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Review

The experiences and impacts of health-care providers during the Coronavirus pandemic: protocol for a mixed methods systematic review

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Abstract

***Introduction*:** Frontline health-care providers are redeployed to areas outside their clinical expertise and assigned high-loading workload to address the surge of patients with each coronavirus outbreaks. Their importance in crisis is not in doubt. However, they experienced considerable physical distress and psychological stressors, even leading to psychological illness and infection in this environment. There is an urgent need to accurately, comprehensively and objectively understand their experiences, perceptions and current situation of anxiety, depression, insomnia and coronavirus infection. Therefore, this protocol is to conduct a mixed methods systematic review to summarize the evidence on the experiences of health-care providers and impacts on their psychological and infection during the coronavirus pandemics.

***Methods*:** Published studies on experience, perspective, impact, anxiety, depression, insomnia, and infection of health-care providers with SRAS, MERS, and COVID-19 and written in English and Chinese will be accepted. Databases (MEDLINE, EMBASE, CENTRAL, Web of Science, PubMed, PsycINFO, WanFang, and SinoMed) from inception until 30 July 2020 will be searched. Two reviewers will select, screen, extract data, and assess the risk of bias independently. Risk of bias of results will be using the MMAT. Using a convergent integrated approach on qualitative/quantitative studies, we will synthesize qualitative and quantitative data separately. The incidence and number of cases about anxiety, depression, insomnia and coronavirus infected among medical staff will be extracted. Thenwe will transform quantitative data to synthesise narratively findings. This protocol will be reported per the PRISMA-P guidelines.

***Conclusion*:** This mixed methods systematic review will be expected to provide a comprehensive picture of experiences and impacts of health-care providers during coronavirus outbreaks through subject description and scale quantification.

***Ethics and dissemination*:** Ethical assessment is not required due to the nature of the proposed systematic review. Findings of our research will be disseminated at conferences related to this field and through publication in peer-reviewed journals.

***PROSPERO registration number*:** CRD42020198506.

***Strengths and limitations of this study*:**

1) This is the first mixed methods systematic review that assessing the experience and impact of health-care providers during the coronavirus outbreak.

2) We will comprehensive understand that the health-care providers' real experiences and impacts when their lives and security are threatened. This is also stronger evidence in clinical practice of sustained and comprehensive support policies and measures adopted to improve their physical and mental feelings and health.

3) This study will includ only English and Chinese, and similar topics in other languages were ignored.

4) The study limitation is that there is no guarantee the quality of the included research and that the definition of first-line health care workers is non-standardised.

***Abbreviations*:** SRAS: Sever Acute Respiratory Syndrome; MERS: Middle East Respiratory Syndrome; COVID-19: Coronavirus Disease 2019; MMAT: Mixed-Methods Appraisal Tool; PRISMA-P: Preferred Reporting Items for Systematic reviews and Meta-Analysis protocol

Keywords: Coronavirus; Experience; Impact; Health-care providers; Systematic review

Introduction

Coronaviruses are a kind of single-stranded, positive-sense RNA viruses with envelope nonsegmented, which exists in nature widely[1]. This host-specific viruses infect other mammals, birds and even humans frequently, and lead to diverse clinical syndromes in humans, including respiratory, digestive, liver, and neurological disorders[2]. Previous studies have identified six coronaviruses can cause human diseases. Four viruses are prevalent and typically trigger common cold symptoms in immuno competent individuals, such as 229E, OC43, NL63, and HKU1. The two other viruses, Sever Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV), are characterized by zoonosis and highly pathogenic, increasing the risk of deaths[3].

Coronavirus of highly pathogenic has been spread in humans for hundreds of years through contact, droplets, aerosols, etc. The number of deaths due to infection SARS-CoV 2-4 and MERS-CoV far exceeded 10,000 in the past two decades[4]. Every outbreak of coronavirus has a tremendous impact on human life and health. World Health Organization (WHO) confirmed 8098 cases and 774 (9.6%) deaths during the Sever Acute Respiratory Syndrome(SARS) outbreak in 2002. Similarly, 2494 infections and 34.4% deaths were confirmed during the Middle East Respiratory Syndrome(MERS) epidemic from 2012 to 2018. Because of the high infection rate and wide spread, coronaviruses infecting poses a constant threat to human health.

Coronavirus Disease 2019 (COVID-2019) is an infectious respiratory illness caused by a novel coronavirus. COVID-2019 infection event is the third outbreak of coronavirus cross-species transmission of sudden public health events after SARS and MERS. First

reported in Wuhan city, Hubei province, China, in late December 2019, and ongoing outbreak widespread all across the world. As of July 16, 2020, there have been 13,378,853 confirmed cases of COVID-19 globally, including 580,045 deaths, already circulating in 216 countries, with the USA being the current epicentre with 3,405,494 confirmed cases and 135,807 deaths so far[5]. WHO declared a state of emergency and could confront long-term challenges worldwide[6].

Every outbreak of a new disease, the demand for resources, especially health-care providers and medical supplies, has increased greatly around the world. In order to resolve this situation, most hospitals have to rapidly reconfigure clinical spaces and restructure clinical teams. Therefore, many health-care providers are redeployed to areas outside their clinical expertise and are assigned high-loading workload to address the surge of patients with COVID-19. The importance of health-care providers in this crisis is not in doubt[6]. Their health and safety can affect the effectiveness of patients' treatment and care. To a certain extent, it can also determine the control of any outbreak[7]. However, they also face great challenges[8].

Frontline health-care providers are ambivalent about choosing between responsibility and self-protection in the early stages of the epidemic. They fear infection and worry about their families during outbreaks, but still apply to join the fight whether it is because of the responsibility of the self or the requirements of superior leadership in the face of unknown diseases and unpredictable risks[9]. Health-care providers experienced considerable physical distress when working with patients diagnosed with SRAS, MERS, and COVID-19[10, 11]. They were exhausted owing to the intensive care they provided during long shifts in protective suits without toilet breaks. The combination of heavy protective clothing and the hot environmental conditions made awkward for them to move, difficult to breathe, hard to hear, and covered with sweat they were unable to wipe off[12]. Health-care providers also

experienced significant psychological stressors. Recent evidence suggests that even someone who is non-symptomatic can spread COVID-19 with high efficiency. At the same time, little was known about the new virus, including its lethality or how to best care for these patients[13]. And they always witness the death of infected people. Hence, they experienced fear of getting infected themselves and spreading infection to their family members. Social stressors experienced by doctors and nurses were particularly high. Not only families but also neighbors or community residents did not want to risk possible exposure to themselves by having a member working in the hospitals[14, 15]. They refused to support the caregivers' work and even tried to prevent the medical staff from going home after finishing work. This added social stress to the nurses or doctors. Moreover, some environmental stress, such as cultural differences of medical staff between different regions, lack of supplies, temporary workplaces, raised the health-care workers' sense of helplessness and frustration[9]. But some of the studies found that health-care providers showed great strength and resilience in the face of various challenges. Meanwhile, they had an extraordinary sense of responsibility and a strong spirit of teamwork when treating patients with coronavirus[16]. Several studies have discussed the experience of health care providers in the face of the epidemic. In this case, systematic review of qualitative study can improve the reliability, generality and policy reference of qualitative research results. In this way, the experiences or perceptions of medical staff are more comprehensively described during an outbreak.

Furthermore, it is worth noting that due to coronavirus outbreaks have led to various psychological disorders and illnesses among many health care professionals, such as anxiety, depression, insomnia and even infection. Stress reaction symptoms have been reported in about 10% of healthcare workers in the course and in the aftermath of previous outbreaks of SARS and MERS[17,18]. Similar challenges have arisen in United States, Canada, Taiwan and

Hong Kong[19-23]。In a cross-sectional survey of 1257 health-care workers in China during the COVID-19 pandemic, over 70% reported distress, with 50% reporting depression and 34% insomnia was reported[16]. In addition, health professionals have become the most vulnerable population to contract the coronavirus virus. Earlier studies reported that infected health care providers accounted for 51% of the SARS cases[24]. However the prevalence of infection with COVID-19 among healthcare workers was only 6% in Netherlands[25]. Similarly, on February 7 the proportion of Chinese medical staff was infected growth of 26% for 2020, up from 3% on January 1, 2020 [26,27]. Although many domestic and foreign studies have reported psychological changes and incidence of coronavirus infection among medical staff, the sample size of studies is different and the results exist visible differences. Therefore, there is an urgent need for a systematic review of quantitative research to accurately, comprehensively and objectively understand the current situation of anxiety, depression, insomnia and coronavirus infection for health-care providers in their the industry during outbreaks.

The main aim of the present protocol is to conduct a mixed methods systematic review to summarize the evidence on the experiences of health-care providers and impacts on their psychological and infection during the coronavirus pandemics.

Methods

Protocol registration

This mixed methods systematic review is reported according to Preferred Reporting Items for Systematic reviews and Meta-Analysis protocol (PRISMA-P) guidelines[28]. The protocol has

been registered in the International Prospective Register of Systematic Review (PROSPERO) (CRD 42020198506, https://www.crd.york.ac.uk).

Design

The mixed methods systematic review incorporating quantitative and qualitative data is conducted. The qualitative component is undertaken first to comprehensively explore the experience and impact of health providers during the coronavirus pandemic. Then the quantitative component of the psychological status and infected condition of caregivers is used to generalize or prove the qualitative results that caregivers are significantly affected during outbreaks. And this review using the convergent integrated approach in which data is transformed in such a way that quantitative transformed in qualitative topics to description and the synthesis of quantitative and qualitative studies results simultaneously[29].

(Insert Figer 1 about here.)

Data Sources and Searches

The literature searches have been conducted in electronic bibliographic databases, including MEDLINE, EMBASE, the Cochrane Library (CENTRAL), Web of Science, PubMed, Psychology Information (PsycINFO), 万方/Wan Fang data, and 中国生物医学文献数据库/SinoMed, from inception until 30 July 2020.

An initial search of PubMed has consulted the original research and review, followed by the identification of keywords found in each title and abstract. Enter these keywords into "Medical terms (MeSH)" box for Advanced Search in the Cochrane library, further search more synonymous terms. After that, add terms through 10 registered unpublished protocols of

the systematic review in PROSPERO. Ultimately, the following searching terms in **Table 1** are used to perform the search. The search terms will be used a combination of MeSH terms, free-text words, and Boolean operators. The reference section of the included studies will be hand-searched for additional relevant studies. The detailed search strategy in PubMed is shown in the **PDF** document (see online supplementary additional file 1).

(Insert Table 1 about here.)

Inclusion and exclusion criteria

Only published studies are original articles, and studies that reported the experience, perspective, anxiety, depression, insomnia, and infection rates of health-care providers who took care of patients with SRAS, MERS, and COVID-19 will be accepted in this study. For language restrictions, only studies in English and Chinese will be accepted.

Types of participants

This review will include studies where participants are health-care providers who treat and cure the patients diagnosed with coronavirus infection, working in designated hospital and having a close contact with infected patients. The gender, age and major field of participants will not be limited. But medical students or trainees will be excluded.

Phenomenon of interest/exposure(s)

Our phenomenon of interest will focus on studies that the experience, perspective and impact of health-care providers who took care of patients will be all considered in qualitative review. The term “experience” and "perspective” consisted of all factors impact on the feeling and mood of providers from coronavirus. The “impact” defined as that health-care providers

perceive the impact by themselves, whether physical or psychological or lifestyle habits. This review will consider quantitative studies that anxiety, depression, insomnia and infection rates of health-care providers during the SRAS, MERS, and COVID-19 pandemic.

Context

This review will consider studies that were in the context of a pandemic caused by coronavirus, including SRAS, MERS, and COVID-19. Coronavirus diagnosis was in accordance with the World Health Organization.

Types of studies

We will include studies that use quantitative (including cross-sectional, cohort studies), qualitative (including but not limited to, designs such as phenomenology, grounded theory, ethnography, action research, qualitative description) and mixed-methods methodologies. We will exclude case reports and articles, such as conference abstracts, editorials, letters, reviews and commentaries. Systematic reviews and meta-analyses will not be included, but if a systematic review is relevant to our topic we will refer to its inclusion articles and reference list for additional potentially qualified studies.

Exclusion criteria

Studies that did not report levels of anxiety, depression or morbidity for health-care providers in pandemics, and studies that didn't state the number of patients will be excluded. Studies that analysed mental and behavioural disorders due to the use of an existing primary disease, alcohol and other drugs will not be included. Studies that measure anxiety, depression and insomnia but do not use the universal international scale will be excluded.

Data collection and analysis

Data management

Covidence systematic review management software, EndNote X9, will be used to assist with further data management[30]. All identified references following the search will be uploaded and collated into EndNote and duplicates will be removed from the list.

Selection of studies

In phase one, the title and the abstract of each identified study will be independently screened according to the established inclusion criteria by each of the two review authors (NX and TL) to determine which should be assessed further. Full-texts for the eligible titles and/or abstracts including those uncertain will be obtained for further assessment on whether to include in the study or not at the second stage.

In order for two reviewers to use consistent evaluation criteria for all retrieved results, we will conduct step-by-step calibration exercises for 30 studies before screening[31]. In case 80% agreement is not reached, we will refine the inclusion and exclusion criteria and the calibration will be repeated until the threshold is reached. Disagreement between the two authors will be resolved through discussion and when needed there will be arbitration by a third reviewer(MH). Reasons for excluding full-text studies will be recorded.

Data extraction

A standardised form based on previous studies[32-34] will be used for data extraction. The form will be created by using a specially developed tool in a Microsoft Excel (2016) spreadsheet. In this systematic review the key data to be extracted as follows.

Research information: first author, year of publication, country of the study; Demographic information: populations(doctors, nurses and others), hospital level, qualification for the job, sample size, age; Qualitative studies: study methods, contexts, culture, and interest outcomes(the experiences, perspectives and impacts of health-care providers); Quantitative studies: study design will be extracted. The incidence and number of cases about anxiety, depression, insomnia and coronavirus infected among medical staff will be extracted.

The extracted information from each paper will be checked for congruency and agreement by two reviewers. If additional information or data are required, we will contact the authors of the original studies through email for clarification or addition.

Data synthesis and integration

We will use a convergent integrated approach in accordance with Joanna Briggs Institute (JBI) methodology for conducting a mixed-methods systematic review[34].

In the first part, synthesize qualitative data by means of thematic synthesis using JBI-QARI software systems. Under the premise of understanding the philosophical thought and methodology of various qualitative studies, two reviewers(NX and TL) repeatedly read, understand, analyze and explain the experiences, perspectives and impacts of medical workers, and combine similar results to form new categories. Then, the new categories are summed up as an integrated result to form new concepts or interpretations. Two reviewers will independently analyse the extracted data and provide thematic codes. In order to derive a matrix structure, both reviewers will discuss coding and identify thematic issues and categories.

Part two, synthesis quantitative data and perform meta-analysis. Statistical analysis will be conducted using Revman 5.3. P(Proportion) and SE(Standard Erro) will be used to analyze the incidence of anxiety, depression, insomnia and infection. Results will be reported as proportions with corresponding 95% confidence intervals (CIs). Between-study heterogeneity will be assessed using the χ^2 test on Cochrane's Q statistic, 20 and quantified by calculating the I^2 statistic (with values of 25%, 50%, and 75% is representative of the low, medium, and high heterogeneity, respectively). There will be a methodological heterogeneity between studies included in this study because different scales are used to evaluate anxiety and depression. We will used a random-effects meta-analysis to estimate the anxiety, depression, insomnia and coronavirus infected among medical staff. The presence of publication bias will be assessed using Egger's test and funnel plots. Pvalue < 0.10 on the Egger's test will be considered statistically significant for publication bias.

The next step is data transformation[33]. According to the JBI convergent integrated approach, quantitative data will be converted to "qualitative data" and be transfigured to textual or narrative interpretations to answer the review question. In a final step, extract themes and subtopics in shape of qualified textual description from qualitative results, whether untransformed or transformed, and collate and categorise them according to consistencies of content. These categories will then be subjected to a synthesis to produce a single comprehensive set of synthesized findings that can be used as a basis for evidence-based practice.

Planned sensitivity and subgroup analysis

If the available data allows, we will conduct sensitivity analyses that exclude studies at high risk of bias in order to determine its impact. Moreover, doctors, nurses and other medical

staff are all working together to combat the coronavirus pandemic, but they have different duties and their experience may vary from each other. Hence, we plan to conduct subgroup analyses to examine whether a profession has different experiences and impacts of nurses and physicians (as well as other groups, such as pharmacists and respiratory therapists). Moreover, we also try to do subgroup analysis by gender if we can.

Assessment of risk and quality

Assessment of risk of bias in included studies.

To assess the risk of bias of all articles selected, the methodological quality criteria, Mixed-Methods Appraisal Tool (MMAT), version 2018 will be conducted using[35]. This document comprises two parts: checklist (Part I) and explanation of the criteria (Part II). Each part is divided into 5 smaller sections according to the category of research designs, and each category includes 5 items respectively. All items from the MMAT will be rated as "Yes", "No" or "Can't tell"[36].

Whereby one reviewer (NX) will apply the MMAT criteria and a second reviewer (TL) will verify the assessments independently. Any disputes will be resolved through discussion or a third reviewer (MH). Regardless of the research quality, all studies will undergo extraction and synthesis where possible.

Assessing confidence in the findings

In order to determine the strength of gathered evidence, the 2010 JBI quality level of evidence and grade of recommendation will be used[37]. It helps us to evaluate the quality of evidence in the domains of feasibility, appropriateness, meaning, effectiveness and economy

by dividing the quality assessment into four grades, the recommended strength into a, b, c three grades.

Timeline for review

At the time of submitting this protocol, we have completed the electronic searches and piloted the study selection process. This systematic review is scheduled to finish in October 2020.

Discussion

This protocol was registered and reported according to Preferred Reporting Items for Systematic reviews and MetaAnalysis protocol (PRISMA-P) guidelines. The PRISMA flow diagram in **Figure 2** will be used to record the review process in different phases[38].

(Insert Figure 2 about here.)

Healthcare providers face a variety of unpredictable challenges in caring for infected patients in the context of coronavirus outbreaks. To our knowledge, there are few systematic reviews that will assess the experience and impact of health-care providers during the coronavirus outbreak. Comprehensive understanding of what their real experiences and impacts are will have a significant meaningful when their lives and security are threatened. Meanwhile, this is also stronger evidence in clinical practice of sustained and comprehensive support measures to health care providers. Findings from this review will be shared in conferences, peer-review journals, and social media platforms.

Conclusion

This mixed methods systematic review will be expected to provide a comprehensive picture of the experiences and impacts of front-line healthcare providers during the coronavirus outbreak through subject description and scale quantification.

Ethics and dissemination

Ethical assessment is not required due to the nature of the proposed systematic review. Findings of our research will be disseminated at conferences related to this field and through publication in peer-reviewed journals.

Statements

Acknowledgement

Competing interests

The authors have no conflicts of interest to declare.

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Authors' contributions

NX and AL conceived and designed the initial study. NX and TL drafted the initial protocol. All authors contributed to the development of the selection criteria, the risk of a bias assessment strategy, and data extraction criteria. AL is the guarantor of the review. All authors read, provided feedback, and approved the final protocol before submission to the journal.

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Table 1 Searching Terms

Entries		Theme	Search Terms
#1	participants	health-care providers	(Healthcare Provider) OR (Healthcare Worker) OR (Health Care Provider) OR (health personnel) OR (health professional) OR (Medical staff) OR (Medical worker) OR (Physician) OR (Clinician) OR (Doctor) OR(Nurse) OR (Nursing Staff) OR (Healthcare employee) OR (Paramedic)
#2	Phenomenon of interest	experience and impact	Experience OR perception OR Attitude OR Opinion OR Impact OR Affect OR Emotion OR Mood OR Mental OR (Stress Psychological) OR (Psychological Distress) OR (Affective Symptoms) OR Suffering OR anxiety OR Nervousness OR depression OR insomnia OR (sleep disorder) OR (stress levels) OR infection OR prevalence
#3	Context	Coronavirus	Coronavirus OR COVID-19 OR SARSCOV2 OR 2019-nCov OR (covid19 Ncov) OR (2019 coronavirus) OR (novel coronavirus) OR (new coronavirus) OR (nouveau coronavirus) OR （COVID19） OR （2019-severe acute respiratory syndrome coronavirus 2） OR （SARS-2） OR (Wuhan seafood market pneumonia virus) OR (SARS) OR SARS-CoV OR (SARS VIRUS) OR (severe acute respiratory syndrome) OR (MERS) OR (MERS-VIRUS) OR (Middle East Respiratory Syndrome) OR (Middle East respiratory syndrome related coronavirus) OR (MERS-CoV)
#4	Types of studies	cross-sectional, cohort studies and qualitative studies	(cohort study) OR (Incidence Study) OR (Cohort Analysis) OR (Cohort Analyses) OR (Concurrent Study) OR (Closed Cohort Study) OR (Historical Cohort Study) OR (Prevalence Study) OR (Disease Frequency Survey) OR (Cross-Sectional) OR (Cross Sectional) OR (Empirical Research) OR (qualitative study) OR (qualitative Research) OR (Qualitative description) OR (phenomenological study) OR (Grounded Theory) OR (ethnography) OR (Anthropology) OR (Behavioral Research) OR (action research) OR (mixed method) OR (mixed-method) OR (Investigative research) OR (Investigative study)
Number of articles #1=2217945, #2=10163250, #3=68640, #4=6261727, #1 AND #2 AND #3 AND #4=2038 (31July 2020-PubMed)			

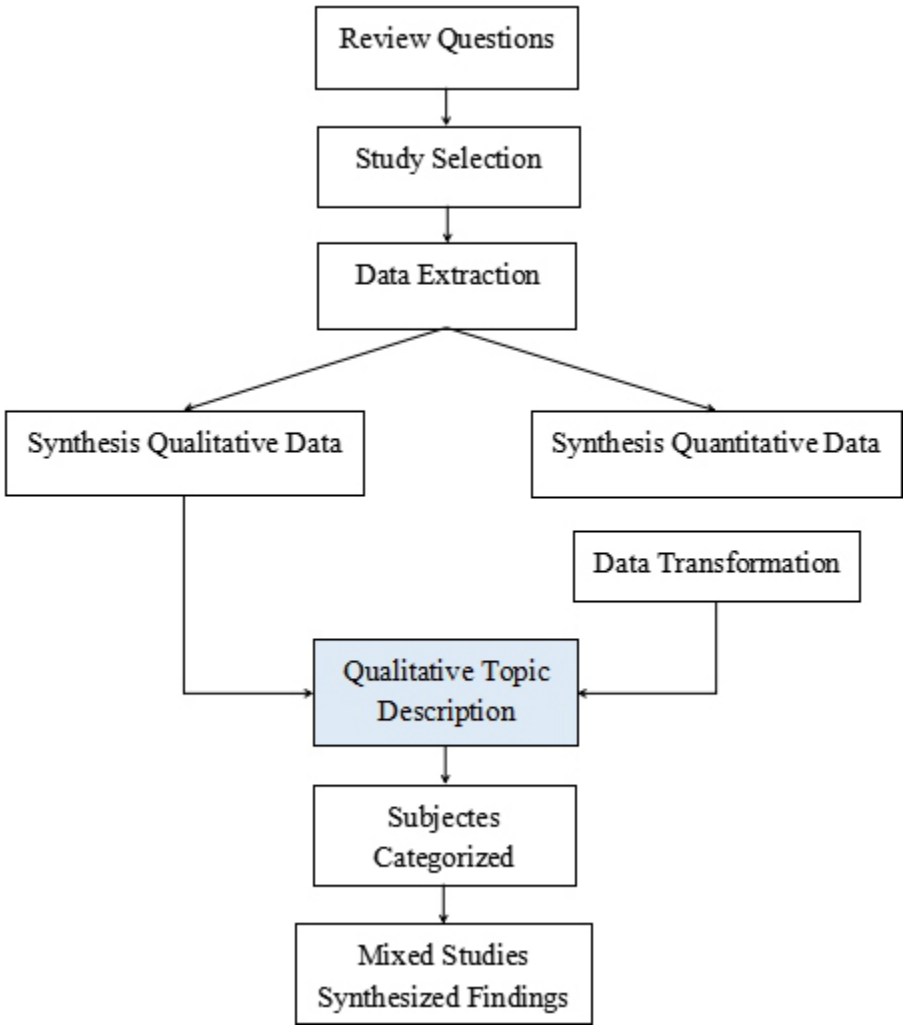

Figure 1. The design process of Systematic review

38x43mm (300 x 300 DPI)

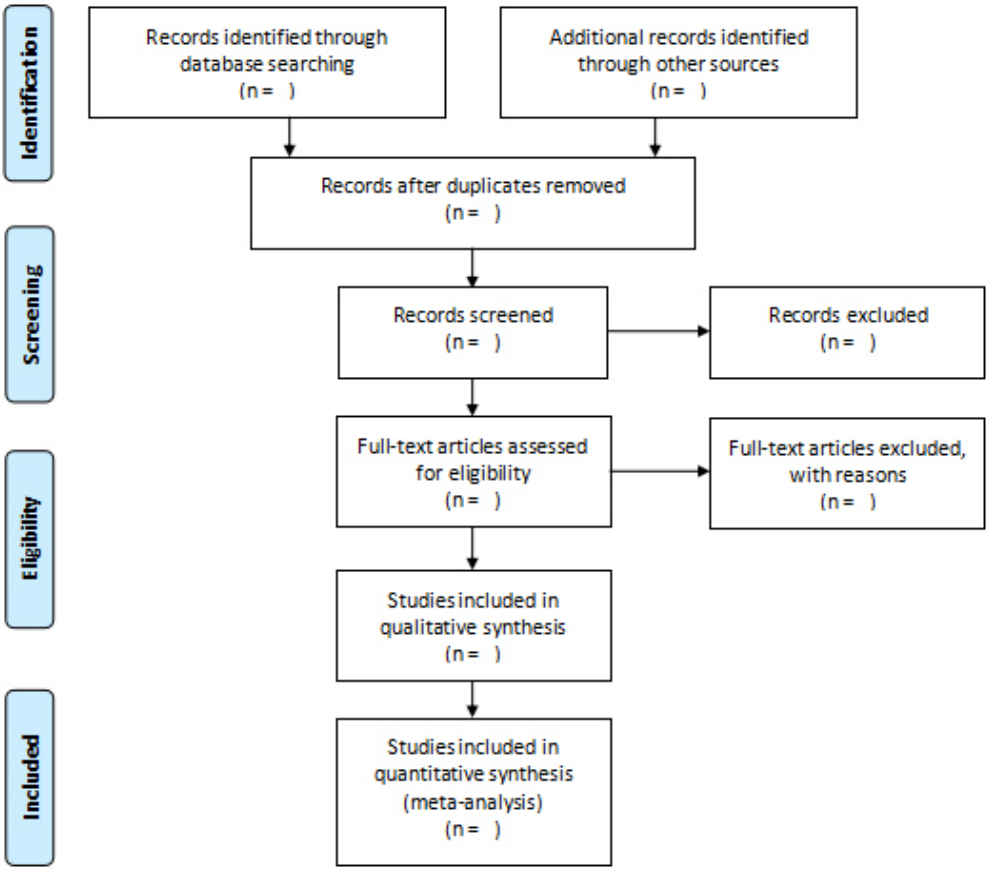

Figure 2. Flow chart diagram will be showed the selection of articles for systemic review.

44x39mm (300 x 300 DPI)

MIXED METHODS APPRAISAL TOOL (MMAT) VERSION 2018

User guide

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Department of Family Medicine | Département de médecine de famille

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Innovation et excellence académique dans les soins, l'enseignement et la recherche

Last update: August 1st, 2018

What is the MMAT?
The MMAT is a critical appraisal tool that is designed for the appraisal stage of systematic mixed studies reviews, i.e., reviews that include qualitative, quantitative and mixed methods studies. It permits to appraise the methodological quality of five categories to studies: qualitative research, randomized controlled trials, non-randomized studies, quantitative descriptive studies, and mixed methods studies.

How was the MMAT developed?
The MMAT was developed in 2006 (Pluye et al., 2009a) and was revised in 2011 (Pace et al., 2012). The present version 2018 was developed on the basis of findings from a literature review of critical appraisal tools, interviews with MMAT users, and an e-Delphi study with international experts (Hong, 2018). The MMAT developers are continuously seeking for improvement and testing of this tool. Users' feedback is always appreciated.

What the MMAT can be used for?
The MMAT can be used to appraise the quality of empirical studies, i.e., primary research based on experiment, observation or simulation (Abbott, 1998; Porta et al., 2014). It cannot be used for non-empirical papers such as review and theoretical papers. Also, the MMAT allows the appraisal of most common types of study methodologies and designs. However, some specific designs such as economic and diagnostic accuracy studies cannot be assessed with the MMAT. Other critical appraisal tools might be relevant for these designs.

What are the requirements?
Because critical appraisal is about judgment making, it is advised to have at least two reviewers independently involved in the appraisal process. Also, using the MMAT requires experience or training in these domains. For instance, MMAT users may be helped by a colleague with specific expertise when needed.

How to use the MMAT?
This document comprises two parts: checklist (Part I) and explanation of the criteria (Part II).

1. Respond to the two screening questions. Responding 'No' or 'Can't tell' to one or both questions might indicate that the paper is not an empirical study, and thus cannot be appraised using the MMAT. MMAT users might decide not to use these questions, especially if the selection criteria of their review are limited to empirical studies.
2. For each included study, choose the appropriate category of studies to appraise. Look at the description of the methods used in the included studies. If needed, use the algorithm at the end of this document.
3. Rate the criteria of the chosen category. For example, if the paper is a qualitative study, only rate the five criteria in the qualitative category. The 'Can't tell' response category means that the paper do not report appropriate information to answer 'Yes' or 'No', or that report unclear information related to the criterion. Rating 'Can't tell' could lead to look for companion papers, or contact authors to ask more information or clarification when needed. In Part II of this document, indicators are added for some criteria. The list is not exhaustive and not all indicators are necessary. You should agree among your team which ones are important to consider for your field and apply them uniformly across all included studies from the same category.

How to score?
It is discouraged to calculate an overall score from the ratings of each criterion. Instead, it is advised to provide a more detailed presentation of the ratings of each criterion to better inform the quality of the included studies. This may lead to perform a sensitivity analysis (i.e., to consider the quality of studies by contrasting their results). Excluding studies with low methodological quality is usually discouraged.

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For dissemination, application, and feedback: Please contact mixed.methods.appraisal.tool@gmail.com
For more information: http://mixedmethodsappraisaltoolpublic.pbworks.com/

Part I: Mixed Methods Appraisal Tool (MMAT), version 2018

Category of study designs	Methodological quality criteria	Responses			
		Yes	No	Can't tell	Comments
Screening questions (for all types)	S1. Are there clear research questions?				
	S2. Do the collected data allow to address the research questions?				
	Further appraisal may not be feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.				
1. Qualitative	1.1. Is the qualitative approach appropriate to answer the research question?				
	1.2. Are the qualitative data collection methods adequate to address the research question?				
	1.3. Are the findings adequately derived from the data?				
	1.4. Is the interpretation of results sufficiently substantiated by data?				
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?				
2. Quantitative randomized controlled trials	2.1. Is randomization appropriately performed?				
	2.2. Are the groups comparable at baseline?				
	2.3. Are there complete outcome data?				
	2.4. Are outcome assessors blinded to the intervention provided?				
	2.5 Did the participants adhere to the assigned intervention?				
3. Quantitative non-randomized	3.1. Are the participants representative of the target population?				
	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?				
	3.3. Are there complete outcome data?				
	3.4. Are the confounders accounted for in the design and analysis?				
	3.5. During the study period, is the intervention administered (or exposure occurred) as intended?				
4. Quantitative descriptive	4.1. Is the sampling strategy relevant to address the research question?				
	4.2. Is the sample representative of the target population?				
	4.3. Are the measurements appropriate?				
	4.4. Is the risk of nonresponse bias low?				
	4.5. Is the statistical analysis appropriate to answer the research question?				
5. Mixed methods	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?				
	5.2. Are the different components of the study effectively integrated to answer the research question?				
	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?				
	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?				
	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?				

Part II: Explanations

1. Qualitative studies	Methodological quality criteria
"Qualitative research is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2013b, p. 3). Common qualitative research approaches include (this list if not exhaustive): **Ethnography** The aim of the study is to describe and interpret the shared cultural behaviour of a group of individuals. **Phenomenology** The study focuses on the subjective experiences and interpretations of a phenomenon encountered by individuals. **Narrative research** The study analyzes life experiences of an individual or a group. **Grounded theory** Generation of theory from data in the process of conducting research (data collection occurs first). **Case study** In-depth exploration and/or explanation of issues intrinsic to a particular case. A case can be anything from a decision-making process, to a person, an organization, or a country. **Qualitative description** There is no specific methodology, but a qualitative data collection and analysis, e.g., in-depth interviews or focus groups, and hybrid thematic analysis (inductive and deductive). Key references: Creswell (2013a); Sandelowski (2010); Schwandt (2015)	1.1. Is the qualitative approach appropriate to answer the research question? Explanations The qualitative approach used in a study (see non-exhaustive list on the left side of this table) should be appropriate for the research question and problem. For example, the use of a grounded theory approach should address the development of a theory and ethnography should study human cultures and societies. This criterion was considered important to add in the MMAT since there is only one category of criteria for qualitative studies (compared to three for quantitative studies). 1.2. Are the qualitative data collection methods adequate to address the research question? Explanations This criterion is related to data collection method, including data sources (e.g., archives, documents), used to address the research question. To judge this criterion, consider whether the method of data collection (e.g., in depth interviews and/or group interviews, and/or observations) and the form of the data (e.g., tape recording, video material, diary, photo, and/or field notes) are adequate. Also, clear justifications are needed when data collection methods are modified during the study. 1.3. Are the findings adequately derived from the data? Explanations This criterion is related to the data analysis used. Several data analysis methods have been developed and their use depends on the research question and qualitative approach. For example, open, axial and selective coding is often associated with grounded theory, and within- and cross-case analysis is often seen in case study. 1.4. Is the interpretation of results sufficiently substantiated by data? Explanations The interpretation of results should be supported by the data collected. For example, the quotes provided to justify the themes should be adequate. 1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation? Explanations There should be clear links between data sources, collection, analysis and interpretation.

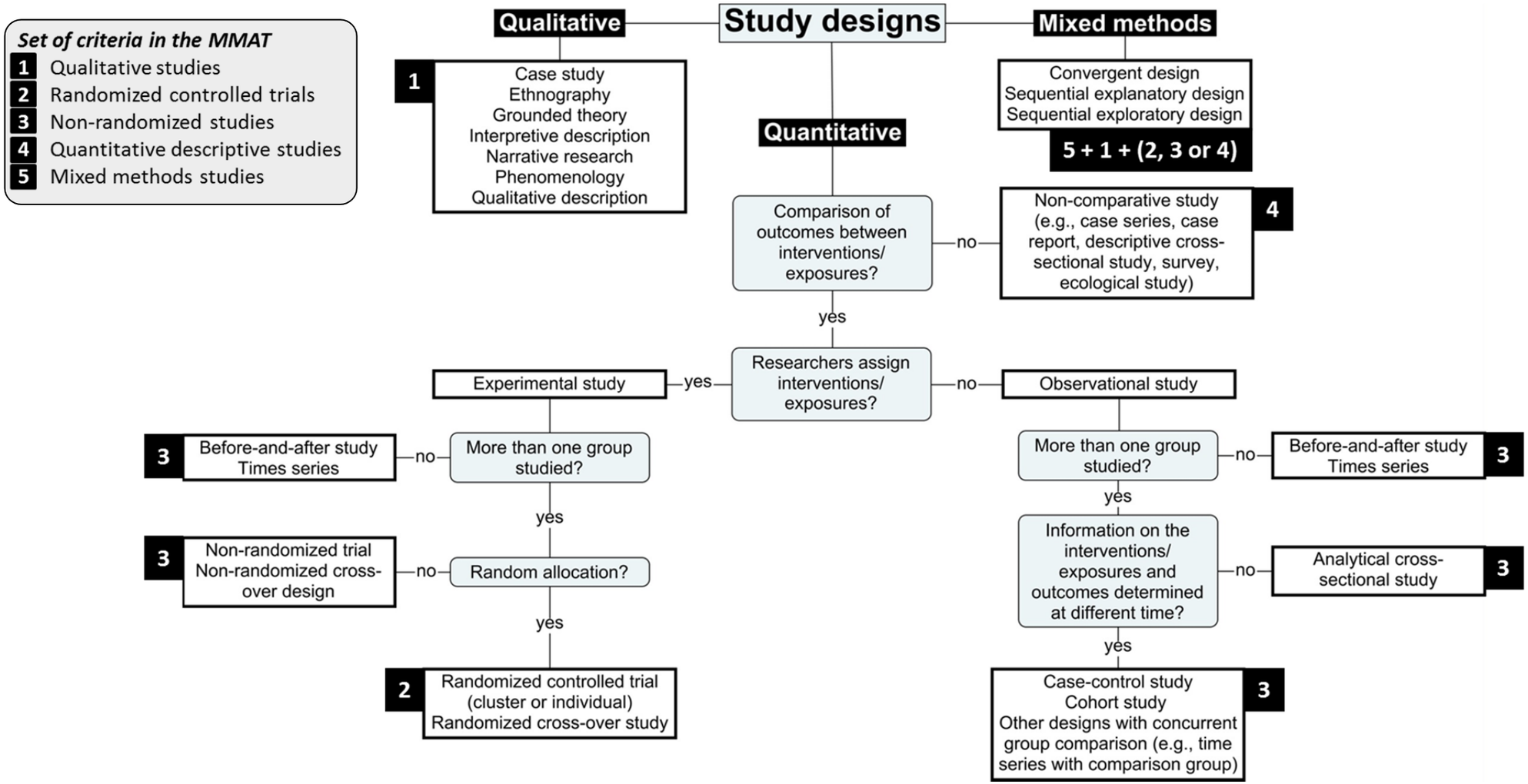
2. Quantitative randomized controlled trials	Methodological quality criteria
Randomized controlled clinical trial: A clinical study in which individual participants are allocated to intervention or control groups by randomization (intervention assigned by researchers). Key references: Higgins and Green (2008); Higgins et al. (2016); Oxford Centre for Evidence-based Medicine (2016); Porta et al. (2014)	2.1. Is randomization appropriately performed? Explanations In a randomized controlled trial, the allocation of a participant (or a data collection unit, e.g., a school) into the intervention or control group is based solely on chance. Researchers should describe how the randomization schedule was generated. A simple statement such as 'we randomly allocated' or 'using a randomized design' is insufficient to judge if randomization was appropriately performed. Also, assignment that is predictable such as using odd and even record numbers or dates is not appropriate. At minimum, a simple allocation (or unrestricted allocation) should be performed by following a predetermined plan/sequence. It is usually achieved by referring to a published list of random numbers, or to a list of random assignments generated by a computer. Also, restricted allocation can be performed such as blocked randomization (to ensure particular allocation ratios to the intervention groups), stratified randomization (randomization performed separately within strata), or minimization (to make small groups closely similar with respect to several characteristics). Another important characteristic to judge if randomization was appropriately performed is allocation concealment that protects assignment sequence until allocation. Researchers and participants should be unaware of the assignment sequence up to the point of allocation. Several strategies can be used to ensure allocation concealment such relying on a central randomization by a third party, or the use of sequentially numbered, opaque, sealed envelopes (Higgins et al., 2016).
	2.2. Are the groups comparable at baseline? Explanations Baseline imbalance between groups suggests that there are problems with the randomization. Indicators from baseline imbalance include: "(1) unusually large differences between intervention group sizes; (2) a substantial excess in statistically significant differences in baseline characteristics than would be expected by chance alone; (3) imbalance in key prognostic factors (or baseline measures of outcome variables) that are unlikely to be due to chance; (4) excessive similarity in baseline characteristics that is not compatible with chance; (5) surprising absence of one or more key characteristics that would be expected to be reported" (Higgins et al., 2016, p. 10).
	2.3. Are there complete outcome data? Explanations Almost all the participants contributed to almost all measures. There is no absolute and standard cut-off value for acceptable complete outcome data. Agree among your team what is considered complete outcome data in your field and apply this uniformly across all the included studies. For instance, in the literature, acceptable complete data value ranged from 80% (Thomas et al., 2004; Zaza et al., 2000) to 95% (Higgins et al., 2016). Similarly, different acceptable withdrawal/dropouts rates have been suggested: 5% (de Vet et al., 1997; MacLehose et al., 2000), 20% (Sindhu et al., 1997; Van Tulder et al., 2003) and 30% for a follow-up of more than one year (Viswanathan and Berkman, 2012).
	2.4. Are outcome assessors blinded to the intervention provided? Explanations Outcome assessors should be unaware of who is receiving which interventions. The assessors can be the participants if using participant reported outcome (e.g., pain), the intervention provider (e.g., clinical exam), or other persons not involved in the intervention (Higgins et al., 2016).
	2.5 Did the participants adhere to the assigned intervention? Explanations To judge this criterion, consider the proportion of participants who continued with their assigned intervention throughout follow-up. "Lack of adherence includes imperfect compliance, cessation of intervention, crossovers to the comparator intervention and switches to another active intervention." (Higgins et al., 2016, p. 25).

3. Quantitative non-randomized studies	Methodological quality criteria
Non-randomized studies are defined as any quantitative studies estimating the effectiveness of an intervention or studying other exposures that do not use randomization to allocate units to comparison groups (Higgins and Green, 2008). Common designs include (this list if not exhaustive): **Non-randomized controlled trials** The intervention is assigned by researchers, but there is no randomization, e.g., a pseudo-randomization. A non-random method of allocation is not reliable in producing alone similar groups. **Cohort study** Subsets of a defined population are assessed as exposed, not exposed, or exposed at different degrees to factors of interest. Participants are followed over time to determine if an outcome occurs (prospective longitudinal). **Case-control study** Cases, e.g., patients, associated with a certain outcome are selected, alongside a corresponding group of controls. Data is collected on whether cases and controls were exposed to the factor under study (retrospective). **Cross-sectional analytic study** At one particular time, the relationship between health-related characteristics (outcome) and other factors (intervention/exposure) is examined. E.g., the frequency of outcomes is compared in different population subgroups according to the presence/absence (or level) of the intervention/exposure. Key references for non-randomized studies: Higgins and Green (2008); Porta et al. (2014); Sterne et al. (2016); Wells et al. (2000)	3.1. Are the participants representative of the target population? Explanations Indicators of representativeness include: clear description of the target population and of the sample (inclusion and exclusion criteria), reasons why certain eligible individuals chose not to participate, and any attempts to achieve a sample of participants that represents the target population.
	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)? Explanations Indicators of appropriate measurements include: the variables are clearly defined and accurately measured; the measurements are justified and appropriate for answering the research question; the measurements reflect what they are supposed to measure; validated and reliability tested measures of the intervention/exposure and outcome of interest are used, or variables are measured using 'gold standard'.
	3.3. Are there complete outcome data? Explanations Almost all the participants contributed to almost all measures. There is no absolute and standard cut-off value for acceptable complete outcome data. Agree among your team what is considered complete outcome data in your field (and based on the targeted journal) and apply this uniformly across all the included studies. For example, in the literature, acceptable complete data value ranged from 80% (Thomas et al., 2004; Zaza et al., 2000) to 95% (Higgins et al., 2016). Similarly, different acceptable withdrawal/dropouts rates have been suggested: 5% (de Vet et al., 1997; MacLehose et al., 2000), 20% (Sindhu et al., 1997; Van Tulder et al., 2003) and 30% for follow-up of more than one year (Viswanathan and Berkman, 2012).
	3.4. Are the confounders accounted for in the design and analysis? Explanations Confounders are factors that predict both the outcome of interest and the intervention received/exposure at baseline. They can distort the interpretation of findings and need to be considered in the design and analysis of a non-randomized study. Confounding bias is low if there is no confounding expected, or appropriate methods to control for confounders are used (such as stratification, regression, matching, standardization, and inverse probability weighting).
	3.5 During the study period, is the intervention administered (or exposure occurred) as intended? Explanations For intervention studies, consider whether the participants were treated in a way that is consistent with the planned intervention. Since the intervention is assigned by researchers, consider whether there was a presence of contamination (e.g., the control group may be indirectly exposed to the intervention) or whether unplanned co-interventions were present in one group (Sterne et al., 2016). For observational studies, consider whether changes occurred in the exposure status among the participants. If yes, check if these changes are likely to influence the outcome of interest, were adjusted for, or whether unplanned co-exposures were present in one group (Morgan et al., 2017).

4. Quantitative descriptive studies	Methodological quality criteria
Quantitative descriptive studies are "concerned with and designed only to describe the existing distribution of variables without much regard to causal relationships or other hypotheses" (Porta et al., 2014, p. 72). They are used to monitoring the population, planning, and generating hypothesis (Grimes and Schulz, 2002). Common designs include the following single-group studies (this list if not exhaustive): **Incidence or prevalence study without comparison group** In a defined population at one particular time, what is happening in a population, e.g., frequencies of factors (importance of problems), is described (portrayed). **Survey** "Research method by which information is gathered by asking people questions on a specific topic and the data collection procedure is standardized and well defined." (Bennett et al., 2011, p. 3). **Case series** A collection of individuals with similar characteristics are used to describe an outcome. **Case report** An individual or a group with a unique/unusual outcome is described in detail. Key references: Critical Appraisal Skills Programme (2017); Draugalis et al. (2008)	4.1. Is the sampling strategy relevant to address the research question? Explanations Sampling strategy refers to the way the sample was selected. There are two main categories of sampling strategies: probability sampling (involve random selection) and non-probability sampling. Depending on the research question, probability sampling might be preferable. Non-probability sampling does not provide equal chance of being selected. To judge this criterion, consider whether the source of sample is relevant to the target population; a clear justification of the sample frame used is provided; or the sampling procedure is adequate. 4.2. Is the sample representative of the target population? Explanations There should be a match between respondents and the target population. Indicators of representativeness include: clear description of the target population and of the sample (such as respective sizes and inclusion and exclusion criteria), reasons why certain eligible individuals chose not to participate, and any attempts to achieve a sample of participants that represents the target population. 4.3. Are the measurements appropriate? Explanations Indicators of appropriate measurements include: the variables are clearly defined and accurately measured, the measurements are justified and appropriate for answering the research question; the measurements reflect what they are supposed to measure; validated and reliability tested measures of the outcome of interest are used, variables are measured using 'gold standard', or questionnaires are pre-tested prior to data collection. 4.4. Is the risk of nonresponse bias low? Explanations Nonresponse bias consists of "an error of nonobservation reflecting an unsuccessful attempt to obtain the desired information from an eligible unit." (Federal Committee on Statistical Methodology, 2001, p. 6). To judge this criterion, consider whether the respondents and non-respondents are different on the variable of interest. This information might not always be reported in a paper. Some indicators of low nonresponse bias can be considered such as a low nonresponse rate, reasons for nonresponse (e.g., noncontacts vs. refusals), and statistical compensation for nonresponse (e.g., imputation). The nonresponse bias is might not be pertinent for case series and case report. This criterion could be adapted. For instance, complete data on the cases might be important to consider in these designs. 4.5. Is the statistical analysis appropriate to answer the research question? Explanations The statistical analyses used should be clearly stated and justified in order to judge if they are appropriate for the design and research question, and if any problems with data analysis limited the interpretation of the results.

5. Mixed methods studies	Methodological quality criteria
Mixed methods (MM) research involves combining qualitative (QUAL) and quantitative (QUAN) methods. In this tool, to be considered MM, studies have to meet the following criteria (Creswell and Plano Clark, 2017): (a) at least one QUAL method and one QUAN method are combined; (b) each method is used rigorously in accordance to the generally accepted criteria in the area (or tradition) of research invoked; and (c) the combination of the methods is carried out at the minimum through a MM design (defined *a priori*, or emerging) and the integration of the QUAL and QUAN phases, results, and data. Common designs include (this list if not exhaustive): **Convergent design** The QUAL and QUAN components are usually (but not necessarily) concomitant. The purpose is to examine the same phenomenon by interpreting QUAL and QUAN results (bringing data analysis together at the interpretation stage), or by integrating QUAL and QUAN datasets (e.g., data on same cases), or by transforming data (e.g., quantization of qualitative data). **Sequential explanatory design** Results of the phase 1 - QUAN component inform the phase 2 - QUAL component. The purpose is to explain QUAN results using QUAL findings. E.g., the QUAN results guide the selection of QUAL data sources and data collection, and the QUAL findings contribute to the interpretation of QUAN results. **Sequential exploratory design** Results of the phase 1 - QUAL component inform the phase 2 - QUAN component. The purpose is to explore, develop and test an instrument (or taxonomy), or a conceptual framework (or theoretical model). E.g., the QUAL findings inform the QUAN data collection, and the QUAN results allow a statistical generalization of the QUAL findings. Key references: Creswell et al. (2011); Creswell and Plano Clark, (2017); O'Cathain (2010)	5.1. Is there an adequate rationale for using a mixed methods design to address the research question? Explanations The reasons for conducting a mixed methods study should be clearly explained. Several reasons can be invoked such as to enhance or build upon qualitative findings with quantitative results and vice versa; to provide a comprehensive and complete understanding of a phenomenon or to develop and test instruments (Bryman, 2006). 5.2. Are the different components of the study effectively integrated to answer the research question? Explanations Integration is a core component of mixed methods research and is defined as the "explicit interrelating of the quantitative and qualitative component in a mixed methods study" (Plano Clark and Ivankova, 2015, p. 40). Look for information on how qualitative and quantitative phases, results, and data were integrated (Pluye et al., 2018). For instance, how data gathered by both research methods was brought together to form a complete picture (e.g., joint displays) and when integration occurred (e.g., during the data collection-analysis or/and during the interpretation of qualitative and quantitative results). 5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted? Explanations This criterion is related to meta-inference, which is defined as the overall interpretations derived from integrating qualitative and quantitative findings (Teddlie and Tashakkori, 2009). Meta-inference occurs during the interpretation of the findings from the integration of the qualitative and quantitative components, and shows the added value of conducting a mixed methods study rather than having two separate studies. 5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed? Explanations When integrating the findings from the qualitative and quantitative components, divergences and inconsistencies (also called conflicts, contradictions, discordances, discrepancies, and dissonances) can be found. It is not sufficient to only report the divergences; they need to be explained. Different strategies to address the divergences have been suggested such as reconciliation, initiation, bracketing and exclusion (Pluye et al., 2009b). Rate this criterion 'Yes' if there is no divergence. 5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved? Explanations The quality of the qualitative and quantitative components should be individually appraised to ensure that no important threats to trustworthiness are present. To appraise 5.5, use criteria for the qualitative component (1.1 to 1.5), and the appropriate criteria for the quantitative component (2.1 to 2.5, or 3.1 to 3.5, or 4.1 to 4.5). The quality of both components should be high for the mixed methods study to be considered of good quality. The premise is that the overall quality of a mixed methods study cannot exceed the quality of its weakest component. For example, if the quantitative component is rated high quality and the qualitative component is rated low quality, the overall rating for this criterion will be of low quality.

Algorithm for selecting the study categories to rate in the MMAT*



*Adapted from National Institute for Health Care Excellence. (2012). *Methods for the development of nice public health guidance*. London: National Institute for Health and Care Excellence; and Scottish Intercollegiate Guidelines Network. (2017). *Algorithm for classifying study design for questions of effectiveness*. Retrieved December 1, 2017, from http://www.sign.ac.uk/assets/study_design.pdf.

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Supplementary additional file 1

The detailed search strategy in PubMed

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#4 Searching results =6261727

#5 (#1 AND #2 AND #3 AND #4) Searching results =2038

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

Section and topic	Item No	Checklist item
ADMINISTRATIVE INFORMATION		
Title:		The experiences and impacts of health-care providers during the Coronavirus pandemic: protocol for a mixed methods systematic review
Identification	1a	Identify the report as a protocol of a mixed methods systematic review
Update	1b	If the protocol is for an update of a previous systematic review, identify as such
Registration	2	The systematic review has registered with the PROSPERO. CRD 42020198506
Authors:		
Contact	3a	Na Xu[1] E-mail: xuna5220@stu.xjtu.edu.cn AiLi Lv[1] E-mail: aili@mail.xjtu.edu.cn TianZi Li[1] E-mail: 2662828124@qq.com XiaoFeng Li[2] E-mail: 2383307590@qq.com Mei Huang[3] E-mail: huangmei_1995@163.com Yan Su[1] E-mail: 3293679480@qq.com 1 Health Science Center, Xi'an Jiaotong University, Xi'an, (Shaan Xi,) China 2 Tongji University Tenth People's Hospital, Shang Hai, China 3 Department of Nursing, Air Force Medical University, Xi'an, (Shaan Xi,) China Corresponding Author Aili Lv Health Science Center

Xi'an Jiaotong University

No.76 Yanta West Road

Xi'an, Shaan Xi, 710061, China

Tel: 13709209696

Contributions	3b	NX and AL conceived and designed the initial study. NX and TL drafted the initial protocol. All authors contributed to the development of the selection criteria, the risk of a bias assessment strategy, and data extraction criteria. AL is the guarantor of the review. All authors read, provided feedback, and approved the final protocol before submission to the journal.
Amendments	4	The protocol does not represent an amendment of a previously completed or published protocol.
Support:		
Sources	5a	This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.
Sponsor	5b	None
Role of sponsor or funder	5c	None

INTRODUCTION

Rationale	6	Frontline health-care providers are redeployed to areas outside their clinical expertise and assigned high-loading workload to address the surge of patients with each coronavirus outbreaks. Their importance in crisis is not in doubt. However, we found that the doctors, especially nurses, who came back from the epidemic in Wuhan, showed obvious changes in characters and mood, resulting in their inability to integrate into their original work or life for a long time. What are their feelings and experiences in the first-line of fighting the epidemic? What is the impact of this experience on them? To our knowledge, there are few systematic reviews that will assess the experience and impact of health-care providers during the coronavirus outbreak. Comprehensive understanding of what their real experiences and impacts are will have a significant meaningful when their lives and security are threatened. Meanwhile, this is also stronger evidence in clinical practice of sustained and comprehensive support measures to health care providers.
Objectives	7	The main aim of the present protocol is to conduct a mixed methods systematic review to summarize the evidence on the experiences of health-care providers and impacts on their psychological and infection during the coronavirus pandemics.

METHODS

Eligibility criteria	8	Only published studies are original articles, and studies that reported the experience, perspective, anxiety, depression, insomnia, and infection rates of health-care providers who took care of patients with SRAS, MERS, and COVID-19 will be accepted in this study. For language restrictions, only studies in English and Chinese will be accepted. Types of participants: This review will include studies where participants are health-care providers who treat and cure the patients diagnosed with coronavirus infection, working in designated hospital and having a close contact with infected patients. The gender, age and major field of participants will not be limited. But medical students or trainees will be excluded. Phenomenon of interest/exposure(s) Our phenomenon of interest will focus on studies that the experience, perspective and impact of health-care providers who took care of patients will be all considered in qualitative review. The term “experience” and "perspective” consisted of all factors impact on the feeling and mood of providers from coronavirus. The “impact” defined as that health-care providers perceive the impact by themselves, whether physical or psychological or lifestyle habits. This review will consider quantitative studies that anxiety, depression, insomnia and infection rates of health-care providers during the SRAS, MERS, and COVID-19 pandemic. Context This review will consider studies that were in the context of a pandemic caused by coronavirus, including SRAS, MERS, and COVID-19. Coronavirus diagnosis was in accordance with the World Health Organization. Types of studies We will include studies that use quantitative (including cross-sectional, cohort studies), qualitative (including but not limited to, designs such as phenomenology, grounded theory, ethnography, action research, qualitative description) and mixed-methods methodologies. We will exclude case reports and articles, such as conference abstracts, editorials, letters, reviews and commentaries. Systematic reviews and meta-analyses will not be included, but if a systematic review is relevant to our topic we will refer to its inclusion articles and reference list for additional potentially qualified studies. Exclusion criteria Studies that did not report levels of anxiety, depression or morbidity for health-care providers in pandemics, and studies that didn’t state the number of patients will be excluded. Studies that analysed mental and behavioural disorders due to the use of an existing primary disease, alcohol and other drugs will not be included. Studies that measure anxiety, depression and insomnia but do not use the universal international scale will be excluded.
Information sources	9	The literature searches have been conducted in electronic bibliographic databases, including MEDLINE, EMBASE, the Cochrane Library (CENTRAL), Web of Science, PubMed, Psychology Information (PsycINFO), 万方/Wan Fang data, and 中国生物医学文献数据库/SinoMed, from inception until 30 July 2020. In addition to the mentioned search strategy, we will manually search reference lists of included studies to identify any additional studies that fit the inclusion criteria.
Search strategy	10	#1 [All Fields] ((Healthcare Provider) OR (Healthcare Worker) OR (Health Care Provider) OR (health personnel) OR (health professional) OR (Medical staff) OR (Medical worker) OR (Physician) OR (Clinician) OR (Doctor) OR (Nurse) OR (Nursing Staff) OR (Healthcare employee) OR (Paramedic)) #2 [All Fields] (Experience OR perception OR Attitude OR Opinion OR Impact OR Affect OR Emotion OR Mood OR Mental OR (Stress Psychological) OR (Psychological Distress) OR (Affective Symptoms) OR Suffering OR anxiety OR

		Nervousness OR depression OR insomnia OR (sleep disorder) OR (stress levels) OR infection OR prevalence) #3 [All Fields](Coronavirus OR COVID-19 OR SARSCOV2 OR 2019-nCov OR (covid19 Ncov) OR (2019 coronavirus) OR (novel coronavirus) OR (new coronavirus) OR (nouveau coronavirus) OR （COVID19）OR （2019-severe acute respiratory syndrome coronavirus 2）OR（SARS-2）OR (Wuhan seafood market pneumonia virus) OR (SARS) OR SARS-CoV OR (SARS VIRUS) OR (severe acute respiratory syndrome) OR (MERS) OR (MERS-VIRUS) OR (Middle East Respiratory Syndrome) OR (Middle East respiratory syndrome related coronavirus) OR (MERS-CoV)) #4 [All Fields]((cohort study) OR (Incidence Study) OR (Cohort Analysis) OR (Cohort Analyses) OR (Concurrent Study) OR (Closed Cohort Study) OR (Historical Cohort Study) OR (Prevalence Study) OR (Disease Frequency Survey) OR (Cross-Sectional) OR (Cross Sectional) OR (Empirical Research) OR (qualitative study) OR (qualitative Research) OR (Qualitative description) OR (phenomenological study) OR (Grounded Theory) OR (ethnography) OR (Anthropology) OR (Behavioral Research) OR (action research) OR (mixed method) OR (mixed-method) OR (Investigative research) OR (Investigative study)) #5 #1 AND #2 AND #3 AND #4
Study records:		
Data management	11a	The search results will be imported into the Endnote X9 software. Duplicate and unrelated studies will be deleted.
Selection process	11b	Two independent evaluators will first screen the study title and abstract to determine its substitutability. Eligibility for each study will be tested against predefined eligibility criteria and quality assessment guidelines. In all cases, the decision to include or exclude a study must be approved by two reviewers. If a decision cannot be made, a third reviewer will make the final decision. A flow chart using PRISMA's reporting guidelines will be used to report the selection process and results.
Data collection process	11c	Two authors will independently extract data. Any disagreement will be resolved by discussion until consensus is reached by consulting a third author.
Data items	12	Research information: first author, year of publication, country of the study; Demographic information: populations(doctors, nurses and others), hospital level, qualification for the job, sample size, age; Qualitative studies: study methods, contexts, culture, and interest outcomes(the experiences, perspectives and impacts of health-care providers); Quantitative studies: study design will be extracted. The incidence and number of cases about anxiety, depression, insomnia and coronavirus infected among medical staff will be extracted.
Outcomes and prioritization	13	experiences, perspectives and impacts of health-care providers
Risk of bias in individual studies	14	To assess the risk of bias of all articles selected, the methodological quality criteria, Mixed-Methods Appraisal Tool (MMAT), version 2018 will be conducted using.
Data synthesis	15	We will use a convergent integrated approach in accordance with Joanna Briggs Institute (JBI) methodology for conducting a mixed-methods systematic review. In the first part, synthesize qualitative data by means of thematic synthesis using JBI-QARI software systems. Part two, synthesis quantitative data and perform meta-analysis. Statistical analysis will be conducted using Revman 5.3. P(Proportion) and SE(Standard Erro) will be used to analyze the incidence of anxiety, depression, insomnia and infection. The next step is data transformation. In a final step, extract themes and subtopics in shape of qualified textual description from qualitative results, whether untransformed or transformed, and collate and categorise them according to consistencies of content.

Meta-bias(es)	16	Results will be reported as proportions with corresponding 95% confidence intervals (CIs). Between-study heterogeneity will be assessed using the T2 test on Cochrane's Q statistic, 20 and quantified by calculating the I2 statistic (with values of 25%, 50%, and 75% is representative of the low, medium, and high heterogeneity, respectively). There will be a methodological heterogeneity between studies included in this study because different scales are used to evaluate anxiety and depression. We will used a random-effects meta-analysis to estimate the anxiety, depression, insomnia and coronavirus infected among medical staff. The presence of publication bias will be assessed using Egger's test and funnel plots. Pvalue < 0.10 on the Egger's test will be considered statistically significant for publication bias.
Confidence in cumulative evidence	17	In order to determine the strength of gathered evidence, the 2010 JBI quality level of evidence and grade of recommendation will be used. It helps us to evaluate the quality of evidence in the domains of feasibility, appropriateness, meaning, effectiveness and economy by dividing the quality assessment into four grades, the recommended strength into a, b, c three grades.

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The experiences and impacts of health-care providers during the Coronavirus pandemic: protocol for a mixed methods systematic review

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Review

The experiences and impacts of health-care providers during the Coronavirus pandemic: protocol for a mixed methods systematic review

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Abstract

***Introduction*:** Frontline health-care providers are redeployed to areas outside their clinical expertise and assigned high-loading workload to address the surge of patients with each coronavirus outbreaks. Their importance in crisis is not in doubt. However, they experienced considerable physical distress and psychological stressors, even leading to psychological illness and infection in this environment. There is an urgent need to accurately, comprehensively and objectively understand their experiences, perceptions and current situation of burnout, PTSD, anxiety, depression, insomnia and coronavirus infection. Therefore, this protocol is to conduct a mixed methods systematic review to summarize the evidence on the experiences of health-care providers and impacts on their psychological and infection during the coronavirus pandemics.

***Methods*:** Published studies on experience, perspective, impact, burnout, PTSD, anxiety, depression, insomnia, and infection of health-care providers with SARS, MERS, and COVID-19 and written in English and Chinese will be accepted. Databases (MEDLINE, EMBASE, CENTRAL, Web of Science, PubMed, PsycINFO, WanFang, and SinoMed) from inception until 30 July 2020 will be searched. Two reviewers will select, screen, extract data, and assess the risk of bias independently. Risk of bias of results will be using the MMAT. Using a convergent integrated approach on qualitative/quantitative studies, we will synthesize qualitative and quantitative data separately. The incidence and number of cases about burnout, PTSD, anxiety, depression, insomnia and coronavirus infected among medical staff will be extracted. Then we will transform quantitative data to synthesise narratively findings. This protocol will be reported per the PRISMA-P guidelines.

***Ethics and dissemination*:** Ethical assessment is not required due to the nature of the proposed systematic review. Findings of our research will be disseminated at conferences related to this field and through publication in peer-reviewed journals.

***PROSPERO registration number*:** CRD42020198506.

***Strengths and limitations of this study*:**

1) This is the first mixed methods systematic review that assessing the experience and impact of health-care providers during the coronavirus outbreak.

2) We will comprehensive understand that the health-care providers' real experiences and impacts when their lives and security are threatened. This is also stronger evidence in clinical practice of

sustained and comprehensive support policies and measures adopted to improve their physical and mental feelings and health.

3) This study will includ only English and Chinese, and similar topics in other languages were ignored.

4) The type of research included in the study is limited by the type of published original research. And the definition of first-line health care workers is non-standardised.

***Abbreviations*:** PTSD: Post-Traumatic Stress Disorder; SARS: Sever Acute Respiratory Syndrome; MERS: Middle East Respiratory Syndrome; COVID-19: Coronavirus Disease 2019; MMAT: Mixed-Methods Appraisal Tool; PRISMA-P: Preferred Reporting Items for Systematic reviews and Meta-Analysis protocol

Introduction

Coronaviruses are a kind of single-stranded, positive-sense RNA viruses with envelope nonsegmented, which exists in nature widely[1]. This host-specific viruses infect other mammals, birds and even humans frequently, and lead to diverse clinical syndromes in humans, including respiratory, digestive, liver, and neurological disorders[2]. Two of the six coronaviruses that have been identified, Sever Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV), are characterized by zoonosis and highly pathogenic, increasing the risk of deaths[3].

Coronavirus of highly pathogenic has been spread in humans for hundreds of years through contact, droplets, aerosols, etc. The number of deaths due to infection SARS-CoV 2-4 and MERS-CoV far exceeded 10,000 in the past two decades[4]. Every outbreak of coronavirus has a tremendous impact on human life and health. World Health Organization (WHO) confirmed 8098 cases and 774 (9.6%) deaths during the Sever Acute Respiratory Syndrome(SARS) outbreak in 2002. Similarly, 2494 infections and 34.4% deaths were confirmed during the Middle East Respiratory Syndrome(MERS) epidemic from 2012 to 2018. Because of the high infection rate and wide spread, coronaviruses infecting poses a constant threat to human health.

Coronavirus Disease 2019 (COVID-2019) infection is the third outbreak of coronavirus cross-species transmission of sudden public health events after SARS and MERS. First reported in late December 2019, and ongoing outbreak widespread all across the world. As of July 16, 2020, there have been 13,378,853 confirmed cases of COVID-19 globally, including 580,045 deaths, already circulating in 216 countries[5]. WHO declared a state of emergency and could confront long-term challenges worldwide[6].

Every outbreak of a new disease, the demand for resources, especially health-care providers and medical supplies, has increased greatly around the world. In order to resolve this situation, most hospitals have to rapidly reconfigure clinical spaces and restructure clinical teams. Therefore, many health-care providers are redeployed to areas outside their clinical expertise and are assigned high-loading workload to address the surge of patients with COVID-19. The importance of health-care providers in this crisis is not in doubt[6]. Their health and safety can affect the effectiveness of patients' treatment and care, and can even determine the control of any outbreak[7]. However, they also face great challenges[8].

Health-care providers experienced considerable physical distress when working with patients diagnosed with SARS, MERS, and COVID-19[9, 10]. They were exhausted owing to the intensive care they provided during long shifts in protective suits without toilet breaks. The combination of heavy protective clothing and the hot environmental conditions made awkward for them to move, difficult to breathe, hard to hear, and covered with sweat they were unable to wipe off[11].

Health-care providers also experienced significant psychological stressors. Recent evidence suggests that even someone who is non-symptomatic can spread COVID-19 with high efficiency. At the same time, little was known about the new virus, including its lethality or how to best care for these patients[12]. And they always witness the death of infected people. Hence, they experienced fear of getting infected themselves and spreading infection to their family members. The families, neighbors and community residents who fear exposing themselves[13, 14] were tried to prevent the medical staff from going home after finishing work, which makes the staff socially stressed. Moreover, some environmental stress, such as

cultural differences of medical staff between different regions, lack of supplies, temporary workplaces, raised the health-care workers' sense of helplessness and frustration[15].

It is worth noting that health care professionals who take care of patients with coronavirus are more prone to psychological disorders and illnesses among, such as burnout, PTSD (Post-Traumatic Stress Disorder), anxiety, depression, insomnia. Stress reaction symptoms have been reported in about 10% of healthcare workers in the course and in the aftermath of previous outbreaks of SARS and MERS[16,17]. Similar challenges have arisen in United States, Canada, Taiwan and Hong Kong[18-22]. In a cross-sectional survey of 1257 health-care workers in China during the COVID-19 pandemic, over 70% reported distress, with 50% reporting depression and 34% insomnia was reported[23]. But the unexpected findings of one study suggest that the frequency of burnout is significantly smaller in frontline workers than that of healthcare providers in their usual ward[24].

In addition, health professionals have become the most vulnerable population to contract the coronavirus virus. Earlier studies reported that infected health care providers accounted for 51% of the SARS cases[25]. However the prevalence of infection with COVID-19 among healthcare workers was only 6% in Netherlands[26]. Similarly, on February 7 the proportion of Chinese medical staff was infected growth of 26% for 2020, up from 3% on January 1, 2020 [27,28].

Although many studies have reported psychological changes and incidence of coronavirus infection among medical staff, the sample size of studies is different and the results exist visible differences. Therefore, there is an urgent need for a systematic review of quantitative research to accurately and objectively understand the current situation of psychology and coronavirus infection for health-care providers in their the industry during outbreaks.

However, some of the studies found that health-care providers showed great strength and resilience in the face of various challenges. Meanwhile, they had an extraordinary sense of responsibility and a strong spirit of teamwork when treating patients with coronavirus[23]. Several studies have discussed the experience of health care providers in the face of the epidemic. In this case, systematic review of qualitative study can improve the reliability, generality and policy reference of qualitative research results. In this way, the experiences or perceptions of medical staff are more comprehensively described during an outbreak.

The main aim of the present protocol is to conduct a mixed methods systematic review to summarize the evidence on the experiences of health-care providers and impacts on their psychological and infection during the coronavirus pandemics.

Methods

Protocol registration

This mixed methods systematic review is reported according to Preferred Reporting Items for Systematic reviews and Meta-Analysis protocol (PRISMA-P) guidelines[29]. The protocol has been registered in the International Prospective Register of Systematic Review (PROSPERO) (CRD 42020198506, https://www.crd.york.ac.uk).

Patient and public involvement

This is a systematic review studies and therefore there not require patients and/or public involvement.

Design

The mixed methods systematic review incorporating quantitative and qualitative data is conducted. The qualitative component is undertaken firstly to comprehensively explore the

experience and impact of health providers during the coronavirus pandemic. Then the quantitative component of the psychological status and infected condition of caregivers is used to generalize or prove the qualitative results that caregivers are significantly affected during outbreaks. And this review using the convergent integrated approach in which data is transformed in such a way that quantitative transformed in qualitative topics to description and the synthesis of quantitative and qualitative studies results simultaneously[30] (see **Figure 1** for design process).

(Insert Figure 1 about here.)

Data Sources and Searches

The literature searches have been conducted in electronic bibliographic databases, including MEDLINE, EMBASE, the Cochrane Library (CENTRAL), Web of Science, PubMed, Psychology Information (PsycINFO), Wan Fang data, and SinoMed, from inception until 30 July 2020.

An initial search of PubMed has consulted the original research and review, followed by the identification of keywords found in each title and abstract. Enter these keywords into "Medical terms (MeSH)" box for Advanced Search in the Cochrane library, further search more synonymous terms. After that, add terms through 10 registered unpublished protocols of the systematic review in PROSPERO. Ultimately, the following searching terms in **Table 1** are used to perform the search. The search terms will be used a combination of MeSH terms, free-text words, and Boolean operators. The reference section of the included studies will be hand-searched for additional relevant studies. The detailed search strategy in PubMed is shown in the **PDF** document (see online supplementary additional file 1).

Table 1 Searching Terms

Entries		Theme	Search Terms
#1	participants	health-care providers	(Healthcare Provider) OR (Healthcare Worker) OR (Health Care Provider) OR (health personnel) OR (health professional) OR (Medical staff) OR (Medical worker) OR (Physician) OR (Clinician) OR (Doctor) OR(Nurse) OR (Nursing Staff) OR (Healthcare employee) OR (Paramedic)
#2	Phenomenon/ outcome of interest	experience and impact	Experience OR perception OR Attitude OR Opinion OR Impact OR Affect OR Emotion OR Mood OR Mental OR (Burn out) OR Burnout OR Burn-out OR (Stress Disorders, Post-Traumatic) OR (Post Traumatic Stress Disorder) OR (Post-Traumatic Stress Disorder) OR (Posttraumatic Stress Disorder) OR PTSD OR (Stress Psychological) OR (Psychological Distress) OR (Affective Symptoms) OR Suffering OR anxiety OR Nervousness OR depression OR insomnia OR (sleep disorder) OR (stress levels) OR infection OR incidence OR morbidity
#3	Context	Coronavirus	Coronavirus OR COVID-19 OR SARSCOV2 OR 2019-nCov OR (covid19 Ncov) OR (2019 coronavirus) OR (novel coronavirus) OR (new coronavirus) OR (nouveau coronavirus) OR (COVID19) OR (2019-severe acute respiratory syndrome coronavirus 2) OR (SARS-2) OR (Wuhan seafood market pneumonia virus) OR (SARS) OR SARS-CoV OR (SARS VIRUS) OR (severe acute respiratory syndrome) OR (MERS) OR (MERS-VIRUS) OR (Middle East Respiratory Syndrome) OR (Middle East respiratory syndrome related coronavirus) OR (MERS-CoV)
#4	Types of studies	cross-sectional, cohort studies and qualitative studies	(cohort study) OR (Incidence Study) OR (Cohort Analysis) OR (Cohort Analyses) OR (Concurrent Study) OR (Closed Cohort Study) OR (Historical Cohort Study) OR (Prevalence Study) OR (Disease Frequency Survey) OR (Cross-Sectional) OR (Cross Sectional) OR (Empirical Research) OR (qualitative study) OR (qualitative Research) OR (Qualitative description) OR (phenomenological study) OR (Grounded Theory) OR (ethnography) OR (Anthropology) OR (Behavioral Research) OR (action research) OR (mixed method) OR (mixed-method) OR (Investigative research) OR (Investigative study)
Number of articles #1=1,811,427 #2=10,519,278 #3=73,347 #4=6,302,298 #1 AND #2 AND #3 AND #4=2380 (31 July 2020-PubMed)			

Inclusion and exclusion criteria

Only published studies are original articles, and studies that reported the experience, perspective, burnout, PTSD, anxiety, depression, insomnia, and infection rates of health-care providers who took care of patients with SARS, MERS, and COVID-19 will be accepted in this study. For language restrictions, only studies in English and Chinese will be accepted.

Types of participants

This review will include studies where participants are health-care providers who treat and cure the patients diagnosed with coronavirus infection, working in designated hospital and having a close contact with infected patients. The gender, age and major field of participants will not be limited. But medical students or trainees will be excluded.

Phenomenon of interest

Our phenomenon of interest will focus on studies that the experience, perspective and impact of health-care providers who took care of patients will be all considered in qualitative review. The term “experience” and "perspective” consisted of all factors impact on the feeling and mood of providers from coronavirus. The “impact” defined as that health-care providers perceive the impact by themselves, whether physical or psychological or lifestyle habits.

Outcome of interest

This review will consider quantitative studies that the impact of physical and mental health of health-care providers during the SARS, MERS, and COVID-19 pandemic. The quantitative outcomes will include the two subsystems. One is included proportions, prevalence and counts of psychological distress and illness (including the incidence of burnout, PTSD, anxiety, depression, insomnia), and the other one is the incidence and number of coronavirus

infection. The results must include one or more the outcomes. The measurement tool must be an international scale, and a self-made scale will not be considered.

Context

This review will consider studies that were in the context of a pandemic caused by coronavirus, including SARS, MERS, and COVID-19. Coronavirus diagnosis was in accordance with the World Health Organization.

Types of studies

We will include studies that use quantitative (including cross-sectional, cohort studies), qualitative (including but not limited to, designs such as phenomenology, grounded theory, ethnography, action research, qualitative description) and mixed-methods methodologies. We will exclude case reports and articles, such as conference abstracts, editorials, letters, reviews and commentaries. Systematic reviews and meta-analyses will not be included, but we will be looking for articles in the systematic review or other types of review in order to identify more articles for this systematic review.

Exclusion criteria

Studies that did not report incidence rate of burnout, PTSD, anxiety, depression or infection rates for health-care providers in pandemics, and studies that didn't state the number of patients will be excluded. Studies that analysed mental and behavioural disorders due to the use of an existing primary disease, alcohol and other drugs will not be included. Studies that measure burnout, PTSD, anxiety, depression and insomnia but do not use the universal international scale will be excluded.

Data collection and analysis

Data management

Covidence systematic review management software, EndNote X9, will be used to assist with further data management[31]. All identified references following the search will be uploaded and collated into EndNote and duplicates will be removed from the list.

Selection of studies

In phase one, the title and the abstract of each identified study will be independently screened according to the established inclusion criteria by each of the two review authors (NX and TL) to determine which should be assessed further. Full-texts for the eligible titles and/or abstracts including those uncertain will be obtained for further assessment on whether to include in the study or not at the second stage.

In order for two reviewers to use consistent evaluation criteria for all retrieved results, we will conduct step-by-step calibration exercises for 30 studies before screening[32]. In case 80% agreement is not reached, we will refine the inclusion and exclusion criteria and the calibration will be repeated until the threshold is reached. Disagreement between the two authors will be resolved through discussion and when needed there will be arbitration by a third reviewer(MH). Reasons for excluding full-text studies will be recorded.

Data extraction

A standardised form based on previous studies[33-35] will be used for data extraction. The form will be created by using a specially developed tool in a Microsoft Excel (2016) spreadsheet. In this systematic review the key data to be extracted as follows.

Research information: first author, year of publication, country of the study; Demographic information: populations(doctors, nurses and others), hospital level, sample size, age;

Qualitative studies: study methods, contexts, culture, and interest outcomes(the experiences, perspectives and impacts of health-care providers); Quantitative studies: study design will be extracted. The incidence, proportions or prevalence and number of cases about burnout, PTSD, anxiety, depression, insomnia and coronavirus infected among medical staff will be extracted.

The extracted information from each paper will be checked for congruency and agreement by two reviewers. If additional information or data are required, we will contact the authors of the original studies through email for clarification or addition.

Data synthesis and integration

We will use a convergent integrated approach in accordance with Joanna Briggs Institute (JBI) methodology for conducting a mixed-methods systematic review[35].

In the first part, synthesize qualitative data by means of thematic synthesis using JBI-QARI software systems. Under the premise of understanding the philosophical thought and methodology of various qualitative studies, two reviewers(NX and TL) repeatedly read, understand, analyze and explain the experiences, perspectives and impacts of medical workers, and combine similar results to form new categories. Then, the new categories are summed up as an integrated result to form new concepts or interpretations. Two reviewers will independently analyse the extracted data and provide thematic codes. In order to derive a matrix structure, both reviewers will discuss coding and identify thematic issues and categories.

Part two, synthesis quantitative data and perform meta-analysis. Statistical analysis will be conducted using Revman 5.3. P(Proportion) and SE(Standard Erro) will be used to analyze the incidence of burnout, PTSD, anxiety, depression, insomnia and infection. Between-study

heterogeneity will be assessed using the χ^2 test on Cochrane's Q statistic, and quantified by calculating the I^2 statistic (with values of 25%, 50%, and 75% is representative of the low, medium, and high heterogeneity, respectively). There will be a methodological heterogeneity between studies included in this study because different scales are used to evaluate. We will use a random-effects meta-analysis to estimate the burnout, PTSD, anxiety, depression, insomnia and coronavirus infected among medical staff. Results will be reported as proportions with corresponding 95% confidence intervals (CIs) (n% [95%CI(a%,b%)]).

The next step is data transformation[34]. According to the JBI convergent integrated approach, quantitative data will be converted to "qualitative data" and be transfigured to textual or narrative interpretations to answer the review question.

In a final step, extract themes and subtopics in shape of qualified textual description from qualitative results, whether untransformed or transformed, and collate and categorise them according to consistencies of content. These categories will then be subjected to a synthesis to produce a single comprehensive set of synthesized findings that can be used as a basis for evidence-based practice.

Subgroup analysis

The doctors, nurses and other medical staffs are all working together to combat the coronavirus pandemic, but they have different duties and their experience may vary from each other. Hence, we plan to conduct subgroup analyses to examine whether a profession has different experiences and impacts. For qualitative data, we will label the results of articles that are only included in a class of research objects when extracting the results of qualitative studies. If the experience of different occupations is the same, we will integrate the results and not report according to different occupations. If people in different occupations do have

differences in experience and experience, we will report it in the results. For quantitative data, the subgroup analysis of different occupations (doctors, nurses and other medical workers) can be performed using a mixed effect model to reduce the heterogeneity of the study and to distinguish the psychological and infection conditions of different occupations during the outbreak of the epidemic.

Moreover, in order to reduce the heterogeneity across Quantitative studies, the subgroup analysis could classify countries by economic income group according to the World Bank list of Economies (High income/Upper middle income/Lower middle income)[36,37]. And we also try to do subgroup analysis by gender(Female/Male) and measuring instrument(various scales and equipment) if data allows.

Sensitivity analysis

If the available data allows, we will conduct the sensitivity analyses that exclude studies at high risk of bias in order to determine its impact.

Assessment of reporting biases

The presence of publication bias will be assessed using Egger's test and funnel plots. Pvalue < 0.10 on the Egger's test will be considered statistically significant for publication bias.

Assessment of risk and quality

Assessment of risk of bias in included studies.

To assess the risk of bias and quality of all articles selected, the methodological quality criteria, Mixed-Methods Appraisal Tool (MMAT), version 2018 will be conducted using[38]. This document comprises two parts: checklist (Part I) and explanation of the criteria (Part II). Each part is divided into 5 smaller sections according to the category of research designs, and

each category includes 5 items respectively. All items from the MMAT will be rated as "Yes", "No" or "Can't tell"[39].

Whereby one reviewer (NX) will apply the MMAT criteria and a second reviewer (TL) will verify the assessments independently. Any disputes will be resolved through discussion or a third reviewer (MH). Regardless of the research quality, all studies will undergo extraction and synthesis where possible.

Assessing confidence in the findings

In order to determine the strength of gathered evidence, the CERQual (Confidence in the Evidence from Reviews of Qualitative Research) approach will be used[40]. The CERQual approach is based on four aspects: (1) methodological limitations component, (2) relevance component, (3) coherence component and (4) adequacy component. Synthesizing the evaluation results of four parts, the confidence in the evidence for each review finding was assessed as high, moderate, low or very low.

Timeline for review

At the time of submitting this protocol, we have completed the electronic searches and piloted the study selection process. This systematic review is scheduled to finish in July 2021.

Discussion

This protocol was registered and reported according to Preferred Reporting Items for Systematic reviews and MetaAnalysis protocol (PRISMA-P) guidelines. The PRISMA flow diagram in **Figure 2** will be used to record the review process in different phases[41].

(Insert Figure 2 about here.)

Healthcare providers face a variety of unpredictable challenges in caring for infected patients in the context of coronavirus outbreaks. To our knowledge, there are few systematic reviews that will assess the experience and impact of health-care providers during the coronavirus outbreak. Comprehensive understanding of what their real experiences and impacts are will have a significant meaningful when their lives and security are threatened. Meanwhile, this is also stronger evidence in clinical practice of sustained and comprehensive support measures to health care providers. Findings from this review will be shared in conferences, peer-review journals, and social media platforms.

Ethics and dissemination

Ethical assessment is not required due to the nature of the proposed systematic review. Findings of our research will be disseminated at conferences related to this field and through publication in peer-reviewed journals.

Statements

Acknowledgement

Competing interests

The authors have no conflicts of interest to declare.

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Authors' contributions

NX and AL conceived and designed the initial study. NX and TL drafted the initial protocol. XL, MH and YS were responsible for the revision of the draft and provided general advice on the protocol. All authors contributed to the development of the selection criteria, the risk of a bias assessment strategy, and data extraction criteria. AL is the guarantor of the review. All authors read, provided feedback, and approved the final protocol before submission to the journal.

Figure 1. The design process of Systematic review.

Figure 2. Flow chart diagram will be showed the selection of articles for systemic review.

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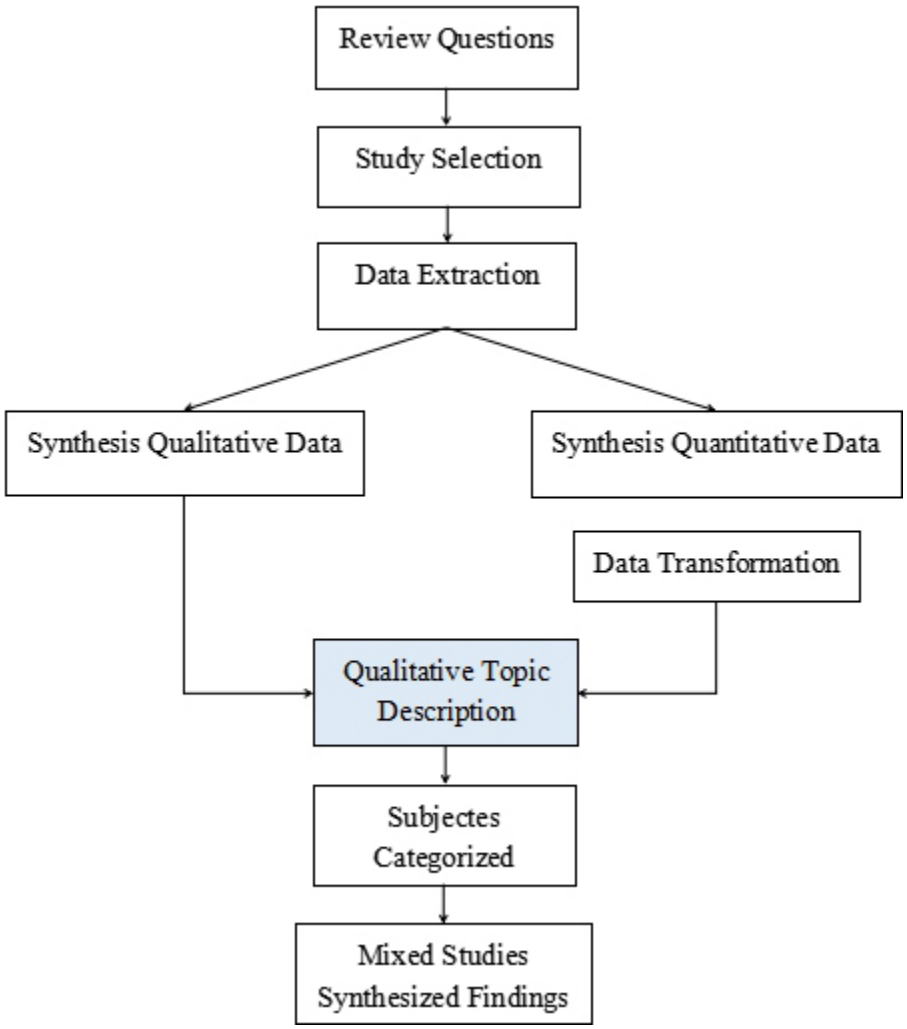

Figure 1. The design process of Systematic review.

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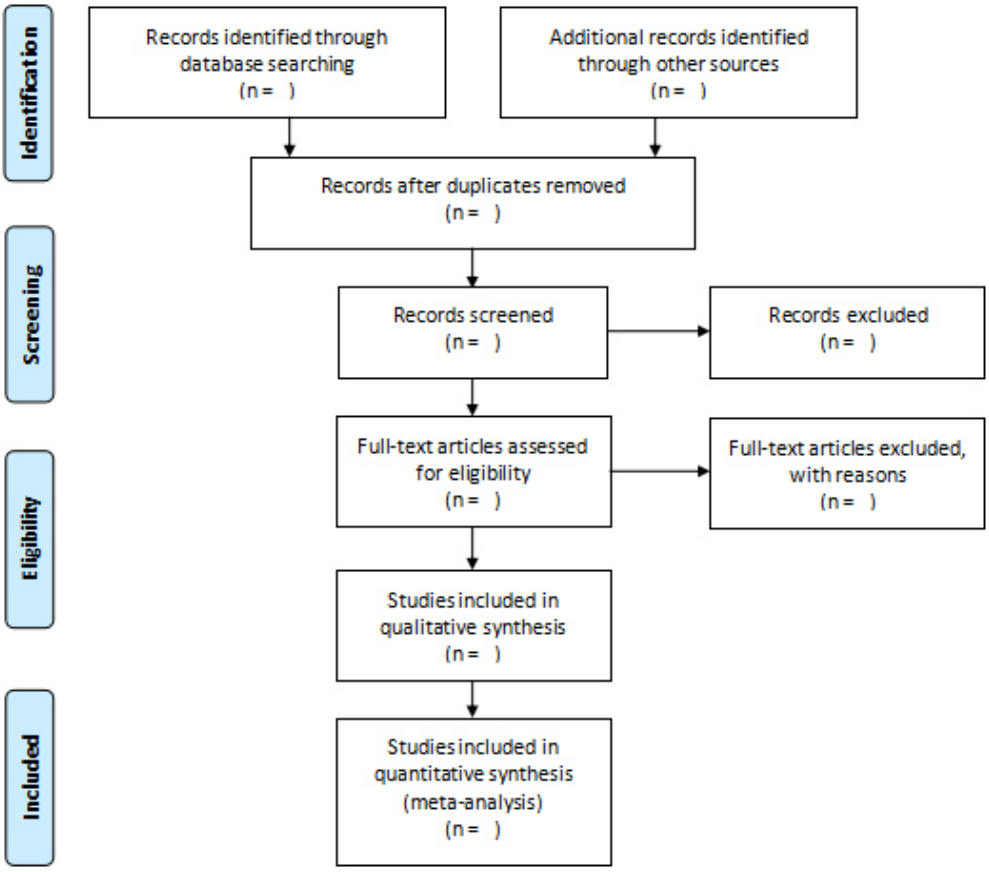

Figure 2. Flow chart diagram will be showed the selection of articles for systemic review.

44x39mm (300 x 300 DPI)

Supplementary additional file 1

The detailed search strategy in PubMed

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#1 Searching results = 1,811,427

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#2 Searching results =10,519,278

#3 ((((((((((((((((((("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields]) OR "coronaviruses"[All Fields]) OR (((((("covid 19"[All Fields] OR "covid 2019"[All Fields]) OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept]) OR "severe acute respiratory syndrome coronavirus 2"[All Fields]) OR "2019 ncov"[All Fields]) OR "sars cov 2"[All Fields]) OR "2019ncov"[All Fields]) OR (("wuhan"[All Fields] AND ("coronavirus"[MeSH Terms] OR "coronavirus"[All

Fields])) AND (2019/12/1:2019/12/31[Date - Publication] OR 2020/1/1:2020/12/31[Date - Publication]))))) OR "SARSCOV2"[All Fields]) OR (("severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2"[All Fields]) OR "2019 ncov"[All Fields])) OR ((("covid 19"[Supplementary Concept] OR "covid 19"[All Fields]) OR "covid19"[All Fields]) AND "Ncov"[All Fields])) OR ("2019"[All Fields] AND (("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields]) OR "coronaviruses"[All Fields]))) OR ((("novel"[All Fields] OR "novel s"[All Fields]) OR "novels"[All Fields]) AND (("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields]) OR "coronaviruses"[All Fields]))) OR ("new"[All Fields] AND (("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields]) OR "coronaviruses"[All Fields]))) OR ("nouveau"[All Fields] AND (("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields]) OR "coronaviruses"[All Fields]))) OR ((("covid 19"[Supplementary Concept] OR "covid 19"[All Fields]) OR "covid19"[All Fields])) OR ((("acute"[All Fields] OR "acutely"[All Fields]) OR "acutes"[All Fields]) AND "respiratory"[All Fields] AND (((((((("syndrom"[All Fields] OR "syndromal"[All Fields]) OR "syndromally"[All Fields]) OR "syndrome"[MeSH Terms]) OR "syndrome"[All Fields]) OR "syndromes"[All Fields]) OR "syndrome s"[All Fields]) OR "syndromic"[All Fields]) OR "syndroms"[All Fields]) AND (("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields]) OR "coronaviruses"[All Fields]) AND "2"[All Fields])) OR "SARS-2"[All Fields]) OR (("severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2"[All Fields]) OR "wuhan seafood market pneumonia virus"[All Fields])) OR "SARS"[All Fields]) OR ((((("sars virus"[MeSH Terms] OR ("SARS"[All Fields] AND "virus"[All Fields])) OR "sars virus"[All Fields]) OR ("SARS"[All Fields] AND "cov"[All Fields])) OR "sars cov"[All Fields])) OR (("sars virus"[MeSH Terms] OR ("SARS"[All Fields] AND "virus"[All Fields])) OR "sars virus"[All Fields])) OR (("severe acute respiratory syndrome"[MeSH Terms] OR ((("severe"[All Fields] AND "acute"[All Fields]) AND "respiratory"[All Fields]) AND "syndrome"[All Fields])) OR "severe acute respiratory syndrome"[All Fields])) OR ((("coronavirus infections"[MeSH Terms] OR ("coronavirus"[All Fields] AND "infections"[All Fields])) OR "coronavirus infections"[All Fields]) OR "mers"[All Fields])) OR ((((("middle east respiratory syndrome coronavirus"[MeSH Terms] OR ((((("middle"[All Fields] AND "east"[All Fields]) AND "respiratory"[All Fields]) AND "syndrome"[All Fields]) AND "coronavirus"[All Fields])) OR "middle east respiratory syndrome coronavirus"[All Fields]) OR ("mers"[All Fields] AND "virus"[All Fields])) OR "mers virus"[All Fields])) OR ((((("coronavirus infections"[MeSH Terms] OR ("coronavirus"[All Fields] AND "infections"[All Fields])) OR "coronavirus infections"[All Fields]) OR ((("middle"[All Fields] AND

"east"[All Fields]) AND "respiratory"[All Fields]) AND "syndrome"[All Fields])) OR "middle east respiratory syndrome"[All Fields])) OR ((((("middle east respiratory syndrome coronavirus"[MeSH Terms] OR ((((("middle"[All Fields] AND "east"[All Fields]) AND "respiratory"[All Fields]) AND "syndrome"[All Fields]) AND "coronavirus"[All Fields])) OR "middle east respiratory syndrome coronavirus"[All Fields]) OR (((((("middle"[All Fields] AND "east"[All Fields]) AND "respiratory"[All Fields]) AND "syndrome"[All Fields]) AND "related"[All Fields]) AND "coronavirus"[All Fields])) OR "middle east respiratory syndrome related coronavirus"[All Fields])) OR ((((("middle east respiratory syndrome coronavirus"[MeSH Terms] OR ((((("middle"[All Fields] AND "east"[All Fields]) AND "respiratory"[All Fields]) AND "syndrome"[All Fields]) AND "coronavirus"[All Fields])) OR "middle east respiratory syndrome coronavirus"[All Fields]) OR ("mers"[All Fields] AND "cov"[All Fields])) OR "mers cov"[All Fields])

#3 Searching results = 73,347

#4 ((((((((((((((((((((((((("cohort studies"[MeSH Terms] OR ("cohort"[All Fields] AND "studies"[All Fields])) OR "cohort studies"[All Fields]) OR ("cohort"[All Fields] AND "study"[All Fields])) OR "cohort study"[All Fields]) OR ((((("cohort studies"[MeSH Terms] OR ("cohort"[All Fields] AND "studies"[All Fields])) OR "cohort studies"[All Fields]) OR ("incidence"[All Fields] AND "study"[All Fields])) OR "incidence study"[All Fields])) OR ((((("cohort studies"[MeSH Terms] OR ("cohort"[All Fields] AND "studies"[All Fields])) OR "cohort studies"[All Fields]) OR ("cohort"[All Fields] AND "analysis"[All Fields])) OR "cohort analysis"[All Fields])) OR ((((("cohort studies"[MeSH Terms] OR ("cohort"[All Fields] AND "studies"[All Fields])) OR "cohort studies"[All Fields]) OR ("cohort"[All Fields] AND "analyses"[All Fields])) OR "cohort analyses"[All Fields])) OR ((((("cohort studies"[MeSH Terms] OR ("cohort"[All Fields] AND "studies"[All Fields])) OR "cohort studies"[All Fields]) OR ("concurrent"[All Fields] AND "study"[All Fields])) OR "concurrent study"[All Fields])) OR ((((("cohort studies"[MeSH Terms] OR ("cohort"[All Fields] AND "studies"[All Fields])) OR "cohort studies"[All Fields]) OR (("closed"[All Fields] AND "cohort"[All Fields]) AND "study"[All Fields])) OR "closed cohort study"[All Fields])) OR ((((("cohort studies"[MeSH Terms] OR ("cohort"[All Fields] AND "studies"[All Fields])) OR "cohort studies"[All Fields]) OR (("historical"[All Fields] AND "cohort"[All Fields]) AND "study"[All Fields])) OR "historical cohort study"[All Fields])) OR ((((("cross-sectional studies"[MeSH Terms] OR ("cross sectional"[All Fields] AND "studies"[All Fields])) OR "cross sectional studies"[All Fields]) OR ("prevalence"[All Fields] AND "study"[All Fields])) OR "prevalence study"[All Fields])) OR ((("cross-sectional studies"[MeSH Terms] OR ("cross sectional"[All Fields] AND "studies"[All Fields])) OR "cross sectional

studies"[All Fields]) OR (("disease"[All Fields] AND "frequency"[All Fields]) AND "survey"[All Fields]))) OR ((((("cross-sectional studies"[MeSH Terms] OR ("cross sectional"[All Fields] AND "studies"[All Fields])) OR "cross sectional studies"[All Fields]) OR ("cross"[All Fields] AND "sectional"[All Fields])) OR "cross sectional"[All Fields])) OR ((((("cross-sectional studies"[MeSH Terms] OR ("cross sectional"[All Fields] AND "studies"[All Fields])) OR "cross sectional studies"[All Fields]) OR ("cross"[All Fields] AND "sectional"[All Fields])) OR "cross sectional"[All Fields])) OR (("empirical research"[MeSH Terms] OR ("empirical"[All Fields] AND "research"[All Fields])) OR "empirical research"[All Fields])) OR ((((("qualitative research"[MeSH Terms] OR ("qualitative"[All Fields] AND "research"[All Fields])) OR "qualitative research"[All Fields]) OR ("qualitative"[All Fields] AND "study"[All Fields])) OR "qualitative study"[All Fields])) OR (("qualitative research"[MeSH Terms] OR ("qualitative"[All Fields] AND "research"[All Fields])) OR "qualitative research"[All Fields])) OR ((("qualitative"[All Fields] OR "qualitatively"[All Fields]) OR "qualitatives"[All Fields]) AND ((((("description"[All Fields] OR "descriptions"[All Fields]) OR "descriptive"[All Fields]) OR "descriptively"[All Fields]) OR "descriptives"[All Fields]))) OR ((("phenomenologic"[All Fields] OR "phenomenological"[All Fields]) OR "phenomenologically"[All Fields]) AND ((((("studies"[All Fields] OR "study"[All Fields]) OR "study s"[All Fields]) OR "studying"[All Fields]) OR "studys"[All Fields]))) OR (("grounded theory"[MeSH Terms] OR ("grounded"[All Fields] AND "theory"[All Fields])) OR "grounded theory"[All Fields])) OR ((((("anthropology, cultural"[MeSH Terms] OR ("anthropology"[All Fields] AND "cultural"[All Fields])) OR "cultural anthropology"[All Fields]) OR "ethnographies"[All Fields]) OR "ethnography"[All Fields])) OR ((("anthropologies"[All Fields] OR "anthropology"[MeSH Terms]) OR "anthropology"[All Fields]) OR "anthropology s"[All Fields])) OR ((("behavioural research"[All Fields] OR "behavioral research"[MeSH Terms]) OR ("behavioral"[All Fields] AND "research"[All Fields])) OR "behavioral research"[All Fields])) OR ((((("health services research"[MeSH Terms] OR (("health"[All Fields] AND "services"[All Fields]) AND "research"[All Fields])) OR "health services research"[All Fields]) OR ("action"[All Fields] AND "research"[All Fields])) OR "action research"[All Fields])) OR ((((("mixed"[All Fields] OR "mixes"[All Fields]) OR "mixing"[All Fields]) OR "mixings"[All Fields]) AND ((((("method s"[All Fields] OR "methods"[MeSH Terms]) OR "methods"[All Fields]) OR "method"[All Fields]) OR "methods"[MeSH Subheading]))) OR "mixed-method"[All Fields]) OR ((((((((((("investigated"[All Fields] OR "investigates"[All Fields]) OR "investigating"[All Fields]) OR "investigation"[All Fields]) OR "investigations"[All Fields]) OR "investigative"[All Fields]) OR "investigator s"[All Fields]) OR "research personnel"[MeSH Terms]) OR

("research"[All Fields] AND "personnel"[All Fields])) OR "research personnel"[All Fields]) OR "investigator"[All Fields]) OR "investigators"[All Fields]) AND ((((((((((("research personnel"[MeSH Terms] OR ("research"[All Fields] AND "personnel"[All Fields])) OR "research personnel"[All Fields]) OR "researcher"[All Fields]) OR "researchers"[All Fields]) OR "research"[MeSH Terms]) OR "research"[All Fields]) OR "research s"[All Fields]) OR "researchable"[All Fields]) OR "researche"[All Fields]) OR "researched"[All Fields]) OR "researcher s"[All Fields]) OR "researches"[All Fields]) OR "researching"[All Fields]) OR "researchs"[All Fields])))) OR ((((((((((("investigated"[All Fields] OR "investigates"[All Fields]) OR "investigating"[All Fields]) OR "investigation"[All Fields]) OR "investigations"[All Fields]) OR "investigative"[All Fields]) OR "investigator s"[All Fields]) OR "research personnel"[MeSH Terms]) OR ("research"[All Fields] AND "personnel"[All Fields])) OR "research personnel"[All Fields]) OR "investigator"[All Fields]) OR "investigators"[All Fields]) AND ((((("studies"[All Fields] OR "study"[All Fields]) OR "study s"[All Fields]) OR "studying"[All Fields]) OR "studys"[All Fields]))

#4 Searching results = 6,302,298

#5 (#1 AND #2 AND #3 AND #4) Searching results =2380 (31 July 2020-PubMed)

PRISMA-P 2015 Checklist

This checklist has been adapted for use with protocol submissions to *Systematic Reviews* from Table 3 in Moher D et al: Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews* 2015 **4**:1

Section/topic	#	Checklist item	Information reported		Line number(s)
			Yes	No	
ADMINISTRATIVE INFORMATION					
Title					
Identification	1a	Identify the report as a protocol of a systematic review	☒	☐	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	☐	☒	NA
Registration	2	If registered, provide the name of the registry (e.g., PROSPERO) and registration number in the Abstract	☒	☐	3
Authors					
Contact	3a	Provide name, institutional affiliation, and e-mail address of all protocol authors; provide physical mailing address of corresponding author	☒	☐	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	☒	☐	18
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	☐	☒	NA
Support					
Sources	5a	Indicate sources of financial or other support for the review	☒	☐	18
Sponsor	5b	Provide name for the review funder and/or sponsor	☐	☒	NA
Role of sponsor/funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	☐	☒	NA
INTRODUCTION					
Rationale	6	Describe the rationale for the review in the context of what is already known	☒	☐	5-8
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	☒	☐	8
METHODS					

Section/topic	#	Checklist item	Information reported		Line number(s)
			Yes	No	
Eligibility criteria	8	Specify the study characteristics (e.g., PICO, study design, setting, time frame) and report characteristics (e.g., years considered, language, publication status) to be used as criteria for eligibility for the review	☒	☐	8-12
Information sources	9	Describe all intended information sources (e.g., electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage	☒	☐	9
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	☒	☐	9-10
STUDY RECORDS					
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	☒	☐	12-13
Selection process	11b	State the process that will be used for selecting studies (e.g., two independent reviewers) through each phase of the review (i.e., screening, eligibility, and inclusion in meta-analysis)	☒	☐	13
Data collection process	11c	Describe planned method of extracting data from reports (e.g., piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	☒	☐	13-14
Data items	12	List and define all variables for which data will be sought (e.g., PICO items, funding sources), any pre-planned data assumptions and simplifications	☒	☐	11-12
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	☒	☐	11--12
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	☒	☐	15-16
DATA					
Synthesis	15a	Describe criteria under which study data will be quantitatively synthesized	☒	☐	14-15
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency (e.g., I^2, Kendall's tau)	☒	☐	14-15
	15c	Describe any proposed additional analyses (e.g., sensitivity or subgroup analyses, meta-regression)	☒	☐	15-16
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	☒	☐	14-15
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (e.g., publication bias across studies, selective reporting within studies)	☒	☐	16
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (e.g., GRADE)	☒	☐	17