Covid-19 Infection, Illness and Deaths Among Healthcare Workers in Low- and Middle-Income Countries: A Systematic Review Protocol

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Abstract

Background: Globally, health care workers continue to be infected, fall ill and die at the frontline of the Coronavirus disease 2019 (COVID-19) fight, an indicator of inadequate safety in health facilities. This rapid evidence synthesis aims to highlight the impacts of COVID-19 on healthcare workers in low-and middle-income countries (LMICs) in terms of infections, illnesses and deaths.

Methods: A systematic review will be done. Article search will be performed by an experienced librarian in PubMed, MEDLINE Ovid, Google Scholar, COVID-END, Cochrane library and targeted search from other relevant sources. MeSH terms and Boolean operators “AND” and “OR” will be used in the article search. Independent reviewers will screen the retrieved articles using a priori criteria. Data abstraction will be done using an excel based abstraction tool and synthesized using structured narratives and summary of findings tables.

Discussion and anticipated use of results: This evidence synthesis seeks to analyze the impact of COVID-19 on the healthcare systems of low- and middle-income countries. Information on healthcare worker infections, illness, and deaths due to COVID-19, will be collated from published research articles. This will help guide decision makers in establishing low- cost high impact interventions to mitigate the effects of COVID-19 in the health work force.

Protocol registration: PROSPERO CRD 42020204174

Introduction

Coronavirus disease (COVID-19) has caused unprecedented morbidity and mortality across the globe since its outbreak in December 2019. The WHO has reported over 200 million infections and over 4 million deaths by end of August 2021 (1). Consequently, the volume of patients and the resulting shortage of medical supplies have overwhelmed healthcare systems across the globe. The toll on healthcare professionals has thus been high.

Notably, healthcare workers are in close contact with patients of known and unknown COVID-19 disease status (2). Their nature of work puts them at a higher risk of contracting contagious diseases and thus necessitates a need for personal protective equipment (PPEs) and safe working environment. Unfortunately, PPEs are often inadequate in low- and middle-income countries (LMICs). Ironically, this has been the case even in high-income countries (3), however LMICs are likely to be more affected due to weak healthcare systems.

Healthcare workers in LMICs often have to endure working within limited health infrastructure setting that increases the risk of contracting COVID-19. There’s a need to equip policy makers and implementers with evidence to guide in establishing decent and safe healthcare working environments especially in LMICs. Our preliminary search indicates that indeed, a number of healthcare workers worldwide have been infected and worse still died of COVID-19. Despite speculations from several sources about the extent of

COVID-19 infections, illnesses and deaths among health workers, there is a dearth of context specific information in LMICs, especially sub-Saharan Africa.

It is against this background that we intend to collate evidence from published research, to provide resource tools and guide policymakers in decision-making for appropriate interventions. This evidence synthesis aims to highlight the impact of COVID-19 on healthcare workers in LMICs in terms of infections, illnesses and deaths; and to drive the agenda of healthcare worker safety to policy windows. Specifically, we intend to determine the prevalence of COVID-19 infections, illnesses and the COVID-19 case fatality rates among health workers in LMICs.

Methods

The protocol for this evidence synthesis has been registered with the International Prospective Register of Systematic Reviews (PROSPERO; Registration number: CRD42020204174). The protocol was developed following PRISMA-P+ (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols) checklist (4) – additional file 2.

The question under review and PECOS framework

The study objective is based on the elements of PECOS (P: Population, E: Exposure, C: Comparator, O: Outcome and S: Setting). The **P**opulation is healthcare workers; **E**xposure is SARS-CoV-2/COVID-19; **C**omparator is the general population; the primary **O**utcome is COVID-19 infection, illness or deaths. The secondary outcomes shall be the access to COVID19 testing, access to COVID19 treatment, mental health co-morbidities related to COVID19, and risk factors for COVID19 death like pre-existing NCDs.

Study designs that will be considered are predominantly observational including cross-sectional, case-control, cohort studies, as well as systematic reviews and meta-analyses. Cross sectional studies and systematic reviews of cross sectional–studies will help in establishing the prevalence of COVID-19 infection, illness and the case fatality rate among healthcare workers. Also, case-control and cohort studies will help in establishing the case-fatality rate of COVID-19 among healthcare workers in LMICs. In addition, the descriptive and analytic cross sectional, case-control, and cohort studies plus systematic reviews of the same designs will be used for descriptive analysis of the nature of illnesses and establishing risk factors for deaths from COVID-19 among healthcare workers. Any of these observational study designs will be used to provide information on access to COVID-19 testing, access to treatment, and mental health outcomes.

Eligibility Criteria

Inclusion criteria

The period covered will be from December 2019 to date. Eligible studies should report at least one outcome of infection, illness and/or death due to COVID-19. Studies will be limited to those conducted

among adult healthcare workers, above the age of 18 years, working in healthcare settings in LMICs during the COVID-19 pandemic. The review will also include studies conducted among the general population with healthcare workers as a sub group if results are stratified. Primary observational studies with cross sectional or prospective research designs, case control studies, systematic reviews, and meta-analyses shall be included. Only studies published after December 2019 will be included in the review.

Exclusion criteria

Case reports and series of single case studies, programme reports, conference abstracts, author's opinions and editorials shall not be included in this review. Studies not published in the English language shall be excluded as those full texts that are inaccessible.

Information sources

Data sources for the review will include PubMed (preliminary search done on June 30th, 2020), MEDLINE Ovid and Google Scholar (July 9th, 2020), COVID-END, and the Cochrane library (September 15th, 2020). Websites of health and medical related organizations (World Health Organization (WHO), Ministry of Health, Uganda (MoH), and Medscape.

Search terms

The search terms used for this review included those for COVID-19 like Coronavirus, novel Coronavirus, Coronavirus Infection, Coronavirus disease 2019, Corona virus disease 2019, Coronavirus disease-19, 2019 novel coronavirus, 2019 novel coronavirus disease, 2019 novel coronavirus infection, novel Respiratory 2019 Coronavirus, 2019-nCoV infection, 2019-nCoV disease, COVID-19, COVID19, COVID-19 virus infection, COVID-19 pandemic, SARS-Cov-2, SARS-CoV-2 infection, Wuhan pneumonia. Terms for healthcare workers were tested in the pilot Health worker, healthcare worker, health professional, healthcare professional, nurses, doctors, ambulance driver, physician, laboratory technician, and the LMIC filter by Cochrane was used to filter articles in all Low- and middle-income countries.

Search strategy

An experienced information scientist (AAK) will conduct article search. Medical Subject Headings (MeSH) will be used in article search. The unique terms will be combined using Boolean operators "OR", "AND" or "NOT". Targeted search for additional relevant articles for this review will be done manually from references of included articles, and grey literature will be considered. The pilot PubMed search string is attached as an additional file 3.

Article screening

All the articles identified from the search will be exported into Endnote and duplicates removed. Article screening will be done using *a priori* criteria. BAK, RNN and RNW will independently screen articles following the PRISMA flow. Any disagreements between the reviewers will be resolved through consensus. A tiebreaker will resolve further disagreements (OM, EAO).

Data abstraction and management

A data abstraction tool will be developed in Excel spreadsheet 2007 (Microsoft Corporation, WA, USA, www.microsoft.com). This tool will capture administrative information as author, title, citation, country, ethical approval, funding, year of publication; methodological data such as study design, sample size, COVID-19 test confirmation method, profession, type of healthcare setting; and outcomes such as number infected, mortality, duration of illness, nature of care for example, need for Intensive Care Unit (ICU) or not, prevalence and case fatality. Ascertainment of infection as an outcome of interest will be through WHO approved laboratory tests for COVID-19, whereas ascertainment of illness or death will be through verbal autopsy or clinical assessment reports. Three reviewers BAK, RNW and RNN will do abstraction.

Risk of bias assessment

This evidence synthesis shall undertake critical quality control assessment at every stage of the review. Biases such as selection bias, outcome assessment bias, attrition bias and analysis bias are expected within the included primary studies. Quality assessment will be done using the New Castle Ottawa tools for Case-control as well as for Observational Cohort and Cross-Sectional Studies to critically appraise the selected studies (5). The AMSTAR-2 (A Measurement Tool to Assess Systematic Reviews 2) Systematic Review Critical Appraisal Tool (6) shall be used to assess quality of the included systematic reviews. The overall quality of the body of evidence will be graded using the GRADE (Grading of Recommendations, Assessment, Development and Evaluations) framework (8). The immediate output will be a rapid evidence brief for policy in line with the SURE Guidelines (Supporting the Use of Research Evidence), which will inform a results deliberation/policy dialogue (9).

Publication bias

Publication bias will be examined using a funnel plot while using the asymmetry of the plots to detect likelihood of publication bias among included articles (19).

Data synthesis and analysis

Synthesis will be by study type. Abstracted data from the included articles will be exported to an open access review management software or EPPI-Reviewer (Evidence for Policy and Practice Information) for analysis. Results from the analysis will be presented as structured narratives or summaries in data tables and graphs where applicable. Measures of central tendencies (means, medians) and frequencies will be used for descriptive statistics. Random effects model, which assumes a hierarchical linear model will be used in meta-analysis, if appropriate.

Heterogeneity and sensitivity analysis

The level of heterogeneity will be assessed using the Higgins I^2 statistic. It will be used to indicate percentage (%) heterogeneity that can be attributed to between-study variance. Interpretation: I^2 = 25% (low heterogeneity), I^2 = 50% (moderate heterogeneity), I^2 = 75% (high heterogeneity). The different study designs will be analyzed using sub-group analysis. For the studies that will show dichotomous outcomes, the DerSimonian and Laird random effects method shall be used in meta-analysis.

Meta-analysis will be conducted to establish aggregate or pooled estimates of the review outcomes from the single studies. In accordance with the PRISMA statement, studies will be combined for meta-analysis following heterogeneity analysis. In our study, based on Higgins I^2 statistic, if the heterogeneity between studies is above 90%, it shall be considered substantial heterogeneity and thus a meta-analysis may not be opted for. Further, both random effects meta-analysis and fixed effects meta-analysis will be conducted and the two results will be compared.

Sensitivity analysis will be done taking into regard risk of bias assessment, heterogeneity and differences in health care workers cadres (nurses, doctors, non-clinical staff).

Discussion

Most healthcare systems in LMICs are inadequately funded and are unable to meet the healthcare needs of the entire population. For instance, despite the 2001 Abuja declaration by African Union states, which stated that 15% budget allocation should be directed towards the health sector, only 6 countries out of 54 hit the mark 10 years down the road. On the contrary, some countries cut their health budgets instead (10). In the wake of a global pandemic like the COVID-19 disease, a poorly funded healthcare sector is likely to be disproportionately affected. This has put healthcare workers in such settings at a higher risk of COVID-19 infection compared to the general population.

The nature of work of health workers puts them at risk of occupational biohazards including nosocomial infections like Coronavirus. There has been an influx of patients to treatment centres, constraining the global health systems which are already complicated by deficits in medical supplies (11). As a result, the healthcare workforce is under great physiological and psychological pressure (2). Emerging evidence from recent studies not only suggests that the health professionals' nature of work puts them at increased risk of acquiring COVID-19, but also other stressful work challenges. The challenges range from medical staff physical and mental exhaustion, the torment of difficult triage decisions, stress and the pain of losing a patient and colleagues (12). Consequently, more than 90, 000 health workers globally are estimated to have been infected with COVID-19 and over 1500 reported dead (13).

Whereas these effects are clearly known, there is a lack of conformity on the magnitude of risk the disease poses on the health workers. One study has reported 8.4% prevalence of COVID-19 infections among health workers in Italy (14). A more extensive study giving a two months' picture of COVID-19 in the United States of America showed that a quarter of the infections were among health workers. This study also indicated that most of the infected health workers did not require hospitalisation while less than 5% were admitted into the ICU (15). Furthermore, there is evidence showing higher rates of infections in this group of professionals (16). This review will focus on generating an up-to-date picture of the outcomes of COVID 19 (including infections, illnesses and deaths) among health workers in LMICs.

Understanding the burden of COVID-19 among healthcare workers in LMICs provides an avenue for redesigning healthcare systems to not only provide appropriate care to the population, but also to protect

the healthcare workers at the forefront of containing the pandemic right from the policy level to the healthcare facility level. Liyanage & Egbu present a conceptual framework for the control of Healthcare Associated Infections (HAI) in Facility Management (FM) services (17). FM includes; (i) availability of infection control facilities, (ii) utilization of these facilities, and (iii) suitability of the facilities. However, it should be notable that most LMIC facilities lack basic infection control facilities and management like hand washing facilities, safe waste disposal, routine and regular cleaning of environment and adequate provision and knowledge of PPEs. As such, this review seeks to evaluate available evidence on COVID-19 among health workers in LMICs.

The findings from this systematic review will help stakeholders in LMICs to appreciate the effect COVID-19 has had on healthcare workers and eventually on the healthcare systems. This will guide decision-makers in designing policies and programs that strengthen healthcare systems to satisfactorily manage pandemics while protecting the healthcare workers.

Abbreviations

AMSTAR-2 - A MeaSurement Tool to Assess Systematic Reviews 2

COVID-19 – Coronavirus Disease 2019

CoVPRES – Coronavirus Pandemic Rapid Evidence Synthesis

EPPI - Evidence for Policy and Practice Information

GRADE - Grading of Recommendations, Assessment, Development and Evaluations

ICU – Intensive Care Unit

LMICs – Low- and Middle-income countries

MeSH – Medical Subject Headings

MoH – Ministry of Health

NIH – National Heart, Lung and Blood Institute

PICOS – Population, Intervention, Comparator, Outcome, Study design.

PPE – Personal Protective Equipment

PRISMA-P – Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols

SARS-CoV-2 – Severe Acute Respiratory Syndrome Coronavirus 2

SURE – Supporting the Use of Research Evidence

WHO – World Health Organization

Operational Definitions Throughout The Review

1. Healthcare worker:

Throughout the systematic review, we will use the term “healthcare worker” to mean any adult who is employed to work and those training in a health care setting. Healthcare workers will therefore include physicians, specialists, nurses, emergency medical personnel like ambulance drivers, dental professionals, students, laboratory technicians, pharmacists, hospital volunteers, cooks, cleaners and administrative staff.

2. Healthcare setting:

Settings will include acute-care hospitals or health centers; long-term care facilities, such as nursing homes and skilled nursing facilities; physicians’ offices; outpatient clinics; and emergency medical service centers including mobile clinics, ambulances; specific sites within non-healthcare settings isolated to offer health services (e.g. a medical clinic or isolation center embedded within a workplace or school or hotel).

3. A health worker death:

This will refer to the death of a healthcare worker with a confirmed positive COVID-19 laboratory test, irrespective of the medical cause of death.

Declarations

Ethics approval and consent to participate

Although this process was not absolutely necessary, this review is part of a bigger project CoVPRES that obtained ethical approval from the Makerere University School of Biomedical Sciences, Institutional Review Board. Clearance from the Uganda National council of Science and Technology is also underway.

Consent for publication

All others have provided the consent for publication.

Availability of data and materials

The data will be available on request.

Competing interests

The authors declare no competing interests.

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Authors' contributions

EAO, MO, and DS developed the concept and the design of this work. BAK, RNW, RNN and EK are the main writers of this protocol, while MO and EAO are the main editors. AAK has done the preliminary database search in PubMed. All authors attend weekly meetings to offer inputs and guidance into the development of this work. All authors have read and approved the final manuscript.

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Figures

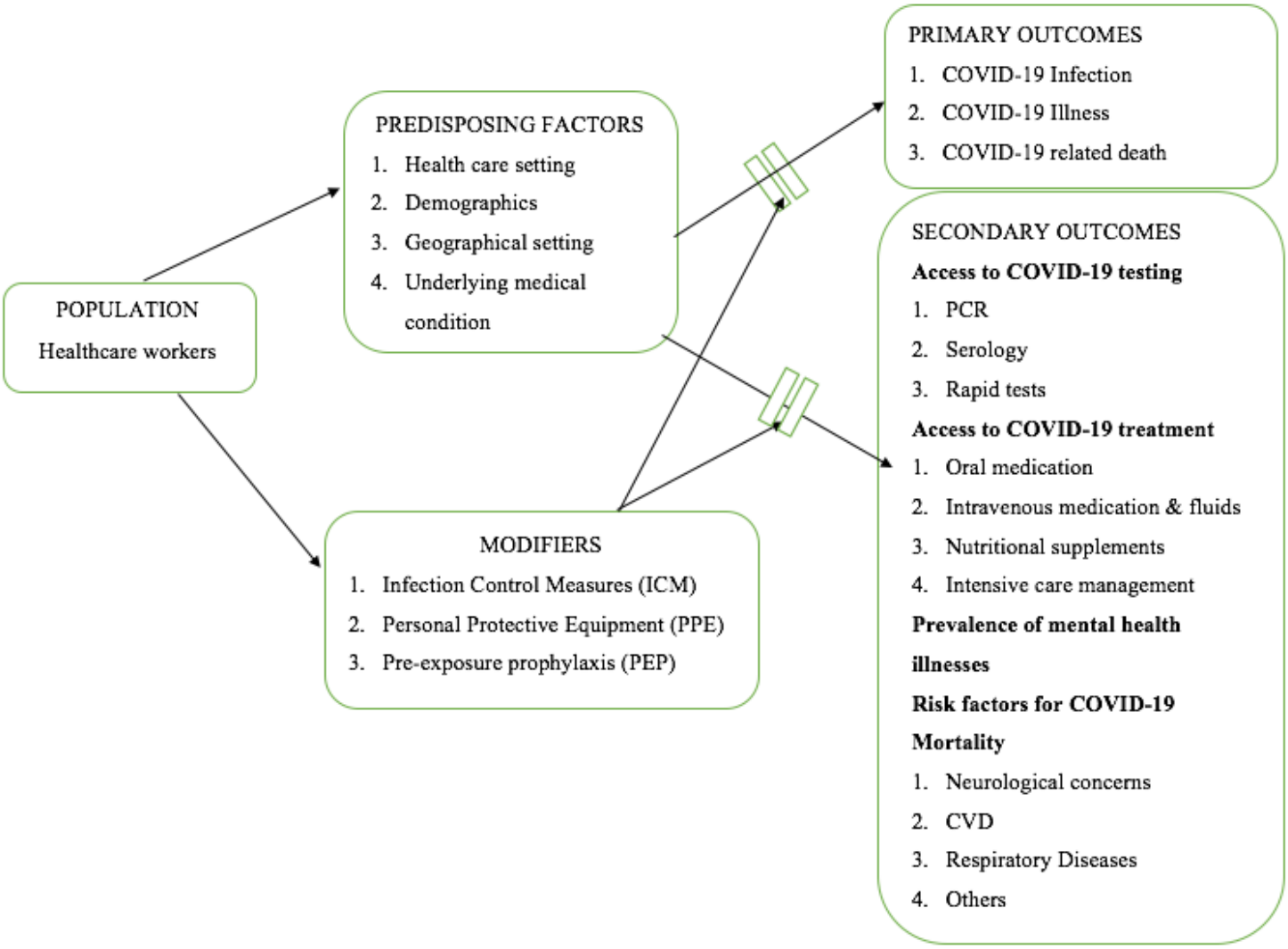

Figure 1

Conceptual framework.