack of knowledge about the Ebola virus disease (physical: β=−1.2, P=0.05; mental: β=−1.3, P=0.03) and fatigue (physical: β=−0.3, P = 0.02; mental: β=−0.53, P< 0.001).

Liu 2012(32) SARS China	Hospital HCWs	N=549	Depression (CES-D - Chinese version), PTSD (IES-R - Adapted and validated in Chinese)	The results of multinomial regression analyses showed that, with other relevant factors controlled for, being single, having been quarantined during the outbreak, having been exposed to other traumatic events before SARS, and perceived SARS-related risk level during the outbreak were found to increase the odds of having a high level of depressive symptoms 3 years later. Altruistic acceptance of risk during the outbreak was found to decrease the odds of high post-outbreak depressive symptom levels
Matsuishi 2012(33) H1N1 Japan	Hospital HCWs	N=1625	Anxiety (19 stress-related questions), PTSD (IES)	Workers at a hospital with intense liaison psychiatric services felt less psychological impact. Workers at a hospital that provided staff with information about the pandemic less frequently, felt unprotected. Workers in work environments that had a high risk of infection felt more anxious and more exhausted. The total IES score was higher in workers in high-risk work environments.
Lancee 2008(34) SARS Canada	Academic and community hospitals HCWs	N=139	Depression, anxiety (Kessler Psychological Distress Scale), PTSD (IES), burnout (MBIy)	The lifetime prevalence of any depressive, anxiety, or substance use diagnosis was 30%. Only one HCW who identified the SARS experience as a traumatic event was diagnosed as having PTSD. New episodes of psychiatric disorders occurred among seven healthcare workers (5%). New episodes of psychiatric disorders were directly associated with a history of having a psychiatric disorder before the SARS outbreak (P=0.02) and inversely associated with years of healthcare experience (P=0.03) and the perceived adequacy of training and support (P=0.03).

Wu 2008(35) SARS China	Hospital HCWs	N=549	PTSD (IES-R)	Current alcohol abuse/dependence symptom counts 3 years after the outbreak were positively associated with having been quarantined, or worked in high-risk locations such as SARS wards, during the outbreak. However, having had family members or friends contract, SARS was not related to alcohol abuse/dependence symptom count. Symptoms of PTS and of depression, and having used drinking as a coping method, were also significantly associated with increased alcohol abuse/dependence symptoms. The relationship between outbreak exposure and alcohol abuse/dependence symptom count remained significant even when sociodemographic and other factors were controlled for. When the intrusion, avoidance and hyperarousal PTS symptom clusters were entered into the model, hyperarousal was found to be significantly associated with alcohol abuse/dependence symptoms
Chen 2007 (36) SARS Taiwan	Tertiary care referral center 66 (73.3%) critical care nurses, 11 (12.2%) physicians, 7 (7.8%) technicians, and 6 (6.7%) respiratory	N=172	Role emotional, and mental health: MOS SF-36	All serum specimens tested negative for SARS antibody. Survey scores for SARS HCWs immediately after care were significantly lower than those for the control group (P <0 .05 by the t test) in 6 categories. Vitality, social functioning, and mental health immediately after care and vitality and mental health after self-quarantine and off-duty shifts were among the worst subscales. The social functioning, role emotional, and role physical subscales significantly improved after self-quarantine and off-duty shifts (P <0.05, by paired t test). The length of contact time (mean number of contact-hours per day) with patients with SARS was associated with some subscales (role emotional, role physical, and mental health) to a mild extent. The total number of contact-hours with symptomatic patients with SARS was a borderline predictor (adjusted R^2=0.069; P= 0.038) of mental health score.

	care specialists.			
Lin 2007(37) SARS Taiwan	Hospital Physicians and nurses	N=92	PTSD (DTS-C)	86 of 92 (93.5%) medical staff considered the SARS outbreak to be a traumatic experience. The DTS-C scores of staff in the emergency department and in the psychiatric ward were significantly different (P= 0.04). Emergency department staff had more severe PTSD symptoms than staff in the psychiatric ward
Marjanovic 2007(38) SARS Canada	Healthcare facilities Nurses	N=333	Emotional exhaustion (MBI-GS); state anger (adapted version of STAXI-2); Avoidance behavior (6 items)	Emotional exhaustion: Less contact with SARS patients (β=-0.15; P=0.003), higher levels of vigor (β=0.34; P<0.001), greater trust in equipment/infection control initiatives (β=-0.15; P=0.005), predicted significantly lower levels of emotional exhaustion. Avoidance behavior: Less time spent in quarantine (β = 0.23; P<0.001), higher levels of vigor (β=0.27; P< 001) and higher organizational support (β=0.26; P< 001) predicted significantly less avoidance behavior. State anger: Less time in quarantine (β=0.14; P=0.008), higher levels of organizational support (β=0.24; P=<0.001) vigor (β=-0.20; P=<0.001) and trust in equipment/infection control initiatives (β=-0.14; P=0.011) predicted lower levels of state anger

Wong 2007(39) SARS China and Canada	Community based primary care clinics Family medicine tutors	N=188	Anxiety (a visual analogue scale ranging from extremely frightened (high score) to not frightened at all (zero score).	51% in Canada and 50.7% in Hong Kong, were classified in the high-anxiety group.
Fiksenbaum 2006(40) SARS Canada	Multiple settings (community health, surgical and pediatrics) Nurses	N=333	Emotional exhaustion (MBI-GS); State anger (STAXI)	Working conditions contributed significantly to an increase in perceived SARS threat, which led to increased emotional exhaustion (β=0.44) and state anger (β=0.41). Lower perceived organizational support was related to increased feelings of emotional exhaustion (β=0.11) and state anger (β=0.26).

Lu 2006(41) SARS Taiwan	Hospital HCWs: physicians, nurses and others	N=127	Extraversion, neuroticism (EPQ). Psychiatric Morbidity (CHQ). Paternal/maternal care and protection (PBI)	Twenty-two (17.3%) developed significant mental symptoms, and 105 (82.7%) showed no obvious symptoms. The structural equation model showed that maternal care (β=-0.18, P = 0.011) and neuroticism (β=0.54, $P<10^{-6}$) directly influenced the ability of HCWs to deal with the impact of SARS. Maternal overprotection (β=-0.30, P< 0.05) had an indirect influence on the ability to cope with the impact of SARS.
Maunder 2006(42) SARS Canada	Hospital HCWs	N=769	PTSD (IES)	From 13 to 26 months after the SARS outbreak, 769 HCWs at 9 Toronto hospitals that treated SARS patients and 4 Hamilton hospitals that did not treat SARS patients completed a survey of several adverse outcomes. Toronto HCWs reported significantly higher levels of burnout (P=0.019), psychological distress (P<0.001), and posttraumatic stress (P<0.001). Toronto workers were more likely to have reduced patient contact and work hours and to report behavioral consequences of stress. Variance in adverse outcomes was explained by a protective effect of the perceived adequacy of training and support and by a provocative effect of maladaptive coping style and other individual factors.
Ho 2005 (43) SARS China	Hospitals HCWs	N=97	PTSD (CIES–R)	Participants with lower self-efficacy tended to have higher fear related to SARS (P<0.05). The mean scores of the three CIES–R subscales ranged from 1.24 to 1.57, with Intrusion scoring highest. Fear related to SARS was also correlated positively with posttraumatic stress symptoms among respondents (P<0.01).

Phua 2005(44) SARS Singapore	Hospital Physicians and nurses	N=99	Psychiatric morbidity (IES and GHQ)	Psychiatric morbidity was 17.7% on the IES and 18.8% on the GHQ 28, with the trend for physicians to report lower psychiatric morbidity.
Tham 2005(45) SARS Singapore	Hospital Physicians and nurses	N=96	Depression, anxiety (GHQ 28), PTSD (IES), somatic symptoms, insomnia, social dysfunction (GHQ 28)	Thirty-eight out of 41 (92.7%) doctors and 58 out of 83 (69.9%) nurses responded. Fewer doctors reported post-event and psychiatric morbidity compared to nurses, with 5 (13.2%) doctors and 12 (20.7%) nurses scoring ≥26 on IES, 6 (15.8%) doctors and 12 (20.7%) nurses scoring ≥5 on GHQ 28. The doctors reported a median of 9.5 (range 0-47) on IES and 0 (range 0-11) on GHQ 28. The nurses reported a median of 15 (range 0-61) on IES and 1 (range 0-25) on GHQ 28.
Wong 2005(46) SARS China	Emergency Department of public hospital HCWs	N=466	Mental distress (unclear), coping strategies (Chinese version of the Brief Cope)	The mean overall distress level was 6.19 out of a 10-point scale.
Chua 2004 (47) SARS China	Hospitals HCWs, mostly nurses (60%)	N=613	StressPSS-10	Stress levels were raised in both groups (PSS=18) but were not relatively increased in the HCWs. HCWs reported significantly more positive (94%, N=256) and more negative psychological effects (89%, N=241) from SARS than did control subjects. HCWs declared confidence in infection-control measures.

Tam 2004(48) SARS China	Hospital (medical units and intensive care units) HCWs	N=652	Subjective job related stress levels (2 Likert-type questions); Psychological morbidity (GHQ-12)	68% reported a high level of stress. About 57% were found to have experienced psychological distress. The HCWs' psychological morbidity was best understood by the perceptions of personal vulnerability, stress and support in the workplace.
Verma 2004(49) SARS Singapore	Unspecified Physicians and Traditional Chinese Medicine (TCM) Practitioners	N=1050	Depression, anxiety (GHQ 28), PTSD (IES), perception of stigma (Questionnaire adopted from the HSS).	A total of 721 (29%) GPs and 329 (22%) TCM practitioners responded to the survey. Significantly more GPs had worked in SARS affected facilities and had been directly involved in the care of patients with SARS than the TCM practitioners (P<0.001). Those GPs who were directly involved in the care of patients with SARS were significantly more likely to be GHQ cases as compared to those not involved in the care of patients with SARS (P=0.02; OR=2.9; 95% CI, 1.3 to 6.3). The mean score of the GHQ somatic, anxiety and social dysfunction subscales were significantly higher in GPs as compared to TCM Practitioners (P<0.001). The GHQ total score as well as the subscales was significantly correlated with the IES-R and stigma subscales (P<0.05).
Wong 2004(50) SARS China	Community based primary care clinics Medicine Tutors	N=137	Anxiety (unclear)	All agreed SARS had changed their clinical practices. Significant anxiety was found in family doctors. Three quarters of respondents recalled requesting more investigations while a quarter believed they had over-prescribed antibiotics. GPs who were exposed to SARS or who had worked in high infection districts were less likely to quarantine themselves (10.8% versus 33.3%; P<0.01; 6.5% versus 27.5%; P<0.01 respectively). Exposure to SARS, the infection rates in their working district, and anxiety levels had significant impact on the level of protection or prescribing behaviour.

Systematic review				
Brooks 2018 (51) SARS Worldwide	Multiple settings HCWs	NR (22 studies)	Depression, anxiety, PTSD, job-related stress	The psychological impact of SARS on HCWs appeared to be associated with occupational role; training/preparedness; high-risk work environments; quarantine; role-related stressors; perceived risk; social support; social rejection/isolation; and impact of SARS on personal or professional life.
Cohort (prospective) studies				
Lung 2009(52) SARS Taiwan	Hospital HCWs: doctors, nurses and others (medical technicians, respiratory therapists, or emergency attendant)	N=127	Extraversion, neuroticism (EPQ). Psychiatric Morbidity (CHQ). Paternal/maternal care and protection (PBI)	The first stage symptom results had a positive direct effect on the second stage results (somatic symptoms: β=0.31, P<0.05; negative affect: β=0.23, P=0.006). The participants presented more somatic symptoms than negative affect at both stages (accounting for 35% and 19% of the variance, respectively). Daily-life stressful events had impact on both dimensions of mental health, which included somatic symptoms (β=0.18, P=0.034) and negative affect (β=0.30, P<0.05). Nurses had fewer somatic realm that other healthcare workers (β=-0.15, P<0.05). Participants who had negative effect at the initial assessment had fewer somatic symptoms (β=-0.21, P<0.05) the following year. Negative affect had impact on somatic symptoms at both assessment stages (initial stage: β=0.25, P<0.05; follow-up stage: β=0.24, P<0.05)

Wu 2009(53) SARS China	Hospitals HCWs	N=549	PTSD (IES-R)	About 10% of the respondents had experienced high levels of posttraumatic stress (PTS) symptoms since the SARS outbreak. Respondents who had been quarantined, or worked in high-risk locations such as SARS wards, or had friends or close relatives who contracted SARS, were 2 to 3 times more likely to have high PTS symptom levels, than those without these exposures. Respondents' perceptions of SARS-related risks were significantly positively associated with PTS symptom levels and partially mediated the effects of exposure. Altruistic acceptance of work-related risks was negatively related to PTS levels.
McAlonan 2007(54) SARS China	Hospitals HCWs	N=176	Depression, anxiety (DASS-21), PTSD (IES), stress (PSS-10)	In 2003, high-risk health care workers had elevated stress levels (PSS-10 score = 17.0) that were not significantly different from levels in low-risk HCW control subjects (PSS-10 score=15.9). More high-risk HCWs reported fatigue, poor sleep, worry about health, and fear of social contact, despite their confidence in infection-control measures. By 2004, however, stress levels in the high-risk group were not only higher (PSS-10 score=18.6) but also significantly higher than scores among low-risk HCW control subjects (PSS-10 score=14.8, P<0.05). In 2004, the perceived stress levels in the high-risk group were associated with higher depression, anxiety, and posttraumatic stress scores (P<0.001).

CES-D= Center for Epidemiologic Studies Depression Scale; CHQ= Chinese Health Questionnaire; CI= confidence interval; CIES–R= Chinese Impact of Event Scale—Revised; DASS-21: Depression= Anxiety and Stress Scale – 21 Items; DRS-15= Dispositional Resilience Scale-15; DTS-C= Davidson Trauma Scale Chinese Version; EPQ= Eysenck Personality Questionnaire; GAD-7= Generalized Anxiety Disorder 7-item; GHQ= General Health Questionnaire; GP= general

practitioner; H1N1: H1N1 influenza virus; HCWs= health care workers; HrQoL= Health-related quality of life; HSS= HIV Stigma Scale; IES= Impact of Events Scales; IES-R= Impact of Event Scale-Revised; MBI-GS= Maslach Burnout Inventory —General Survey; MERS-CoV: Middle East respiratory syndrome coronavirus; MOS SF-36= Medical Outcome Study Short-Form 36 Survey; OR= odds ratio; PBI= Parental Bonding Instrument; PCL-C= PTSD Checklist-Civilian Version; PHQ-9= Patient Health Questionnaire-9; PSS-10= 10-item Perceived Stress Scale; PTSD= Post-Traumatic Stress Disorder; SARS= severe acute respiratory syndrome; SE= standard error; SF12= 12-item Short Form Health Survey; SF-36= Short Form-36 questionnaire; STAXI-2= State-Trait Anger Expression Inventory.

C. **Summary of Findings table of studies examining the impact on mental health problems in healthcare workers during and after viral epidemics (N= 2)**

Author/ year/health emergency/ country/	**Setting Type of healthcare professionals**	**Sample size (N)**	**Mental health problem (tool)**	**Main results**
Lee 2007(55) SARS China	Hospitals HCWs	Cohort (prospective) N=33	Depression, anxiety (DASS-21), Subjective stress (PSS-10), PTSD (IER-R), psychiatric morbidity (GHQ-12)	SARS survivors had higher stress levels during the outbreak, compared with control subjects (PSS-10 scores=19.8 and 17.9, respectively; P<0.01). SARS survivors had stress levels similar to those of non–HCWs, but HCWs showed significantly higher stress levels in 2004 (PSS-10 score=22.8, compared with PSS-10 score=18.4; P<0.05) and had higher depression (P<0.01), anxiety (P<0.001), posttraumatic symptoms (Intrusion P<0.001, Avoidance P<0.05 and Hyperarousal P<0.05), and GHQ-12 scores (P<0.001).
Chong 2004(56) SARS China	Tertiary hospital HCWs	Cross-sectional N=1,257	Depression (CHQ), anxiety (CHQ), intrusion and avoidance (IES), and somatization (CHQ)	In the initial phase of the outbreak, when the infection was spreading rapidly, feelings of extreme vulnerability, uncertainty and threat to life were perceived, dominated by somatic and cognitive symptoms of anxiety. During the 'repair' phase, when the infection was being brought under control, depression and avoidance were evident. Prevalence of psychiatric morbidity (CHQ) about 75%.

CHQ= Chinese Health Questionnaire; DASS-21= Depression= Anxiety and Stress Scale – 21 Items; GHQ-12= 12-item General Health Questionnaire; HCWs= healthcare workers; IES= Impact of Events Scales; PSS-10= Perceived Stress Scale; PTSD= Post-Traumatic Stress Disorder; SARS= severe acute respiratory syndrome.

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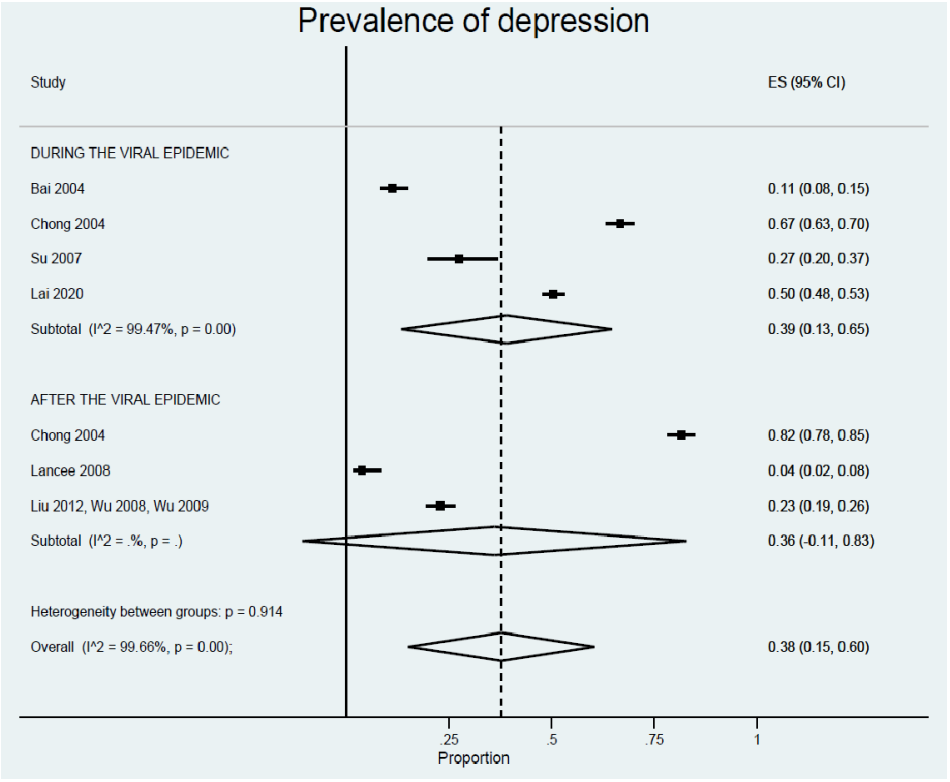
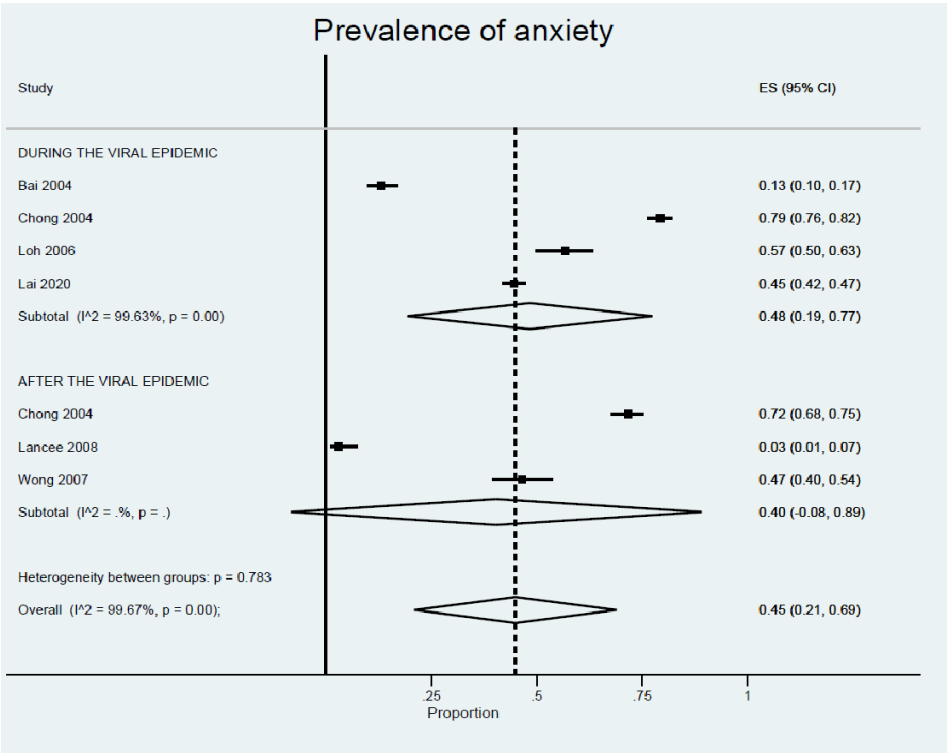
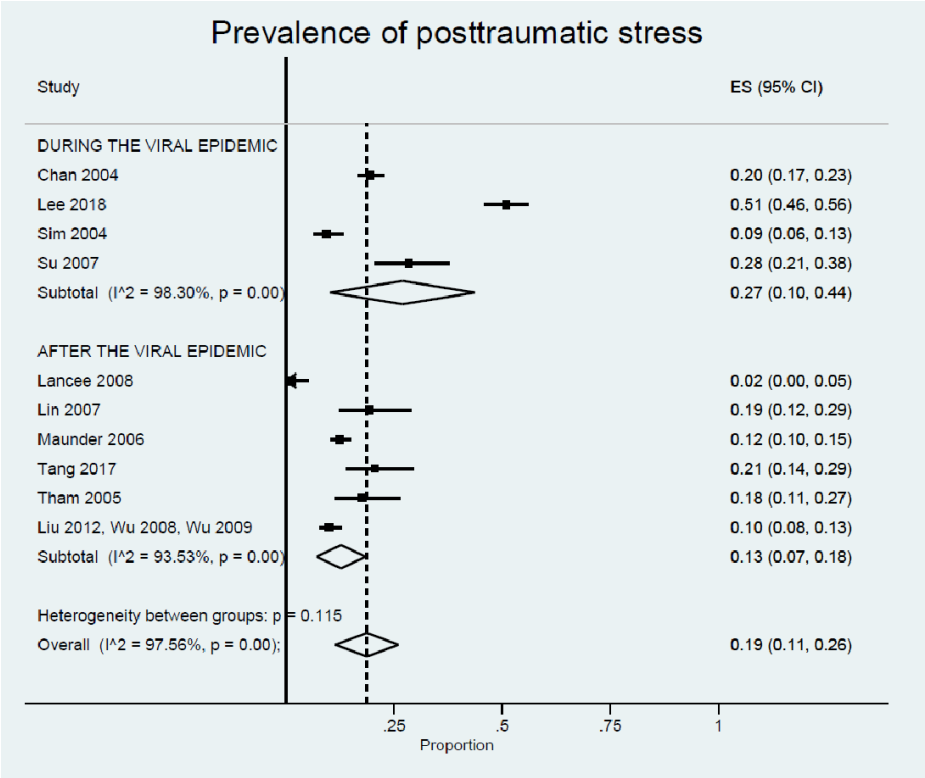
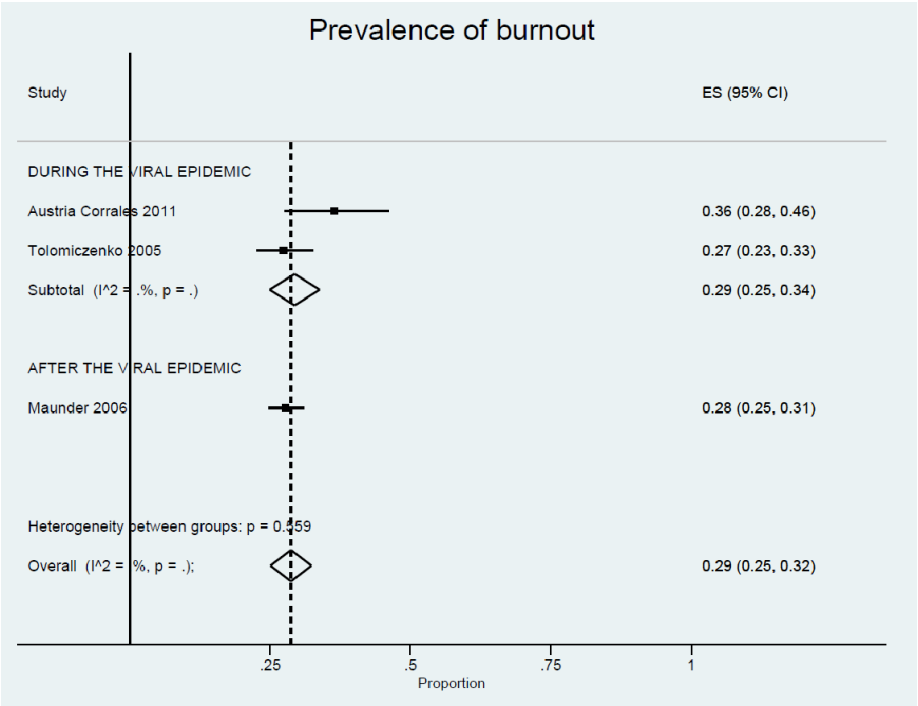
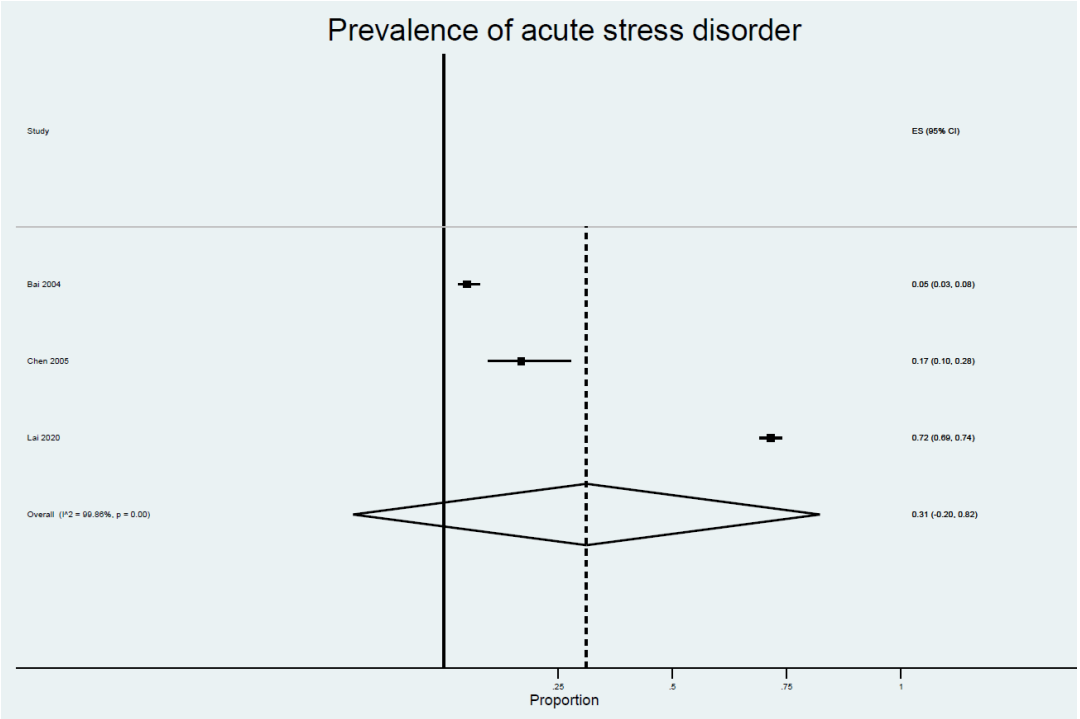
Online Appendix 5. Forest plots











Online Appendix 6. Summary of Findings table of studies of interventions to reduce impact of epidemic outbreaks on mental health of healthcare professionals

Author/ year/health emergency/ country/	Setting/ Healthcare professionals/ Timing	Design N Mental health area	Description of the intervention	Main results
Educational interventions				
Aiello 2011(1)/ SARS/ Canada	Hospital/ HCWs/ after the emergency	cross-sectional/ 1020/ resilience	Face to face group training session, based on Folkman and Greer's model of coping. Content included: stressors associated with pandemic influenza (e.g., rapid spread of illness, rapidly changing state of knowledge, personal and family risk, social isolation); common concerns (e.g., family, burden of job stress); normal responses to extraordinary stress; evidence of the impact of SARS-related stress on HCWs; organizational approaches to building resilience and reducing stress; individual approaches to coping and maintaining resilience; and resources for further support.	A high proportion of participants found the session relevant to work life and personal life, useful, helpful, and informative. While most participants did not feel prepared to deal confidently with the pandemic before the session (N=356; 35%), there was a higher proportion of participants who felt better able to cope after the session (N=776; 76%) (Statistically significant difference: z=17.98, P=0.0020).
Maunder 2010(2)/ H1N1/ Canada	Hospital/ HCWs/ before the emergency	Uncontrolled before-after study / 158/	Computer-assisted resilience training to prepare healthcare workers for pandemic influenza. The participants were randomly assigned to the short (7 sessions, median cumulative duration 111 minutes), medium (12 sessions, 158 minutes) or long (17	The course was associated with significant improvements in confidence in support and training (P<0.0001), pandemic self-efficacy (P<0.0001), and interpersonal problems (P<0.05 for seven out of the nine constructs examined).

		Stress	sessions, 223 minutes) version. The course consisted of modules incorporating different modalities of learning. Knowledge-based modules addressed the topics listed below using audio and video mini-lectures accompanied by onscreen notes and printed fact sheets. Quizzes and games provided brief diversions and reinforced knowledge. Relaxation skills were taught with audio modules guiding participants in progressive muscle relaxation, relaxation breathing, imagery, and combined techniques. Self-assessment modules used psychological questionnaires to characterize interpersonal problem and coping style. Feedback was provided that was both individualized and relevant to the context.	Comparison of doses showed improved interpersonal problems in the medium and long course but not in the short course. There was a trend towards higher drop-out rates with longer duration of training.
Multifaceted interventions				
Chen 2006(3)/ SARS/ Taiwan	Hospital/ Nurses/ before, during, and after the emergency	Uncontrolled before-after study/ 116/ Depression and anxiety	SARS prevention program, based on information provided by WHO and Centers for Disease Control. The program included in-service training, manpower allocation, gathering sufficient protective equipment, and establishment of a mental health team. In order to guard against cross-infection in the hospital, several measures were taken with regard to handling procedure for SARS cases in general isolation room that included space, staff preparation, and environment.	Statistically significant (P<0.05) improvements observed in nursing staff's anxiety and depression along with sleep quality after 2 weeks of the initiation of the SARS prevention program.
Schreiber 2019(4)/ Ebola/	Unclear/	Cross-sectional/ 45/	The Anticipate, Plan and Deter (APD) Responder Risk and Resilience Model was designed to maximize the resilience of HCWs. The intervention includes pre-deployment development of an individualized	Impact of the intervention not described. Authors report case examples of the APD model

USA, Philippines & West Africa	HCWs/ before, during, and after the emergency	PTSD	resilience plan and an in-theatre, real-time self-triage system, which together allow HCWs to assess and manage the full range of psychological risk and resilience for themselves and their families. It includes objective mental health risk factors to prompt activation of a coping plan, in connection with unit leadership real-time situational awareness to address responder risk early before PTSD and impairment become established.	implementation, but empirical data concerning its impact is not provided.
Psychotherapy interventions				
Khee 2004(5)/ SARS/ Singapore	Hospital/ Nurses/ during the emergency	Cross-sectional/ 188/ General mental health	Psychological support group sessions (not based on any specific psychotherapeutic model). The scheduled period of time for each session was around 75 min. The primary goal of therapy was to externalize all emotions, and bring support to each other. All participants were committed to overcome issues encouraging one another to express their emotions.	Impact of the intervention per se not reported. Instead, the authors describe the psychological reactions experienced by the nurses to the emergency. At the beginning of the outbreak the nurses experienced dynamic development of specific behaviours (fear, anger, and blame). After the outbreak the participants developed a significant sense of grief and frustration after specific events such as the death of a colleague.

H1N1= H1N1 influenza virus; HCWs= health care workers; N= sample size; PTSD= Post-Traumatic Stress Disorder; SARS= severe acute respiratory syndrome; WHO= World Health Organization.

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Online Appendix 7. Evidence profiles of the certainty of evidence concerning interventions for preventing the psychological impact of infectious epidemic outbreaks in healthcare workers

Evidence profile 1: Educational interventions compared to usual care for preventing the psychological impact of infectious epidemic outbreaks in healthcare workers

Certainty assessment							Impact	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations		
Confidence in support and training								
1 (1)	observational studies	very serious [a]	not serious	not serious	not serious	none	Confidence in training and support was measured with a questionnaire derived to measure responses of healthcare workers to SARS that was found to predict long-term effects of SARS, modified to apply to influenza. Nine items (e.g. "If I have problems using equipment in an influenza pandemic, I am confident that I will have someone to ask for help") are rated on a 5-point scale from 1 (strongly disagree) to 5 (strongly agree). Summed item scores were normally distributed. Cronbach's alpha was 0.85 Participants showed significant improvements from the start to the end of the course in confidence in training and support: mean [sd] pre vs. post intervention = 32.6 [4.9] vs 33.8 [4.7]; <0.001.	⨁◯◯◯ VERY LOW
Pandemic-related self-efficacy								

Certainty assessment							Impact	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations		
2 (1,2)	observational studies	very serious [a,b]	not serious	not serious	not serious	none	Maunder et al. 2010 measured perceived efficacy to adapt to pandemic conditions using the Pandemic Self-Efficacy Scale (authored for this study). This 24-item scale measures attitudes toward working in a pandemic (e.g. "How confident are you now that in the event of an influenza pandemic you will be able to do your job effectively, even if you are stressed or tired?") rated on a 5-point scale from 1 (Not confident at all. I don't think I can do this) to 5 (Very confident. I am sure of it). Scores were normally distributed. Cronbach's alpha was 0.93. Participants showed significant improvements from the start to the end of the course in pandemic self-efficacy: mean [sd] pre vs. post intervention = 87.7 [12.6] vs 92.9 [12.9]; <0.001. Aiello et al. 2011 measured perceived efficacy based on two questions ("Prior to the session, I felt prepared to deal confidently with the situations that I might face in the event of a pandemic", and "Following today's session, I believe that I will be better able to cope in the event of a pandemic") rated on a 5-point agreement scale. While most participants did not feel prepared to deal confidently with the pandemic before the session (35%), there was a higher proportion of participants who felt better able to cope after the session (76%). This difference was statistically significant (z = 17.98, p = 0.0020.)	⊕◯◯◯ VERY LOW
Coping style								

Certainty assessment							Impact	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations		
1 (2)	observational studies	very serious [a]	not serious	not serious	not serious	none	Coping via problem-solving, seeking support from others and escape-avoidance were measured with subscales of the Ways of Coping Inventory an instrument which yields eight subscales of coping strategies. In this study coping scales were selected that have predictive power with respect to longterm stress-related outcomes of working during the SARS outbreak. Coping scales were calculated as the mean of item scores on a 4 point scale from 0 ("Not used") to 4 ("Used a great deal"). Problem-solving and seeking support were both normally distributed. Cronbach's alpha was 0.76 for problem-solving and 0.77 for seeking support. Escape-avoidance was skewed toward zero. Cronbach's alpha 0.73. Coping with stress using problem-solving, seeking support from others or through escape-avoidance did not change over the course.	⨁◯◯◯ VERY LOW
1 (2)	observational studies	very serious [a]	not serious	not serious	not serious	dose response gradient	Interpersonal problems were measured with the 32-item Inventory of Interpersonal Problems (IIP-32), an abbreviated version of the IIP-64. Participants rate the degree to which they experience interpersonal problems on a 5-point scale from 0 (not at all) to 4 (extremely). Each of the eight subscales of the IIP (Controlling, Self-Centered, Cold/Distant, Socially Inhibited, Nonassertive, Overly Accommodating, Self-Sacrificing, and Intrusive/ Needy) are calculated as the mean of 4 items. Cronbach's alpha was 0.90. Participants showed significant improvements from the start to the end of the course in interpersonal problems overall score: mean [sd] pre vs. post intervention = 31.4 [16.0] vs 27.6 [15.6]; <0.001.	⨁◯◯◯ VERY LOW

CI: Confidence interval. a. Maunder et al. 2010 presents critical risk of bias due to potential bias due to confounding (no adjusted analysis of confounding factors), Proportions of missing participants differ substantially across interventions (attrition was 12% in short courses and 28% in long courses.) The authors state an intention to treat analysis in the methods, but no results were provided. b. Aiello et al 2011 presents serious risk of bias due the use of not validated survey instruments, and unclear reporting of the method used to estimate the pre-post change in self-efficacy.

Evidence profile 2. Multifaceted interventions compared to usual care for reducing the psychological impact during infectious epidemic outbreaks in healthcare workers

Certainty assessment							Impact	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations		
Anxiety								
1 (3)	observational studies	serious [a]	not serious	not serious	not serious	none	Anxiety was measured with Zung's self-rating anxiety scale (SAS). After implementation of the SARS prevention program, the mean scores of anxiety level decreased with time. The mean score from the first questionnaire before caring for SARS patients is 60 points (SD= 9.28), indicating moderate anxiety compared to the mean scores of after the implementation of the anti-SARS program, the mean scores of 51, 50, and 46 indicating mild anxiety, mild anxiety, no anxiety, respectively, at the remaining time points. GEE models showed that anxiety levels 2 weeks after the implementation of the prevention program and while caring for SARS patients were significantly lower than anxiety level before caring for SARS patients (p = 0:075). The anxiety level month after caring for SARS patients was also significantly lower than the anxiety levels before care of SARS patients (p<0:0001). After caring for SARS patients for 3 months and 1 month after the hospital returned to normal operations, nursing personnel exhibited anxiety levels significantly lower than that prior to caring for SARS patients (p<0:0001).	⨁◯◯◯ VERY LOW
Depression								

Certainty assessment							Impact	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations		
1 (3)	observational studies	serious [a]	not serious	not serious	not serious	none	Depression was measured with Zung's self-rating depression scale (SDS). After the implementation of the SARS prevention program, mean scores of depression level decreased with time. At the time of the first questionnaire before care of SARS patients began, the mean score was 61 points (SD =12.62), indicating moderate depression. After program initiation, the mean scores of 51, 50, and 48 points indicated mild depression, mild depression, and no depression, respectively. Using GEE, the levels of depression 2 weeks after initiation of the SARS prevention program and while caring for SARS patients were significantly lower than the level before caring for SARS patients (p<0:0001). At 1 month after caring for SARS patients, the level of depression was also significantly lower than the levels of depression levels before the staff began to care for SARS patients (p<0:0001). After the hospital had returned to normal operations, the level of depression was significantly lower than that prior to taking care of SARS patients (p<0:0001).	⨁◯◯◯ VERY LOW
Sleep quality								
1 (3)	observational studies	serious [a]	not serious	not serious	not serious	none	Sleep quality was measured with the Pittsburgh sleep quality index. The mean score from the first questionnaire was 12 points (SD =3.83), meaning that sleep quality was poor. Of the remaining three questionnaires, the mean scores were 10, 10, and 8 indicating poor sleep quality. GEE showed that the mean score at 2 weeks after the SARS prevention program began when the staff was caring for SARS patients was significantly lower than the mean score before they began caring for SARS patients (p =0.0053). At 1 month after caring for SARS patients and at 1 month after the hospital resumed normal operations, the mean score (p =0:0017) was also significantly lower than the score before the nursing care began (p =0:0008).	⨁◯◯◯ VERY LOW

CI: Confidence interval. a. Chen et al. 2006 presents serious risk of bias due to serious risk of selection bias (nurses volunteered to participate in the study - participation probably related to intervention/outcome), and serious bias in measurement of outcomes (subjective measures, and the team was aware of allocation status.)

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Online Appendix 8. PRISMA checklist

Section/topic	#	Checklist item		Reported on page #
TITLE				
Title	1	Identify the report as a systematic review, meta-analysis, or both.	IMPACT OF VIRAL EPIDEMIC OUTBREAKS ON MENTAL HEALTH OF HEALTHCARE WORKERS: A RAPID SYSTEMATIC REVIEW	Page 1
ABSTRACT				
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	We have provided all the items, except Background, limitations and Systematic review registration number. There is a summary box with the Implications of key findings.	Page 3
INTRODUCTION				
Rationale	3	Describe the rationale for the review in the context of what is already known.	To date, the impact of viral disease outbreaks on specific mental health problems and the effectiveness of interventions to ameliorate such impact have not been systematically reported.	Page 5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	The aim of this rapid systematic literature review is twofold: i) to examine the impact of health emergencies caused by a viral pandemic or epidemic on HCWs mental health; and ii) to assess the effectiveness of interventions to reduce such impact.	Page 5
METHODS				
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide	There is no review protocol, as it is a rapid systematic review, in the current context of the Covid-19 pandemic.	N/A

		registration information including registration number.		
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Study and report characteristics are fully explained in the text.	Page 6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	We designed specific search strategies for biomedical databases (MEDLINE/Ovid, EMBASE/Elsevier, and PsycInfo/EBSCO), combining MeSH terms and free-text keywords	(Online Appendix 1)
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	A fully explanation of electronic search strategy is provided.	(Online Appendix 1)
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	We included empirical studies examining the impact on mental health of epidemic outbreaks on HCWs, and studies about interventions to reduce such impact. We included observational (cross-sectional, case-control, and cohort studies), and experimental studies (non-controlled before-after studies, controlled before-after studies, non-randomised controlled trials, and randomised controlled trials) according to the taxonomy of study designs proposed by Cochrane Effective Practice and Organisation of Care. We included studies on any type of health emergency caused by a viral epidemic or pandemic, and examining its impact on HCWs mental health during or after the crisis. For intervention studies, we included also those that examined the impact of the intervention on mental health problems (or their determinants) prior to the outbreak onset. All types of settings and healthcare professionals were accepted for inclusion. We included studies measuring any type of mental health problem or psychiatric morbidity. We excluded narrative reviews, thesis, editorials, protocols, letters to the editor, and studies not published in English, Spanish or Portuguese.	Page 6

Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	One reviewer screened the retrieved references on title and abstract against the selection criteria. Two reviewers (of those aforementioned) independently and blinded against the others' judgements assessed full-text eligibility. Disagreements were solved by consensus or by involving a third reviewer, if needed.	Page 7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	We included studies on any type of health emergency caused by a viral epidemic or pandemic, and examining its impact on HCWs mental health during or after the crisis, and for intervention studies, we included also those that examined the impact of the intervention on mental health problems (or their determinants) prior to the outbreak onset. All types of settings and healthcare professionals were accepted for inclusion. We included studies measuring any type of mental health problem or psychiatric morbidity.	Page 7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	We assessed the risk of bias of observational studies (i.e., cross-sectional, case-control, and cohort studies) by using the set of tools developed by Evidence Partners (McMaster University); whereas ROBINS I was applied to uncontrolled trials, and AMSTAR for systematic reviews. One reviewer extracted all the data and assessed the risk of bias, while a second reviewer cross-checked the information for accuracy and completeness.	Page 7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	For studies about the impact of outbreaks on mental health, we conducted random-effects meta-analyses to estimate the prevalence and 95% confidence interval (CI) of each type of mental health condition, using the STATA command "metaprop".	Page 7
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	We conducted subgroup analyses to explore potential differences in the prevalence of mental health disorders during vs. after the outbreak. Heterogeneity was quantified by the I2 statistic, where I2>50% was deemed as substantial heterogeneity. Publication bias was examined with funnel plots and presence of asymmetry tested with Begg and Egger tests. We used Stata, version 12.0 to conduct meta-analyses.	Page 7
Section/topic	**#**	**Checklist item**		**Reported on page #**
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g.,	We used the GRADE approach to assess the quality of evidence related to the outcomes included in this rapid review. We used GRADEpro 2011 software to create 'Summary of	Page 8

		publication bias, selective reporting within studies).	findings' tables. In Online Appendix 7, we integrated analysis of the quality of evidence and the magnitude of effect of the interventions. For assessments of the overall quality of evidence for each outcome that included pooled data, we downgraded the evidence from 'high quality' by one level for serious (or by two levels for very serious) study limitations (risk of bias), indirectness of evidence, inconsistency, imprecision of effect estimates, or potential publication bias.	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	We conducted subgroup analyses to explore potential differences in the prevalence of mental health disorders during vs. after the outbreak. Heterogeneity was quantified by the I^2 statistic, where I^2>50% was deemed as substantial heterogeneity.	Page 7
RESULTS				
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	The search resulted in a total of 2,174 records. After 143 duplicates were removed, 2,174 records remained to be screened. We excluded 2,042 records on title and abstract screening. We assessed 132 articles in full-text and excluded 74 full-text articles. Sixty-one published studies met the inclusion criteria for this systematic rapid review. Fully information is provided in a PRISMA flow diagram.	Page 9, and Figure 1. PRISMA flowchart.
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Fully information is provided in the text "*Characteristics of the studies*" subsection and in Table 1.	Page 9, Table 1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	In general, main risks of bias in the 50 cross-sectional studies were the lack of use of reliable and valid instruments to measure mental health outcomes (high risk of bias in 22% of the studies) and selection bias (12%). The main sources of bias across the seven cohort studies were selection bias (43%) and inadequate follow-up of the cohorts (29%). Main sources of bias of the two uncontrolled before-after studies were bias in selection of participants, and bias in outcome measurement. The case-control and the systematic review identified did not present serious risks of bias. Results of the risk of bias assessment are provided in Online Appendix 3.	Page 10 and Online Appendix 3.
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence	We have presented both summarized data of each and the corresponding forest plots (with effect estimates and confidence intervals).	Page 12 and Online Appendix 5.

		intervals, ideally with a forest plot.		
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	We have fully provided this information on the Online Appendix 5.	Page 12 and Online Appendix 5.
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	In Online Appendix 7, we integrated analysis of the quality of evidence and the magnitude of effect of the interventions. For assessments of the overall quality of evidence for each outcome that included pooled data, we downgraded the evidence from 'high quality' by one level for serious (or by two levels for very serious) study limitations (risk of bias), indirectness of evidence, inconsistency, imprecision of effect estimates, or potential publication bias. Begg's and Egger's tests suggested the absence of publication bias for all the meta-analyses conducted.	Online Appendix 7
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A	N/A
DISCUSSION				
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	In this timely systematic rapid review we synthesized evidence from 61 studies examining the impact on mental health of providing frontline healthcare during infectious disease outbreaks. Results showed that HCWs commonly present high levels of anxiety, depression, PTSD, acute disorder and burnout, both during and after the outbreaks. We identified a broad number of risk factors for these conditions, including sociodemographic factors such as younger age and female gender, and social factors such as lack of social support, social rejection or isolation, stigmatization. Occupational factors entailed working in a high risk environment (frontline staff), specific occupational roles (e.g., nurse), and having lower levels of specialized training, preparedness and job experience. In contrast with the high number of studies examining impact on mental health, there is limited evidence regarding the impact of interventions to reduce mental health problems in this particularly vulnerable population, and overall its certainty is very low, mainly due to study design and serious	Page 15

			risk of bias.	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Despite searching on three major databases and that we manually searched references of previously published systematic reviews, we did not examine gray literature; hence, we cannot discard that relevant references may have been missed out. We observed high heterogeneity when pooling data, which could be partially attributed to the high variability across studies in terms of study population (e.g. occupational role), context (e.g. magnitude of the health emergency caused by epidemic) and outcome measures. In light of this, our results should be interpreted with caution.	Page 15
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Given the current COVID-19 pandemic, the need for timely high-quality synthesized evidence has emerged as a priority worldwide. This rapid review found HCWs serving at the frontline exhibit high prevalence of mental health problems, such as anxiety, depression, PTSD, and burnout. Risk factors for these conditions have also been identified. Few studies have documented the effects of intervention for improving HCWs mental health during and after infectious outbreaks, and the quality of this evidence is very low. Further well-conducted studies are warranted.	Page 17
FUNDING				
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	No specific funding for this study. IRC is a recipient of a Miguel Servet Fellowship (project number CP17/00017) funded by the Spanish Government. The funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.	Page 18

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