Methods to derive composite indicators used for quality and safety measurement and monitoring in healthcare: a scoping review protocol

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ABSTRACT

Introduction Composite indicators of quality and safety in healthcare summarise performance across multiple indicators into a single performance measure. Composite indicators can identify domains and drivers of quality, improve the ability to detect differences, aid prioritisation for quality improvement and facilitate decision making about future healthcare needs. However, the use of composite indicators can be controversial, particularly when used to rank healthcare providers. Many of the concerns around transparency, appropriateness and uncertainty may be addressed by a robust and transparent development and review process.

The aim of this scoping review is to describe methodologies used at each of the stages of development of composite indicators of quality and safety in healthcare. This review will provide those tasked with developing or reviewing composite indicators with a valuable consolidated analysis of a substantial and wide-ranging literature.

Methods and analysis The framework proposed by the Joanna Briggs Institute and enhancements proposed by Peters et al (2015, 2017, 2020) will be used in conducting this scoping review, and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for scoping reviews will guide the reporting. Grey literature and peer-reviewed documents will be in-scope. Electronic databases (PubMed, Embase, CINAHL, ABI/INFORM and SafetyLit) will be searched, and publications will be screened by two reviewers. Discussion, policy and guidance publications will be included if they discuss any aspect of the methods used in the development of a composite indicator of quality or safety in a healthcare setting. The search period ranges from 1 January 2000 to 31 December 2022. Data extraction will capture information on 11 stages of composite indicator development, augmenting a 10-stage framework developed by the European Commission Joint Research Centre.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This scoping review will offer those developing or reviewing composite indicators of quality and safety in healthcare a valuable consolidated analysis of a substantial and wide-ranging literature.

⇒ Methods used to derive composite indicators of quality and safety will be classified across 11 stages of development, augmenting a 10-stage framework developed by the European Commission Joint Research Centre, reflecting the development process from conception through to dissemination and post implementation review.

⇒ Our extensive search of the literature will include all published peer-reviewed and grey literature to provide a comprehensive overview of current research on this topic. The inclusion of literature critiquing aspects of the methodology applied to the development of composite indicators will ensure this scoping review presents a comprehensive summary of each of the stages of development.

⇒ This scoping review will be performed in accordance with the framework proposed by the Joanna Briggs Institute and enhancements proposed by Peters et al (2015, 2017, 2020), and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for scoping reviews will be applied to ensure rigorous methodology and reporting. While a formal tool will not be used to evaluate the quality of included studies, the quality of the methodology applied to the development of composite indicators by relevant studies will be assessed against the 11 stages of development.

⇒ This is a scoping review of literature on the methods used to derive composite indicators of quality and safety in healthcare and, as such, will not be a comprehensive census of such indicators.

INTRODUCTION

Healthcare is a complex multidimensional activity.1 Health systems delivering care are tasked with providing safe, high-quality care to meet the needs of those they serve, and quality and safety measurement are commonplace across healthcare contexts...
indicators developed by international organisations such as the Organisation for Economic Co-operation and Development (OECD) and the World Health Organisation (WHO), and national organisations such as the Agency for Healthcare Research and Quality (AHRQ), National Health Service (NHS) England, the National Institute for Health and Care Excellence (NICE) and the Canadian Institute for Health Information (CIHI), have been widely adopted. Such indicators can be classified using Donabedian’s structure, process and outcome indicator classification, and are often clustered across domains of quality, with the Institute of Medicine’s framework perhaps the most widely adopted. This framework proposes six domains: safety, effectiveness, patient-centredness, timeliness, efficiency and equity.

Single indicators measuring a particular aspect of quality and safety may be of interest; however, the multitude of indicators available may make it challenging to assess overall performance across multiple dimensions. Therefore, a composite indicator may better facilitate comparison. A composite performance measure is a combination of two or more component measures, each of which individually reflects quality of care, into a single performance measure with a single score. Composite measures combine multiple measures using a predetermined weighting methodology to produce a single score. While framework documents note the potential value of composite indicators of quality and safety, their use is currently limited. Perhaps the most well-established composite indicators are used to compare quality and performance within the US health system. The Hospital Overall Star Rating operated by the Centers for Medicare & Medicaid Services (CMS) summarises a variety of measures across the five areas of quality, mortality, safety, readmission, patient experience and timely and effective care, into a single star rating for each hospital. Composite indicators summarising patient safety developed by the AHRQ also feature within the CMS Hospital Star Rating. For example, the Patient Safety and Adverse Events Composite (PSI90) is a single measure of safety across 10 individual indicators which include rates of pressure ulcers, postoperative haemorrhage and postoperative sepsis. The AHRQ proposes that composite measures can improve the ability to detect differences, identify important domains and drivers of quality, aid prioritisation for quality improvement and inform current decisions about future (unknown) healthcare needs.

Composite indicators of quality and safety within healthcare can be controversial, particularly when used to rank healthcare providers. The summarised nature of composite measures may obscure either serious failings or excellent performance on specific elements of performance. Designing composite quality and safety ratings involves many technical decisions, for example, decisions about the selection of constituent measures, the design and the assignment of final ratings. Critics highlight potential problems with composite indicators such as lack of transparency around the interpretation of constituent measures and aspects of the derivation of the composite measures such as selection of individual measures, how missing data are handled, standardisation of underlying measures, choice of weights and failure to present uncertainty. A recent literature review which focused on the weighting and aggregation methods used in the derivation of composite indicators of quality of healthcare based on process indicators found that methodological considerations were not addressed in the majority of the publications in their review. Different stakeholders may vary in their view of the relative importance of the constituent measures. Small changes in the weighting and aggregation of constituent measures can dramatically alter relative positioning. Furthermore, available data must be of sufficient quality to support a meaningful composite measure. Indeed, the CMS conducted a 3-year review process to reconfigure the Hospital Overall Star Rating in response to some of these criticisms. Some of these limitations may be addressed through greater transparency around the aims and limitations of the composite measure or by allowing users to adapt composites to reflect individual preference. Barclay et al (2022) advise that many current composite indicators suffer from conceptual and statistical flaws that greatly limit their usefulness. However, they also declare most flaws can be addressed, reiterating the need for greater transparency around the goal of a composite indicator, but also suggest that guidelines on the design, development and reporting of such indicators would be beneficial.

METHODS AND ANALYSIS

The aim of this scoping review is to describe the methodologies applied to the derivation of composite indicators used for the measurement and monitoring of quality and safety in healthcare. A scoping review generally includes diverse sources of evidence and can be used to clarify key concepts and knowledge gaps in a topic area. Therefore, as the aim of this review is to identify the approaches taken to derive relevant composite indicators, and due to the extensive range of sources of literature on this topic, a scoping review was deemed the most suitable methodological approach. This scoping review is descriptive and explanatory in nature and will not seek to critically appraise sources of evidence. By identifying the methods applied to the various stages of development of composite indicators, the findings of this scoping review will enable the authors to judge the feasibility of introducing composite measures of quality and safety performance to the Irish Healthcare System. The review also aims to inform a transparent and robust process for the development and reporting of composite measures. This protocol has been prepared following the Best practice guidance and reporting items for the development of scoping review protocol and sets out in detail how the scoping review will be conducted.

There are many important steps in the derivation of composite indicators. In order to ensure this scoping review comprehensively captures relevant information...
on the methodological stages and choices throughout the development process, the 10-stage methodology for constructing composite indicators developed by the European Commission Joint Research Centre will be adopted. This methodology has been widely used in the development of composite measures applied in sectors such as road safety, and energy, and to compare countries across economic, political, social or environmental domains. This methodology also aligns with guidance on composite indicator development published by the National Quality Forum and underpins indicator development in aspects of healthcare delivery. Periodic review of all individual and composite measures should also be conducted to ensure measures remain valid and relevant, and to ensure decisions are made to revise or withdraw where necessary. Therefore, an 11th stage will be added, post implementation review, to capture information on how composite indicators are reviewed once implemented to ensure continued relevance and effectiveness.

**Research question and objectives**

The aim of this scoping review is to identify the methodologies applied to the derivation of composite indicators used for the measurement and monitoring of quality and safety in healthcare.

The aim of this review will be achieved through addressing each of the following objectives:

a. Identify the frameworks applied in the development of composite indicators;

b. Identify the methods used to identify single indicators for inclusion in composite indicators;

c. Describe approaches to preliminary analysis, missing data, normalisation/scaling, aggregation and weighting in the derivation of composite indicators;

d. Describe how uncertainty is handled and presented (effect of subjective choices and chance variation), linkage to other metrics (validation), deconstruction, and presentation and dissemination (format, metrics of uncertainty);

e. Describe the role of subject matter experts and other stakeholders in the development process, including their role, the nature and stage of their involvement and the methods used to facilitate this involvement;

f. Describe the methods used to obtain consensus on the adoption of composite indicators;

g. Identify the types of post implementation review adopted and the reasons for such reviews.

The main research question expressed using the Population–Concept–Context (PCC) framework is as follows (table 1).

**Inclusion and exclusion criteria**

Based on the review question and PCC, the eligibility criteria for the scoping review are set out in table 2. There will be no restriction on the inclusion of study types. Discussion, policy, commentary and guidance-based publications will be included if they discuss any aspect of the stages of development of a relevant composite indicator. This scoping review will be limited to publications in English due to the time and costs associated with translation. Studies published before 2000 will be excluded, consistent with the increased focus on quality and safety measurement in healthcare following the publication of *To Err is Human*. A preliminary search identified no existing or imminent scoping or systematic reviews on this topic.

**Information sources and search strategy**

The bibliographic database searching will apply a three-step strategy and will identify both peer-reviewed studies and grey literature. An initial search will be conducted searching PubMed using the key words in table 3.

Terms for population and context are selected based on those commonly used in the literature. It will not be possible to restrict the search to publications mentioning methodology in the title or abstract due to the broad application of the relevant key words. With input from an information specialist, key words and search terms will be reviewed and refined following this initial search and adapted to inform the final search strategy. An analysis of the text words in the titles and abstracts of retrieved papers will be conducted, and of the index terms used to describe the articles.

Second, the final key words and index terms will then be applied across each of the following databases:

- PubMed
- CINAHL
- Embase
- ABI/INFORM
- SafetyLit

To ensure a broad reach across topics and specialisms relevant to the delivery of healthcare, three databases were selected (PubMed, CINAHL and Embase), with ABI/INFORM ensuring publications relevant to management and organisation are incorporated. The inclusion of the SafetyLit database will ensure the capture of publications specifically related to safety not captured elsewhere. The full proposed search criteria for each of these databases are detailed in online supplemental file 1. The online machine learning tool, Elicit, will also be used to search for relevant papers that may not have been identified by searches of these five databases. Sources of evidence outside of peer-reviewed journals will play an important role in the review.

### Table 1 Definition of population, concept, context

<table>
<thead>
<tr>
<th>Category</th>
<th>Defined</th>
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<tr>
<td>Population</td>
<td>Composite indicators of safety and/or quality</td>
</tr>
<tr>
<td>Concept</td>
<td>Methodology of derivation of composite indicator</td>
</tr>
<tr>
<td>Context</td>
<td>Studies adopting the perspective of health professionals, healthcare providers, funders of healthcare or society more broadly</td>
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role in this search as, given the nature of the topic, relevant frameworks, guidelines and explanatory documents may not be published in peer-reviewed journals. Searches within the five databases listed above will not be restricted to peer-reviewed papers, and will incorporate posters, abstracts, online sources such as newspapers and blogs. Grey literature searching will also be conducted using combinations of the key words and index terms used in the bibliographic database search and will include Grey Literature Report, DANS EASY, Google Scholar and OpenAIRE. Direct searches of websites and publications by organisations tasked with health system management, monitoring safety and quality, developing frameworks and guidelines for reporting and measuring safety and quality, and organisations with a research interest in healthcare safety and quality measurement, are expected to yield relevant information. Such organisations include:

- WHO
- OECD
- AHRQ
- The National Quality Forum
- National Institute of Medicine
- The National Quality Forum
- Institute for Healthcare Improvement
- National Institute for Health and Care Excellence
- NHS England; NHS Scotland; NHS Wales; NHS Northern Ireland
- Canadian Institute for Health Information
- Australian Institute of Health and Welfare
- Health Quality and Safety Commission New Zealand

In the case of relevant conference proceedings, abstracts or protocols retrieved, attempts will be made to access full texts by contacting the authors if a published document/paper is not sourced.

Finally, backward tracing of the reference lists of all included articles will then be conducted to identify any additional relevant articles and documents. The definitive search strategy and results will be reported in detail in the published review.

### Study screening and selection

The final included studies for screening will be downloaded to a reference management software package (EndNote 20: https://endnote.com/) and duplicates removed. The title and abstract of each publication will be independently screened against the eligibility criteria.
by two reviewers using Covidence. Titles and abstracts that mention composite indicators, by whatever name, in any healthcare setting, and also mention any aspect of the development process of composite indicators, specifically or generally, will be selected for full-text review. All potentially relevant articles selected by both reviewers will be retrieved, and the full text will be examined for eligibility by two reviewers. Disagreement between reviewers about inclusion at either title and abstract or full-text review stage will be resolved by discussion with a third reviewer. Documents sourced from grey literature searches where there is no abstract, will undergo full-text review. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for scoping reviews checklist will be used to report the process of study selection.26

Data extraction
Data will be extracted from the selected documents in the review using a data extraction template. The data extracted will include general information related to each document including details of the aim of the document (eg, development of a specific composite indicator or general discussion of methodology), context, organisation, the name and purpose of the composite indicator and details of constituent indicators/data. The methods outlined in each selected document will be collated under each of the 11 methodological headings, from theoretical framework to post implementation review. While a broad range of potential composite indicators are expected to emerge from this review, it is expected that few documents will cover all development stages. However, many of these stages may be discussed across different documents and will therefore be grouped by composite indicator where relevant. One reviewer will extract the data from the included studies and 10% of these will be randomly checked for consistency by a second reviewer.

Data synthesis
A narrative approach will be used to synthesise the findings from the review. Included publications will be grouped by composite indicator where relevant. The methods adopted at each of the 11 stages of development detailed in table 4 will be summarised.

Where possible, descriptive categories for each of the 11 stages will be developed to streamline the findings. The extent and nature of stakeholder involvement in each stage will also be described. Where information is not provided on particular stages, this will be noted, or if it is clear that any of the 11 stages were not part of the development of a specific indicator, this will be captured. The methodological rigour applied by studies that derive composite measures will be assessed against the 11 methodological stages, and those with a robust consideration of the entire range of these stages will be judged to be of greater methodological quality than those with limited or no consideration of some stages. Papers that do not derive composite measures but offer a critical assessment of any of these stages of development will be grouped separately and will undergo a more abridged data extraction. It is anticipated that screening, full-text review and data extraction will be completed by December 2023, with an expected completion date of June 2024 for narrative synthesis.

<table>
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<th>Table 4 Data extraction</th>
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<td><strong>The paper</strong></td>
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| Population | 1. Aim: specific composite indicator (name) or general methodological  
2. Purpose of composite indicator (if specific)  
3. Details of constituent indicators/data (if specific) |
| Context | 1. Healthcare setting, specialty, organisation, region  
2. Focus of document: framework, guidance, commentary, other |
| Concept: methods | 1. Theoretical framework explained  
2. Method of selection of constituent indicators  
3. Preparation of data analysis (incl outliers; directionality)  
4. Missing data: assessed, nature, method  
5. Normalisation: method  
6. Weighting (statistical and participatory) and aggregation methods (eg, additive, multiplicative, non-compensatory)  
7. Uncertainty analysis (effect of subjective choices and chance variation)  
8. Link to other metrics (validation)  
9. Deconstruction  
10. Presentation and dissemination (format, metrics of uncertainty)  
For each of the above: Yes/No. If yes, categorise and provide brief description |
| Additional stage | 11. Post implementation review  
Yes/No. If yes, categorise and provide brief description |
| Concept: stakeholder involvement | Stages in which there was stakeholder involvement (1–11), description of stakeholders, nature of their involvement, methodology deployed to engage |
Patient and public involvement
While there was no involvement of the public or patients in the design of this scoping review, patient advocates will be included as members of the overall Composite Signals Study Steering Committee and will therefore provide feedback on the scoping review before publication.

Ethics and dissemination
Ethical approval is not required as this review will be using previously collected data. The findings of this review will be disseminated through publication in a peer-reviewed journal and presentations at national and international scientific conferences, in particular those focused on health systems and quality and patient safety. We will disseminate the results to a broader audience through social media posts by the research team and the National Quality and Patient Safety Directorate of the Health Service Executive (HSE), and through an online briefing that will be made available on the website of the both the HSE and University College Dublin.

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Contributors Design of the protocol—ThM, GC, EH, JM, TrM, MO’D, FR and EM. Draft of the manuscript—ThM. Review and final approval of the manuscript—ThM, JM, TrM, MO’D and EM.
Funding This scoping review forms part of the QS Signals Project, which aims to design and implement a national dashboard to monitor quality and patient safety within the Irish healthcare system, the Health Service Executive (HSE). This scoping review is funded by the National Quality and Patient Safety Directorate of the HSE who are responsible for the delivery of QS Signals (NQPSD Collaborative Research Award ‘NQPSD RA2/2022’).
Competing interests None declared.
Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.
Patient consent for publication Not applicable.
Provenance and peer review Not commissioned; externally peer reviewed.
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