



Quality indicators for anesthesia and perioperative medicine

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Purpose of review

Routine monitoring of care quality is fundamental considering the high reported rates of preventable perioperative morbidity and mortality. However, no set of valid and feasible quality indicators is available as the gold standard for comprehensive routine monitoring of the overall quality of perioperative care. The purpose of this review is to describe underlying difficulties, to summarize current trends and initiatives and to outline the perspectives in support of suitable perioperative quality indicators.

Recent findings

Most perioperative quality indicators used in the clinical setting are based on low or no evidence. Evidence-based perioperative quality indicators validated for research purposes are not always applicable in routine care. Developing a core set of perioperative quality indicators for clinical practice may benefit from matching feasible routine indicators with evidence-based indicators validated for research, from evaluating additional new indicators, and from including patients views.

Summary

A core set of valid and feasible quality indicators is essential for monitoring perioperative care quality. The development of such a set may benefit from matching evidence-based indicators with feasible standard indicators and from including patients views.

Keywords

anesthesia, patient safety, perioperative care, preventable patient harm, quality indicators

INTRODUCTION

The goal of safety and quality initiatives is to improve the quality of care [1–3]. Numerous safety and quality interventions have been developed and evaluated [4,5]. Regarding perioperative care, however, there is a shortage of valid and practicable measures that can be used to monitor overall patient outcomes and care quality under the countless influences of changing diagnostic and therapeutic approaches, hospital processes, patient profiles, workforce characteristics, and quality interventions [6]. In particular, to date, there is no generally accepted ‘gold standard’ set of indicators to comprehensively monitor the quality of perioperative care [7,8].

The goals of this review are to describe difficulties contributing to this shortcoming, to summarize current initiatives supporting more suitable perioperative quality indicators and to outline future perspectives. The emphasis is on anesthesia and the perioperative care of adult patients. A nonsystematic search of PubMed [9], Embase [10], Google Scholar [11], Cochrane Library [12], Web of Science Cited References Search [13], article reference lists, and the internet was conducted. Articles published between 2021 and 2022 were prioritized. Notably,

the terms ‘quality indicator’, ‘measure’, and ‘metric’ are used inconsistently and sometimes interchangeably in the literature, and hence in this review [14]. ‘Perioperative’ describes all aspects of patient care except surgery itself [15¹⁶].

WHY IS IT IMPORTANT TO MEASURE THE QUALITY OF PERIOPERATIVE CARE?

A systematic review found that approximately 20% of surgical and 34% of ICU patients are harmed during their hospital stay [16]. Perioperative

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KEY POINTS

- Routine monitoring of perioperative care quality is critical because of high reported rates of preventable perioperative morbidity and mortality.
- To date, no valid and feasible set of quality indicators is available for monitoring patient outcomes and overall quality of perioperative care.
- Developing a core set of quality indicators for assessing perioperative care may benefit from matching feasible routine indicators with evidence-based indicators validated for research, from evaluating additional indicators, and from including patients views.

mortality ranged between 0.4% and 4% [17–19,20[■]]. Importantly, approximately 50% of patient harm [16] and surgical mortality [21] may be preventable, particularly deaths after complications, termed ‘failure to rescue’ [22].

Anesthesia-specific mortality risk is very low (approximately 1:100 000 [3]), but anesthesia management can impact the overall incidence of perioperative complications [23]. The majority of perioperative complications and deaths occur postoperatively on the ward [24], and anesthesiologists may miss most of them. Patients experiencing postoperative acute renal failure, myocardial infarction, or stroke have high rates of failure to rescue, which typically occurs during the first postoperative week [19,25–28]. Postoperative infections typically occur even later [28].

Modifiable features of perioperative management may impact such outcomes. For example, using peripheral nerve blocks for primary hip and knee arthroplasty was associated with significantly lower rates of postoperative complications [29]. Moreover, intraoperative anesthesia handovers [30[■],31] as well as staffing ratios of supervising anesthesiologists [32[■]] were related to higher rates of postoperative mortality and complications. Hence, monitoring overall postoperative complications and mortality is crucial.

Quality monitoring can be used in different ways. First, for *quality improvement* [14], quality indicators are used for *internal* improvement within institutions. For example, quality data helped identify a high rate of failed brachial plexus blocks in a Norwegian anesthesia department, which could be reduced by service reorganization and improved use of ultrasound [33]. Second, for *quality assurance* [14], quality indicators are used for *external* reporting. For example, an excessive adjusted death rate at the pediatric cardiac surgery unit in Bristol (UK) led to an external investigation [34]. After recommendations were implemented, it dropped from 29% to 3% within 3 years [34].

WHY IS IT DIFFICULT TO DEFINE ‘SUITABLE’ QUALITY INDICATORS FOR ROUTINE PERIOPERATIVE CARE?

High demands on quality indicators may explain the difficulty to find a suitable indicator set for perioperative care: considering Donabedian’s widely accepted model of care quality, such indicators should cover together the structures, processes, and outcomes of care [35]. They are used to evaluate the implementation of guideline-recommended interventions, improve care processes, and assess patient outcomes [36[■],37].

Good quality indicators should measure something *important* in a *scientifically sound* and *practically feasible* way [38–40] and have the *potential for future improvements* [41[■]]. However, healthcare quality is a broad concept consisting of different aspects and attributes that describe the expectations of different stakeholders [7]. For example, safety may be crucial for patients [42], while efficiency or cost-effectiveness may be particularly important for healthcare administrators or funders [43]. Hence, it is difficult to find few quality indicators that are generally meaningful. Furthermore, quality indicators should also produce reliable and valid results [39]. However, several systematic reviews found that most quality indicators used in routine perioperative care were based on low level or no scientific evidence [7,44,45[■],46[■]]. Conversely, clinical indicators should be feasible and applicable for potential audiences [39], but evidence-based indicators validated for research purposes are not always practicable in routine care. Examples are presented in the following sections.

PERIOPERATIVE QUALITY INDICATOR SETS VALIDATED FOR RESEARCH PURPOSES

Some quality indicator sets validated for use in clinical trials may be beneficial for assessing the evidence level of similar routine measure candidates.

The Core Outcome Measures for Perioperative and Anesthetic Care-Standardized Endpoints in Perioperative Medicine (COMPAC-StEP) initiative seeks to harmonize outcome reporting in perioperative trials [15[■],47]. COMPAC seeks consensus on *what* to measure and StEP on *how* to measure it [15[■]]. The COMPAC core set represents a minimum of outcomes to be reported in perioperative trials [15[■]]. It was based on a systematic review to identify suitable measures, a survey of patients, their carers, clinicians, and researchers to rate their importance, and a Delphi process with representatives of all groups. This outcome set included postoperative mortality and morbidity, length of hospital stay, unplanned readmission, and patient-centered

outcomes [15¹¹]. Other StEP publications have described ‘how’ to exactly measure these outcomes [15¹¹,47–55]. For example, the StEP Consensus Clinical Indicators presented a set of eight clearly defined outcome indicators for research uses, including surgical site infection at 30 days, stroke within 30 days of surgery, death within 30 days of coronary artery bypass grafting, death within 30 days of surgery, admission to the intensive care unit within 14 days of surgery, readmission to the hospital within 30 days of surgery, and length of hospital stay (with or without in-hospital mortality) [53]. Expert researchers rated them as valid, reliable, easy to use, and clearly defined [53]. Other StEP publications provide further definitions for research, including cardiovascular outcomes [50], infection and sepsis [49], pulmonary complications [51], postoperative cancer outcomes [52], renal endpoints [54], patient-centered outcomes [48], and patient comfort [55].

QUALITY INDICATORS VALIDATED FOR PARTICULAR ASPECTS OF PERIOPERATIVE CARE

Certain indicators have been developed and validated for defined areas or aspects of perioperative care. For example, structure indicators describe the presence of organizational resources, while process indicators may allow the identification of necessary changes in care processes [56]. In a recent systematic review, 7 structure and 35 process indicators had a high scientific level of 1 [57,58].

Specific quality indicators have also been described for monitoring particular areas of care, for example perioperative patient safety [56], regional anesthesia [46¹²], perioperative pain management [59¹³], obstetric anesthesia [60], cardiovascular assessment and management of patients undergoing non-cardiac surgery [36¹⁴,37], cardiac anesthesia [61,62], or temperature management [63]. Importantly, failure to rescue is increasingly supported as a quality indicator [22] because it reflects the ability of hospitals to treat complications early and prevent deaths [22,64¹⁵].

PATIENT VIEWS AS THE ESSENTIAL PERSPECTIVE: PATIENT-REPORTED EXPERIENCE MEASURES AND PATIENT-REPORTED OUTCOME MEASURES

The indicators discussed thus far represent a mostly professional view on quality, but as Donabedian noted in 1988, patient satisfaction is indispensable in quality assessments [35]. The health economic concept of ‘value’ is defined as health outcomes (that matter to patients) achieved per dollar spent [65,66] It offers a

financial incentive for value-based interventions. Surprisingly, patient-centered metrics were rare among published clinical indicators [44] and missing as study endpoints [67] or in clinical indicator sets [68].

Patient-reported *outcome measures* (PROMs) [69] are patients’ views on their health status [70], for example, quality of recovery [71¹⁶,72]. Patient-reported *experience measures* (PREMs) [69] are views on their care experience, for example, communication with staff [70]. The 15-item quality of recovery (QoR-15) questionnaire [73] for research may be considered for routine use: completed in a few minutes [71¹⁶], it provides a summary measure of patient well being [48].

EXAMPLES OF QUALITY INDICATOR SETS EMPIRICALLY DEVELOPED IN CLINICAL PRACTICE

Professional societies and other organizations have practically developed and worked with perioperative quality indicators for a long time. Such empirical indicators often lack a robust basis of scientific evidence [7,44,45¹⁷,46¹⁸], but they are usually *feasible* in routine care. Several anesthesiologists’ societies have published perioperative quality indicator sets on the internet (for details and abbreviations, see Table 1).

There are noticeable features of these very heterogeneous sets. For example, data linkage to other registries is possible with the Danish Anesthesia Database (DAD) [68] and the PQIP Programme run by the RCoA in the UK [81,82,90]. In addition, the DAD allows day-to-day reporting [68]. The Swiss SSAPM database has been used for relevant practical analyses, for example, projecting anesthesia drug supply during the pandemic [78] or estimating future anesthesiologist workforce shortages [91]. On a supranational level, the WFSA has published an indicator set for tracking timely access to safe surgical, anesthesia and obstetric care at the national level [87¹⁹,88]. The Helsinki Declaration on Patient Safety in Anesthesiology launched by the European Society of Anesthesiology and Intensive Care (ESAIC) and partner organizations in 2010 [3] contains 17 ‘principal requirements’ that resemble structure quality indicators (e.g., monitoring standards, safety protocols, and reports about safety, morbidity and mortality) [92].

CHALLENGES IN ESTABLISHING A ROUTINE CORE SET OF PERIOPERATIVE QUALITY INDICATORS

Numerous problems complicate the establishment of a generally accepted, standardized, valid, feasible, and short but comprehensive core set of perioperative quality indicators. Indicator sets in clinical use

Table 1. Examples of perioperative quality indicator sets published by anesthesiologists' societies on the internet

Anesthesiologists' societies	Related web page	Topics covered by the quality indicators	Comments
German Society of Anaesthesiology and Intensive Care Medicine (DGAI) and Association of German Anaesthetists (BDA)	https://www.dgai.de/publikationen/vereinbarungen.html#viii_qualitaetsicherung	Ten indicators including: safety protocols required by HD; [3] DGAI's core dataset; CIRSS and/or M&M conferences; PBM; temperature management; WHO SSC; M&M report; handover & discharge protocols; routine postop. anesthesiologic visit (SOP or instructions); physician staffing according to DGAI [41, 74, 75]	Implementation of these ten indicators was found to be mostly feasible, but no hospital had implemented all indicators [41]. Mortality is tracked until 24 h postoperatively [41].
Swiss Society for Anaesthesiology and Perioperative Medicine (SSAPM)	https://ssapm.ch/qualitaet/programm-aqua/aqua-datensatz-und-codierung/	Part 1: Annual institution related structure data including setting, staffing, operating rooms, number of anesthetics, etc. [76] Part 2: Case-related process, outcome, and service data [76]	Part 1 and 2 data reporting to SSAPM is mandatory for teaching hospitals [77]. Until 2020, only approximately 55% of anesthesia departments participated in Part 1 [78]. Mortality is measured up to 24 h postoperatively [76].
Austrian Society of Anaesthesiology, Resuscitation and Intensive Care (GAR)	https://www.oegari.at/arbeitsgruppen/plattform-kennzahlen-outcome	Website presents quality indicators for key data, respectively separately for intensive care, emergency medicine, anesthesia (preoperative, (intra) operative, postoperative) [79]	72-h follow-up: mortality, neurological abnormalities, patient satisfaction, regional anesthesia & catheter care post anesthesia; 48-h follow-up: unplanned ICU readmission [79]
Danish Society of Anaesthesiology and Intensive Care Medicine (DASAIM), and RKKP	https://www.rkkp.dk/kvalitetsdatabaser/databaser/dansk-anaesthesi-database/	Danish Anesthesia Database (DAD): Data are collected according to 13 process and outcome indicators [68]. Reporting is mandatory; coverage is increasing [68]	DAD: part of a National Clinical Database, but DASAIM is represented in steering board [68]. DAD data can be linked to 30-day and 90-day mortality rates in other databases [68, 80]
Royal College of Anaesthetists (RCoA) - Perioperative Quality Improvement Programme (PQIP)	https://rcoa.ac.uk/research/research-projects/perioperative-quality-improvement-programme-pqip	Data collection: Patient characteristics, perioperative processes, clinical outcomes (including failure to rescue) and patient-related outcome measures in major noncardiac surgery [81, 82].	PQIP: Combined research/quality improvement initiative: Participating hospitals receive a live dashboard of results, and regular reports [82]. Long-term mortality rates are tracked by linking PQIP data to national mortality registry data [82]
American Society of Anesthesiologists - Anesthesia Quality Institute (AQI)	https://www.aqihq.org/indicators.aspx	AQI recommended indicators include: business/structure indicators, process indicators, clinical outcome indicators, patient experience indicators [83]. AQI runs the National Anesthesia Clinical Outcomes Registry (NACOR) [84]	Follow up: In NACOR, perioperative mortality includes deaths occurring intraoperatively or during the immediate postoperative period until discharge from the PACU [85]
Australian and New Zealand College of Anaesthetists (ANZCA)	https://www.anzca.edu.au/safety-advocacy/standards-of-practice/policies,-statements,-and-guidelines	An ANZCA educational professional guideline document provides an overview of quality assurance and quality improvement in anesthesia [86]. Structure, process and outcome measure examples are listed [86]	The guideline document outlines topics for measure examples, but without specific definitions (e.g., follow-up period for mortality) [86]
World Federation of Societies of Anaesthesiologists (WFSA)	https://wfsahq.org/our-work/safety-quality/utstein-surgical-indicators/	Indicator set for tracking timely access to safe surgical, anesthesia and obstetric care (national level) [87]. Surgical volume; geospatial access; workforce; perioperative mortality; catastrophic expenditure [88]	WFSA has revised indicators proposed by the Lancet Commission on Global Health [87]. Perioperative mortality follow-up includes deaths before discharge (up to 30 days) [87].

CIRSS, critical incident reporting system; HD, Helsinki Declaration on Patient Safety in Anaesthesiology [3]; M&M, morbidity and mortality; PACU, post anesthesia care unit; PBM, patient blood management; SOP, standard operating procedure; WHO SSC, World Health Organization surgical safety checklist; English names of the European NAS are listed according to the NAS website of the European Society of Anaesthesiology and Intensive Care (ESAIC) [89].

are rarely based on high levels of evidence [7,44, 45[■],46[■]]. Composition of such sets and indicator definitions may be strikingly heterogeneous (see Table 1). Indeed, inconsistent indicator definitions can make it impossible to use quality monitoring for comparing clinical results with research results or for comparing results obtained with different systems. For example, the postoperative follow-up period used for assessing mortality may range from 24 h [41[■],76], 72 h [79], until discharge from the PACU [85], until hospital discharge (up to 30 days) [87[■]], 30 days, or 90 days [68] (see Table 1). Furthermore, the validity of indicator sets may be limited if important aspects of care are not represented, for example, if patient-centered metrics are under-represented in existing indicator sets or as study endpoints [44,67,68].

Practical obstacles may hinder the implementation of quality monitoring: time, funding, necessary structures, technical requirements may be lacking, or employee compliance may be poor [41[■],56,93[■]]. An important problem is that existing data can be hard to utilize for quality purposes [56,93[■]]. In an Australian study, clinicians had limited access to data exports, which was a significant barrier to the utilization of such data [93[■]]. Learning opportunities are also limited if registries containing complementary information, for example, anesthetic and surgical registries, cannot be linked [94]. Furthermore, mandatory data reported to government agencies or other organizations may be published too late to benefit clinical frontline quality management. For example, the publication of national in-hospital mortality rates by the Swiss Federal Office of Public Health can take up to approximately two years [95,96].

OPPORTUNITIES FOR ESTABLISHING A ROUTINE CORE SET OF PERIOPERATIVE QUALITY INDICATORS

In view of the multiple perspectives involved in quality monitoring, developing a core set requires close cooperation of all involved. Because professional societies are usually strongly connected to current research activities as well as to practice development in their fields, they can assume a prominent role in the promotion of a standardized, valid, and feasible core set, together with research and clinical institutions, governmental agencies, and other organizations.

For example, future efforts to establish such a set may benefit from approaches that seek to match well validated evidence-based measures developed for research purposes with the feasibility and usability of empirical indicators developed in clinical practice. Accordingly, the Patient Safety and Quality Committee of ESAIC has launched the ESAIC

Quality Indicator Project (EQUIP) [97], a survey of National Anesthesiologists Societies (NAS) to understand if these societies provide their members with a set of quality indicators and a data collection system, and to review such existing *clinical* indicators in comparison with *published* indicators [97]. This may contribute to establishing a comprehensive core set of perioperative quality indicators [97].

In addition, professional societies can support research and practice development aimed at advancing indicator contents. New modifiable risk factors emerging from research may be evaluated as quality indicators (e.g., anesthesia handovers [30[■],31], staffing [32[■]]). In terms of value [65,66], the perspectives of patients and their caregivers should be included in indicator research [15[■]] and development [98]. Importantly, the content validity of a new set composed of validated indicators needs to be assessed again in its entirety [40].

Furthermore, professional societies may contribute to increasing the utilization of existing data for quality purposes. For example, a study coordinated from the Australian and New Zealand College of Anesthetists (ANZCA) Clinical Trials Network (CTN) found inconsistent use of existing data for quality purposes and suggested the establishment of a national perioperative outcomes registry [93[■]]. Cooperation between professional societies and governmental agencies or other organizations may also contribute to realizing the link between registries to enhance learning opportunities [68,80,82,94].

Finally, obstacles at local levels are not easy to overcome. Until a generally accepted, valid and feasible core set of perioperative quality indicators equipped with the necessary infrastructure becomes available, clinicians and institutions may choose pragmatic solutions using locally tailored quality indicators based on national requirements and local priorities (e.g., following critical incident reports). Priority should be given to outcomes that matter to patients [65,66] and to reliable, valid, feasible and usable methods of measurement [38].

CONCLUSION

Considering high rates of preventable perioperative patient harm, monitoring the quality of perioperative care is a priority. To date, no 'gold standard' set of routine perioperative quality indicators is available. Most quality indicators used in routine perioperative care are based on low levels of evidence, while some of the high-level indicators validated for research use may not be feasible in routine practice. Future research and practice development may benefit from matching evidence-based and feasible indicators, from evaluating additional indicators

using new evidence, and from including patients' views. In the absence of a gold standard set of indicators, a pragmatic approach to quality monitoring is necessary.

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Conflicts of interest

The author is Past Chair of the Patient Safety and Quality Committee, European Society of Anaesthesiology (ESA), Brussels, Belgium; Member of the Data and Quality Committee, Swiss Society for Anaesthesiology and Resuscitation (SGAR), Bern, Switzerland; Associate Lecturer, University of Zurich, Switzerland; and Lecturer, Z-INA Nursing School, Zurich, Switzerland.

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