RESEARCH ARTICLE

Monitoring childbirth and immediate postpartum care quality: A scoping review of indicators in high-income countries

M. Allison Warren[1☯], Dayana Hamparsoumian[1☯], Elsa Lorthe[1,2], Gilles Cattani[1], Francisca Barcos Munoz[3], David Baud[4], Caroline Daelemans[5,6], Pauline De Vries[4], Manuela Epiney[5,6], Emanuela Gerhard[7], Markus Hodel[8,9], Marzia Loghi[10], Begoña Martinez De Tejada[6], Raegan MacSTravic[11], Beatrice Mosimann[12], Marianne Philibert[2], Tonia A. Rihs[13], Anne Steiner[7], Laurent Gaucher[1,14], Thomas Desplanches[1,14]*

1 Geneva School of Health Sciences, HES-SO University of Applied Sciences and Arts Western Switzerland, Geneva, Switzerland, **2** Université Paris Cité and Université Sorbonne Paris Nord, Inserm, INRAE, Centre for Research in Epidemiology and Statistics, Paris, France, **3** Division of Neonatal and Pediatric Intensive Care of Women, Children and Adolescents, University Hospitals of Geneva, Geneva, Switzerland, **4** Obstetric Service, Woman-Mother-Child Department, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, **5** Faculty of Medicine, University of Geneva, Geneva Switzerland, **6** Department of the Woman, the Child and the Teenager, Geneva University Hospitals, Geneva, Switzerland, **7** Fédération Suisse des sages-femmes, Bern, Switzerland, **8** Department of Obstetrics and fetal-maternal Medicine Kanton Spital, Lucerne, Switzerland, **9** University of Lucerne, Health Department, Lucerne, Switzerland, **10** ISTAT, SWC Servizio Sistema integrato salute, assistenza e previdenza, DCSW Direzione Centrale per le Statistiche Sociali e il Welfare, DISD - Dipartimento per le Statistiche Sociali e Demografiche, Viale Liegi Roma, Italy, **11** Digital Workplace Squared, IT Skills and Solutions, Geneva, Switzerland, **12** Department of Obstetrics and Perinatal Medicine, Women's Clinic, University Hospital Basel, Switzerland, **13** Federal Statistical Office, FSO, Neuchâtel, Switzerland, **14** Research on Healthcare Performance (RESHAPE), Université Claude Bernard Lyon 1, INSERM U1290, Lyon, France

☯ These authors contributed equally to this work.
* thomas.desplanches@hesge.ch

Check for updates

OPEN ACCESS

Citation: Warren MA, Hamparsoumian D, Lorthe E, Cattani G, Barcos Munoz F, Baud D, et al. (2026) Monitoring childbirth and immediate postpartum care quality: A scoping review of indicators in high-income countries. PLoS One 21(9): e0350665. https://doi.org/10.1371/journal.pone.0350665

Editor: Umberto Simeoni, University of Lausanne: Universite de Lausanne, SWITZERLAND

Received: March 18, 2026

Accepted: August 21, 2026

Published: September 15, 2026

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: https://doi.org/10.1371/journal.pone.0350665

Copyright: © 2026 Warren et al. This is an open access article distributed under the terms of the Creative Commons Attribution License,

Abstract

Background

Most maternal and neonatal morbidity and mortality occur during childbirth and the immediate postnatal period. In high-income countries, where most births occur in maternity units, systematic monitoring of care quality is essential to improve safety and reduce preventable adverse outcomes.

Objective

To identify maternal and neonatal indicators of quality-of-care at childbirth and immediate postnatal period in high-income countries, and to assess their level of validity.

Methods

This scoping review followed PRISMA-ScR guidelines. A systematic search was conducted in April 2024 (updated March 2025) in Medline, Embase, CINAHL, and Web

which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data availability statement: All data required to replicate the findings of this scoping review are available within the manuscript and Supporting information files. The minimal dataset consists of the complete list of included studies and the extracted study-level information used to identify, map, and classify childbirth and immediate postpartum care quality indicators (S1 Table. Characteristics of included studies).

Funding: TD received funding from the Fonds de Recherche Impulsion HES-SO (Grant number 127974) and the Swiss National Science Foundation (grant number PT0043_222882). The funders provided support in the form of salary support for author TD but did not have any additional role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. RM is employed by Digital Workplace Squared, IT Skills and Solutions, Geneva, Switzerland. The company provided support in the form of salary for author RM but had no additional role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. The specific roles of these authors are articulated in the "Author Contributions" section.

Competing interests: RM is the owner and operator of Digital Workplace Squared, IT Skills and Solutions, Geneva, Switzerland. This commercial affiliation did not influence the conduct, analysis, or reporting of this study. The authors declare that there are no other competing interests related to employment, consultancy, patents, products in development, or marketed products. This does not alter our adherence to PLOS ONE policies on sharing data and materials.

of Science. Eligible studies included literature from high-income countries reporting quality-of-care indicators. Indicators were extracted as reported and consolidated: those with aligned definitions were clustered into standardised indicators and subsequently grouped into broader constructs reflecting key dimensions of care. Indicators were grouped into four domains (access, structure, process, and outcome) and evaluated using a structured validity scoring system. Indicators were classified as high-validity if they included a clear definition (with specified numerator and denominator) and achieved a validity score of 3 or 4 on a 0–4 scale.

Results

Eighty-four studies were included. In total, 981 individual indicators were identified; 546 were clearly defined and consolidated into 214 standardised indicators and 61 indicator constructs. Most focused on outcomes (n = 253, 46.3%) and processes (n = 243, 44.5%), with substantial heterogeneity in definitions. Fewer indicators addressed structure (n = 47, 8.6%) and access (n = 3, 0.6%). Nearly one third of all indicators demonstrated high-validity, mainly within outcome and process domains.

Conclusions

This review identified a large set of quality-of-care indicators, reflecting sustained efforts to monitor care around childbirth. However, heterogeneity in definitions and variable validation limit comparability and routine use. These findings highlight the need for greater validation and standardisation of indicators, followed by the prioritisation of high-validity measures to support meaningful quality monitoring and improvement.

Introduction

In high-income countries, nearly all births occur in maternity units and are attended by skilled health professionals, with overall good health outcomes [1]. Although maternal and neonatal mortality is rare [2–4], more than half of maternal deaths are considered preventable [5]. Maternal and neonatal morbidity, however, remain major concerns, particularly severe maternal morbidity related to postpartum haemorrhage and serious neonatal complications that continue to affect births even in high-income settings [6–9].

Interventions during childbirth play a crucial role in safeguarding maternal and neonatal health when appropriately indicated. Caesarean delivery is among the most frequently performed obstetric interventions worldwide [10,11]. However, its use illustrates a broader paradox in obstetric care: both underuse and overuse are associated with adverse outcomes. In line with World Health Organization (WHO) recommendations [12], very low caesarean rates are associated with increased maternal and neonatal mortality and morbidity [13,14], whereas excessively high rates are associated to higher maternal morbidity. Similar patterns have been observed for other common

intrapartum interventions, with wide variations in use across high-income countries reflecting unwarranted differences in practice [15]. These findings highlight the need for regular monitoring of obstetric care.

To address these challenges, the concept of quality of care provides a comprehensive framework for evaluating and improving maternal and newborn health services. Perinatal quality of care refers to the degree to which health services during pregnancy, childbirth, and the postnatal period maximize the likelihood of optimal health outcomes and adhere to professional standards and evidence-based practice [16,17]. It encompasses five domains; access, structure, process, patient experience, and outcomes [18], in line with the Donabedian model [19].

Monitoring perinatal indicators is essential for developing effective strategies to improve quality of care. Indicators can be defined as "standardised, evidence-based measures of health care quality that can be used with readily available hospital inpatient administrative data to measure and track clinical performance and outcome" [17]. In high-income settings, the widespread availability of large medico-administrative databases provides an opportunity to systematically monitor such indicators.

While quality indicators are relevant throughout pregnancy and the postpartum period [20], the time of childbirth is particularly critical for assessing care quality, as it concentrates the highest risks for both mother and newborn [6,21,22]. This has led to the development of numerous indicators intended to monitor care during labour and the immediate postnatal period.

However, beyond data availability, indicators must be validated before risk-adjusted standardisation and benchmarking. This requirement is particularly important for cross-country comparisons, which are valuable for rare but serious outcomes such as maternal and neonatal mortality, yet remain constrained by variations in data completeness and indicator validation across health systems [23]. At the local level, maternity units require specific indicators that more accurately reflect the quality of routine care. These should capture events that are sufficiently frequent to allow regular analysis, be reproducible across institutions, and be sensitive to changes in practice over time, making continuous quality monitoring both feasible and sustainable.

This study aimed to identify indicators developed to assess the quality of maternal and neonatal care during childbirth and the immediate postnatal period in high-income countries, and to assess their level of validity.

Materials and methods

Design

This scoping review was conducted in accordance with the Joanna Briggs Institute (JBI) methodology and is reported following the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [24] (S1 File).

Conceptual framework

The study was guided by the Society for Maternal–Fetal Medicine (SMFM) [18] framework. Indicators were organised into four domains: access, structure, process, and outcome, to provide a clear taxonomy for classification and to support systematic analysis of indicators.

Eligibility criteria and types of studies

We followed the JBI methodology and applied the Population–Concept–Context (PCC) framework to define eligibility criteria and guide the search strategy. The review focused on: (1) Population, covering maternal and neonatal care during labour, birth, and the early postnatal period; (2) Concept, defined as quality of care indicators; and (3) Context, limited to high-income countries as classified by the World Bank [25].

Studies reporting at least one indicator assessing the quality of maternal and/or neonatal care during labour, birth, or within the first seven days postpartum were eligible for inclusion. No restrictions were applied on sample size, year of

publication, or data source, but only English-language full texts were considered. Studies were excluded if they focused on populations, outcomes, or time periods outside the scope of this review, or if the indicator related exclusively to phases of care other than childbirth and the immediate postpartum period. Publications were also excluded if the study design was not suitable for data extraction (commentaries, protocols, reviews, conference abstracts, and case reports or case series).

Search strategy and screening processes

To identify all relevant studies, a systematic search was conducted on 19 April 2024, using the following electronic bibliographic databases: Medline (via PubMed), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, and Web of Science. The search strategy was developed in consultation with subject experts and the academic liaison librarian of the University of Applied Sciences and Arts Western Switzerland in Geneva, refined through multiple discussions, and then executed across the selected databases. The electronic search strategy was developed in accordance with the Peer Review of Electronic Search Strategies (PRESS) 2015 Guideline Statement. Controlled vocabulary (e.g., Medical Subject Headings) and free-text keywords, including truncations, were combined to capture each concept comprehensively (S2 File). Searches were conducted in titles, abstracts, and keywords using Boolean and proximity operators as appropriate. On 24 March 2025, an update was conducted to check for additional potential articles.

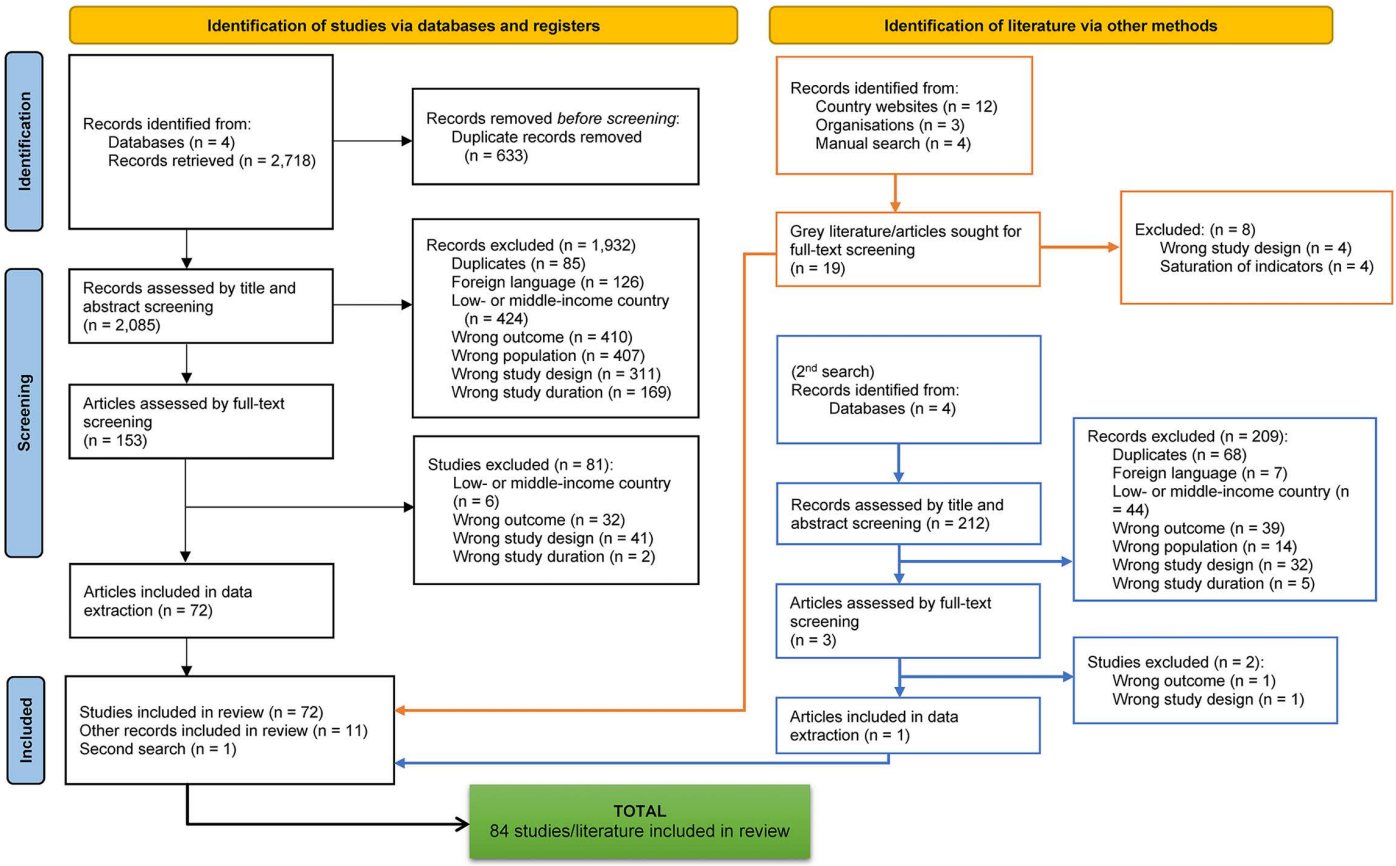
All references were imported into EndNote library version X9 for de-duplication and exported to the Rayyan platform. Two researchers independently screened titles and abstracts against the eligibility criteria. Full texts of relevant studies were then retrieved and reviewed for eligibility. Discrepancies at any stage were resolved through discussion, with adjudication by a third reviewer when necessary. Studies were excluded according to the predefined eligibility criteria described above. Reasons for exclusion at the full-text screening stage are reported in the PRISMA flow diagram (Fig 1). Reference lists of included articles were also screened to identify additional relevant studies (Fig 1). Manual searches of national and international indicator databases from high-income countries were initially conducted in April 2024 and updated in March 2025, based on the World Bank classification [25]. Searches were performed using the Google search engine with the search term “maternal and neonatal quality-of-care health indicators”, with a particular focus on national organizations responsible for developing or reporting maternal and neonatal quality-of-care indicators. Article characteristics were summarised by country, data source (e.g., medico-administrative, medical records), and reported methodology (e.g., validation study, consensus panel).

Data extraction, classification and validity of indicators

Indicators were systematically extracted from each resource, compiling all available data, including indicator name, definition, numerator, and denominator. Indicators based on patient-reported experience and outcome measures (PREM or PROM) were not extracted because they were outside the scope of this review. All extracted indicators were verified for accuracy and completeness. Only complete indicators (defined as those with a name, definition, numerator, and denominator) were included in the analysis.

To enable systematic analysis of underlying concepts, a stepwise funnel approach was used to organize the indicators. First, all individual indicators were extracted and reviewed as originally reported. Individual indicators with closely aligned definitions and overlapping terminology were then clustered into standardised indicator labels (hereafter referred to as standardised indicators), representing sets of indicators that measured essentially the same concept using comparable definitions. These standardised indicators constituted the primary unit of analysis.

Next, related standardised indicators were aggregated into indicator constructs, which were subsequently organized within broader conceptual categories reflecting major dimensions of care (e.g., indicators of third- or fourth-degree tears grouped under the construct *Perineal tears*).



Source: Page MJ, et al. BMJ 2021;372: n71. doi: 10.1136/bmj.n71

Fig 1. PRISMA 2020 flow diagram of the study selection process. Flow diagram illustrating the identification, screening, eligibility assessment, and inclusion of studies included in this scoping review.

https://doi.org/10.1371/journal.pone.0350665.g001

To provide a structured assessment of the level of validity of the identified quality indicators, we adapted the validity scale from a previous systematic review [8]. Expert consensus methods (e.g., Delphi panels), which are widely used in quality indicator development, were not adequately represented in the original scoring system. We therefore expanded the scale to better reflect these approaches. Thus, the revised scoring system was as follows: 0 = no validation information; 1 = selected by authors with described methods; 2 = based on expert consensus with methods; 3 = used in prior research (e.g., a pilot study validating indicators from an expert panel); 4 = validated by national/international authority. This approach allowed reproducible assessment and comparison of indicator validity across studies. Complete indicators with validity scores ≥3 were classified as high-validity indicators and considered to have stronger measurement properties, allowing comparison of validity patterns across domains and publication periods.

Results

Search and screening outcomes

The initial search yielded 2,718 articles. After removing duplicates, 2,085 articles were screened in Rayyan, resulting in 153 articles retained at the title-abstract stage. Following full-text screening, 72 articles were included. Four additional articles were identified from bibliographies and 15 from national or international indicator databases, of

which 11 were included. The updated search additionally identified 212 articles; 3 underwent full-text screening, with 1 included. In total, 84 articles were included for data extraction (Fig 1). These studies are cited in References [9,17,20,26–106].

Characteristics of studies

The 84 included articles span 1989–2025, with 5 published before 2000 and 19 since 2020 (S1 Table). Studies covered 14 countries plus two multinational sources. Nearly one-third originated from the Unites States of America (USA), while European studies contributed the largest share with 36 articles providing 443 indicators – almost half of all extracted indicators, with the Netherlands (17%) and France (11%) providing a significant amount of the overall indicators. Most articles (52%, n = 44) used medico-administrative databases, 18% (n = 15) relied on data extracted from medical records, and 30% (n = 25) reported no patient data. Validation studies represented 21% (n = 18), while consensus studies accounted for 27% (n = 23), and 51% (n = 43) were observational studies (S1 Table).

Overview of extracted indicators

From the 84 included articles, a total of 981 individual indicators were extracted and recorded as originally reported. After exclusion of socio-demographic (n = 26, 2.7%) (S2 Table) and incomplete indicators (n = 409, 41.7%) (S3 Table), 546 (55.7%) complete indicators were retained for analysis, of which 134 were reported only once across the included sources. Using the stepwise funnel approach, these indicators were organised into 61 indicator constructs and 214 standardised indicators.

By domain, indicators were classified as outcome (n = 253, 46.3%), process (n = 243, 44.5%), structure (n = 47, 8.6%), or access (n = 3, 0.6%) (See the complete list in S3 File: Perinatal Care Quality Indicators).

The 253 outcome indicators were grouped into 36 indicators constructs, and 94 standardised indicators (S4, S5, S6 Tables). Mortality was a prominent theme, comprising 46 indicators (18.2%) across maternal, neonatal, and foetal populations. In addition, maternal and neonatal morbidity outcome indicators were identified, including severe maternal morbidity (n = 19), obstetric trauma (n = 13), infection (n = 10), prematurity (n = 9), neonatal asphyxia (n = 4), and ICU (n = 7)/ NICU admission (n = 9). Indicators relating to perineal tears deserve special mention, as 42 indicators were extracted on this construct alone. Three composite indicators integrating maternal and neonatal outcomes were also reported, including the Adverse Outcome Index and related severity scores (S6 Table). Overall, significant variability in definitions and operationalisation was observed across outcome concepts.

The 243 process indicators were aligned under 20 indicator constructs, containing 82 standardised indicators (S7, S8, S9 Tables). Maternal process indicators mainly reflected intrapartum care, including labour onset (n = 13) and management (n = 19), pain relief (n = 5), and mode of delivery (n = 98), with caesarean section (n = 65) emerging as one of the most extensively developed process indicators. A substantial proportion also focused on postpartum management, particularly prevention (n = 11) and management (n = 27) of postpartum haemorrhage, blood transfusion (n = 7), and post-caesarean care (n = 7). Additional maternal process indicators addressed prematurity-related care (n = 6), and maternal screening practices (n = 4) (S7 Table).

Neonatal process indicators (n = 12) were all unique and mainly addressed immediate postnatal care, including delivery room resuscitation, respiratory support, and essential preventive treatments. Additional indicators covered evidence-based therapies for preterm or high-risk infants and neonatal screening practices (S8 Table).

Quality of care indicators relating to both mothers and their neonates focused on infant feeding (n = 14) and skin-to-skin contact (n = 2) (S9 Table).

The 47 structure and 3 access indicators were organised into 6 indicator constructs (Organisation, Evaluation, Resources, Communication, Labour management, and Counselling on mode of delivery (S10 Table)) and 39 standardised indicators, of which 32 were unique.

Validity of extracted indicators

Overall, 278 indicators met the criteria for high-validity, defined as complete indicators with a validity score ≥3, representing 29.1% of all identified indicators (278/955). Among these, 132 indicators (13.8%) had a validity score of 3 and 146 (15.3%) had a score of 4.

Among complete indicators, the proportion of high-quality indicator was 50.9%. High-validity indicators were predominantly observed in the outcome and process domains. In contrast, only a small number of structure indicators and no access indicators reached the high-validity threshold (Table 1).

Discussion

In this scoping review, we identified a large and heterogeneous set of quality of care indicators developed to assess maternal and neonatal care during childbirth and the immediate postnatal period in high-income countries. Using a stepwise funnel approach, 546 complete individual indicators were grouped into 214 standardised indicators with closely aligned definitions and aggregated into 61 indicator constructs representing key dimensions of perinatal quality of care. Most indicators focused on health outcomes and care processes, whereas structure and access indicators were less frequently represented. Nearly one third of all indicators demonstrated a high level of validity, mainly within outcome and process domains. These findings reflect sustained efforts to monitor care during childbirth and early postpartum but also reveal substantial variation in indicator definitions, levels of validation and scope.

Our findings extend previous work by providing an updated synthesis specifically focused on the intrapartum and immediate postnatal periods. In 2018, a scoping review compiled current indicators from selected global multi-stakeholder initiatives to support harmonized monitoring of maternal and newborn health and identified 140 indicators [108]. A subsequent systematic review published in 2019 examined 87 indicators across the maternal and child (up to age 18) continuum of care using scientific literature, indicator sets, and grey literature, but was limited to publications from 2012 to 2016 [109]. By consolidating the evidence from high-income countries without time constraints, our review provides an updated and detailed overview of quality of care indicators at the time of birth.

In addition to the large number of available indicators, our results underscore the presence of major methodological challenges. Multiple operational definitions frequently coexist for the same underlying concept, affecting core measurement elements. This heterogeneity limits comparability across settings and limits the formation of broad agreement among stakeholders. Although consensus-based approaches have been proposed to address these issues [68,76,110], the growing number of indicators may hinder the feasibility of standardisation. Also, the breadth of high-validity indicators identified in this review highlights the need to move from compilation towards prioritisation. Establishing a core set of indicators requires explicit consideration of the level at which they are intended to be used – whether for international benchmarking, national monitoring, or centre-level quality improvement. It also requires assessing their feasibility, particularly when they are derived from existing or routinely collected data. These considerations are central to ensuring that consensus-driven indicator selection is both methodologically robust and operationally viable.

Table 1. Distribution of validity scores by domain in complete indicators.

Domain	Total number of indicators	Validity score, n (%)				
		4	3	2	1	0
Outcome	253	95 (17.4)	68 (12.5)	72 (13.2)	16 (2.9)	2 (0.4)
Process	243	47 (8.6)	58 (10.6)	119 (21.8)	17 (3.1)	2 (0.4)
Structure	47	4 (0.7)	6 (1.1)	35 (6.4)	2 (0.4)	0
Access	3	0	0	3 (0.6)	0	0
Total	546	146 (26.7)	132 (24.2)	229 (41.9)	35 (6.4)	4 (0.7)

https://doi.org/10.1371/journal.pone.0350665.t001

Regional differences in healthcare systems, policy priorities, and data infrastructures may also influence the development, selection, and implementation of quality indicators. Future research should explore these contextual differences to better understand their impact on the comparability and applicability of quality indicators across high-income countries.

Our findings also highlight the complexity of assessing perinatal quality of care. In many contexts, meaningful assessment requires the combined interpretation of complementary indicators, particularly when practices involve trade-offs between benefits and risks. For example, interpreting episiotomy policies alongside rates of severe perineal tears provides a more nuanced understanding of obstetric practice than either indicator alone [111]. Similarly, our indicator classification underscores the multidimensional nature of care quality for a given clinical topic. Postpartum haemorrhage illustrates this complexity, with indicators spanning care processes (e.g., prevention, obstetric and anaesthesiologic management), structural indicators (e.g., resource availability), and health outcomes (e.g., mortality, severe complications). Together, these dimensions reflect different but complementary facets of care quality that are rarely captured by a single measure. Furthermore, quality assessment at birth is further complicated by the dual consideration of maternal and neonatal outcomes, as interventions beneficial for one may not confer equivalent benefits for the other [107,112]. Future research should emphasise the joint collection and interpretation of complementary indicators within a given clinical theme to reflect the multidimensional nature of routine maternity care.

Indicator quality itself remains a major concern. A substantial proportion (42%) of indicators identified in this review were incompletely reported, lacking the basic elements required for meaningful measurement, including clear definitions and specified numerators or denominators. As a result, these indicators cannot be consistently interpreted or implemented across settings, highlighting important limitations in the current quality indicator literature. Among the indicators identified, assessment of validity highlighted additional limitations, with approximately one third demonstrating high validity. Consistent with previous work [113], these findings highlight the need for clearer validation standards and appropriate validation methods, as well as a shared terminology to support meaningful measurement and comparison of perinatal quality of care.

Finally, this synthesis highlights gaps in the current indicator landscape, as indicators regarding access and structure remain relatively underdeveloped and insufficiently validated. Although these indicators may capture important system-level dimensions of care, their measurement properties and relevance for routine monitoring require further investigation.

Strengths and limitations

This scoping review applied a rigorous methodology to enhance the reliability, transparency, and reproducibility of its findings in accordance with PRISMA-ScR guidelines. To support a comprehensive synthesis, extracted indicators were subjected to a multi-dimensional analysis, including thematic grouping, and classification by both population and domain (access, structure, process, and outcome). This approach enabled a structured overview of a large and heterogeneous body of indicators.

Several limitations should nonetheless be acknowledged. Although no protocol was prospectively registered or published for this scoping review, all methodological steps, including the eligibility criteria, search strategy, study selection process, data extraction, and analytical approach, are reported in sufficient detail to support the transparency and reproducibility of the review. Despite a comprehensive search strategy covering four major electronic databases and grey literature sources, it remains possible that some relevant publications were not identified. However, the breadth of sources included and the convergence of indicators across studies suggest that most commonly used quality of care indicators were likely captured. No formal critical appraisal of the included studies was undertaken. Although this is consistent with current methodological guidance for scoping reviews when such an appraisal is not required to address the review objectives [114], it limits the ability to comment on the methodological quality of the included evidence. In addition, as this review also assessed the level of validity of the identified quality indicators, we

applied an adapted validity scale based on prior work. This assessment focused on the reported methods used for the development and validation of the identified quality indicators and was therefore dependent on the completeness of reporting in the included publications. More broadly, this limitation reflects a well-recognised challenge in the field. As previously highlighted by Saturno-Hernández et al. [109], fewer than 10% of quality indicators met established criteria for scientific soundness, underscoring the need for more rigorous development, validation, and reporting of quality indicators. Methodologically, we chose to exclude PROMs and PREMs, despite their recognised importance for capturing care quality from the service user's perspective. Future research should specifically focus on integrating these dimensions into perinatal quality measurement frameworks.

Conclusion

This scoping review has identified a wide range of indicators developed to assess the quality of maternal and neonatal care during childbirth and the immediate postnatal period in high-income countries. Although many indicators focus on clinical outcomes and care processes, their comparability and routine use is limited by substantial heterogeneity in definitions and variable levels of validation. By organising existing indicators into a structured dataset, this review provides a foundation for more consistent and transparent assessment of care quality. Progress in this field will require greater standardisation of indicator definitions, more robust validation, and the prioritisation of high-validity measures. Their context-sensitive implementation in routine maternity care is essential to ensure meaningful and sustainable monitoring and to support the development of a coherent set of core indicators.

Supporting information

S1 File. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist. JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews. * Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media 7platforms, and Web sites. † A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote). ‡ The frameworks by Arksey and O'Malley [6] and Levac and colleagues [7] and the JBI guidance [4,5] refer to the process of data extraction in a scoping review as data charting. § The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).
(DOCX)

S2 File. Research strategy.
(DOCX)

S3 File. Final included articles Perinatal Care Quality Indicators.
(HTML)

S1 Table. Characteristics of included studies.
(DOCX)

S2 Table. Socio-demographic indicators.
(DOCX)

S3 Table. List of incomplete indicators.
(DOCX)

S4 Table. List of maternal outcome indicators (N = 132).
(DOCX)

S5 Table. List of foetal and neonatal outcome indicators (N = 118).
(DOCX)

S6 Table. List of maternal and neonatal outcome indicators (N=3).
(DOCX)

S7 Table. List of complete maternal process indicators (N = 210).
(DOCX)

S8 Table. List of complete neonatal process indicators (N = 12).
(DOCX)

S9 Table. List of complete maternal and neonatal process indicators (N = 21).
(DOCX)

S10 Table. List of complete structure and access indicators (N = 50).
(DOCX)

Acknowledgments

We gratefully acknowledge Suzanne Rankin for her careful review of the paper's language, clarity, and overall readability. Our thanks also to Marie-Thérèse Pugliese, reference librarian, for her essential role in designing and implementing the search strategy, and Ana Castillo Cebollero for her assistance in extracting indicators.

Author contributions

Conceptualization: Laurent Gaucher, Thomas Desplanches.

Data curation: M. Allison Warren, Dayana Hamparsoumian.

Funding acquisition: Thomas Desplanches.

Investigation: Thomas Desplanches.

Methodology: Elsa Lorthe, Laurent Gaucher, Thomas Desplanches.

Project administration: Thomas Desplanches.

Software: M. Allison Warren, Dayana Hamparsoumian, Gilles Cattani, Raegan MacSTRAVIC.

Supervision: Thomas Desplanches.

Validation: Elsa Lorthe, Gilles Cattani, Laurent Gaucher.

Visualization: Elsa Lorthe, Gilles Cattani.

Writing – original draft: M. Allison Warren, Dayana Hamparsoumian, Thomas Desplanches.

Writing – review & editing: M. Allison Warren, Dayana Hamparsoumian, Elsa Lorthe, Gilles Cattani, Francisca Barcos Munoz, David Baud, Caroline Daelemans, Pauline De Vries, Manuella Epiney, Emanuela Gerhard, Markus Hodel, Marzia Loghi, Raegan MacSTRAVIC, Begoña Martinez De Tejada, Beatrice Mosimann, Marianne Philibert, Tonia A. Rihs, Anne Steiner, Laurent Gaucher, Thomas Desplanches.

References

1. Campbell OMR, Graham WJ, Lancet Maternal Survival Series steering group. Strategies for reducing maternal mortality: getting on with what works. Lancet. 2006;368(9543):1284–99. https://doi.org/10.1016/S0140-6736(06)69381-1 PMID: 17027735
2. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller A-B, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Health. 2014;2(6):e323-33. https://doi.org/10.1016/S2214-109X(14)70227-X PMID: 25103301
3. Liu Y, Kang L, He C, Miao L, Qiu X, Xia W, et al. Neonatal mortality and leading causes of deaths: a descriptive study in China, 2014-2018. BMJ Open. 2021;11(2):e042654.
4. Rossen LM, Hoyert DL, Horon I, Branum AM. Trends in maternal mortality rates by state, United States, 2018 to 2023. Am J Obstet Gynecol. 2026;234(1):250–69.
5. Diguisto C, Saucedo M, Kallianidis A, Bloemenkamp K, Bødker B, Buoncristiano M, et al. Maternal mortality in eight European countries with enhanced surveillance systems: descriptive population based study. BMJ. 2022;379:e070621. https://doi.org/10.1136/bmj-2022-070621 PMID: 36384872
6. MBRRACE-UK. Saving lives, improving mothers' care: lessons learned to inform maternity care from the UK and Ireland confidential enquiries into maternal deaths and morbidity 2019–21. London: MBRRACE-UK; 2023. Available from: https://www.npeu.ox.ac.uk/mbrrace-uk/reports#mbrrace-uk-saving-lives-improving-mothers-care-lessons-learned-to-inform-maternity-care-from-the-uk-and-ireland-confidential-enquiries-into-maternal-deaths-and-morbidity-2019-21
7. Patek K, Friedman P. Postpartum hemorrhage-epidemiology, risk factors, and causes. Clin Obstet Gynecol. 2023;66(2):344–56.
8. England N, Madill J, Metcalfe A, Magee L, Cooper S, Salmon C, et al. Monitoring maternal near miss/severe maternal morbidity: a systematic review of global practices. PLoS One. 2020;15(5):e0233697. https://doi.org/10.1371/journal.pone.0233697 PMID: 32470099
9. Euro-Peristat. European Perinatal Health Report, 2015—2019. Euro-Peristat. [cited 2024 Apr 12]. Available from: https://www.europeristat.com/index.php/reports/ephr-2019.html
10. Betran AP, Ye J, Moller AB, Zhang J, Gulmezoglu AM, Torloni MR. The increasing trend in caesarean section rates: global, regional and national estimates: 1990-2014. PLoS One. 2016;11(2):e0148343. https://doi.org/10.1371/journal.pone.0148343
11. Amyx M, Philibert M, Farr A, Donati S, Smárason AK, Tica V, et al. Trends in caesarean section rates in Europe from 2015 to 2019 using Robson's Ten Group Classification System: a Euro-Peristat study. BJOG. 2024;131(4):444–54. https://doi.org/10.1111/1471-0528.17670 PMID: 37779035
12. World Health Organization. WHO statement on caesarean section rates. Geneva: World Health Organization; 2015. Available from: https://www.who.int/publications/i/item/WHO-RHR-15.02
13. Molina G, Weiser TG, Lipsitz SR, Esquivel MM, Uribe-Leitz T, Azad T, et al. Relationship between cesarean delivery rate and maternal and neonatal mortality. JAMA. 2015;314(21):2263–70. https://doi.org/10.1001/jama.2015.15553 PMID: 26624825
14. Sandall J, Tribe RM, Avery L, Mola G, Visser GH, Homer CS, et al. Short-term and long-term effects of caesarean section on the health of women and children. Lancet. 2018;392(10155):1349–57. https://doi.org/10.1016/S0140-6736(18)31930-5 PMID: 30322585
15. Seijmonsbergen-Schermers AE, van den Akker T, Rydahl E, Beeckman K, Bogaerts A, Binfa L, et al. Variations in use of childbirth interventions in 13 high-income countries: a multinational cross-sectional study. PLoS Med. 2020;17(5):e1003103. https://doi.org/10.1371/journal.pmed.1003103 PMID: 32442207
16. World Health Organization. Quality of care for maternal, newborn, child and adolescent health. Geneva: World Health Organization; [cited 2024 Feb 17]. Available from: https://www.who.int/teams/maternal-newborn-child-adolescent-health-and-ageing/quality-of-care
17. Agency for Healthcare Research and Quality. AHRQ QI: Quality Indicator Resources [Internet]; 2024 [cited 2025 Apr 29]. Available from: https://qualityindicators.ahrq.gov/measures/MHI_TechSpec
18. Society for Maternal-Fetal Medicine, Combs CA, Kern-Goldberger A, Bauer ST, Patient Safety and Quality Committee. Society for Maternal-Fetal Medicine special statement: clinical quality measures in obstetrics. Am J Obstet Gynecol. 2024;230(3):B2–17. https://doi.org/10.1016/j.ajog.2023.11.011 PMID: 37939984
19. Donabedian A. Evaluating the quality of medical care. Milbank Mem Fund Q. 1966;44(3):Suppl:166-206. https://doi.org/10.2307/3348969 PMID: 5338568
20. Nijagal MA, Wissig S, Stowell C, Olson E, Amer-Wahlin I, Bonsel G, et al. Standardized outcome measures for pregnancy and childbirth, an ICHOM proposal. BMC Health Serv Res. 2018;18(1):953. https://doi.org/10.1186/s12913-018-3732-3 PMID: 30537958
21. MBRRACE-UK. State of the nation report [Internet]; 2025 [cited 2025 May 28]. Available from: https://timms.le.ac.uk/mbrrace-uk-perinatal-mortality/surveillance/supporting-materials.html
22. Lawn JE, Cousens S, Zupan J, Lancet Neonatal Survival Steering T. 4 Million neonatal deaths: when? where? why? Lancet. 2005;365(9462):891–900.
23. Philibert M, Gissler M, Zurriaga O, Donati S, Drausnik Z, Heller G, et al. Evaluating perinatal health in Europe: a comparison of routine population birth data sources. Paediatr Perinat Epidemiol. 2025;39(5):405–16. https://doi.org/10.1111/ppe.13178 PMID: 40070031
24. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467–73. https://doi.org/10.7326/M18-0850 PMID: 30178033

25. World Bank Country and Lending Groups. [cited 2025 Aug 13]. Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups
26. Foglia LM, Nielsen PE, Hemann EA, Walker S, Pates JA, Napolitano PG, et al. Accuracy of the adverse outcome index: an obstetrical quality measure. Jt Comm J Qual Patient Saf. 2015;41(8):370–7. https://doi.org/10.1016/s1553-7250(15)41048-7 PMID: 26215526
27. Gregory KD, Korst LM, Lu MC, Fridman M. AHRQ patient safety indicators: time to include hemorrhage and infection during childbirth. Jt Comm J Qual Patient Saf. 2013;39(3):114–22. https://doi.org/10.1016/s1553-7250(13)39017-5 PMID: 23516761
28. Holubkov R, Holt VL, Connell FA, LoGerfo JP. Analysis, assessment, and presentation of risk-adjusted statewide obstetrical care data: the StORQS II study in Washington State. Statewide Obstetrics Review and Quality System. Health Serv Res. 1998;33(3 Pt 1):531–48. PMID: 9685121
29. El Haj Ibrahim S, Fridman M, Korst LM, Gregory KD. Anesthesia complications as a childbirth patient safety indicator. Anesth Analg. 2014;119(4):911–7. https://doi.org/10.1213/ANE.0000000000000358 PMID: 25126702
30. Ueda K, Sado T, Takahashi Y, Igarashi T, Nakayama T. Applicability of care quality indicators for women with low-risk pregnancies planning hospital birth: a retrospective study of medical records. Sci Rep. 2020;10(1):12484. https://doi.org/10.1038/s41598-020-69346-8 PMID: 32719471
31. Bottle A, Aylin P. Application of AHRQ patient safety indicators to English hospital data. Qual Saf Health Care. 2009;18(4):303–8. https://doi.org/10.1136/qshc.2007.026096 PMID: 19651936
32. Boesveld IC, Hermus MAA, van der Velden-Bollemaat EC, Hitzert M, de Graaf HJ, Franx A, et al. An approach to assessing the quality of birth centres results of the Dutch birth centre study. Midwifery. 2018;66:36–48. https://doi.org/10.1016/j.midw.2018.07.008 PMID: 30121477
33. Grobman WA, Feinglass J, Murthy S. Are the Agency for Healthcare Research and Quality obstetric trauma indicators valid measures of hospital safety? Am J Obstet Gynecol. 2006;195(3):868–74. https://doi.org/10.1016/j.ajog.2006.06.020 PMID: 16949428
34. Mann S, Pratt S, Gluck P, Nielsen P, Risser D, Greenberg P, et al. Assessing quality obstetrical care: development of standardized measures. Jt Comm J Qual Patient Saf. 2006;32(9):497–505. https://doi.org/10.1016/s1553-7250(06)32065-x PMID: 17987873
35. Howell EA, Zeitlin J, Hebert PL, Balbierz A, Egorova N. Association between hospital-level obstetric quality indicators and maternal and neonatal morbidity. JAMA. 2014;312(15):1531–41. https://doi.org/10.1001/jama.2014.13381 PMID: 25321908
36. Crenn-Hébert C, Barasinski C, Debost-Legrand A, Da Costa-Correia C, Rivière O, Fresson J, et al. Can hospital discharge data be used for monitoring indicators associated with postpartum hemorrhages? The HERA multicenter observational study. J Gynecol Obstet Hum Reprod. 2018;47(4):145–50. https://doi.org/10.1016/j.jogoh.2018.01.005 PMID: 29391291
37. Sandin-Bojö A-K, Kvist LJ. Care in labor: a Swedish survey using the Bologna Score. Birth. 2008;35(4):321–8. https://doi.org/10.1111/j.1523-536X.2008.00259.x PMID: 19036045
38. Baghurst PA. The case for retaining severe perineal tears as an indicator of the quality of obstetric care. Aust N Z J Obstet Gynaecol. 2013;53(1):3–8. https://doi.org/10.1111/ajo.12014 PMID: 23113874
39. Mesterton J, Lindgren P, Ekenberg Abreu A, Ladfors L, Lilja M, Saltvedt S, et al. Case mix adjustment of health outcomes, resource use and process indicators in childbirth care: a register-based study. BMC Pregnancy Childbirth. 2016;16(1):125. https://doi.org/10.1186/s12884-016-0921-0 PMID: 27245845
40. Goossens SMTA, Hukkelhoven CWPM, de Vries L, Mol BW, Nijhuis JG, Roumen FJME. Clinical indicators associated with the mode of twin delivery: an analysis of 22,712 twin pairs. Eur J Obstet Gynecol Reprod Biol. 2015;195:133–40. https://doi.org/10.1016/j.ejogrb.2015.09.034 PMID: 26546755
41. Romano PS, Yasmeen S, Schembri ME, Keyzer JM, Gilbert WM. Coding of perineal lacerations and other complications of obstetric care in hospital discharge data. Obstet Gynecol. 2005;106(4):717–25. https://doi.org/10.1097/01.AOG.0000179552.36108.6d PMID: 16199627
42. Thompson SM, Nieuwenhuijze MJ, Budé L, de Vries R, Kane Low L. Creating an Optimality Index - Netherlands: a validation study. BMC Pregnancy Childbirth. 2018;18(1):100. https://doi.org/10.1186/s12884-018-1735-z PMID: 29661167
43. Andersson CB, Flems C, Kesmodel US. The Danish national quality database for births. Clin Epidemiol. 2016;8:595–9. https://doi.org/10.2147/CLEP.S99492 PMID: 27822105
44. Kritchevsky SB, Braun BI, Gross PA, Newcomb CS, Kelleher CA, Simmons BP. Definition and adjustment of Cesarean section rates and assessments of hospital performance. Int J Qual Health Care. 1999;11(4):283–91. https://doi.org/10.1093/intqhc/11.4.283 PMID: 10501598
45. Pyykönen A, Gissler M, Jakobsson M, Petäjä J, Tapper A-M. Determining obstetric patient safety indicators: the differences in neonatal outcome measures between different-sized delivery units. BJOG. 2014;121(4):430–7. https://doi.org/10.1111/1471-0528.12507 PMID: 24299178
46. Boesveld IC, Hermus MAA, de Graaf HJ, Hitzert M, van der Pal-de Bruin KM, de Vries RG, et al. Developing quality indicators for assessing quality of birth centre care: a mixed- methods study. BMC Pregnancy Childbirth. 2017;17(1):259. https://doi.org/10.1186/s12884-017-1439-9 PMID: 28768487
47. Patel MS, Rathi B, Tashfeen K, Yarubi MA. Development and implementation of maternity dashboard in regional hospital for quality improvement at ground level: a pilot study. Oman Med J. 2019;34(3):194–9. https://doi.org/10.5001/omj.2019.38 PMID: 31110625
48. Melman S, Schoorel ECN, de Boer K, Burggraaf H, Derks JB, van Dijk D, et al. Development and measurement of guidelines-based quality indicators of caesarean section care in the Netherlands: a RAND-modified Delphi procedure and retrospective medical chart review. PLoS One. 2016;11(1):e0145771. https://doi.org/10.1371/journal.pone.0145771 PMID: 26783742

49. Dyess-Nugent P, Bouzid J, Roberson A, Quint-Bouzid M, Nelson DB. Development of a quality indicator to measure urgent requests to the bedside. Nurs Womens Health. 2020;24(6):404–12. https://doi.org/10.1016/j.nwh.2020.09.003 PMID: 33166492

50. Shinjo D, Ozawa N, Nakadate N, Kanamori Y, Matsumoto K, Noguchi T, et al. Development of a set of quality indicators in paediatric and perinatal care in Japan with a modified Delphi method. BMJ Paediatr Open. 2023;7(1):e002209. https://doi.org/10.1136/bmjpo-2023-002209 PMID: 37940343

51. Soong B, Grimes K, Baade P. The development of clinical indicators--the impact on midwifery practice in Queensland in the future. Aust Coll Midwives Inc J. 1999;12(2):26–31. https://doi.org/10.1016/s1031-170x(99)80019-1 PMID: 10754813

52. Smit M, Sindram SIC, Woiski M, Middeldorp JM, van Roosmalen J. The development of quality indicators for the prevention and management of postpartum haemorrhage in primary midwifery care in the Netherlands. BMC Pregnancy Childbirth. 2013;13:194. https://doi.org/10.1186/1471-2393-13-194 PMID: 24139411

53. Bookhart LH, Anstey EH, Kramer MR, Perrine CG, Ramakrishnan U, Young MF. A dose-response relationship found between the Ten Steps to Successful Breastfeeding indicators and in-hospital exclusive breastfeeding in US hospitals. Birth. 2023;50(4):916–22. https://doi.org/10.1111/birt.12742 PMID: 37435951

54. Nair M, Kurinczuk JJ, Knight M. Establishing a national maternal morbidity outcome indicator in england: a population-based study using routine hospital data. PLoS One. 2016;11(4):e0153370. https://doi.org/10.1371/journal.pone.0153370 PMID: 27054761

55. Srinivas SK, Fager C, Lorch SA. Evaluating risk-adjusted cesarean delivery rate as a measure of obstetric quality. Obstet Gynecol. 2010;115(5):1007–13. https://doi.org/10.1097/AOG.0b013e3181d9f4b6 PMID: 20410776

56. Kazandjian VA, Summer SJ. Evaluating the appropriateness of care: a study of cesarean section rates. QRB Qual Rev Bull. 1989;15(7):206–14. https://doi.org/10.1016/s0097-5990(16)30295-0 PMID: 2771383

57. Friedman AM, Ananth CV, Prendergast E, D'Alton ME, Wright JD. Evaluation of third-degree and fourth-degree laceration rates as quality indicators. Obstet Gynecol. 2015;125(4):927–37. https://doi.org/10.1097/AOG.0000000000000720 PMID: 25751203

58. Hutcheon JA, Lee L, Joseph KS, Kinniburgh B, Cundiff GW. Feasibility of implementing a standardized clinical performance indicator to evaluate the quality of obstetrical care in British Columbia. Matern Child Health J. 2015;19(12):2688–97. https://doi.org/10.1007/s10995-015-1791-1 PMID: 26169814

59. de Bruin-Kooistra M, Amelink-Verburg MP, Buitendijk SE, Westert GP. Finding the right indicators for assessing quality midwifery care. Int J Qual Health Care. 2012;24(3):301–10. https://doi.org/10.1093/intqhc/mzs006 PMID: 22457241

60. Korst LM, Gregory KD, Lu MC, Reyes C, Hobel CJ, Chavez GF. A Framework for the Development of maternal quality of care indicators. Matern Child Health J. 2005;9(3):317–41. https://doi.org/10.1007/s10995-005-0001-y PMID: 16160758

61. Woiski MD, Scheepers HC, Liefers J, Lance M, Middeldorp JM, Lotgering FK, et al. Guideline-based development of quality indicators for prevention and management of postpartum hemorrhage. Acta Obstet Gynecol Scand. 2015;94(10):1118–27. https://doi.org/10.1111/aogs.12718 PMID: 26222391

62. Korst LM, Fridman M, Friedlich PS, Lu MC, Reyes C, Hobel CJ, et al. Hospital rates of maternal and neonatal infection in a low-risk population. Matern Child Health J. 2005;9(3):307–16. https://doi.org/10.1007/s10995-005-0006-6 PMID: 16160757

63. Bamber JH, Lucas DN, Plaat F, Allin B, Knight M, collaborators for the Obstetric Anaesthetists' Association Quality and Outcomes Working Group. The identification of key indicators to drive quality improvement in obstetric anaesthesia: results of the Obstetric Anaesthetists' Association/National Perinatal Epidemiology Unit collaborative Delphi project. Anaesthesia. 2020;75(5):617–25. https://doi.org/10.1111/anae.14861 PMID: 31657014

64. Alfirevic Z, Edwards G, Platt MJ. The impact of delivery suite guidelines on intrapartum care in "standard primigravida". Eur J Obstet Gynecol Reprod Biol. 2004;115(1):28–31. https://doi.org/10.1016/j.ejogrb.2003.10.036 PMID: 15223161

65. Gilbert WM, Bliss MC, Johnson A, Farrell W, Gregg L, Swanson C. Improving recording accuracy, transparency, and performance for obstetric quality measures in a community hospital-based obstetrics department. Jt Comm J Qual Patient Saf. 2013;39(6):258–66. https://doi.org/10.1016/s1553-7250(13)39035-7 PMID: 23789163

66. Walker S, Strandjord TP, Benedetti TJ. In search of perinatal quality outcome measures: 1 hospital's in-depth analysis of the Adverse Outcomes Index. Am J Obstet Gynecol. 2010;203(4):336.e1-7.

67. Mesterton J, Brommels M, Ladfors L, Lindgren P, Amer-Wåhlin I. Inter-hospital variations in health outcomes in childbirth care in Sweden: a register-based study. Int J Qual Health Care. 2019;31(4):276–82. https://doi.org/10.1093/intqhc/mzy153 PMID: 30032271

68. Sibanda T, Fox R, Draycott TJ, Mahmood T, Richmond D, Simms RA. Intrapartum care quality indicators: a systematic approach for achieving consensus. Eur J Obstet Gynecol Reprod Biol. 2013;166(1):23–9. https://doi.org/10.1016/j.ejogrb.2012.09.018 PMID: 23069000

69. Maga G, Brigante L, Del Bo E, Cappadona R, Daniele MAS, Arrigoni C, et al. The Italian midwifery core outcome set (M-COS) for healthy childbearing women and newborns: development and initial validation study. Midwifery. 2022;108:103292. https://doi.org/10.1016/j.midw.2022.103292 PMID: 35235891

70. Jayaratnam S, Burton A, Connan KF, de Costa C. Maternal "near miss" at Royal Darwin Hospital: an analysis of severe maternal morbidity at an Australian regional tertiary maternity unit. Aust N Z J Obstet Gynaecol. 2016;56(4):381–6. https://doi.org/10.1111/ajo.12436 PMID: 26847161

71. Kesmodel US, Jølving LR. Measuring and improving quality in obstetrics--the implementation of national indicators in Denmark. Acta Obstet Gynecol Scand. 2011;90(4):295–304. https://doi.org/10.1111/j.1600-0412.2011.01078.x PMID: 21306336

72. Sprague AE, Dunn SI, Fell DB, Harrold J, Walker MC, Kelly S, et al. Measuring quality in maternal-newborn care: developing a clinical dashboard. J Obstet Gynaecol Can. 2013;35(1):29–38. https://doi.org/10.1016/s1701-2163(15)31045-8 PMID: 23343794

73. Peoples-Sheps MD, Guild PA, Farel AM, Cassady CE, Kennelly J, Potrzebowski PW, et al. Model indicators for maternal and child health: an overview of process, product, and applications. Matern Child Health J. 1998;2(4):241–56. https://doi.org/10.1023/a:1022311524144 PMID: 10728281

74. Korst LM, Fridman M, Lu MC, Mitchell C, Lawton E, Griffin F, et al. Monitoring childbirth morbidity using hospital discharge data: further development and application of a composite measure. Am J Obstet Gynecol. 2014;211(3):268.e1-268.e16. https://doi.org/10.1016/j.ajog.2014.03.011 PMID: 24631432

75. Boulkedid R, Sibony O, Bossu-Salvador C, Oury JF, Alberti C. Monitoring healthcare quality in an obstetrics and gynaecology department using a CUSUM chart. BJOG. 2010;117(10):1225–35. https://doi.org/10.1111/j.1471-0528.2010.02632.x PMID: 20560945

76. Sauvegrain P, Chantry AA, Chiesa-Dubruille C, Keita H, Goffinet F, Deneux-Tharaux C. Monitoring quality of obstetric care from hospital discharge databases: a Delphi survey to propose a new set of indicators based on maternal health outcomes. PLoS One. 2019;14(2):e0211955. https://doi.org/10.1371/journal.pone.0211955 PMID: 30753232

77. Roberts CL, Bell JC, Ford JB, Morris JM. Monitoring the quality of maternity care: how well are labour and delivery events reported in population health data? Paediatr Perinat Epidemiol. 2009;23(2):144–52. https://doi.org/10.1111/j.1365-3016.2008.00980.x PMID: 19159400

78. Kogan MD, Dykton C, Hirai AH, Strickland BB, Bethell CD, Naqvi I, et al. A new performance measurement system for maternal and child health in the United States. Matern Child Health J. 2015;19(5):945–57. https://doi.org/10.1007/s10995-015-1739-5 PMID: 25823557

79. Florea A, Caughey SS, Westland J, Berckmans M, Kennelly C, Beach C, et al. The Ottawa hospital quality incident notification system for capturing adverse events in obstetrics. J Obstet Gynaecol Can. 2010;32(7):657–62. https://doi.org/10.1016/s1701-2163(16)34569-8 PMID: 20707954

80. Howell EA, Zeitlin J, Hebert P, Balbierz A, Egorova N. Paradoxical trends and racial differences in obstetric quality and neonatal and maternal mortality. Obstet Gynecol. 2013;121(6):1201–8. https://doi.org/10.1097/AOG.0b013e3182932238 PMID: 23812453

81. Zeitlin J, Wildman K, Bréart G, Alexander S, Barros H, Blondel B, et al. PERISTAT: indicators for monitoring and evaluating perinatal health in Europe. Eur J Public Health. 2003;13(3 Suppl):29–37. https://doi.org/10.1093/eurpub/13.suppl_1.29 PMID: 14533746

82. Fabricant SP, Opara KN, Paul JV, Blissett G, Rau AR, White JD, et al. The positive predictive value of hospital discharge data for identifying severe maternal morbidity with and without blood transfusion. Jt Comm J Qual Patient Saf. 2023;49(9):467–73. https://doi.org/10.1016/j.jcjq.2023.05.004 PMID: 37365038

83. Smit M, Chan K-LL, Middeldorp JM, van Roosmalen J. Postpartum haemorrhage in midwifery care in the Netherlands: validation of quality indicators for midwifery guidelines. BMC Pregnancy Childbirth. 2014;14:397. https://doi.org/10.1186/s12884-014-0397-8 PMID: 25481692

84. Moser D. Quality aspects relating to giving birth in Switzerland: an analysis of quality indicators in inpatient obstetrics from 2013 to 2017. Front Public Health. 2022;10:1009412. https://doi.org/10.3389/fpubh.2022.1009412 PMID: 36311608

85. Pileggi C, Squillace L, Giordano M, Papadopoli R, Bianco A, Pavia M. Quality in perinatal care: applying performance measurement using joint commission on accreditation of healthcare organizations indicators in Italy. BMC Med Res Methodol. 2019;19(1):83. https://doi.org/10.1186/s12874-019-0722-z PMID: 31018835

86. Guiguet-Auclair C, Rivière O, Gerbaud L, Vendittelli F. Quality indicators during delivery and the immediate postpartum period: a modified Delphi study. Healthcare (Basel). 2023;11(6):848. https://doi.org/10.3390/healthcare11060848 PMID: 36981505

87. Boulkedid R, Sibony O, Goffinet F, Fauconnier A, Branger B, Alberti C. Quality indicators for continuous monitoring to improve maternal and infant health in maternity departments: a modified Delphi survey of an international multidisciplinary panel. PLoS One. 2013;8(4):e60663. https://doi.org/10.1371/journal.pone.0060663 PMID: 23577143

88. Bailit JL, Love TE, Dawson NV. Quality of obstetric care and risk-adjusted primary cesarean delivery rates. Am J Obstet Gynecol. 2006;194(2):402–7. https://doi.org/10.1016/j.ajog.2005.07.045 PMID: 16458637

89. Rich R, D'Hont T, Murphy KE, Veillard J, Chatwood S. Selecting contextually appropriate performance indicators in a circumpolar context: a modified Delphi approach. BMC Health Serv Res. 2021;21(1):530.

90. Santos JV, Correia C, Cabral F, Bernardes J, Costa-Pereira A, Freitas A. Should European perinatal indicators be revisited? Eur J Obstet Gynecol Reprod Biol. 2013;170(1):85–9. https://doi.org/10.1016/j.ejogrb.2013.05.017 PMID: 23809998

91. Voerman GE, Calsbeek H, Maassen ITHM, Wiegers TA, Braspenning J. A systematic approach towards the development of a set of quality indicators for public reporting in community-based maternity care. Midwifery. 2013;29(4):316–24. https://doi.org/10.1016/j.midw.2012.01.012 PMID: 23357096

92. Clapp MA, James KE, Bates SV, Kaimal AJ. Unexpected term NICU admissions: a marker of obstetrical care quality? Am J Obstet Gynecol. 2019;220(4):395.e1-395.e12. https://doi.org/10.1016/j.ajog.2019.02.001 PMID: 30786256

93. Ueda K, Kaso M, Ohtera S, Nakayama T. Updating quality indicators for low-risk labour care in Japan using current clinical practice guidelines: a modified Delphi method. BMJ Open. 2019;9(2):e023595. https://doi.org/10.1136/bmjopen-2018-023595 PMID: 30819701

94. Havranek MM, Rüter F, Bilger S, Dahlem Y, Oliveira L, Ehbrecht D, et al. Validity of 16 AHRQ Patient Safety Indicators to identify in-hospital complications: a medical record review across nine Swiss hospitals. Int J Qual Health Care. 2023;35(4):0.

95. Wagner B, Meirowitz N, Shah J, Nanda D, Reggio L, Cohen P, et al. Comprehensive perinatal safety initiative to reduce adverse obstetric events. J Healthc Qual. 2012;34(1):6–15. https://doi.org/10.1111/j.1945-1474.2011.00134.x PMID: 22060764

96. Knight H, Gurol-Urganci I, Cromwell D, Mahmood T, Templeton A, Kiran A. Development of a suite of indicators for quality improvement in maternity care. BJOG. 2014;121:96–7.
97. Lain SJ, Algert CS, Nassar N, Bowen JR, Roberts CL. Incidence of severe adverse neonatal outcomes: use of a composite indicator in a population cohort. Matern Child Health J. 2012;16(3):600–8. https://doi.org/10.1007/s10995-011-0797-6 PMID: 21505774
98. Fridman M, Korst LM, Reynen DJ, Nicholas LA, Greene N, Saeb S, et al. Severe maternal morbidity in California hospitals: performance based on a validated multivariable prediction model. Jt Comm J Qual Patient Saf. 2021;47(11):686–95. https://doi.org/10.1016/j.jcjq.2021.08.009 PMID: 34548236
99. Pyykönen A, Gissler M, Jakobsson M, Lehtonen L, Tapper A-M. The rate of obstetric anal sphincter injuries in Finnish obstetric units as a patient safety indicator. Eur J Obstet Gynecol Reprod Biol. 2013;169(1):33–8. https://doi.org/10.1016/j.ejogrb.2013.01.027 PMID: 23474118
100. NHS England Digital. UK Maternity Services dashboard. NHS England Digital; 2024 [cited 2025 Apr 29]. Available from: https://fingertips.phe.org.uk/profile/child-health-profiles/data#page/1/gid/1938133222
101. Main EK, Abreo A, McNulty J, Gilbert W, McNally C, Poeltler D, et al. Measuring severe maternal morbidity: validation of potential measures. Am J Obstet Gynecol. 2016;214(5):643.e1-643.e10. https://doi.org/10.1016/j.ajog.2015.11.004 PMID: 26582168
102. Australian Institute of Health and Welfare. National Core Maternity Indicators, Summary. Australian Institute of Health and Welfare; 2024 [cited 2025 Apr 29]. Available from: National Core Maternity Indicators, About - Australian Institute of Health and Welfare
103. Canada PHA of. Perinatal Health Indicators — Canada.ca [Internet]; 2024 [cited 2025 Apr 29]. Available from: https://health-infobase.canada.ca/phi/
104. Maternity Clinical Indicators - Health New Zealand | Te Whatu Ora [Internet]. [cited 2025 Feb 18]. Available from: https://www.tewhatuora.govt.nz/for-health-professionals/data-and-statistics/maternity/maternity-clinical-indicators
105. Joint Commission. Specifications Manual for Joint Commission National Quality Measures [Internet]; 2022 [cited 2025 Apr 29]. Available from: https://manual.jointcommission.org/releases/TJC2022B2/
106. Cundiff GW, Kaur P, Hanley GE, Janssen P. Vaginal uncomplicated delivery rate as a quality indicator compared to cesarean delivery rate: a quantitative analysis of a population database. J Obstet Gynaecol Can. 2024;46(12):102693. https://doi.org/10.1016/j.jogc.2024.102693 PMID: 39419443
107. Clapp MA, James KE, Bates SV, Kaimal AJ. Patient and hospital factors associated with unexpected newborn complications among term neonates in US hospitals. JAMA Netw Open. 2020;3(2):e1919498. https://doi.org/10.1001/jamanetworkopen.2019.19498 PMID: 32049289
108. Moller A-B, Newby H, Hanson C, Morgan A, El Arifeen S, Chou D, et al. Measures matter: a scoping review of maternal and newborn indicators. PLoS One. 2018;13(10):e0204763. https://doi.org/10.1371/journal.pone.0204763 PMID: 30300361
109. Saturno-Hernández PJ, Martínez-Nicolás I, Moreno-Zegbe E, Fernández-Elorriaga M, Poblano-Verástegui O. Indicators for monitoring maternal and neonatal quality care: a systematic review. BMC Pregnancy Childbirth. 2019;19(1):25. https://doi.org/10.1186/s12884-019-2173-2 PMID: 30634946
110. Bunch KJ, Allin B, Jolly M, Hardie T, Knight M. Developing a set of consensus indicators to support maternity service quality improvement: using Core Outcome Set methodology including a Delphi process. BJOG. 2018;125(12):1612–8. https://doi.org/10.1111/1471-0528.15282 PMID: 29770557
111. Houlbracq R, Le Ray C, Blondel B, Lelong N, Chantry AA, Desplanches T. Episiotomies and obstetric anal sphincter injuries following a restrictive episiotomy policy in France: an analysis of the 2010, 2016, and 2021 National Perinatal Surveys. PLoS Med. 2025;22(1):e1004501.
112. Singh M. Heuristics in the delivery room. Science. 2021;374(6565):324–9. https://doi.org/10.1126/science.abc9818 PMID: 34648341
113. Benova L, Moller A-B, Hill K, Vaz LME, Morgan A, Hanson C, et al. What is meant by validity in maternal and newborn health measurement? A conceptual framework for understanding indicator validation. PLoS One. 2020;15(5):e0233969. https://doi.org/10.1371/journal.pone.0233969 PMID: 32470019
114. Pollock D, Evans C, Menghao Jia R, Alexander L, Pieper D, Brandao de Moraes E. How-to: scoping review? J Clin Epidemiol. 2024;176:111572.