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STUDY PROTOCOL

REVISED Nurse staffing and patient care outcomes: protocol for an umbrella review to identify evidence gaps for low and middle-income countries in global literature [version 2; peer review: 3 approved]

Previous title: Nurse staffing and patient care outcomes: protocol for an umbrella review to identify evidence gaps for low and middle-income countries

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Abstract

Background: Adequate staffing is key to the delivery of nursing care and thus to improved inpatient and health service outcomes. Several systematic reviews have addressed the relationship between nurse staffing and these outcomes. Most primary studies within each systematic review are likely to be from high-income countries which have different practice contexts to low and middle-income countries (LMICs), although this has not been formally examined. We propose conducting an umbrella review to characterise the existing evidence linking nurse staffing to key outcomes and explicitly aim to identify evidence gaps in nurse staffing research in LMICs.
Methods and analysis: This protocol was developed using the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA-P). Literature searching will be conducted across Ovid Medline, Embase and EBSCO Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases. Two independent reviewers will conduct searching and data abstraction and discordance will be handled by discussion between both parties. The risk of bias of the individual studies will be performed using the AMSTAR-2**.**
Ethics and dissemination: Ethical permission is not required for this review as we will make use of already published data. We aim to

Open Peer Review

Approval Status ✓ ✓ ✓

	1	2	3
version 2 (revision) 12 May 2022		✓ view ⬆	✓ view ⬆
version 1 23 Dec 2021	✓ view	? view	✓ view

1. **Denny John** [ID], Ramaiah University of Applied Sciences, Bengaluru, India

2. **Aduragbemi Banke-Thomas** [ID], University of Greenwich, London, UK

3. **Uzochukwu Egere** [ID], Liverpool School of Tropical Medicine, Liverpool, UK

Any reports and responses or comments on the article can be found at the end of the article.

publish the findings of our review in peer-reviewed journals.

Corresponding author: Abdulazeez Imam (abdulimam2001@yahoo.com)

> **REVISED** **Amendments from Version 1**
>
> In this version, the authors have modified the protocol to reflect the global nature of the umbrella review with a focus on LMIC settings. We have also worked on providing a stronger justification for the umbrella review and improving the flow and content of our discussion section. The title has been updated to "Nurse staffing and patient care outcomes: protocol for an umbrella review to identify evidence gaps for low and middle-income countries in global literature".
>
> **Any further responses from the reviewers can be found at the end of the article**

Background

Globally, nurses represent almost three-fifths of all health professionals and are key to the attainment of universal health coverage[1]. They are integral to ensuring the quality of patient care and are crucial in all health systems, playing significant roles at all levels of healthcare, including primary care where they promote mental health and well-being and anchor maternal health, growth monitoring and immunization services. They also have important roles within secondary and tertiary inpatient care settings where they plan, deliver and coordinate care and represent a critical part of the hospitals' surveillance system in detecting adverse patient events[2]. As a result, having the right number of nurses with the right skills is paramount to sustaining any health system.

In the year 2020, the World Health Organization has estimated that there was a need for an extra six million nurses to actualise the global health agenda[1]. It is estimated that around 90% of nursing shortages occur in low and middle-income countries (LMICs); particularly in Africa, South-East Asia, and the eastern Mediterranean region[1]. Only 3% of the global nurses reside in Africa, which houses 17.2% of the world's population and where there is an ever increasing non-communicable disease epidemic which requires long term care and for which nurses are critical[1,3,4]. The nursing crisis in LMICs represents a mismatch between increasing health service demand and the supply or employment of the nursing workforce supply[5]. The demand is fuelled by rapid population expansion and health policies promoting universal free medical care without commensurate expansion in health services to cater for these demands[1]. It is also driven by a rapid expansion in the scope of healthcare, changing population expectations and the increasing use of medical technologies that require more intensive nursing, for example, the use of mechanical ventilators or continuous positive airway pressure machines. The supply of nurses, on the other hand, is limited by inadequate workforce planning, financing, and investments in healthcare. The migration of highly skilled nurses from LMICs to developed countries, in search of better remuneration and improved career prospects, plays part of the role in reducing nursing levels in LMICs[6]. It has also been suggested that LMIC source countries play a role due to limited strategies for attracting and retaining such staff[6,7].

This imbalance in supply and demand of nurses has stimulated research on how nurse staffing might affect quality of patient care outcomes but these have come mainly from HICs which have distinctively different organisational contexts and comparatively better staffing ratios than LMICs[8–10]. The relative extent and nature of the evidence gaps for LMICs in the global literature for nurse staffing and quality of care has not been formally examined.

An Umbrella review (an overview of systematic reviews) provides broad and complete evidence on specific topics by synthesising the information across multiple systematic reviews[11]. This is also seen as a more efficient way of synthesising data from areas of research where a large amount of research might have been conducted[11]. Over the last two decades, several published reviews have examined the relationship between nurse staffing and the quality of hospital inpatient care[12–16]. A synthesis of these reviews examining the global evidence with special attention paid to identifying and highlighting possible evidence gaps for nurse staffing research in LMICs would be highly informative to highlighting the evidence gaps for LMICs. This would be relevant to guide the future conduct of nurse staffing research in LMIC settings and would be important for policymakers who are involved in defining nurse staffing in these areas.

Our umbrella review thus aims to characterise the literature examining the consequences of nurse staffing on inpatient care and identify evidence gaps for LMICs. Our review will aim to:

1. Identify the origins of studies within published reviews and determine what proportion of these were conducted in LMICs?

2. Identify the patient care outcomes reported across reviews and determine how reported outcomes differ across HICs and LMICs?

3. Describe the range of nurse staffing levels that have been researched across acute care settings and determine how these differ between LMICs and HICs?

Methods

The protocol for this review was developed using the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA-P)[17], and the Joanna Briggs Institute (JBI) guidelines for preparing and conducting umbrella reviews[11]. Our review was registered with the International Prospective Register of Systematic Reviews (PROSPERO) on 27th October 2021 (Registration number - CRD42021286908).

Ethics and dissemination

Our review is secondary research and so will not require any ethical approval. We hope to publish our findings in a peer-reviewed journal.

Study design

An umbrella review pulls together evidence from various systematic reviews and authors can also extract data from

primary studies included in the reviews[18]. Our umbrella review will focus on systematic reviews that investigate how nurse staffing levels affect the quality of care outcomes in hospitals. It will appraise the existing evidence within these reviews and specifically highlight what evidence has been put forward for LMICs in comparison to HICs. We will also abstract data on the range of nurse staffing level contexts described within the primary studies of each of our included systematic reviews. We will only consider quantitative systematic reviews; qualitative, mixed-method, narrative and other umbrella reviews will be excluded from our review, as well as commentaries, editorials, and review protocols. LMIC in this paper will be defined using the World Bank's country and lending groups classification system, which classifies 135 countries into low-income, low-middle-income and upper-middle-income economies, based on gross national income per capita as at 23rd December, 2021.

Population
We will include systematic reviews where the focus was on patients admitted to hospital ward settings which might either include newborn, paediatric or adult wards. We will however exclude systematic reviews of intensive care units, as the staffing ratios of these units tend to be better than regular ward care settings[19], which is the focus of our umbrella review. We will also exclude systematic reviews of non-hospital settings, such as community clinics and nursing homes or settings where care is not carried out continuously, such as outpatient clinics. For those systematic reviews that combine both studies conducted in intensive care units and hospital ward settings, if feasible, we will include them but only report on the primary studies that were conducted in ward care settings.

Exposure
Our exposure of interest is nurse staffing and its effect on patient care outcomes. Our review will consider a wide variety of staffing metrics reported by authors. This includes but is not limited to, nurse-to-patient ratios, nurse-to-bed ratios, or nursing hour per patient days. Our focus will be to identify systematic reviews that investigate the impact of any of these staffing metrics on patient outcomes. We will exclude systematic reviews which investigated the impact of other nursing metrics, for example, nursing skill mix and nursing work schedules on patient care outcomes, as the focus of this umbrella review is on the effects of variation nurse number or time available related to nurse staffing rather than how existing nurse numbers are organised.

Outcome
Our primary outcome of interest will be the quality of patient care. This includes patient care outcomes described in systematic reviews, for example length of hospital stays and the incidences of hospital-acquired infection and mortality. We will also consider nursing process outcomes such as missed nursing care or errors in administering medications. For reviews that report mixed outcomes, for example reviews on nurse and patient outcomes, we will include them but only report on their patient care outcomes.

Setting
We aim to identify the broad range of quality-of-care outcomes studied across systematic reviews and identify how these reported outcomes differ between HICs and LMICs. We will also identify the range of staffing levels, where individual studies reported in the reviews have been conducted and we will compare these across LMIC and HICs.

Search strategy
We will conduct our search in databases for systematic reviews, these include the Cochrane Register of Systematic Reviews, the JBI Database of Systematic Reviews and Implementation Reports and other databases such as Medline, Embase and Cumulative Index to Nursing and Allied Health Literature (CINAHL). The databases will be filtered by, to only show reviews published in English, due to limitations in translation capacity among the research team. There will be no date restrictions applied to our search and we will identify reviews published from inception of the databases till when we conduct our searches. We will also perform hand searches in some select journals and search the reference list of articles we identify for additional papers.

Prior to commencing the review, weconducted initial searches in Prospero to identify ongoing or planned umbrella reviews that might be similar to ours. We contacted a health information librarian to develop our search strategy, and this was piloted in Ovid Medline (see *Extended data*[20]). We identified our search terms by identifying repeated keywords and MESH terms of some pre-identified papers in Scopus and searching for synonyms of these.

Data management
Following our search, we will upload all retrieved abstracts of the identified systematic reviews to Zotero, a reference management software, where we will perform deduplication[21]. Following this, titles and abstracts of the retrieved papers will be screened for relevance by two independent reviewers using the Rayyan – Intelligent Systematic Review, a web-based application for screening[22]. Full text of potentially relevant articles will then be scrutinised by both reviewers independently using the pre-defined inclusion criteria. In the event of any discordance, this will be resolved through discussion and if unsuccessful, arbitration by a third reviewer.

Quality assessment
We will use the AMSTAR-2 criteria to assess the methodological quality of each systematic review[23]. This is a widely used tool for appraising systematic reviews and is recommended by the JBI guidelines for preparing and conducting umbrella reviews[11]. Assessments will be carried out independently by two reviewers, AI and SO. Any disagreements will be managed through discussions and in event of a lack of consensus, a third reviewer will be invited as a tiebreaker. As we aim for our umbrella review to provide broad information on patient care outcomes in LMICs, we will include all eligible systematic reviews in our synthesis irrespective of their risk of bias scores, but we will discuss any potential impact of these scores in our evidence synthesis.

Data items

We developed a standardised Microsoft Excel form to extract data on each of the identified systematic reviews for our umbrella review. This included publication year, first author's surname, outcome type/types measured, the number of studies included in each identified review that reported on specific patient outcomes in regular ward settings, and countries where these studies were conducted. This will be used to determine the proportion of studies conducted in LMIC settings and if a difference exists in outcomes studied in both LMICs and HICs. To address our objective on the range of nurse staffing reported across care settings, we will also extract the type of staffing metrics reported by the individual studies within each review, and a summary statistic describing this. We will abstract this from the study summary table, provided in each of our eligible reviews. If this data is unavailable or incomplete, we will retrieve this from the primary articles of the selected systematic reviews. The range of staffing will be our preferred metric. In the event there is no range specified, the mean or median staffing metric will be preferred.

Data synthesis

The findings of our umbrella review will be reported using a narrative synthesis as we do not include any effect estimates[24]. We will summarise each review, providing details on the research context, period of review, objectives and primary studies included in the review.

We intend to group studies conducted within each systematic review into those conducted in LMIC settings and those in non-LMIC settings using the World Bank's country and lending group classification system. Our data synthesis will describe the proportion of LMIC studies within each systematic review. We will also compare the broad range of patient care outcomes described across both LMIC and HIC settings and the range of staffing levels in both care settings. Our data will be presented using a combination of tables and figures.

Study status

We confirm that at the time of submission of this protocol, we have completed full-text screening of identified articles.

Discussion

Nurse staffing has long been recognised as one of the key factors that affect the quality of patient care. While staffing requirements might vary across different health care settings, HICs have traditionally had better staffing-to-patient ratios compared to many LMICs. Additionally, more research into staffing and patient care outcomes is conducted in HICs and these studies might form the bulk of evidence for systematic reviews in this area. Such research has shaped Human Resource for Health policies particularly in nurse staffing in HICs, where for example, UK Paediatric general wards report ratios of one nurse to four patients, which might approach one to one nursing in intensive care[25]. In contrast, studies from Ethiopia and Kenya, both LMICs report ratios as low as one nurse caring for 25 patients on a shift[26,27]. The evidence for nurse staffing in LMICs is unclear and data to guide this is limited[15].

Pre-review we identified one systematic review which focused on nurse staffing and patient care outcomes in LMICs that demonstrated poor quality evidence[15]. Our Umbrella review builds on this earlier work my appraising the evidence for LMICs in the context of global literature and identifying evidence gaps for such settings through comparisons made with HICs. This is an essential first step to mapping out areas for future LMIC research.

Data availability

No underlying data are associated with this article.

Extended data

Open Science Framework: Nurse staffing and patient care outcomes: protocol for an umbrella review to identify evidence gaps for low and middle-income countries https://doi.org/10.17605/OSF.IO/ZYE7X[20]

This project contains the following extended data:

- Search strategy for Ovid Medline.docx

- Search strategy for Embase

- Search strategy for CINAHL

Reporting guidelines

Open Science Framework: PRISMA-P checklist for 'Nurse staffing and patient care outcomes: protocol for an umbrella review to identify evidence gaps for low and middle-income countries'. https://doi.org/10.17605/OSF.IO/ZYE7X[20]

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Open Peer Review

Current Peer Review Status: ✓ ✓ ✓

Version 2

Reviewer Report 17 May 2022

https://doi.org/10.21956/wellcomeopenres.19774.r50498

✓ **Aduragbemi Banke-Thomas** (iD)

School of Human Sciences, University of Greenwich, London, UK

Thanks to the authors for taking the time to address my comments in the earlier version painstakingly. These have now all been resolved and I wish them the very best in the actual review.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Maternal Health; Health Policy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 13 May 2022

https://doi.org/10.21956/wellcomeopenres.19774.r50497

✓ **Uzochukwu Egere** (iD)

Department of International Public Health, Liverpool School of Tropical Medicine, Liverpool, UK

I am happy with the amendments the authors have made on this manuscript, and am happy for it to be indexed in its current form.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Clinical medicine (Paediatrics), Public health, Implementation research, Health systems analysis, Health services research.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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Version 1

Reviewer Report 23 March 2022

https://doi.org/10.21956/wellcomeopenres.19273.r49080

✔   **Uzochukwu Egere** 🆔
Department of International Public Health, Liverpool School of Tropical Medicine, Liverpool, UK

General comments:
Thanks for asking me to review this protocol which details an umbrella review to characterize the existing evidence linking nurse staffing to key outcomes, and also identifies and highlights possible evidence gaps for nurse staffing research in low- and middle-income countries (LMICs). The authors make a strong case for conducting this review and draw on several important publications to bring more clarity into the subject.

At this time of renewed determination to ensure universal health coverage especially in the vulnerable LMIC settings, this umbrella review has a huge potential to impact policy and inform strategies for health systems strengthening.
I would like to see data from LMICs disaggregated by countries and health system levels. Though there are huge nursing staff shortages in these settings, the shortages are likely to vary widely across health systems levels. I suggest that the authors consider these data items during data extraction.

Specific comments:
Background: The data on percentage of global nurses resident in each region versus the population they serve, is helpful. However, I wonder if this ratio would change for Latin America, for instance, if the USA is taken out of the 'Americas' region. Secondly, the discussion on the demand and supply crisis could also highlight intra-country dynamics such as movements from rural to urban areas as contributory to the crisis within LMICs.

Study design: It is in order to focus on quantitative variables as the authors have done here, given the review questions. It may therefore be necessary to consider abstracting quantitative data from the mixed methods studies instead of completely excluding all mixed methods studies.

Population: The authors mention in the review questions that they will find out the "range of nurse staffing levels that have been researched across acute care settings" but then in this (Population) section, it mentioned that systematic reviews of intensive care units will be excluded. It might be in order to clarify what is meant by "acute care settings" in this review.

Is the rationale for, and objectives of, the study clearly described?
Yes

Is the study design appropriate for the research question?
Yes

Are sufficient details of the methods provided to allow replication by others?
Yes

Are the datasets clearly presented in a useable and accessible format?
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Clinical medicine (Paediatrics), Public health, Implementation research, Health systems analysis, Health services research.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 15 March 2022

? **Aduragbemi Banke-Thomas** (iD)
School of Human Sciences, University of Greenwich, London, UK

Thank you for inviting me to review this protocol. I read it with a lot of interest.

I have suggested a number of points that I believe will help to really strengthen the protocol. The two big comments point to the need to provide a stronger rationale underpinning the need for this umbrella review. This needs to come out very clearly. Second is there is a need to clarify if the focus of this review is purely LMIC or if it is global. I think it is global, that wants to show there is an evidence gap for LMICs. I would argue that the protocol needs to reflect this.

Specific points are presented below:
- The title as written, "Nurse staffing and patient care outcomes: protocol for an umbrella

review to identify evidence gaps for low and middle-income countries" might not be appropriate as you still collect data from HICs to identify gaps. This is more of a global review. Your review questions certainly do not suggest that this is a purely LMIC focused review. Please tweak the title to reflect the focus.

○ Please specify the period when you write "In recent times, the World Health Organization...".

○ For this statement, "Only 3% of the global nurses reside in Africa, which houses 17.2% of the world's population..". Rather than relating this to the population, please relate to the burden of disease, especially NCDs that need long term care for which nurses are particularly critical.

○ Kindly motivate the introduction better to improve flow. This statement, "Nursing shortages, while prevalent in LMICs, also occur in high-income countries (HICs)..." shows the global reach of this planned review. Please structure the section in a way that shows the LMIC and HIC foci.

○ A stronger case for this review of reviews is needed. You write that "Umbrella reviews provide broader and more complete evidence on specific topics[16]. They have also been previously shown to be an efficient way of summarising the evidence base for extensively researched topics, such as nurse staffing[1]"· Can you evidence that nurse staffing is an example of an "extensively researched topic"? Yet you make a point already that this topic is minimally researched in LMICs. If it is not well sufficiently studied in LMICs, then a review of LMIC original papers will do. Summary: The rationale for an umbrella review does not come out clearly. Please review and rephrase.

○ Ref 16 will be better as a methodology paper that describes the process of an umbrella review not an example of another one. Maybe consider using Ref 19 and deleting 16.

○ You have cited JBI guidelines for umbrella reviews, registered with PROSPERO, and leveraged PRISMA-P. Good!

○ This statement "We hope to publish our findings in a peer-reviewed journal." has nothing to do with ethics. It is more about dissemination. Please remove or move elsewhere.

○ Please align your methods to your research question and frankly the entire protocol (title, background and methods). Under study design, you only talk about LMIC. Elsewhere, you talk about LMIC and HIC. This is difficult to follow. Please be more consistent in this protocol.

○ The World Bank classification is fluid. Be specific with cut off date of definition where you write "LMIC in this paper will be defined using the World Bank's country and lending groups classification system, which classifies 135 countries into low-income, low-middle-income and upper-middle-income economies, based on gross national income per capita".

○ Please use evidence to justify your exclusion criteria. For example, you write, "We will however exclude systematic reviews of intensive care units, as the staffing of these units varies significantly from regular ward care settings...".

○ These sort of protocols typically include their detailed search strategy across multiple databases, so this will not be needed with the same level of detail in the actual review. Please include the detailed search strategy across the different databases to be searched.

○ It might also be helpful to show how you have actually reached the search terms used. So, in essence, detail the piloting of the search strategy.

○ Not sure if this will be possible in all cases "For those systematic reviews that combine both studies conducted in intensive care units and hospital ward settings". Please rethink.

○ You write, "We will exclude systematic reviews which investigated the impact of other staffing metrics, for example, nursing skill mix and nursing work schedules on patient care outcomes". Please explain why.

○ This is not clear, "...due to limitations in translation". Do you mean no services available? Or no one on the team can translate? Please think about this a bit more. Are there actually papers that you will really be missing?

○ This sentence is consuming "We also conducted initial searches in Prospero to identify ongoing or planned reviews that might relate to our proposed research before undertaking the review.". Was this done to find out if another team is doing an umbrella review? Or if there are ongoing reviews of primary studies? If former, then this should be moved upwards. Either way, this needs to be rephrased for clarity.

○ You write, "Pre-review, we will develop a standardised Microsoft Excel form to extract data on each of the identified systematic reviews for our umbrella review". Should this not be available already?

○ Should quality assessment come before data extraction?

○ Please review the content being extracted from the reviews. You write "first author's name". Is it the name or surname or full name? It is not clear why the metrics such as nurse-to-patient ratios, nurse-to-bed ratios, or nursing hour per patient days need to be extracted from the primary studies. Do you want to maybe review this and fix it from the point of inclusion?

○ Please cite the approach being used for synthesis - narrative synthesis.

○ Clustered bar charts are also Figures. Is there a reason why this is being specified?

○ Please rewrite the discussion to reflect the global nature of this review of reviews. In addition, make a case for why it is important to conduct this review of reviews. What will it show differently compared to what the actual reviews will not show? You can also bring in your dissemination plan (which I suggested should be deleted from ethics above) here.

I hope you find these comments useful and look forward to the revised version. Very best wishes.

Is the rationale for, and objectives of, the study clearly described?

No

Is the study design appropriate for the research question?

Yes

Are sufficient details of the methods provided to allow replication by others?

Yes

Are the datasets clearly presented in a useable and accessible format?

Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Maternal Health; Health Policy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 14 Apr 2022

Abdulazeez Imam, University of Oxford, Oxford, UK

Reviewer: 2
[Aduragbemi Banke-Thomas, School of Human Sciences, University of Greenwich, London, UK]

We thank the reviewer for making time to read our manuscript and providing invaluable feedback. We have responded to all their comments and our responses come in italics under each specific comment

Comment 1: The title as written, "Nurse staffing and patient care outcomes: protocol for an umbrella review to identify evidence gaps for low and middle-income countries" might not be appropriate as you still collect data from HICs to identify gaps. This is more of a global review. Your review questions certainly do not suggest that this is a purely LMIC focused review. Please tweak the title to reflect the focus.

Thank you for this comment. We recognise the reviewer's concerns have now modified the title to: ***"Nurse staffing and patient care outcomes: protocol for an umbrella review to identify evidence gaps for low and middle-income countries in global literature".***

Comment 2: Please specify the period when you write "In recent times, the World Health Organization

We thank the reviewer for this comment and have now stated this. Please see introduction line 11.

Comment 3: For this statement, "Only 3% of the global nurses reside in Africa, which houses 17.2% of the world's population..". Rather than relating this to the population, please relate to the burden of disease, especially NCDs that need long term care for which nurses are particularly critical.

We thank the reviewer for this comment. We have now modified the introduction to include a statement relating the nursing crisis in LMICs to the burden of NCDs. Introduction lines 14 to 17.

Comment 4: Kindly motivate the introduction better to improve flow. This statement, "Nursing shortages, while prevalent in LMICs, also occur in high-income countries (HICs)..." shows the global reach of this planned review. Please structure the section in a way that shows the LMIC and HIC foci.

We thank the reviewer for this comment and have now restructured our introduction

5: A stronger case for this review of reviews is needed. You write that "Umbrella reviews provide broader and more complete evidence on specific topics[16]. They have also been previously shown to be an efficient way of summarising the evidence base for extensively researched topics, such as nurse staffing[1]". Can you evidence that nurse staffing is an example of an "extensively researched topic"? Yet you make a point already that this topic is minimally researched in LMICs. If it is not well sufficiently studied in LMICs, then a review of LMIC original papers will do. Summary: The rationale for an umbrella review does not come out clearly. Please review and rephrase.

We thank the reviewer for this comment. We have re-written this section to strengthen the rationale for an umbrella review. Please see the introduction, lines 35 to 45.

Comment 6: Ref 16 will be better as a methodology paper that describes the process of an umbrella review not an example of another one. Maybe consider using Ref 19 and deleting 16

This has now been modified.

Comment 7: You have cited JBI guidelines for umbrella reviews, registered with PROSPERO, and leveraged PRISMA-P. Good!

Thank you.

Comment 8: This statement "We hope to publish our findings in a peer-reviewed journal." has nothing to do with ethics. It is more about dissemination. Please remove or move elsewhere.

We thank the reviewer for this comment and have now edited this section to Ethics and dissemination.

Comment 9: Please align your methods to your research question and frankly the entire protocol (title, background, and methods). Under study design, you only talk about LMIC.

Elsewhere, you talk about LMIC and HIC. This is difficult to follow. Please be more consistent in this protocol

We thank the reviewer for this comment, and we have now checked we are consistent throughout the paper. We have edited our title and objectives to also reflect the global nature of the review.

Comment 10: The World Bank classification is fluid. Be specific with cut off date of definition where you write "LMIC in this paper will be defined using the World Bank's country and lending groups classification system, which classifies 135 countries into low-income, low-middle-income and upper-middle-income economies, based on gross national income per capita"

We thank the reviewer for this comment, and we have now amended this.

Comment 11: Please use evidence to justify your exclusion criteria. For example, you write, "We will however exclude systematic reviews of intensive care units, as the staffing of these units varies significantly from regular ward care settings..."

We thank the reviewer for this comment, and we have now amended this. Please see population, lines 81 to 83.

Comment 12: These sorts of protocols typically include their detailed search strategy across multiple databases, so this will not be needed with the same level of detail in the actual review. Please include the detailed search strategy across the different databases to be searched

We thank the reviewer for this comment, and we have included these searches in the extended data.

Comment 13: It might also be helpful to show how you have actually reached the search terms used. So, in essence, detail the piloting of the search strategy.

We have now detailed the piloting of our search strategy. Please see search strategy, lines 123 to 127.

Comment 14: Not sure if this will be possible in all cases "For those systematic reviews that combine both studies conducted in intensive care units and hospital ward settings". Please rethink.

We thank the reviewer for this comment and have now modified this statement to state: we would do this if feasible.

Comment 15: You write, "We will exclude systematic reviews which investigated the impact of other staffing metrics, for example, nursing skill mix and nursing work schedules on patient care outcomes". Please explain why.

We thank the reviewer for this comment. These are other nurse metrics rather than staffing metrics; we have corrected this and stated the focus of our review is on nurse staffing. Please see exposure, lines 94 to 96.

Comment 16: This is not clear, "...due to limitations in translation". Do you mean no services available? Or no one on the team can translate? Please think about this a bit more. Are there actually papers that you will really be missing?

We thank the reviewer for this comment. We have clarified this as a limitation in the translation capacity of the research team.

Comment 17: This sentence is consuming "We also conducted initial searches in Prospero to identify ongoing or planned reviews that might relate to our proposed research before undertaking the review.". Was this done to find out if another team is doing an umbrella review? Or if there are ongoing reviews of primary studies? If former, then this should be moved upwards. Either way, this needs to be rephrased for clarity.

We thank the reviewer for this comment. This was done to identify ongoing or planned reviews and we have now moved this earlier on in our protocol. Please see search strategy, lines 119 to 121.

Comment 17: You write, "Pre-review, we will develop a standardised Microsoft Excel form to extract data on each of the identified systematic reviews for our umbrella review". Should this not be available already

We have now corrected this statement.

Comment 18: Should quality assessment come before data extraction?

We thank the reviewer for this comment and have now corrected this.

Comment 19: Please review the content being extracted from the reviews. You write "first author's name". Is it the name or surname or full name? It is not clear why the metrics such as nurse-to-patient ratios, nurse-to-bed ratios, or nursing hours per patient days need to be extracted from the primary studies. Do you want to maybe review this and fix it from the point of inclusion? Clustered bar charts are also Figures. Is there a reason why this is being specified?

We thank the reviewer for this comment and have now corrected this to surname. We also plan to extract the staffing metrics from review summary tables of primary articles and if these are not presented, extract them from the cited primary studies. Please see data items section.

Comment 20: Clustered bar charts are also Figures. Is there a reason why this is being specified?

This has been corrected to tables and figures.

> Comment 21: Please rewrite the discussion to reflect the global nature of this review of
> reviews. In addition, make a case for why it is important to conduct this review of reviews.
> What will it show differently compared to what the actual reviews will not show? You can
> also bring in your dissemination plan (which I suggested should be deleted from ethics
> above) here.
>
> *This has now been revised and the importance of conducting a review of reviews has been*
> *emphasized. Please see discussion lines 175 to 190.*
>
> **Competing Interests:** No competing interests

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✓   **Denny John** 🆔

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The authors have used standard guidelines for umbrella reviews, registered with PROSPERO, and also mentioned use of the AMSTAR-2 checklist for assessing quality of systematic reviews. However, for patient reported outcomes some reviews might come from cost-effectiveness studies where the CiCERO might be useful (Mandrik *et al.*, 2021[1]).

The authors are also suggested to use the PRISMA-S checklist during the final review process to report search strategy details.

References
1. Mandrik OL, Severens JLH, Bardach A, Ghabri S, et al.: Critical Appraisal of Systematic Reviews With Costs and Cost-Effectiveness Outcomes: An ISPOR Good Practices Task Force Report.*Value Health*. **24** (4): 463-472 PubMed Abstract | Publisher Full Text

Is the rationale for, and objectives of, the study clearly described?
Yes

Is the study design appropriate for the research question?
Yes

Are sufficient details of the methods provided to allow replication by others?
Yes

Are the datasets clearly presented in a useable and accessible format?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Evidence synthesis, health technology assessment, public health in developing countries.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.