This is a repository copy of *Contextually appropriate nurse staffing models: a realist review protocol*.

White Rose Research Online URL for this paper:
https://eprints.whiterose.ac.uk/212617/

Version: Published Version

Article:
Tate, K. orcid.org/0000-0002-3711-7515, Penconek, T., Booth, A. orcid.org/0000-0003-4808-3880 et al. (7 more authors) (2024) Contextually appropriate nurse staffing models: a realist review protocol. BMJ Open, 14 (5). e082883. ISSN 2044-6055

https://doi.org/10.1136/bmjopen-2023-082883

Reuse
This article is distributed under the terms of the Creative Commons Attribution-NonCommercial (CC BY-NC) licence. This licence allows you to remix, tweak, and build upon this work non-commercially, and any new works must also acknowledge the authors and be non-commercial. You don't have to license any derivative works on the same terms. More information and the full terms of the licence here: https://creativecommons.org/licenses/

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk/

BMJ Open

Contextually appropriate nurse staffing models: a realist review protocol

Kaitlyn Tate ,[1] Tatiana Penconek,[1] Andrew Booth,[2] Gillian Harvey ,[3] Rachel Flynn,[4] Pieterbas Lalleman,[5] Inge Wolbers,[6] Matthias Hoben,[7] Carole A Estabrooks ,[1] Greta G Cummings,[1] ReSoNANCE (Realist Synthesis of Nursing in Australia Netherlands Canada and England)[8]

To cite: Tate K, Penconek T, Booth A, *et al*. Contextually appropriate nurse staffing models: a realist review protocol. *BMJ Open* 2024;**14**:e082883. doi:10.1136/bmjopen-2023-082883

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2023-082883).

Received 05 December 2023
Accepted 08 April 2024

Check for updates

© Author(s) (or their employer(s)) 2024. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to
Dr Greta G Cummings;
gretac@ualberta.ca

ABSTRACT

Introduction Decisions about nurse staffing models are a concern for health systems globally due to workforce retention and well-being challenges. Nurse staffing models range from all Registered Nurse workforce to a mix of differentially educated nurses and aides (regulated and unregulated), such as Licensed Practical or Vocational Nurses and Health Care Aides. Systematic reviews have examined relationships between specific nurse staffing models and client, staff and health system outcomes (eg, mortality, adverse events, retention, healthcare costs), with inconclusive or contradictory results. No evidence has been synthesised and consolidated on how, why and under what contexts certain staffing models produce different outcomes. We aim to describe how we will (1) conduct a realist review to determine how nurse staffing models produce different client, staff and health system outcomes, in which contexts and through what mechanisms and (2) coproduce recommendations with decision-makers to guide future research and implementation of nurse staffing models.

Methods and analysis Using an integrated knowledge translation approach with researchers and decision-makers as partners, we are conducting a three-phase realist review. In this protocol, we report on the final two phases of this realist review. We will use **C**itation tracking, tracing **L**ead authors, identifying **U**npublished materials, Google **S**cholar searching, **T**heory tracking, ancestry searching for **E**arly examples, and follow-up of **R**elated projects (CLUSTER) searching, specifically designed for realist searches as the review progresses. We will search empirical evidence to test identified programme theories and engage stakeholders to contextualise findings, finalise programme theories document our search processes as per established realist review methods.

Ethics and dissemination Ethical approval for this study was provided by the Health Research Ethics Board of the University of Alberta (Study ID Pro00100425). We will disseminate the findings through peer-reviewed publications, national and international conference presentations, regional briefing sessions, webinars and lay summary.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is a multinational project (Australia, Canada, The Netherlands, UK), including teams with many similarities and dissimilarities to support comparative consideration of a range of healthcare contexts and varying perspectives on hidden mechanisms and their operation.
⇒ This study is led by a team of substantive experts, methodologists in realist methods and health system decision-makers across four countries, thereby supporting a rigorous integrated knowledge translation approach.
⇒ Our findings will be limited to high-income countries.

INTRODUCTION

The nursing profession is the largest healthcare profession globally, making nurse staffing one of the most significant costs of healthcare systems around the world.[1–3] At the same time, demands for nurses are increasing due to demographic changes, including ageing populations worldwide.[3–5] The COVID-19 pandemic has exposed many long-standing nursing workforce issues such as high turnover that, unattended to prepandemic, contributed to a critical nursing shortage.[6] Nursing shortages, staffing reductions due to fiscal constraints, and high rates of burnout and turnover compound healthcare costs and lead to suboptimal client health outcomes.[7 8] Effective nursing care enhances client health outcomes and health system productivity and reduces costs through lower rates of infections, client complications and other adverse client events.[2 9 10] This makes decisions about nurse staffing one of the most critical decisions for health system managers and policymakers. Providing safe and efficient healthcare relies on effective and economical nurse staffing, yet within modern health systems, decision-makers, researchers and nurses struggle to agree on what that means and looks like.[3 11] The current state of evidence gives no clear direction on how to make decisions about appropriate nurse staffing levels, including staff/skill mix, which is broadly defined as the combination or grouping of different categories of healthcare workers employed to

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

provide care to clients.[12] This lack of a long-term workforce strategy is a serious concern for healthcare systems globally and was identified by the European Commission as *the* most significant threat to some national health services, even pre-pandemic.[3 8 13]

Over the past two decades, considerable research on nurse staffing models and the impact of Registered Nurse (RN) staffing on client health outcomes has been conducted in various countries.[10 14–17] Despite over two decades of research synthesis (at least 25 systematic reviews)[18–42] to measure how nurse staffing models impact client, staff and economic outcomes, findings are inconclusive and lack contextualisation. Although work is underway (involving one of our team members) that synthesises the available quantitative evidence on interactions between nurse staffing and organisational context variables,[43] this work does not include qualitative studies or theoretical papers, and it does not aim to comprehensively unpack the mechanisms, or human responses, through which these contexts produce particular outcomes. Based on that work, we will not know how and why and under what contexts certain nurse staffing models produce different outcomes. The aforementioned review is complementary with our proposed realist review, though, and we will examine the relevant studies and the review's findings, applying our realist lens.

Nurse staffing models inform deployment of both regulated nurses (ie, being subject to the standards and laws defining specific healthcare professional group's education level, practice requirements and other measures)[44] and unregulated nurse staff with varying levels of education (table 1). A key feature of nurse staffing models is staff/skill mix—the number and type of care staff (which can include regulated and unregulated staff) whose roles are differentiated by levels of education. Two predominant schools of thought have emerged in advocating for a particular staff/skill mix: (1) employing more RNs with higher education and more experience reduces client mortality, infection rates, client complications, other adverse events (such as falls and medication errors) and related costs[8 10 45] and (2) strategically 'ensuring the right people, with the right skills, are in the right place at the right time' enables optimal outcomes for clients, healthcare professionals and health systems (primarily labour costs and value for investment).[46 47] Complex health environments, and current drivers of cost-containment and self-preservation, speak to the importance of determining the 'best' nurse staffing model to achieve 'optimum' client, staff and health system outcomes within each of the diverse contexts in which healthcare is delivered.[48]

Rationale

Many systematic reviews and meta-analyses of nurse staffing models have attempted to determine the relationships between different nurse staffing models and client health outcomes, without conclusive results. Some reports find significant relationships between higher nurse staffing levels, higher educated nurses and better client health outcomes (eg, lower failure to rescue rates, lower mortality, fewer adverse events).[9 45] Other findings are contradictory, insignificant or equivocal.[19 49] Contextual factors such as economic climate and surrounding regulatory environments (regional, national, organisational), which are historically grounded, confound the

Table 1 Important terms

Term	Definition
Nurse staffing models	Systems for organising and delivering nursing care to clients and their families. A key component of these models is **staff/skill mix,** which is broadly defined as the combination or grouping of different categories of healthcare workers employed to provide care to clients.[75 76] It includes the number and type of staff (regulated and unregulated) in different care roles.
Nursing designations*	**Nurse practitioners**, who are typically Masters degree prepared and in a category of advanced practice nurses that also include c**linical nurse specialists** and **nurse educators**; **registered nurses**, who are generally Baccalaureate degree prepared, but may hold a diploma; **registered psychiatric nurses**, who may hold a diploma or baccalaureate degree; this designation is distinct from **registered practical nurses, licensed practical nurses** or **enrolled nurses**, who typically hold a community college diploma or vocational training; and unregulated **healthcare aides/assistants**, who may hold a certificate ranging anywhere from 6 to 24 months.[77 78]
Context	The social and physical conditions in which mechanisms operate.[79] It encompasses locations, roles, relationships and interactions in which programmes or interventions are situated, and comprises 'characteristics and circumstances consist(ing) of active and unique factors'.[80]
Mechanisms	The 'underlying entities, processes or [social] structures which operate in particular contexts of interest'.(p. 368)
Outcomes	Include client health outcomes (eg, adverse events, satisfaction with care), healthcare professional outcomes (eg, turnover, empowerment, burnout) and health system outcomes (eg, labour/healthcare cost).

*This is not a comprehensive list of nursing designations. Instead, we highlight examples of ones commonly reported on in the research literature[77] or ones that often conflated with other designations in one or more of the regions of our study team.

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

impact of various nurse staffing models, making nurse staffing models considerably more complex than a simple formula or ratio of staff to clients.[50 51] Complex problems such as these are non-linear, ambiguous and cannot be resolved with generalisable certainty—they require an understanding of distinct, local contexts to be effectively addressed.[50] Moreover, the complexity of nurse staffing models means that the same model may lead to different outcomes depending on additional factors such as characteristics and needs of clients and their family/friend caregivers; the availability of non-nursing staff (eg, medical, allied healthcare professionals, unit/ward clerks, other support staff); structures of and processes within the healthcare facility/building, organisation or health authority and healthcare professional characteristics and their perspectives on best care practices. Global policy reports identify the critical need to consider contextual factors in formulating appropriate nursing workforce policy and health system guidelines, which can support more robust causal explanations of optimal nurse staffing models.[12 52–54]

The realist review

Realist reviews seek to answer questions of *what works, for whom, in what circumstances, how and why* by expanding the common causal model in which intervention X leads to a given outcome (O). Realism asks what contexts (C) and mechanisms (M) allow X to lead to O, so the X-O model becomes a CMO model.[55] This CMO model enables the realist review process to be contextually sensitive and exploratory. This is necessary when a topic is under-theorised and the literature is inconclusive, as in nurse staffing models. To address complex problems pragmatically in the real world, a focus on context is essential to avoid unintended consequences and differential outcomes. Contexts include social, economic and political structures; healthcare settings; organisational settings or social conditions (eg, leadership, team interactions); programme participants (eg, clients); programme staffing and experience; and geographical, cultural[56] and historical context.[57] Mechanisms (eg, clinical judgement, nurse surveillance) are not directly observable but may be explored through theory building and theory testing.[58 59] We anticipate that the outcomes considered in this review will include client health outcomes (eg, failure to rescue rates, mortality, adverse events, satisfaction with care, quality of life); healthcare professional outcomes (eg, turnover, empowerment, retention, burnout, satisfaction with working conditions, use of research evidence) and health system outcomes (eg, labour/healthcare cost).

From a realist perspective, a nurse staffing model includes an explicit, as well as often implicit, logic of what responses it will produce, in identified contexts and through particular mechanisms. In realist approaches, this logic model can be referred to as a programme theory. We will identify and evaluate various programme theories through a realist review. The realist review method is rooted in the realist philosophy of science, which recognises that our knowledge of the world can be improved but is always filtered through human senses, relationships, institutions, languages and cultures.[58] Rather than determining whether a specific intervention (in this case, a nurse staffing model) works within tightly controlled circumstances, we will map and test specific understandings of what works and how it works, within diverse circumstances. Realist review is a method by which we *learn from*, rather than *control for*, real-world phenomena and unexpected human actions.

Conventional systematic reviews strip away context, and, therefore, do not consider the messiness of real-life implementation in complex healthcare delivery.[60] These reviews do not adequately account for (a) varied evidence from different disciplines (eg, behavioural models in sociology and psychology); (b) diversity of terminology associated with nurse staffing models (such as those related to designations, roles within the nurse staffing models and those related to healthcare programmes and systems in varying regions); (c) ambiguity and complexity of mechanisms of causation associated with nurse staffing models and (d) the influence of contextual factors, including structure of the healthcare system, on staffing model characteristics, performance and effectiveness. A previous realist evaluation offers a tentative model to understand the complexities of nurse staffing but is limited by its focus on supposed outcomes rather than on the complexity of mechanisms within nurse staffing models that produce those outcomes.[59]

Purpose and research questions

To use the vast amount of nursing research already completed, we are conducting a realist review to (1) examine in which contexts and through what mechanisms nurse staffing models produce client, staff and health system outcomes in health settings (in-patient and out-patient settings including acute care settings (ED and in hospital), primary care settings, community care settings, palliative care settings, transitional or rehabilitation care settings and continuing care settings)[55 58 61] and (2) coproduce contextualised recommendations for policy and practice with decision-makers to guide future research and implementation of nurse staffing models across different health systems.

To achieve these aims, we seek to address the following research questions:

1. What theories underlie the development of nurse staffing models within interdisciplinary teams?
2. In which contexts and by what mechanisms do various staffing models produce outcomes for clients (eg, failure to rescue rates, mortality, adverse events, satisfaction with care, quality of life); healthcare professionals (eg, turnover, empowerment, retention, burnout, satisfaction with working conditions, use of knowledge and best practices); and health systems (eg, labour/healthcare cost, integration of teams)?

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

Research team

Our research team encompasses Canadian, Australian, Dutch and British health services researchers, senior knowledge users, academic leaders and trainees, with substantive, experiential and methodological expertise related to nurse staffing models and realist approaches. Many research team members are also RNs with clinical background in various settings (eg, long-term care, home and community care, acute and critical care settings). We created this four-country team to build on established collaborative relationships and to bring critical expertise to this research. Our international team spans both similarities and dissimilarities to support comparative consideration of diverse healthcare contexts and varying perspectives on causal mechanisms and their operation in those contexts. A Royal College of Nursing funded scoping review of nursing skill mix and client outcomes, completed by our British team, identified current conceptual models of nurse staffing and the effect of RN staffing on outcomes such as client mortality, missed care and workplace injuries.[62] This offers a valuable starting point for conceptualising how nurse staffing models work, which informed the development of initial programme theories in the previous phase of this work, reported on elsewhere.

METHODS AND ANALYSIS

Design

Using an integrated knowledge translation (iKT) approach with researchers and decision-makers as partners,[63] we are conducting a three-phase realist review using established methods[64] (figure 1). Each phase informs the next phase. We report on the proposed procedures for phases 2 and 3 in this protocol, specifically stages 4, 5 and 6 within these phases as described in figure 1. The work described in this protocol began in January 2023 and the anticipated end date is December 2024.

Completed phase 1 (stages 1–3)

Our research team identified candidate initial programme theories through literature review and focus groups with relevant stakeholders. Specifically, we presented findings of an initial search to stakeholders in Edmonton (Canada), Adelaide and Melbourne (Australia), South Yorkshire (UK) and various regions of The Netherlands, via these focus groups to (a) expand on and refine context-mechanism-outcome configurations and (b) prioritise initial programme theories to focus on in the subsequent search in phase 2.

Protocol for phase 2 (stages 4–6)

Search strategy

To locate empirical examples of nurse staffing models for testing and refining candidate programme theories (stage 4), we will conduct purposive search strategies. Revised searches in MEDLINE and de novo searches in other databases (Ovid Embase, EBSCOhost CINAHL, Web of Science, Scopus) will include database-appropriate subject headings, search terms from core articles and consider suggestions from the stakeholders. Resulting strategies will be submitted for feedback and confirmation from an experienced information specialist (eg, search strategy in online supplemental file 1).

We will use **C**itation tracking, tracing **L**ead authors, identifying **U**npublished materials, Google **S**cholar searching, **T**heory tracking, ancestry searching for **E**arly examples, and follow-up of **R**elated projects (CLUSTER) searching, specifically designed for realist searches, as the review progresses.[65] We will retrieve grey literature and regulatory/policy documents through diverse approaches: searches in bibliographic databases,

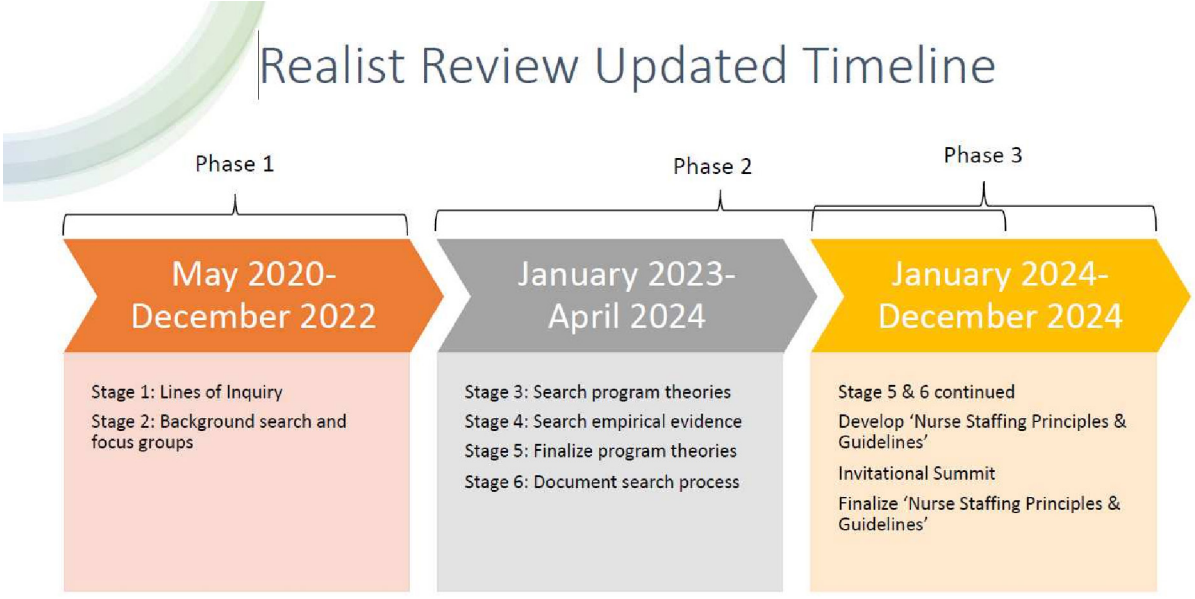

Figure 1 Realist review phases and timelines.

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

web engine searches and examination of websites of organisations concerned with nurse staffing (eg, nursing unions).

To create a manageable workload, each country team will focus on a programme theory for a nursing specialty area or line of enquiry most relevant to their team members' substantive expertise (eg, quality and safety in nursing care, clinical leadership and nursing governance, workforce planning), as prioritised from phase 1. Review team members will select literature against explicit eligibility criteria relevant to one of four prioritised initial programme theories, which are specified in part B of the inclusion and exclusion criteria table (box 1; online supplemental file 2). These four targeted search approaches will continue until theoretical saturation is achieved. We will also identify 'landmark' texts and main research traditions associated with staffing models and then annotate selected texts to create an evidence framework. We will prioritise studies of higher relevance within geographical regions of research team members: North America, Europe and Australasia.

Screening procedures

Study articles will be divided based on relevant CMO configuration, with each country team leading the examination of one of four CMO configurations. For each country, two independent reviewers will screen each abstract. Consensus meetings will be held to resolve any conflicts. Similar procedures will be followed for full-texting screening.

Quality appraisal

The research team will use published methods to determine thresholds for richness, relevance and rigour for each identified candidate theory as applied to the identified empirical studies.[66] This will allow us to explore confirmatory and contradictory findings in relation to our hypotheses.[67] When examining relevance, richness and rigour, we will adapt study appraisal questions previously employed by Jagosh *et al* to determine richness of description for nurse staffing models and completeness of available study materials.[68] Quality appraisal in realist reviews is interpretive, when included. No articles will be excluded based solely on study quality. Articles will be appraised by reviewers independently using the 'traffic light system', proposed by Morton *et al*,[69] in which articles are appraised as having minor (green), moderate (yellow) and major (red) concerns in terms of richness (ie, the degree of theoretical and conceptual development that explains how an intervention is expected to work based on grounded and detailed descriptions), relevance (ie, whether the data can contribute to theory building and/or testing for included contexts/regions) and rigour (ie, the trustworthiness of the source and coherence/transparency of theory).[66 70] Consensus meetings will be held to resolve any discrepancies between reviewers.

Box 1 Inclusion criteria

Part A: Must include 1 and 2 and must include either 3 or 4 or 5 or 6

1. A nurse staffing model (which may include other healthcare professionals) conceptualised, developed, implemented or evaluated in any of the following health settings (in-patient and out-patient settings including acute care settings (ED and in hospital)), primary care settings, community care settings, palliative care settings, transitional or rehabilitation care settings and continuing care settings).
2. A nurse staffing model conceptualised, developed, implemented or evaluated in high-income countries based on World Bank income groups (https://data.worldbank.org/income-level/high-income).
3. The main focus of the paper is to include a formal or substantive theory, mid-range theory, theoretical/conceptual framework that describes how nurse staffing models are intended to work.
4. The main focus of the paper is to review/provide ideas about how nurse staffing models are intended to work or provide a critique of the ideas underlying how nurse staffing models are intended to work.
5. The main focus of the paper is to provide stakeholder accounts or opinions of how nurse staffing models do OR do not work.
6. The main focus of the paper is to outline, discuss or review potential unintended consequences of nurse staffing models.

Part B: The following are inclusion criteria for each CMO configuration that must be included in addition to those mentioned in part A.

For the Australian team and CMO configuration 1

1. Empirical evidence, that is relevant, rich and robust and supports, challenges or gives insight into a nurse staffing model that uses fixed minimum nurse-to-patient ratios, with higher ratios of (qualified) nurses to nursing assistants and support workers, as mandated by legislation (context), which could lead to enhanced nurse competence and rapid and appropriate responses (mechanisms) improving the work environment, client outcomes and nurse recruitment and retention (outcomes).

For the Canadian team and CMO configuration 2,

2. Empirical evidence that is relevant, rich and robust and supports, challenges or gives insight into a nurse staffing model that has sufficient RN staffing who have the appropriate skillset, experience and knowledge (maximising the efficiency of team in a fiscally responsible way; safe nurse to patient ratio dependent on the acuity of the patients) with a complement of assistive nursing personnel who also have the appropriate training or skillset for the work place (context), which leads to Registered Nurse (RNs) feeling more supported in greater responsibilities, confident in their work, spending less time on non-nursing tasks, working relations among the staff are emphasised, and perceptions of sufficient staffing may improve to reduce stress among staff (mechanisms), which will improve staff outcomes, quality of care and lower hospital costs (outcomes).

AND/OR

3. For rival programme theory* CMO configuration 2, empirical evidence, that is relevant, rich and robust and supports, challenges or gives insight into a nurse staffing model that has sufficient RN staffing who have the appropriate skillset, experience and knowledge (maximising the efficiency of team in a fiscally responsible way; safe nurse to patient ratio dependent on the acuity of the patients) with a complement of assistive nursing personnel who also have the appropriate training or skillset for the work place (context), then RNs will feel like they are not engaging in relational practice, will worry about appropriate task sharing with LPNs, and will feel that the support by assistive personnel is not

Continued

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

Box 1 Continued

adequate or appropriate for acutely unwell patients (eg, neuro patients) (mechanisms), which will lead to decreased job satisfaction, lack of role clarity and duplication of tasks, respectively (outcomes).
For the UK team and CMO configuration 3,
1. Empirical evidence, that is relevant, rich and robust and supports, challenges or gives insight into a nurse staffing model, which increases the proportion of assistive nursing personnel in acute care (context), then nurses with professional knowledge will feel overburdened (mechanism), leading to lower quality of care, turnover, poor staff outcomes and increased cost (outcomes).
For the Netherlands team and CMO configuration 4,
1. Empirical evidence, that is relevant, rich and robust and supports, challenges or gives insight into a nurse staffing model that frequently uses non-full time and temporary nurses who are unfamiliar with a unit (context), then this threatens care continuity and permanent RN staff will feel overburdened and demotivated (mechanisms), leading to poor teamwork, burnout, more adverse events, longer hospital stays and increase costs (outcomes).

*This CMO configuration has a rival theory derived from the results of phase 1 of this realist review, in which rival CMO configurations were derived from the research literature and augmented and refined through focus groups with relevant stakeholders and team discussions.

Data extraction procedures

We will extract relevant data using a standardised data extraction form developed and refined in conjunction with the literature search and through ongoing team meetings. Data will be extracted according to key realist components of context, mechanisms and outcomes, with added granularity supplied from the identified nurse staffing models.[71] Of note, we will ensure to extract specific information about educational level and distinctions of particular nurse designations in the local context described. Methodologists on our team will meet together and with each country team before extraction to ensure a shared understanding of terms, concepts and processes required for extraction. At least three independent reviewers will be on each team (including one trainee). A small set of initial extractions from each set of reviewers will be cross-checked by a methodologist to ensure a shared understanding of the process. Consensus meetings will be held between reviewers to resolve discrepancies through discussion.

Data synthesis procedures

The resulting data extraction meta-framework will be used for data synthesis. The standardised extraction template will ensure that data are collected and synthesised in a consistent way to optimise comparisons between nurse staffing models.[66] Realist synthesis is an interpretive, cyclic process that integrates evidence by cross-referencing extracted data and generating CMO configurations.[72] The research team will review and synthesise extracted data elements to examine how context influences outcomes via the activation of mechanisms. Members from each country team will review, compare, merge and refine ad then collapse similar CMO configurations that support, refute or are unaligned with the programme theories being tested. Contextualised action points will be presented in the form of 'If A then B' or 'If C occurs, then D is unlikely to result'.[55] Hypothetical examples might be 'When length of service is longer and inadequate staffing is reported, higher rates of emotional exhaustion and job dissatisfaction lead to intent to leave the profession' or 'If nurses are more experienced, then through better clinical judgement, timely intervention and lower rates of failure to rescue will occur'.[59] We will follow-up on reference theories, linking empirical cases to their supporting conceptual bases.[65 73] Research team meetings will be held to discuss and obtain consensus on the findings. Involvement of knowledge-user team members in these meetings will keep our findings actionable and aid in contextualising findings (ie, by clarifying the meaning of nursing designations related to scope of practice and training in particular contexts). Through this iterative synthesis process, our initial programme theories will be refined (stage 5).

Protocol for phase 3 (stages 5 and 6 continued)

During the final stages of evidence synthesis and analysis, in which we finalise programme theories (stage 5) and document search processes (stage 6), additional literature searches will target remaining gaps in the evidence. Intensity sampling through focused searches will be employed to identify where robust research has been produced for particular contexts (eg, nurse staffing for adult critical care, or for older adults in long-term care settings).[74] Involvement of knowledge-user team members in follow-up focus groups or knowledge sharing workshops will keep our findings actionable, with clear contextualised findings that can be translated into practice. We will conduct a 2-day face-to-face meeting of team leads, to synthesise findings, identify mechanisms that are transferable across contexts (eg, engaging in reciprocal professional relationships)[18] and draw preliminary conclusions for practice recommendations. This meeting of team leads will result in the development of contextualised *Recommendations for Policy and Practice: Nurse Staffing Principles and Guidelines*. We will document search terms and sources to expedite verification and to permit updating of the evidence base within and even beyond this project. All search strategies will be made publicly available via Figshare, an online open access data repository (https://figshare.com/) to facilitate future replication.

Patient and public involvement

None.

iKT approach

No patients are involved in this study. However, we will involve (and have involved) key stakeholders (decision-makers, healthcare managers) as needed at various phases of this realist review process. We interacted with participant stakeholders iteratively to refine our research questions, and prioritise context-mechanism-outcome

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

configurations. In phase 1 of this review, we held two focus group discussions in each country with key stakeholders (eg, executive directors, policy makers, healthcare managers at low, middle and upper levels). Senior health decision-makers in our team facilitated recruitment of key stakeholders by sending information letters via email to relevant stakeholders mailing lists. We presented findings of our initial literature search to stakeholders in Edmonton, Adelaide and Melbourne, Sheffield and Utrecht via these focus groups to (a) determine which theories to focus on, (b) refine our research question and (*c*) specify contexts, mechanisms and outcomes for data extraction in subsequent stages. We also asked them to articulate the factors they consider in implementing nurse staffing models, and their reasoning on why certain nurse staffing models produce expected and unexpected outcomes in particular contexts. These focus group discussions helped in (a) examining the integrity of a specific nurse staffing model, (b) comparing rival theories, (c) reviewing the same theory in comparative settings and (d) reviewing official expectations against actual practice. In phase 3, as a part of our initial activity, we will conduct repeat focus groups, one each in Australia, Edmonton, Sheffield and Utrecht. During these focus groups, we will present findings to local stakeholders, generate and refine recommendations based on our conclusions and gather feedback to ensure applicability of our recommendations. Involvement of knowledge-user team members in follow-up focus groups will keep our findings actionable, with clear contextualised findings that can be translated into policy and practice.

Ethics and dissemination

We obtained ethical approval from the Health Research Ethics Board of the University of Alberta (Study ID Pro00100425). We will disseminate the findings through peer-reviewed publications, national and international conference presentations, regional briefing sessions (eg, for EU policy makers through the White Rose Networks http://wrocah.ac.uk/collaborations/networks/) and webinars. We will prepare a lay summary of the findings for our knowledge users, present these findings to local stakeholders, generate and refine recommendations based on our conclusions and gather feedback to ensure applicability of our recommendations. Furthermore, our findings will allow us to produce *Recommendations for Policy and Practice: Nurse Staffing Principles and Guidelines* with our health system decision-makers and collaborators from four countries (Canada, Australia, United Kingdom, Netherlands) that will guide decision-making on the deployment of nursing roles across diverse healthcare contexts to achieve better healthcare outcomes.

Author affiliations
[1]College of Health Sciences, Faculty of Nursing, University of Alberta, Edmonton, Alberta, Canada
[2]School of Medicine and Population Health, University of Sheffield, Sheffield, UK
[3]College of Nursing and Health Sciences, Flinders University, Adelaide, South Australia, Australia
[4]School of Nursing and Midwifery, University College Cork, Cork, Ireland
[5]Fontys University of Applied Science, Eindhoven, Netherlands
[6]University of Applied Sciences Utrecht, Utrecht, Netherlands
[7]School of Health Policy and Management, York University, Toronto, Ontario, Canada
[8]Realist Synthesis of Nursing in Australia Netherlands Canada and England, Edmonton, Alberta, Canada

X Gillian Harvey @GillHar26

Collaborators The authors acknowledge the active partnership and full contribution of the research team of decision-makers and researchers as listed below: Principal Applicants & Project Advisory Team Greta Cummings, Nominated Principal Applicant, University of Alberta. Christy Raymond, Principal Applicant, MacEwan University. Alison Kitson, Principal Applicant, Flinders University. Gillian Harvey, Principal Applicant, Flinders University. Pieterbas Lalleman, Principal Applicant, Fontys University. Lisette Schoonhoven, Principal Applicant, University of Applied Science Utrecht. Andrew Booth, Principal Applicant, The University of Sheffield. Tony Ryan, Principal Applicant, The University of Sheffield. Kaitlyn Tate, Principal Applicant, University of Alberta. Independent Researcher Co-Applicants Carole Estabrooks, Co-Applicant, University of Alberta. Malcolm Doupe, Co-Applicant, University of Manitoba. Matthias Hoben, Co-Applicant, York University. Rachel Flynn, Co-Applicant, University College Cork. Steve Robertson, Co-Applicant, The University of Sheffield. Angela Tod, Co-Applicant, The University of Sheffield. Tim Schultz, Co-Applicant, Flinders University. Catharina J van Oostveen, Co-Applicant, Erasmus University. Knowledge User Co-Applicants Alison Hutchinson, Co-Applicant, Deakin University. Sean Chilton, Co-Applicant, Alberta Health Services. Deb Gordon, Co-Applicant, Alberta Health Services. Mike Villeneuve, Co-Applicant, Canadian Nurses Association (Ottawa)/Association des infirmières et infirmiers du Canada (Ottawa). Wilma Jackson, Co-Applicant, Elisabeth-Tweestedenziekenhuis Hospital. Dewi Stalpers, Co-Applicant, Dutch Hospital Association and St. Antonius Hospital. Sam Debbage, Co-Applicant, Doncaster and Bassetlaw NHS Teaching Hospitals Foundation Trust. Trainees & Staff Inge Wolbers, Doctoral Trainee, University of Applied Science Utrecht. Tatiana Penconek, Doctoral Trainee, University of Alberta. Sadie Deschenes, PhD, University of Alberta. Patrick Chiu, PhD, University of Alberta. Additional MembersCandice Oster, Flinders University. Lemma Bulto, Flinders University. Katherine Jones, The University of Sheffield.

Contributors KT, TP, AB, GH, RF, PL, IW, MH, CAE, GGC and members of the ReSoNANCE (Realist Synthesis of Nursing in Australia Netherlands Canada and England) group contributed to the conceptualisation, writing, review and/or editing of the manuscript.

Funding This study was funded by a grant from the Canadian Institutes of Health Research (#169127) to Greta G. Cummings.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer-reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iDs
Kaitlyn Tate http://orcid.org/0000-0002-3711-7515
Gillian Harvey http://orcid.org/0000-0003-0937-7819
Carole A Estabrooks http://orcid.org/0000-0002-4753-6510

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

REFERENCES

1 Spetz J. The cost and cost-effectiveness of nursing services in health care. *Nurs Outlook* 2005;53:305–9.
2 Aiken LH, Cimiotti JP, Sloane DM, *et al*. The effects of nurse staffing and nurse education on patient deaths in hospitals with different nurse work environments. *Med Care* 2011;49:1047–53.
3 van Oostveen CJ, Mathijssen E, Vermeulen H. Nurse staffing issues are just the tip of the iceberg: a qualitative study about nurses' perceptions of nurse staffing. *Int J Nurs Stud* 2015;52:1300–9.
4 Rumbold BE, Smith JA, Hurst J, *et al*. Improving productive efficiency in hospitals: findings from a review of the International evidence. *Health Econ Policy Law* 2015;10:21–43.
5 Barua B, Hasan S, Timmermans I. *Comparing Performance of Universal Health Care Countries*. Fraser Institute, 2017.
6 Murphy GT, Sampalli T, Bourque Bearskin L, *et al*. Investing in Canada's nursing workforce post-pandemic: A call to action. *FACETS* 2022;7:1051–120.
7 Roche MA, Duffield CM, Homer C, *et al*. The rate and cost of nurse turnover in Australia. *Collegian* 2015;22:353–8.
8 O'Brien-Pallas L, Tomblin Murphy G, Shamian J. *Final Report: Understanding the Costs and Outcomes of Nurses' Turnover in Canadian Hospitals*. University of Toronto: Nursing Health Services Research Unit, 2008.
9 Lankshear AJ, Sheldon TA, Maynard A. Nurse staffing and Healthcare outcomes: a systematic review of the International research evidence. *ANS Adv Nurs Sci* 2005;28:163–74.
10 Aiken LH, Sloane DM, Bruyneel L, *et al*. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet* 2014;383:1824–30.
11 van der Mark C, Bitter J, Hendriks PHJ, *et al*. The nurse perceived adequacy of staffing scale for general hospital wards: a development and psychometric validation study. IJNS 2023;5:100138.
12 Buchan J. Determining skill mix: lessons from an international review. Human Resources for Health Development Journal; 1999.
13 OECD/European Observatory on Health Systems and Policies. *State of Health in the EU: United Kingdom Country Health Profile 2017*. Brussels: OECD Publishing, 2017.
14 Aiken LH, Clarke SP, Cheung RB, *et al*. Educational levels of hospital nurses and surgical patient mortality. *JAMA* 2003;290:1617–23.
15 Aiken LH, Clarke SP, Sloane DM, *et al*. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA* 2002;288:1987.
16 Needleman J, Buerhaus PL, Mattke S, *et al*. Nurse staffing levels and the quality of care in hospitals. *N Engl J Med* 2002;346:1715–22.
17 Sherenian M, Profit J, Schmidt B, *et al*. Nurse-to-patient ratios and neonatal outcomes: a brief systematic review. *Neonatology* 2013;104:179–83.
18 Currie J, Chiarella M, Buckley T. Realist evaluation of privately practising nurse practitioners in Australia: development and refinement of theories. *Collegian* 2019;26:8–15.
19 Backhaus R, Verbeek H, van Rossum E, *et al*. Nurse staffing impact on quality of care in nursing homes: a systematic review of longitudinal studies. *J Am Med Dir Assoc* 2014;15:383–93.
20 Bostick JE, Rantz MJ, Flesner MK, *et al*. Systematic review of studies of staffing and quality in nursing homes. *J Am Med Dir Assoc* 2006;7:366–76.
21 Brennan CW, Daly BJ, Jones KR. State of the science: the relationship between nurse staffing and patient outcomes. *West J Nurs Res* 2013;35:760–94.
22 Butler M, Schultz TJ, Halligan P, *et al*. Hospital nurse-staffing models and patient- and staff-related outcomes. *Cochrane Database Syst Rev* 2019;4.
23 Currie V, Harvey G, West E, *et al*. Relationship between quality of care, staffing levels, skill mix and nurse autonomy: literature review. *J Adv Nurs* 2005;51:73–82.
24 Driscoll A, Grant MJ, Carroll D, *et al*. The effect of nurse-to-patient ratios on nurse-sensitive patient outcomes in acute specialist units: a systematic review and meta-analysis. *Eur J Cardiovasc Nurs* 2018;17:6–22.
25 Fernandez R, Johnson M, Tran DT, *et al*. Models of care in nursing: a systematic review. *Int J Evid Based Healthc* 2012;10:324–37.
26 Fulton BD, Scheffler RM, Sparkes SP, *et al*. Health workforce skill mix and task shifting in low income countries: a review of recent evidence. *Hum Resour Health* 2011;9:1.
27 Goryakin Y, Griffiths P, Maben J. Economic evaluation of nurse staffing and nurse substitution in health care: a scoping review. *Int J Nurs Stud* 2011;48:501–12.
28 Hodgkinson B, Haesler EJ, Nay R, *et al*. Effectiveness of staffing models in residential, subacute, extended aged care settings on patient and staff outcomes. *Cochrane Database Syst Rev* 2011.
29 Hurst K. Primary and community care workforce planning and development. *J Adv Nurs* 2006;55:757–69.
30 Lang TA, Hodge M, Olson V, *et al*. Nurse-patient ratios: a systematic review on the effects of nurse staffing on patient, nurse employee, and hospital outcomes. *JONA* 2004;34:326–37.
31 McGahan M, Kucharski G, Coyer F, *et al*. Nurse staffing levels and the incidence of mortality and morbidity in the adult intensive care unit: a literature review. *Aust Crit Care* 2012;25:64–77.
32 Numata Y, Schulzer M, van der Wal R, *et al*. Nurse staffing levels and hospital mortality in critical care settings: literature review and meta-analysis. *J Adv Nurs* 2006;55:435–48.
33 Richards D. Skill-mix and service transfer to primary care settings: question: within general and oral healthcare is the transfer of care from secondary to primary settings effective; and what is the effectiveness of increased use of skill-mix? *Evid Based Dent* 2011;12.
34 Robinson S, Griffiths P, Maben J. Calculating skill mix: implications for patient outcomes and costs: Sarah Robinson and colleagues explore the evidence for the inclusion of a second-level qualified nurse in the UK nursing workforce. *Nurs Manage* 2009;16:22–3.
35 Robnett MK. Critical care nursing: workforce issues and potential solutions. *Crit Care Med* 2006;34:S25–31.
36 Shekelle PG. Nurse–patient ratios as a patient safety strategy: a systematic review. *Ann Intern Med* 2013;158:404–9.
37 Shin JH, Bae S-H. Nurse staffing, quality of care, and quality of life in U.S. nursing homes, 1996–2011: an integrative review. *J Gerontol Nurs* 2012;38:46–53.
38 Sibbald B, Shen J, Mcbride A. Changing the skill-mix of the health care workforce. *J Health Serv Res Policy* 2004;9:28–38.
39 Spilsbury K, Hewitt C, Stirk L, *et al*. The relationship between nurse staffing and quality of care in nursing homes: a systematic review. *Int J Nurs Stud* 2011;48:732–50.
40 Williams DM, Medina J, Wright D, *et al*. A review of effective methods of delivery of care: skill-mix and service transfer to primary care settings. *Prim Dent Care* 2010;17:53–60.
41 Wilson S, Bremner A, Hauck Y, *et al*. The effect of nurse staffing on clinical outcomes of children in hospital: a systematic review. *Int J Evid Based Healthc* 2011;9:97–121.
42 Thungjaroenkul P, Cummings GG, Embleton A. The impact of nurse staffing on hospital costs and patient length of stay: a systematic review. *Nurs Econ* 2007;25:255–65.
43 Choroschun K, Kennedy M, Hoben M. More than just staffing? Assessing evidence on the complex interplay among nurse staffing, other features of organisational context and resident outcomes in long-term care: a systematic review protocol. *BMJ Open* 2022;12:e061073.
44 Kreutzberg A, Reichebner C, Maier CB, *et al*. Regulating the input: health professions. In: Busse R, Klazinga N, Panteli D, et al, eds. *Improving healthcare quality in Europe: Characteristics, effectiveness and implementation of different strategies. 53*. Copenhagen (Denmark): European Observatory on Health Systems and Policies, 2019.
45 Kane RL, Shamliyan TA, Mueller C, *et al*. The Association of registered nurse staffing levels and patient outcomes: systematic review and meta-analysis. *Med Care* 2007;45:1195–204.
46 National Quality Board.How to ensure the right people, with the right skills, are in the right place at the right time: A guide to nursing, Midwifery and care staffing capacity and capability. 2014.
47 Alberta Health. Alberta's health system outcomes and measurement framework. 2014. Available: https://open.alberta.ca/dataset/da2ccb08-3d8d-4b4f-8b66-293fb55338d7/resource/806cb451-6a89-4bec-976a-86cb7ba5eef5/download/pmis-outcomes-measurement-framework-2014.pdf
48 Antunes V, Moreira JP. Skill mix in healthcare: an international update for management debate. Int J Healthc Manag 2013;6:12–7.
49 Butler M, Collins R, Drennan J, *et al*. Hospital nurse staffing models and patient and staff-related outcomes. *Cochrane Database Syst Rev* 2011.
50 Glouberman S, Zimmerman B. Complicated and complex systems: what would successful reform of Medicare look like?: Commission on the future of health care in Canada. 2002.
51 Schalkwijk EA. n.d. Fifty years' debate on five pathways into one profession: a historical case study on differentiated nursing practice in a layered institutional environment. JPO.
52 Buchan J, Dal Poz MR. Skill mix in the health care workforce: reviewing the evidence. *Bull World Health Organ* 2002;80:575–80.
53 Bourgeault IL, Kuhlmann E, Neiterman E, *et al*. How can optimal skill mix be effectively implemented and why? WHO European Ministerial Conference on Health Systems; 2008. Available: http://www.euro.who.int/en/media-centre/events/events/2008/06/who-european-ministerial-conference-on-health-systems/documentation/

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

background-documents/how-can-optimal-skill-mix-be-effectively-implemented-and-why
54 McGillis Hall L. Skill mix decision-making for nursing. International Centre for Human Resources in Nursing; 2009. Available: http://www.mcgillishall.com/wp-content/uploads/2010/05/Skill_Mix_EN_web.pdf
55 Pawson R, Greenhalgh T, Harvey G, *et al*. Realist review: a new method of systematic review designed for complex policy interventions. *J Health Serv Res Policy* 2005;10:21–34.
56 Engeström Y. *Learning by Expanding*. Cambridge University Press, 2015.
57 Pawson R. *Realistic Evaluation*. London: Sage, 1997.
58 Wong G, Greenhalgh T, Westhorp G, *et al*. Realist methods in medical education research: what are they and what can they contribute *Med Educ* 2012;46:89–96.
59 Subirana M, Long A, Greenhalgh J, *et al*. A realist logic model of the links between nurse staffing and the outcomes of nursing. J Nurs Res 2014;19:8–23.
60 Greenhalgh T. Why are Cochrane reviews so boring? *Br J Gen Pract* 2012;62:371.
61 Wong G, Greenhalgh T, Westhorp G, *et al*. RAMESES publication standards: realist syntheses. *BMC Med* 2013;11:21:1–14:.
62 Sworn K, Booth A. Scoping review: patient safety and nursing skill mix interventions. The Univeristy of Sheffield; 2018.
63 Gagliardi AR, Berta W, Kothari A, *et al*. Integrated knowledge translation (IKT) in health care: a scoping review. *Implement Sci* 2016;11:38.
64 Booth A, Wright J, Briscoe S. Scoping and searching to support realist approaches. In: Emmel N, Greenhalgh J, Manzano A, et al., eds. *Doing Realist Research. 55 City Road*. London: SAGE Publication Ltd, 2018.
65 Booth A, Harris J, Croot E, *et al*. Towards a methodology for cluster searching to provide conceptual and contextual “richness” for systematic reviews of complex interventions: case study (CLUSTER). *BMC Med Res Methodol* 2013;13:118.
66 Dada S, Dalkin S, Gilmore B, *et al*. Applying and reporting relevance, richness and rigour in realist evidence appraisals: advancing key concepts in realist reviews. *Res Synth Methods* 2023;14:504–14.
67 Booth A, Carroll C, Ilott I, *et al*. Desperately seeking dissonance: identifying the disconfirming case in qualitative evidence synthesis. *Qual Health Res* 2012.
68 Jagosh J, Pluye P, Macaulay AC, *et al*. Assessing the outcomes of participatory research: protocol for identifying, selecting, appraising and synthesizing the literature for realist review. *Implement Sci* 2011;6:24.
69 Morton T, Wong G, Atkinson T, *et al*. Sustaining community-based interventions for people affected by dementia long term: the SCI-Dem realist review. *BMJ Open* 2021;11:e047789.
70 Calderón-Larrañaga S, Milner Y, Clinch M, *et al*. Tensions and opportunities in social prescribing. developing a framework to facilitate its implementation and evaluation in primary care: a realist review. *BJGP Open* 2021;5.
71 Bunn F, Goodman C, Reece Jones P, *et al*. What works for whom in the management of diabetes in people living with dementia: a realist review. *BMC Med* 2017;15:141.
72 Noyes J, Booth A, Moore G, *et al*. Synthesising quantitative and qualitative evidence to inform guidelines on complex interventions: clarifying the purposes, designs and outlining some methods. *BMJ Glob Health* 2019;4:e000893.
73 Booth A, Carroll C. Systematic searching for theory to inform systematic reviews: is it feasible? Is it desirable *Health Info Libr J* 2015;32:220–35.
74 Booth A. Searching for qualitative research for inclusion in systematic reviews: a structured methodological review. *Syst Rev* 2016;5:74.
75 Fowler J, Hardy J, Howarth T. Trialing collaborative nursing models of care: the impact of change. *Aust J Adv Nurs* 2006;23:40–6.
76 Seymour J, Sworn K, Ryan T, *et al*. Protocol for Scoping review: patient safety outcomes and nursing skill mix interventions. 2018.
77 van Kraaij J, Veenstra M, Stalpers D, *et al*. Uniformity along the way: a scoping review on characteristics of nurse education programs worldwide. *Nurse Educ Today* 2023;120:105646.
78 van Kraaij J, van Oostveen C, Vermeulen H, *et al*. Nurse practitioners' perceptions of their ability to enact leadership in hospital care. *J Clin Nurs* 2020;29:447–58.
79 Astbury B, Leeuw FL. Unpacking black boxes: mechanisms and theory building in evaluation. AJE 2010;31:363–81.
80 Pfadenhauer LM, Mozygemba K, Gerhardus A, *et al*. Context and implementation: a concept analysis towards conceptual maturity. *Z Evid Fortbild Qual Gesundhwes* 2015;109:103–14.

BMJ Open: first published as 10.1136/bmjopen-2023-082883 on 6 May 2024. Downloaded from http://bmjopen.bmj.com/ on May 20, 2024 by guest. Protected by copyright.

Supplemental file 1: Example search strategy

CMOc2	**Staffing model that focuses on skill mix with sufficient RNs and complement of support staff**
Search Strategy (Sample)	**Strategy 1** exp Nursing Assistants/ OR ((healthcare or "health care" or health) adj4 (aide* or assistant* or attendant*)).mp. OR (nurs* adj4 (aide* or assistant* or attendant* or auxillar*)).mp. OR ("nursing support worker*" OR "nursing support staff" OR "unlicensed personnel" OR "unregulated staff" OR "healthcare support worker*" OR "Assistive Nursing Personnel" OR “health care aide” OR “healthcare aide” OR “registered nurses” OR “staffing levels” OR “workload”) AND (“Nursing care” OR "Quality of Health Care" OR "Outcome Assessment, Health Care" OR "Continuity of Patient Care" OR "Personnel Turnover" OR "Absenteeism" OR "Costs and Cost Analysis" OR "Health Care Costs" OR "Hospital Costs" OR Deaths OR "Quality of Care" OR Turnover OR Retention OR Costs OR Job Satisfaction OR Interprofessional relations OR Staff relations OR Nursing team OR “role clarification” OR “role clarity” OR “role competency” OR “workload”) **Strategy 2** Search: ("Personnel Delegation" OR delegation OR "substitution role*" OR "skill mix substitution*" OR « task substitution » OR « task allocation » OR “indirect care” OR “non nursing task*” OR “nursing task* left undone” OR "Nurse Substitution" OR “personnel staffing and scheduling”) OR Personnel Selection/ (staffing or staffed).ti,ab. OR exp Workforce/ OR (staffing adj3 model$).mp. OR care model*.mp. OR ((staff* or skill* or care or case or nurs* or RN or LPN) adj3 (mix or mixes or mixture* or composition*)).mp. AND ("Nurse’s Role" OR "Nursing Staff" OR "Nurse Practitioners" OR "Nursing Care" OR "Staffing Models" OR "Nurse Patient Ratios" AND "Acute Care" OR "Nursing Staff, Hospital") **Combined Strategy 1 and Strategy 2** Limited to English and 2014-2023

Supplemental file 2: Exclusion criteria

Exclusion
1. Articles not written in English or Dutch 2. A staffing model that focuses on midwives/nurse-midwives (or other healthcare professionals) only 3. A nurse staffing model conceptualized, developed, implemented, or evaluated in any of the following health settings: academic and/or administrative settings (e.g., nurses in policy or executive management positions) 4. A nurse staffing model conceptualized, developed, implemented, or evaluated in low income, lower-middle, or upper-middle income countries 5. The main focus of the paper is to report findings of an intervention that is conducted by a nurse staffing model, without examining or evaluating the staff model (e.g., a study examining an intervention of geriatric assessment/ambulation efforts to improve hospital post-discharge outcomes and is simply reported as conducted by nursing staff/multidisciplinary team). 6. Models of care (integrative or integrative care) or Disease models (animals used to study human diseases). Note that we won't exclude articles simply if these are included in the paper, but instead if they are the type of 'model or framework' being discussed instead of nurse staffing. 7. Articles that examine concepts closely related to nurse staffing, but do not link it to nurse staffing (i.e., staff/skills mix). 8. Conference abstracts and proceedings, news items, protocols, interviews, 'tweets of the week', 'union rallies', commentaries that describe a referenced model (label as 'snowball' and search for referenced model instead) 9. Articles not referring to the CMO configuration chosen from your country team (see inclusion criteria)