

Perioperative structure and process quality and safety indicators: A systematic review

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Perioperative structure and process quality and safety indicators: A systematic review

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Summary (Abstract)

Background

Clinical indicators assess healthcare structures, processes and outcomes. While used widely, the exact number and level of scientific evidence of these indicators remains unclear. The aim of this study was to evaluate the number, type and evidence base of clinical process and structure indicators currently available for quality and safety measurement in perioperative care.

Methods

We performed a systematic review searching Medline, Embase, CINAHL, Cochrane, Google Scholar and SIGLE databases for English language human studies in adults (age >18) published in the last 10 years (January 2005 – January 2016). We also included professional and governmental body publications and guidelines describing the development, validation and use of structure and process indicators in perioperative care.

Results

We identified 43,860 journal articles and 43 relevant indicator program publications. From these we identified a total of 1282 clinical indicators, split into structure (36%, n=463) and process indicators (64%, n=819). The dimensions of quality most frequently addressed were effectiveness (38%, n=475) and patient safety (29%, n=363). The majority of indicators (53%, n=675) did not have a level of evidence ascribed in their literature. Patient centred metrics accounted for the fewest published clinical indicators.

Conclusions

Despite widespread use, the majority of clinical indicators are not based on a strong level of scientific evidence. There may be scope in setting standards for the development and validation process of clinical indicators. Most indicators focus on the effectiveness, safety and efficiency of care.

Editor's Key Points

1. This systematic review investigates and summarises process and structure clinical indicators currently available for quality and safety measurement in perioperative care.
2. Despite widespread use, the majority of indicators are not supported by a high grade of scientific evidence.
3. Most indicators focus on the effectiveness, safety and efficiency of care, with patient centred metrics found less frequently in the literature.

MeSH Keywords

Perioperative Period
Quality Indicators, Healthcare
Review, Systematic

Introduction

Clinical indicators assess healthcare structures, processes and outcomes, and can provide a quantitative basis for quality improvement.¹³ Variation in practices, outcomes, and costs of care is substantial.^{10,11} Variability in postoperative outcomes may not be attributable to patient risk factors alone; some variation will be due to differing processes and structures of care within medical centres and some variation will simply be random or unattributable.¹⁴

Indicators are typically classified into specific areas of care using the conceptual model of quality assessment developed by Donabedian.¹⁵ Here, patients and antecedent conditions enter an organisation's structure (how care is organised) to undergo processes of care (what is done), leading to healthcare outcomes (the achieved results). Process indicators examine all the steps and activities taken in implementing a treatment or care episode. Structure indicators assess the settings in which healthcare occurs. These include physical resources (such as facilities and equipment), human resources (such as number, qualifications and availability of personnel) and the administrative structure.

A previous systematic review¹⁶ of the literature until 2005 described 108 anaesthetic quality and safety indicators. With many new initiatives and further developments since the study was published, we hypothesised that it was likely that new quality indicators will have been developed. With substantial parallel work in the outcomes domain^{17,18} already underway, we decided to limit our investigation to structure and process indicators.

The aim of this systematic review was to investigate the process and structure clinical indicators currently available for quality and safety measurement in perioperative care, and their level of scientific evidence.

Methods

Definitions for the purposes of this review

Quality of care

The Institute of Medicine (IOM) defines health care quality as “the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge”.¹⁹ It further subdivides health care quality into the six dimensions of: effectiveness, safety, patient-centredness, timeliness, efficiency and equity.¹⁹

Clinical Indicators

An indicator is a measurable aspect of care for which there is evidence that it represents quality.²⁰

Level of evidence

The levels of evidence for papers were ranked using the Oxford Centre for Evidence-based Medicine scale.²¹

Search strategy and selection criteria

This systematic review was registered with the PROSPERO database (CRD42015017277). Methods and reporting conform to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), BMC and Cochrane guidelines^{22,23,24}, and the BJA guidelines.

We searched Ovid Medline, Ovid Embase, and the Cochrane DARE library for all articles relating to the development and use of structure and process clinical indicators in general perioperative care. We additionally searched grey literature databases: Google Scholar²⁵, and the System for Information in Grey Literature in Europe (SIGLE). We also included professional, governmental and quality standard initiative publications and guidelines (see Table 1). We limited the search to English language human studies in adults (age >18), published in the last 10 years (1 January 2005 – 1 January 2016). The detailed search strategy is presented in Appendix 1.

Data extraction

We screened titles and abstracts for relevance. We included national audit projects, clinical practice guidelines, literature reviews, surveys, service evaluations and validation studies. Conference abstracts and letters were excluded. Indicators had to be generalizable to all surgical specialities, but their use may have been described for a specific surgical population. We excluded indicators relating only to intensive care, paediatrics, neurosurgery, cardiothoracics and obstetrics. We searched the citations and the references (snow-balling) of the shortlisted publications for relevant literature. The final shortlisted publications are presented in Table 1.

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3 The full text of all shortlisted articles was reviewed and the data extracted
4 using a data extraction form (presented in Appendix 2). The indicators were
5 tabulated and classified into structure or process indicators. We added the
6 timing of use of the perioperative indicator defined as: preoperative (from the
7 decision to operate to entry into the theatre suite), intraoperative (from entry
8 into the theatre suite to leaving the recovery area), postoperative (following
9 transfer from the recovery area) or all (spanning the whole perioperative
10 journey).
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13 We also included the indicator's name, country of origin, developer's
14 definition, the type of article the indicator is identified from, the surgical
15 subspecialty the indicator is based on, the level of evidence for its validity and
16 the quality domain measured. We reported ranges rather than individual
17 scores of evidence in order to account for the heterogeneity of the literature
18 on which indicators are based. The search and data extraction were
19 performed by two authors (MC and DG). Differences in extracted data were
20 discussed and consensus reached with a third author (SRM).
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Results

We identified 43,860 journal articles of which 98 articles met colleagues' inclusion criteria. Figure 1 provides a description of the selection process for the journal articles. The most common reason for excluding articles after full text review was the absence of a clinical indicator. The grey literature search further identified 43 relevant indicator programme publications, resulting in a total of 131 publications included in this review.

The included publications are presented in Table 1. From these we identified a total of 1282 indicators. The majority of these indicators came from clinical practice guidelines (36%, n=456), followed by service evaluations (13%, n=166), validation studies (12%, n=153), audits (11%, n=142), systematic literature reviews (10%, n=124), expert consensus (7%, n=88), narrative reviews (7%, n=86), surveys, (3%, n=57) and case studies (1%, n=10).

Most of the indicators were developed for general surgery (83%, n=1064), followed by orthopaedic (6%, n=82), upper gastrointestinal (6%, n=73), urology (3%, n=39), vascular (1%, n=10), gynaecological (1%, n=9), and breast surgery (n=5).

The indicators were split into structure (36%, n=463) and process measures (64%, n=819). These were further sub-divided into preoperative (27%, n=342), intraoperative (29%, n=373), postoperative (18%, n=227) and All (26%, n=339). The majority of indicators (53%, n=675) did not have a level of evidence described in the shortlisted publication. These indicators were split into structure (48%, n=325) and process indicators (52%, n=350). The remaining 47% of indicators (n=598) had a published evidence base, ranging from 1a (randomized controlled trials) to 5 (expert opinion based).

As some indicators were mentioned in several different publications, duplicated indicators were aggregated, resulting in a total of 261 indicators. The aggregated structure indicators (n=112) are presented in Table 2 and the aggregated process indicators (n=149) are presented in Table 3.

The dimensions of quality measured by the aggregated indicators were: Effectiveness (38% n=136) (split into structure (S) 21%, n=35, process (P) 79%, n=145), safety (29% n=104) (S 68% n=71, P 32% n=33), efficiency (26% n=64) (S 57% n=36, P 44% n=28), timeliness (14% n=30) (S 28% n=8, P 72% n=28), patient-centredness (4% n=13) (S 31% n=4, P 69% n=9) and equity (2% n=7) (S 100% n=7). Note that some indicators measured multiple quality domains.

Discussion

We have identified 261 clinical indicators relevant to structure and process measurement of perioperative care. The majority were process indicators (58%). About half of the structure indicators (51%) were relevant to the whole perioperative pathway. The process indicators were approximately evenly split between preoperative (32%), perioperative (28%), and postoperative (27%) care. The dimensions of quality most frequently addressed were effectiveness (38%) and patient safety (29%). Our most notable finding was that the majority of indicators (53%) did not have a level of evidence ascribed in their literature.

This is the first systematic review of perioperative process and structure indicators that has been performed, allowing no direct comparison with previous work. A systematic review clarifying the number of indicators available solely for anaesthesia care was published in 2009.¹⁶ This identified 108 anaesthetic clinical indicators, split between process (42%), outcome (57%) and structure (1%) indicators. Our review focussing on the whole perioperative pathway identified a higher proportion of structure indicators. The previous systematic review of anaesthesia-related indicators also identified that the majority (62%) of their prescriptive indicators had a low level (4-5) of evidence associated with their descriptions.

Our review also shows that most perioperative indicators have no or a very low associated level of evidence beyond face validity. For the indicators with a published evidence base, the level of evidence varied between level 1a (randomized clinical trials) to 5 (expert opinion). 'Expert opinion' was itself a broad category ranging from a singular expert viewpoint to a more rigorous international Delphi process.

Clinical indicators should be based on the best available and most robust scientific evidence.²⁶ The strength of the evidence for an indicator will determine its scientific soundness and the likelihood that improvements in the clinical indicator will produce consistent and meaningful improvements in quality of care.¹³ Moreover, indicators only become convincing improvement tools if a causal link to important outcomes can be demonstrated. For example, if it is shown that a documented pre-anaesthetic consultation leads to a decrease in postoperative morbidity, only then can this indicator be considered a valid quality improvement target.²⁷ However, this approach illustrates why developing higher level evidence from randomized trials can be challenging for clinical indicators. It may be unethical to assign care considered by clinicians to be substandard. Other trial designs can offer sufficient evidence if sources of bias are identified and controlled for.²⁸ Both the Effective Healthcare Program of the U.S. Agency for Healthcare Research and Quality²⁹ and the Grading of Recommendations Assessment, Development and Evaluation Working Group³⁰ provide guidance for using nonrandomized study designs in guideline development.

Pronovost and colleagues state: "Indicators are the lenses through which we quantitatively determine quality."¹² Our review demonstrates the majority of

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3 perioperative indicators, both structural and process, measure the
4 effectiveness, safety and efficiency of care, with patient centredness and
5 equity less common. Healthcare professionals strive for efficiently delivered
6 safe and effective patient care. However, this approach may not completely
7 reflect the needs and wants of patients themselves. Given the opportunity,
8 patients are unlikely to ask their perioperative teams about rates of goal
9 directed haemodynamic optimisation when they could ask about waiting times
10 for surgery, presence of consultant led care etc.³¹⁻³² Further research should
11 aim at developing clinical indicators that are based on patient's perceptions
12 and perspective over quality of perioperative care.³³ This approach is already
13 being supported by work in the outcomes domain, such as the Core Outcome
14 Measures for Perioperative and Anaesthetic Care (COMPAC) initiative,^{17,18}
15 which is part of the Core Outcome Measures for Effectiveness Trials
16 (COMET) campaign.³⁴ The aim of COMPAC is to develop a core outcome set
17 for trials in perioperative medicine agreed by multiple stakeholders, including
18 patients and carers.
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22 Our review shows an increasing number of perioperative clinical and safety
23 indicators are published year on year. The majority of the indicators we
24 identified came from clinical practice guidelines followed by service
25 evaluations, perhaps reflecting an increasing provider drive for accountability,
26 benchmarking and quality improvement. As such, there is a powerful
27 imperative to ensure the indicators chosen are valid and relevant.³⁵ Quality
28 indicators should comply with high quality standards and should be
29 constructed in a careful and transparent manner. They should be relevant
30 (relevant to the dimensions of quality), valid (based on the best available
31 evidence²⁶ and have a strong correlation with the current quality of care and
32 caregiver experience),³⁶ interpretable,³⁷ generalisable,¹² and feasible. It has
33 previously been suggested that the clinical and academic communities
34 produce a specific perioperative Quality Indicator Development Framework to
35 funnel potential quality indicators from the latest research and quality
36 improvement practices into a formal development or consensus programme.³⁹
37 This could then be followed by an rigorous evaluation of indicator
38 implementation, to complete the loop back to the assessment of potential
39 indicators.
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43 As healthcare is continually changing, even established well-developed
44 indicators should be re-evaluated on a regular basis, possibly by regular audit
45 of their use or establishing and reassessing links to important patient
46 outcomes. The decision can then be made to "retain, revise, replace or retire"
47 them.⁴⁰⁻⁴²
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50 Our review shows the majority of the indicators have been developed in the
51 United States. Indeed, the adoption of "practice parameters" (standards and
52 guidelines) by anaesthetists in the United States in the 1980s helped increase
53 the safety of anaesthesia. The first sets of structure indicator standards for
54 basic monitoring were developed by the Harvard hospitals,⁴³ and similar ones
55 were later adopted by the American Society of Anaesthesiologists.⁴⁴ In recent
56 years, there has been an upsurge of value-based healthcare and payment
57 policies which may drive the development of new quality metrics. These
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3 include the Centers for Medicare & Medicaid Services (CMS) new Quality
4 Payment Program and Merit-based Incentive Payment System.
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7 Despite most indicators being developed in the United States, the United
8 Kingdom has the most published indicators addressing the provision of
9 specialist hospital services, for example the provision of out-of-hours
10 endoscopy, elderly review, radiology and other diagnostic services. This may
11 reflect the National Health Service current model of care of disseminated
12 services amongst hospitals within a region rather than centralisation.
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14 We found that the most frequently cited structure indicators refer to the annual
15 case volumes of provider hospitals and their availability of set perioperative
16 management protocols. The majority of structure indicators span the whole
17 perioperative pathway: hospitals either provide access to 24hr CT scanning or
18 they do not. Healthcare can be assessed by monitoring the settings in which it
19 takes place.⁴⁵ This evaluation assumes that given the proper environment,
20 instruments and staff, good medical care is achieved.⁴⁶ This approach offers
21 the advantage of dealing with fairly stable and accessible information that can
22 be reliably surveyed.⁴⁷ The major limitation is that the relationship between
23 structures and patient outcomes may not be well established.
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26 In our review, 62% of structure indicators had no associated level of evidence
27 compared with 47% of process indicators. Few perioperative structure
28 indicators have been tested in prospective trials. This may be because
29 systems and structural change is costly, and often requires large-scale
30 investment. Changes in processes may be more feasible for the front-line
31 clinician and researcher. Structural changes may include local or nationwide
32 policy developments. However, writing a policy does not ensure it is widely
33 implemented in practice. Qualitative research approaches may be useful tools
34 for the evaluation of the impact of policy change.^{48,35}
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37 Process indicators offer great promise as quality improvement tools as they
38 often define targets that have to be reached. They reflect the care that
39 clinicians are delivering day to day and can be incorporated into routine data
40 collection. Clinicians feel accountable for them, rather than for outcome
41 measures that may be affected by other variables.⁴⁹ However they have to be
42 used cautiously, even if links to causal outcomes have been demonstrated. A
43 clinician may perform well in one process but not in another. If the indicators
44 do not cover all the processes that can affect outcomes, they may be
45 misleading.⁴⁹
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48 Reviewing the most frequent aggregated process indicators of this review, we
49 see that patients are recommended to have a well-documented preoperative
50 assessment and consent process, with a risk of death estimated and
51 communicated. Timely and appropriate antibiotics should be given to a warm
52 patient, and in their recovery period they should be mobilised early with
53 appropriate venothromboembolic prophylaxis. These are all straightforward
54 and uncontroversial processes. The focus should be on performing these
55 effective processes reliably and consistently. It has been reported that
56 clinicians rarely deliver effective interventions more than 80% of the time.⁵⁰
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3 Healthcare has turned to high reliability organisations (e.g. aviation) for
4 guidance.⁵¹ The use of checklists and other memory aids, and visible QI data
5 analysis such as run charts could help prompt healthcare staff and even
6 patients themselves to achieve important targets. Technological advances
7 mean that compliance rates to quality indicators could be assisted and
8 monitored, for example with the Enhanced Recovery compliance mobile
9 app.⁵²
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12 Indicators can also help reduce levels of waste, benchmark current care, and
13 support patient choice of providers.²⁶ However, defining the right indicators
14 alone is insufficient to close the feedback loop required for quality
15 improvement. Benn and colleagues⁵³ investigated the use of quality indicators
16 in anaesthesia and how to feedback the data to improve care. They
17 concluded that effective feedback from quality indicators is timely, continuous,
18 and tailored to the recipient. The goal of measurement is to learn, understand
19 and improve, so the measurement system must fit within a system geared for
20 continual improvement.¹² This could include an electronic health record
21 system which continually monitors and analyses routinely collected patient
22 data. This could have inbuilt mechanisms to facilitate personalised timely
23 feedback for targeted local improvement.
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26 *Limitations*

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29 Established methods for the systematic retrieval, appraisal and synthesis of
30 the literature were used. However, we also searched the unpublished and
31 grey literature, including information available from quality initiatives and
32 accreditation bodies, to maximise the likelihood of identifying all relevant work.
33 This may have enhanced the sensitivity of our search strategy but led to
34 including information that has not been peer-reviewed.
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37 Only work published in English was included. This may have introduced
38 language bias, and a number of clinical indicators may have been missed. It is
39 possible that our search was not exhaustive despite using a comprehensive
40 search strategy, but it is unlikely that we missed broad categories of important
41 quality indicators.
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43 *Future work*

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46 This list of indicators should contribute to promote and support quality
47 improvement initiatives in perioperative care. Gaps in evidence for the validity
48 of indicators should be explored, by exploring causal relationships between
49 the structures, processes and outcomes of healthcare. There may be scope in
50 setting standards for describing the level of evidence for quality indicators.
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53 This may inform development of a specific perioperative Quality Indicator
54 Development Framework to aid the expansion of feasible, reliable and valid
55 perioperative indicators. There is also a need for more patient-centred clinical
56 indicators, and indicators ensuring the equity of delivered care.
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58 *Conclusions*

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4 Despite widespread use, the majority of indicators for measurement of quality
5 and safety in perioperative care are not supported by a high grade of scientific
6 evidence. The reporting of the evidence underpinning these indicators is also
7 poor. Most indicators focus on the effectiveness, safety and efficiency of care,
8 with patient centred metrics found less frequently in the literature. There may
9 be scope for clinical and academic communities to develop a specific
10 perioperative Quality Indicator Development Framework to funnel potential
11 quality indicators from the latest research and quality improvement practices
12 into a formal development or consensus programmes.
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For Peer Review

Details of Authors Contributions

MC – Conception, design, acquisition and analysis of data and drafting of article

DG – Acquisition and analysis of data

SRM – Design, interpretation of data, revision and drafting of article

Declarations of Interest

SRM is Director of the NIAA Health Services Research Centre, which has governance oversight of the Royal College of Anaesthetists' National Audit Projects, Perioperative Quality Improvement Programme and National Emergency Laparotomy Audit. She is Chief Investigator and Project team lead of the Perioperative Quality Improvement Programme and a project team member of the National Emergency Laparotomy Audit and Royal College of Anaesthetists' 6th National Audit Project. She is associate National Clinical Director for elective care with NHS England, which provide funding to HQIP for National Clinical Audits.

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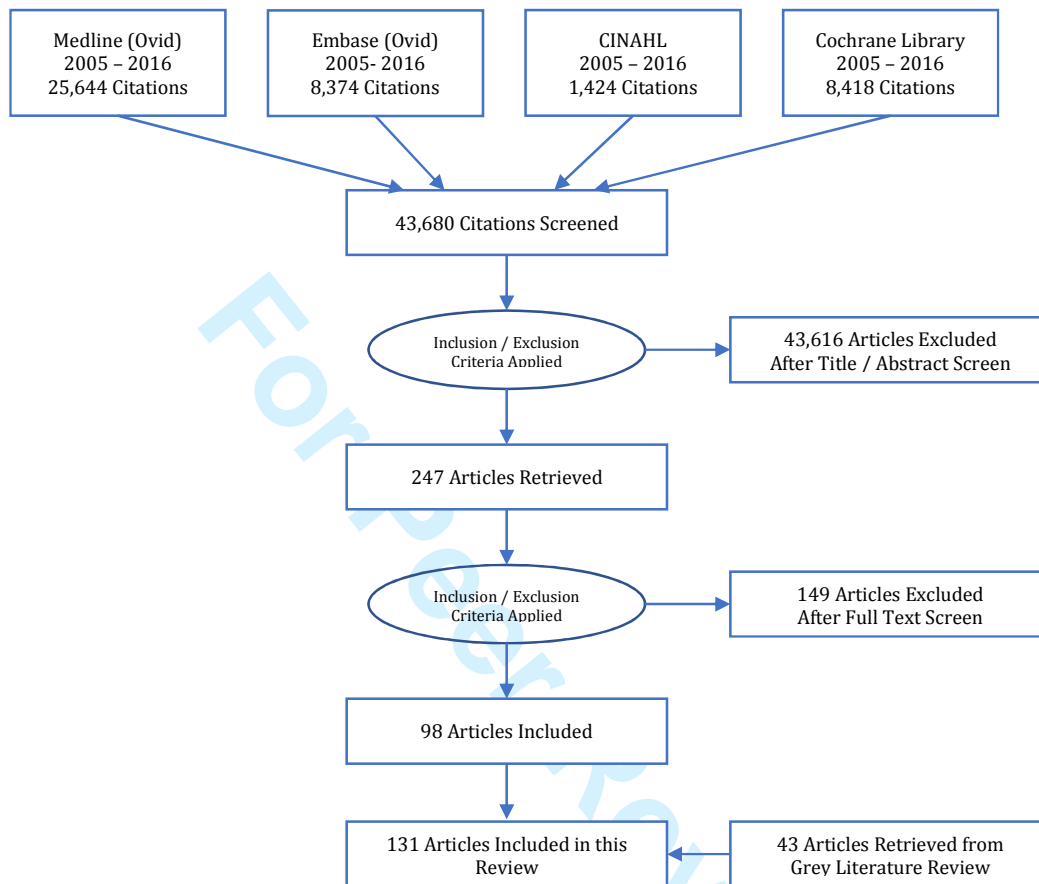
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Tables and Figures



PRISMA flow diagram

Figure 1

Table 1

Type of Article	Year	Article Author	Developer Country	No of Measures
A	2015	HQIP Audits: Adult Cardiac Surgery (ACS). Bowel Cancer Audit (RCoS). NELA (RCoA). National Joint Registry (NJR). National Vascular Registry. NAOGC. Prostate Cancer Audit. National Hip Fracture Audit ⁵⁴⁻⁶¹	UK	P: 80, S: 61
CPG	2009	AQA ⁶²	USA	P: 7
CPG	2009	NICE ⁶³	UK	S: 2
CPG	2009	Vimlati et al ⁶⁴	Europe, Hungary	P: 9, S: 13
CPG	2010	ACI ⁶⁵	Australia	P: 12
CPG	2010	ASA ⁶⁶	USA	P: 4, S: 4
CPG	2010	ASA ⁶⁷	USA	P: 1
CPG	2010	CMS SCIP ⁶⁸	USA	P: 9
CPG	2010	NICE ⁶⁹	UK	P: 7
CPG	2011	AHRQ ⁷⁰	USA	S: 1
CPG	2011	RCoS ⁷¹	UK	P: 39, S: 53
CPG	2012	NICE ⁷²	UK	P: 4, S: 1
CPG	2012	NQF ⁷³	USA	P: 8
CPG	2012	Wickham et al ⁷⁴	Australia	P: 4
CPG	2013	ACHS ⁷⁵	Australia	P: 18
CPG	2013	ASA ⁷⁶	USA	P: 3
CPG	2013	Lassen et al ⁷⁷	Europe, Norway	P: 19, S: 1
CPG	2013	NICE ⁷⁸	UK	P: 4
CPG	2014	ASA ⁷⁹	USA	P: 2, S: 2
CPG	2014	AQI ⁸⁰	USA	P: 3, S: 1
CPG	2014	AQI ⁸¹	USA	P: 6
CPG	2014	SCIP ⁸²	USA	P: 9
CPG	2015	AQI ⁸³	USA	P: 22
CPG	2015	AQI ⁸⁴	USA	P: 11
CPG	2015	AQI ⁸⁵	USA	P: 8
CPG	2015	ISD Scotland ⁸⁶	UK	P: 1
CPG	2015	ISD Scotland ⁸⁷	UK	P: 1
CPG	2015	Merchant et al ⁸⁸	Canada	P: 3, S: 13
CPG	2015	NICE ⁸⁹	UK	S: 1
CPG	2015	PQRS ⁹⁰	USA	P: 22
CPG	2015	RCoA ⁹¹	UK	P: 24, S: 124
CS	2013	Gort et al ⁹²	Europe, Netherlands	S: 10
CS	2015	NCEPOD ⁹³	UK	S: 1
EC	2006	McGory et al ⁹⁴	USA	P: 24, S: 2
EC	2007	Meredith et al ⁹⁵	USA	S: 1
EC	2009	McGory et al ⁹⁶	USA	P: 25
EC	2009	Weiser et al ⁹⁷	USA	S: 4
EC	2011	Goossens-Laan et al ⁹⁸	Europe, Netherlands	P: 4, S: 2
EC	2013	Kalish et al ⁹⁹	USA	P: 4, S: 1
LR	2007	McGory et al ¹⁰⁰	USA	P: 5
LR	2007	Arora et al ¹⁰¹	USA	P: 14
LR	2010	Passman et al ¹⁰²	USA	P: 2
LR	2012	Wang et al ¹⁰³	UK	P: 3, S: 4
LR	2015	Hyder et al ¹⁰⁴	USA	P: 2
R	2005	Dimick et al ¹⁰⁵	USA	S: 1
R	2006	Bratzler et al ¹⁰⁶	USA	P: 7
R	2008	Fry et al ¹⁰⁷	USA	P: 8
R	2009	Dixon et al ¹⁰⁸	Canada	P: 1
R	2010	Courech Staal et al ¹⁰⁹	Europe, Netherlands	P: 3, S: 4
R	2010	Rosselli del Turco et al ¹¹⁰	Europe	P: 2
R	2012	Nygren et al ¹¹¹	Europe, Sweden	P: 18, S: 1
R	2013	Collins et al ¹¹²	USA	P: 9
R	2013	Mohammed et al ¹¹³	USA	P: 3, S: 3
S	2005	Broder et al ¹¹⁴	USA	S: 1
S	2007	Main et al ¹¹⁵	USA	P: 5, S: 7
S	2007	Schiffner et al ¹¹⁶	USA	P: 3, S: 16
S	2008	Wick et al ¹¹⁷	USA	P: 5
S	2013	Tillman et al ¹¹⁸	USA	P: 5
S	2014	Sooyoung et al ¹¹⁹	Asia, South Korea	P: 2
S	2015	Emond et al ¹²⁰	Europe, Netherlands	P: 4, S: 7
S	2015	Gockel et al ¹²¹	Europe	S: 3

SE	2005	Currie et al ¹²²	UK	P: 6, S: 1
SE	2010	NCEPOD ¹²³	UK	P: 2, S: 1
SE	2010	Watkins et al ¹²⁴	USA	P: 11
SE	2011	Gray et al ¹²⁵	USA	S: 1
SE	2011	NCEPOD ¹²⁶	UK	P: 12, S: 13
SE	2011	Rosenberger et al ¹²⁷	USA	P: 7
SE	2011	RCoS ¹²⁸	UK	P: 5
SE	2012	Andersson et al ¹²⁹	Europe, Sweden	P: 2
SE	2012	Kwon et al ¹³⁰	USA	P: 5
SE	2012	Urman et al ¹³¹	USA	P: 4
SE	2014	RCoA (NELA organisational audit) ⁴⁷	UK	P: 4, S: 43
SE	2014	Sutherland et al ¹³²	USA	P: 3
SE	2015	GIRFT ¹³³	UK	P: 2, S: 6
SE	2015	Pronovost et al ¹³⁴	USA	P: 2
SE	2015	RCoA ¹³⁵	UK	P: 11
SE	2015	Liang et al ¹³⁶	USA	P: 3
SE	2015	Gwatinisa et al ¹³⁷	USA	P: 2
SE	2015	Da Silva Costa ¹³⁸	Brazil	S: 2
SE	2015	Steelman et al ¹³⁹	USA	P: 1
SE	2015	Marshall et al ¹⁴⁰	Canada	P: 2
SLR	2005	Fearon et al ¹⁴¹	Europe	P: 9
SLR	2006	Wind et al ¹⁴²	Europe, Denmark	P: 11, S: 2
SLR	2008	Lemmens et al ¹⁴³	Europe, Netherlands	P: 5
SLR	2009	Haller et al ¹⁶	Europe, Switzerland	P: 29, S: 1
SLR	2011	ASA ¹⁴⁴	USA	P: 5
SLR	2011	De Hert et al ¹⁴⁵	Europe, Belgium	P: 15
SLR	2012	ASA ¹⁴⁶	USA	P: 2, S: 4
SLR	2013	Cerantola et al ¹⁴⁷	Europe	P: 14
SLR	2013	Dikken et al ¹⁴⁸	Europe, Netherlands	P: 5, S: 2
SLR	2013	Gustafsson et al ¹⁴⁹	Europe, Sweden	P: 21
SLR	2014	Halverson et al ¹⁵⁰	USA	P: 9
VS	2005	Gagliardi et al ¹⁵¹	Canada	P: 2, S: 2
VS	2006	Birkmeyer et al ¹⁵²	USA	S: 1
VS	2006	Hollenbeck et al ¹⁵³	USA	P: 2, S: 1
VS	2007	Hedrick et al ¹⁵⁴	USA	P: 5
VS	2007	Hollenbeck et al ¹⁵⁵	USA	P: 4, S: 1
VS	2007	Holt et al ¹⁵⁶	UK	S: 1
VS	2007	Makary et al ¹⁵⁷	USA	P: 1
VS	2008	Kaplan et al ¹⁵⁸	USA	S: 1
VS	2009	Bhattacharrya et al ¹⁵⁹	USA	P: 3, S: 1
VS	2009	Bilimoria et al ¹⁶⁰	USA	P: 3, S: 7
VS	2009	Kreckler et al ¹⁶¹	UK	P: 4
VS	2009	Kuwabara et al ¹⁶²	Japan	P: 1, S: 1
VS	2010	Ball et al ¹⁶³	USA	P: 2
VS	2010	Bozic et al ¹⁶⁴	USA	P: 4, S: 2
VS	2010	Brokelmann et al ¹⁶⁵	Europe, Germany	P: 4, S: 1
VS	2010	Brooke et al ¹⁶⁶	USA	P: 1
VS	2010	Chen et al ¹⁶⁷	USA	P: 1
VS	2010	Sedlack et al ¹⁶⁸	UK	P: 1
VS	2011	Gastmeier et al ¹⁶⁹	Europe, Germany	P: 1
VS	2011	Mu et al ¹⁷⁰	USA	S: 1
VS	2011	Soohoo et al ¹⁷¹	USA	P: 16, S: 2
VS	2012	Comber et al ¹⁷²	Europe, Ireland	S: 2
VS	2012	Mathoulin-Pelissier et al ¹⁷³	Europe, France	S: 1
VS	2012	Kondo et al ¹⁷⁴	Japan, USA	P: 10
VS	2012	Renzi et al ¹⁷⁵	Europe, Italy	P: 1
VS	2012	Vrijens et al ¹⁷⁶	Europe, Belgium	P: 1, S: 1
VS	2013	Bergman et al ¹⁷⁷	Canada	P: 14
VS	2013	Bilimoria et al ¹⁷⁸	USA	P: 1, S: 8
VS	2013	Dimick et al	USA	S: 2
VS	2013	Nojiri et al ¹⁷⁹	Japan	P: 1, S: 2
VS	2013	Kwon et al ¹⁸⁰	USA	P: 1
VS	2014	Bergman et al ¹⁸¹	Canada	P: 10
VS	2014	Cataife et al ¹⁸²	USA	P: 2
VS	2014	Keenan et al ¹⁸³	USA	P: 5
VS	2014	Kitazawa et al ¹⁸⁴	Japan	S: 1
VS	2014	Leonard et al ¹⁸⁵	Europe, Belgium	S: 1
VS	2014	Richman et al ¹⁸⁶	USA	P: 2
VS	2014	Singh et al ¹⁸⁷	USA	S: 2
VS	2015	Stordeur et al ¹⁸⁸	Europe, Belgium	S: 1
VS	2015	Scott et al ¹⁸⁹	USA	P: 1

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VS	2015	Gourin et al ¹⁹⁰	USA	S: 1
VS	2015	Scally et al ¹⁹¹	USA	P: 5

Table 1: List of publications included within this review, grouped by type of publication: audit (A), case study (CS), clinical practice guideline (CPG), expert consensus (EC), review article (R), service evaluation (SE), systematic literature review (SLR), and validation study (VS). Also included is the developer country, and the number and type of clinical indicators; structure (S) vs process (P) obtained from each publication.

For Peer Review

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Table 2

Structure Indicators

Number	Perioperative Timing of Measure	Frequency measure described	Structure Indicator definition	Evidence base	Dimension of Quality measure d
1	Pre op	13	There is a designated area suitable for private communication with patients. Patients are given adequate information upon which to base their decision about informed consent.	1a, 4, 5	P
2	Pre op	9	There are multidisciplinary team clinics to discuss patients preoperatively	3b, 4, 5	EC
3	Pre op	5	There are agreed local policies for preoperative preparation as listed: preoperative fasting, investigations, blood cross-match, thromboprophylaxis, diabetes management, latex allergy, and antacid prophylaxis	5	EC, S
4	Pre op	4	Preoperative assessment teams use standard preoperative assessment protocols	3b, 4	EC
5	Pre op	2	Up to date, clear and complete information about operating lists is immediately available. Any changes are agreed by all relevant parties	3b	EN
6	Pre op	2	There is support for patients with individual or special needs including children: Patients and/or advocates have access to an interpreter	NA	S, P
7	Pre op	2	Patients admitted for unscheduled surgical care are nursed and managed in a surgical ward or critical care environment.	NA	S, EN, EC
8	Pre op	2	When immediate outcome is dependent on imaging studies (i.e. the patient is to go directly to theatre after imaging) a provisional report is available within 30 minutes and a definitive report within 1 hour).	NA	EC, T
9	Pre op	1	Availability of cardiopulmonary exercise (CPEX) testing for all patients undergoing major surgery	NA	EQ, EC
10	Pre op	1	There is a consultant anaesthetist with responsibility to lead the anaesthetic preoperative assessment service, and this is factored into their job plan.	NA	EC, S
11	Pre op	1	There are agreed specialty risk scoring mechanisms in place and these are applied to all patients admitted as an emergency.	NA	EC
12	Pre op	1	Before surgery, except in the case of acute, life-threatening situations, there are clear mechanisms in place, in the absence of patient records, to elicit information from supporters, particularly for unconscious/elderly/confused patients.	NA	S, EN
13	Pre op	1	Availability of elderly medicine in the pre-operative period for assessments of patients admitted as emergency general surgical patients	NA	EC
14	Pre op	1	There is a documented policy to address the airway management of patients in the emergency department	NA	S
15	Pre op	1	Availability of a protocol on performing prospective risk analysis preoperatively	5	S, EC
16	Intraop	8	Availability of anaesthetic equipment in the operating room: Measurement of inspired gas concentrations, saturations, tidal volumes, temperature, non-invasive blood pressure equipment available	NA	S
17	Intra op	6	The recovery room staff are appropriately trained in all relevant aspects of post-operative care and are present in appropriate numbers	NA	S, EN
18	Intra op	3	Fully resourced, dedicated daytime emergency and trauma lists are available	NA	S, T, EN
19	Intra op	3	Devices for maintaining or raising the temperature of the patient are available including control of theatre temperature	NA	S
20	Intra op	3	Access to blood and blood conservation techniques (cell salvage or acute normovolaemic haemodilution) are available	NA	S
21	Intra op	3	There is a planned maintenance and replacement programme for all anaesthetic equipment as required	NA	S

22	Intra op	2	All patients should have a named and documented supervisory anaesthetist who has overall responsibility for the care of the patient intraoperatively	NA	S
23	Intra op	2	After general or regional anaesthesia, or sedation, all patients recover in a specially designated area which meets AAGBI and DoH guidelines (UK)	NA	S, EN
24	Intra op	2	There are agreed criteria for discharge from recovery	NA	S
25	Intra op	2	Equipment to provide a full range of local and regional blocks is available in the operating suite	NA	EC
26	Intra op	2	In every site where anaesthesia is given emergency drugs including intralipid, sugammadex and dantrolene are available and an in-date supply is maintained	NA	S
27	Intra op	2	After agreed criteria for discharge have been met, an appropriately trained member of staff accompanies patients during transfer	NA	S
28	Intra op	1	In a usual week, how many dedicated and planned consultant anaesthetic sessions (i.e. outside of on-call and other duties) support those operating theatres available for adult general surgical emergency cases?	NA	EN
29	Intra op	1	All records for anaesthesia and sedation contain the relevant portion of the recommended anaesthetic data set and are kept as a permanent document in the patient's record	NA	EN
30	Intra op	1	Where sedation is provided by an anaesthetist there is a policy for the provision of this service in all subspecialty areas and the specifications of the facilities provided	NA	S
31	Intra op	1	An emergency call system is in place and understood by all relevant staff Verbal confirmation of the system and how it is used should be given by any member of staff when asked	NA	S
32	Intra op	1	People having surgery for inflammatory bowel disease have it undertaken by a colorectal surgeon who is a core member of the inflammatory bowel disease MDT	NA	EC
33	Intra op	1	Clinicians performing endoscopy supported by dedicated endoscopy staff as opposed to other nursing staff (e.g. theatre staff)	NA	S, EN
34	Intra op	1	Drugs intended for regional anaesthesia are stored separately from those intended for intravenous use	NA	S
35	Intra op	1	There is a written policy for the management of complications of neuraxial blockade	NA	S
36	Intra op	1	Blood storage facilities are in close proximity to emergency theatres and contain O rhesus negative blood	NA	S
37	Intra op	1	Equipment for fluid and blood warming and rapid infusion is available	NA	S
38	Intra op	1	Equipment is available to administer oxygen to all patients undergoing procedures under sedation by an anaesthetist	NA	S
39	Intra op	1	There is specialised equipment for the management of difficult airways available in every area where anaesthesia is given. The equipment on it should be checked. All members of staff should be able to confirm its location.	NA	S
40	Intra op	1	Facilities for external cardiac pacing are available Defibrillators should be checked to ensure they include pacing mode	NA	S
41	Intra op	1	Clinicians wishing to perform ultrasound guided regional anaesthesia should be experienced in the administration of regional nerve blocks and trained in ultrasound guidance techniques	1b	S, EC
42	Post op	6	There is regular (at least bi monthly) review of all deaths following emergency general surgery	NA	S
43	Post op	4	PACU Bed area, capacity, and equipment are all maintained to national standards	5	S, EN
44	Post op	4	Regular education and training of PACU staff to national standards.	5	S, EN
45	Post op	4	Transfer from operating room to PACU is with a formal handover process	5	S
46	Post op	4	There is a policy for the post-procedural review of all patients: surgical and anaesthetic	3b	S, EC, T
47	Post op	3	Availability of postoperative elderly medicine review for postoperative patients	3b	S, EC
48	Post op	2	Presence of postoperative multidisciplinary consultation for facilitated discharge of patients	3b	S, EC
49	Post op	2	Patients and supporters are given clear information on discharge from the service and are able to make contact with a healthcare professional for advice and support	NA	P
50	Post op	2	Availability of inpatient and post-discharge rehabilitation	NA	EC

51	Post op	1	There is specialised equipment for the management of post-operative pain An adequate number of PCAs epidural pumps and the arrangements for their use should be available for the services being provided	NA	S, EC
52	Post op	1	Presence of a surveillance system for postoperative wound infections	NA	S
53	Post op	1	Availability of surgical follow up within 30 days following hospital discharge	1a	S, T
54	Post op	1	Each PACU unit should have suitable recovery and discharge criteria	5	S
55	Post op	1	Audit and critical incident systems should be in place in PACU	5	S
56	All	33	Hospital annual case volume	1a, 1b, 2a, 2b, 3b, 4, 5	EN
57	All	21	Protocols exist for the perioperative management of: VTE prophylaxis, avoidance of hypothermia, management of diabetes mellitus, handover, anaesthetic emergencies, morbidly obese patients, handling of complaints, elderly patients, remote site anaesthesia, end of life care, and critical care referral.	1b	S
58	All	19	Surgical monthly / annual case volume by surgical specialty.	1a, 1b, 2b, 3b, 4, 5	S, EC
59	All	18	Availability of specialist services: Burn care, Transplant, Trauma, ERCP, Prosthetics, Brachytherapy, Radiotherapy, Sexual function, Specialist continence, Psychological counselling, Diabetes nurse specialist, Physiotherapy, and Acute medical admissions.	3b	EQ
60	All	17	24 hour availability of: X-ray, CT, ultrasound, isotope bone scan, multi-parametric MRI, teleradiology, reporting by radiologist, reporting by specialised radiologist.	3b	S, EC, EQ
61	All	16	Availability of: Malignant hyperthermia kit, Difficult intubation kit and Cardiac Arrest cart in the theatre complex	NA	S, EN
62	All	15	24 hour availability of: Biochemistry, Haematology, Microbiology, and Blood bank laboratories	NA	S, EC, EN, EQ
63	All	15	Surgical on call rota is in compliance with national guidance	NA	S, EN
64	All	15	Formal staff training in: Use of equipment, clinical practice guidelines, technical and non-technical skills of perioperative care.	3b	S, EC
65	All	12	All perioperative services are consultant led.	NA	S, EN
66	All	10	Availability of appropriate facilities for rest and refreshment. Availability of consultant within 30 min of base site.	2b	S, EN, T
67	All	10	How many operating theatres in the hospital? (excluding radiology suites, dedicated obstetric, minor ops but including day case theatres)	3b, 4, 5	EN, T
68	All	6	Number of General Surgical Beds: The number of funded level 2 and 3 beds available for adult (>18) general surgical patients	NA	EN
69	All	6	Availability of Elderly medicines on site. Routine daily assessment of surgical patients?	NA	S, EC
70	All	6	Rotas should be provided and include the allocation of formal handover time and place as well as which staff should be present at this handover	NA	S, EC, EN
71	All	5	Does the hospital accept emergency surgical admissions.	NA	EQ
72	All	5	24 hr availability of diagnostic and interventional radiology	NA	S, EC, EQ
73	All	5	The service submits data to prescribed national audits. Regular audit of critical incidents.	NA	EN
74	All	5	The department has a funded and staffed acute pain service	2b	S, EC
75	All	5	Bed size of hospital: How many adult inpatient/overnight/23hr stay available within the hospital	1b, 3b, 4	EN
76	All	4	Perioperative team size and composition	3b, 4	EC, EN
77	All	4	The service has mechanisms to receive feedback from patients and supporters. Printed patient information and Alternative language leaflets available.	NA	P

78	All	4	Availability of dedicated office space, swipe card access, admin staff, and skilled assistance for surgical staff	NA	S, T
79	All	3	There are formal protocol / pathways for emergency general surgical patients	2a	S
80	All	3	University affiliation of the general surgery subsection	3b, 4	NA
81	All	3	Pharmacists are readily available to consult with nurses and medics on non-critical care units; pharmacy formularies are accessible	3b	S, EC, EQ
82	All	3	Day surgery patients should have access to a 24 hour staffed telephone line for advice and help.	4	S, EN, T
83	All	3	Theatre suite conforms to Department of Health building standards	NA	S
84	All	3	Presence of a formal handover process for consultants and non-consultant clinicians	NA	S, EC, EN
85	All	3	There is a trained resuscitation team for adults.	NA	S
86	All	2	Accreditation of the surgical unit by the joint commission or cancer commission	3b	S, EC
87	All	2	Dedicated operating rooms are available for each surgical speciality	5	EC
88	All	2	There is adequate protection provided for staff in hazardous situations	NA	EN
89	All	2	Are admitted patients retained by the on-call consultant or are they handed over? Is there a formal handover policy?	NA	S, EC, EN
90	All	2	All research is R&D reviewed and REC reviewed. Opportunities to engage in research are prioritised by the unit/network.	NA	EN
91	All	2	The emergency surgical service has an identified medical and nurse lead (separate to the leads of elective surgery)	NA	EN
92	All	2	There is a resuscitation officer responsible for coordinating and training of staff.	NA	S, EN
93	All	2	Adequate surgeon training and experience for each speciality in compliance with national training guidance	2b, 5	S, EC
94	All	2	Anaesthetists offering perioperative analgesia services should provide, in collaboration with other healthcare professionals as appropriate, on-going education in analgesia	2b, 5	S
95	All	2	The presence of centralisation of hospital specialities	2b	EN
96	All	1	Anaesthetists and other healthcare providers should use standardized, validated instruments to facilitate the regular evaluation and documentation of pain intensity, the effects of pain therapy, and side effects caused by the therapy.	2b	S
97	All	1	Presence of appropriate operating room equipment in compliance with national standards	3b	S
98	All	1	Does the hospital participate in clinical trials	3b	EN
99	All	1	Does the hospital disseminate reports to its community on quality and costs of healthcare services	3b	EN
100	All	1	Number of accredited surgeons professionals	5	EN
101	All	1	Number of accredited anaesthesia professionals	5	EN
102	All	1	Dedicated surgical scrub nurses for each surgical speciality are present	NA	EC
103	All	1	Modified early warning score (MEWS) are used on surgical wards	NA	S, EC
104	All	1	There is a defined governance structure to assure the quality of the service and allow for continuous improvement.	NA	S
105	All	1	Senior clinicians are involved in the discussion of end of life pathways Written policy should be provided as well as a verbal account of discussions of end of life pathways	NA	EC
106	All	1	Presence of agreed protocols to defer elective activity in order to give adequate priority to unscheduled admissions.	NA	S
107	All	1	Suitable administrative and secretarial support is available at all times for the emergency surgical team.	NA	EN
108	All	1	A representative range of resuscitation equipment, matching that in use and including mannequins, is available for training purposes by the resuscitation training officer	NA	S
109	All	1	There is a local resuscitation policy in compliance with national guidelines	NA	S
110	All	1	Surgical speciality under which amputation was performed (vascular, general, foot and ankle surgeons)	NA	EC
111	All	1	Availability of a perioperative antibiotic protocol	5	S, EC
112	All	1	Availability of a perioperative anticoagulant protocol	5	S, EC

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8 **Table 2:** Aggregated structure indicators arranged in the timing of perioperative care, from preoperative (pre op), intraoperative
9 (intra op), postoperative (post op) or spanning the whole perioperative pathway (all). Within these subsections, they are arranged in
10 descending order by the highest level of evidence available, presented in the shortlisted publications of our review. We map the
11 aggregated indicators to the IOM quality domains: Effectiveness (EC), Efficiency (EN), Patient centredness (P), Equity (EQ), Safety
12 (S), and Timeliness (T).
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For Peer Review

Table 3

Process Indicators

Number	Perioperative Timing of Measure	Frequency measure described	Process Indicator definition	Evidence base	Dimension of Quality measured
1	Pre op	27	Percentage of patients who have received an anaesthetic assessment before the day of surgery	1b, 2b, 3b, 4, 5	EN, EC, T
2	Pre op	24	Each patient should have his or her expected risk of death estimated and documented prior to intervention and due adjustments made in urgency of care and seniority of staff involved	1b, 2b, 3b, 4, 5	EC, EN, S
3	Pre op	24	The following medical history should be documented in the medical record prior to the operation: Past Medical History, Past Surgical History, Drug History, Allergies	2a, 2b, 3a, 3b, 4, 5	EC, EN, S
4	Pre op	14	Elapsed time between admission and entry into operating theatre is measured	3b	T
5	Pre op	10	Each patient should have appropriate preoperative tests: Haemoglobin or Haematocrit, Platelets, Sodium, Potassium, Chloride, Glucose, Urea, Creatinine, chest x-ray, height and weight	3b, 5	S, EC, EN
6	Pre op	10	Patients and their advocates understand the risks and outcomes associated with their procedure	2a, 3b, 5	P
7	Pre op	10	For alcohol abusers 1 month abstinence before surgery. For daily smokers, 1 month abstinence before surgery. Offer smoking cessation advice.	1b, 2b, 3b, 4, 5	EC
8	Pre op	10	Adequate preoperative fasting: clear fluids up to 2h prior to surgery, solids up to 6h prior to surgery	1b, 2b, 3b, 4, 5	EC
9	Pre op	9	Consultant surgeon review before surgery	3b	EC, T
10	Pre op	8	What proportion of patients had a CT scan before surgery?	3a	EC, T
11	Pre op	8	Time from diagnosis / referral to operation should be less than 2 months	3b, 4, 5	T
12	Pre op	8	The following review of systems should be documented in the medical prior to the operation: Skin (lesions/rash), Cardiovascular (Peripheral Vascular Disease, thromboembolic disease), Respiratory (upper respiratory tract infection), Urology (Urinary Tract Infection, urinary retention), Musculoskeletal (arthralgia, inflammatory arthritis), Endocrine (Diabetes Mellitus).	4, 5	S, EC, EN
13	Pre op	7	All patients, on admission, receive an assessment of VTE and bleeding risk using risk assessment criteria.	5	S, EC
14	Pre op	5	Patient nutritional status assessed within 48 hours of admission to hospital by a dietician	1b, 5	EC
15	Pre op	5	What proportion of patients was reviewed by a consultant surgeon within 12 hours of emergency presentation at hospital	4	EC, T

16	Pre op	5	No routine administration of preoperative anaesthetic medication or sedation	1a, 1b, 2a, 3b, 5	EC
17	Pre op	5	Mechanical bowel prep not used routinely for colonic surgery	1a, 1b	EC
18	Pre op	5	What proportion of patients had preoperative Prophylactic venothromboembolism therapy	1a, 2b, 4	S, EC
19	Pre op	4	Performance of risk assessment for pressure ulcers using a standardised scale upon admission	3b, 5	EC
20	Pre op	4	The proportion of cancer patients discussed by a multidisciplinary team (MDT) preoperatively	4, 5	EC
21	Pre op	4	Was a discharge or rehabilitation plan discussed and recorded at the pre-assessment clinic?	NA	P, EC
22	Pre op	4	Preoperative oral carbohydrate treatment used routinely for all non-diabetic patients	1a, 1b, 5	EC
23	Pre op	3	Proportion of patients with hip fracture operated on within 48 hours of hospital admission	3b	T
24	Pre op	3	Cancer care plan intent documented in the medical notes: curative, palliative, or no active treatment (supportive)	NA	EC, EN
25	Pre op	2	Presence of an up to date medication list is documented in the medical record	3b	EN
26	Pre op	2	Percentage of surgery patients who do not see an anaesthesia provider before day of operation	4, 5	EN
27	Pre op	2	Percentage of patients having a preoperative Specialist falls assessment	5	EC
28	Pre op	2	Patients and/or their advocates are given information about the possible side effects of pain relief drugs	NA	P
29	Pre op	2	Preoperative MRSA patient screening is undertaken and documented	NA	EC
30	Pre op	2	Elderly patients should have a pre-op mobility and cognitive assessment	NA	S
31	Pre op	1	If a patient is to undergo intestinal surgery, then the plan for surgery should be communicated to the referring physician and the patient's primary care physician	2a	EN
32	Pre op	1	Preoperative Glucose monitoring for patients with diabetes mellitus is undertaken	2b	EC
33	Pre op	1	Days from fracture injury to admission to hospital measured and documented	3b	T
34	Pre op	1	Proportion of patients who have a Chlorhexidine shower preoperatively	3b	EC
35	Pre op	1	Percentage of patients with malignancy who undergo adjuvant chemotherapy preoperatively	5	EC
36	Pre op	1	Written instructions for specific medicines are handed out to patients preoperatively. This includes information on: Anticoagulants, Diabetic medications, Cardiovascular medications and Hormonal medications	5	EC, S
37	Pre op	1	Percentage of patients/carers who are offered verbal and written information on venousthromboembolism prevention as part of their hospital admission process	NA	P
38	Pre op	1	Patients provided with anti-embolism stockings have them fitted and monitored in accordance with NICE guidance	NA	EC
39	Pre op	1	Elapsed time between admission / referral to when first seen by consultant surgeon is measured and documented	NA	T
40	Pre op	1	The maternity team is notified when a pregnant woman is admitted with a non-obstetric surgical problem.	NA	EN
41	Pre op	1	Hip fracture patients are admitted under the joint care of a consultant geriatrician and a consultant orthopaedic surgeon.	NA	EC, EN
42	Pre op	1	People having surgery are advised not to remove hair from the surgical site and to have a shower, bath the day on or before surgery	NA	EC
43	Pre op	1	Percentage of patients who had preoperative physiotherapy	NA	EC
44	Pre op	1	If the patient was admitted with ischaemia or diabetic foot sepsis, did a consultant vascular surgeon review them within 24 hours of admission?	NA	EC
45	Pre op	1	Was the patient seen by an amputation / discharge coordinator preoperatively	NA	EC, EN
46	Pre op	1	Patient seen by inpatient acute pain team preoperatively	NA	EN
47	Pre op	1	Stoma Care - Patients with colorectal cancer who require a stoma are assessed and have their stoma site marked pre-	NA	EC

			operatively by a nurse with expertise in stoma care.		
48	Pre op	1	Any changes to surgical lists are agreed by all relevant parties	NA	EN, T
49	Intra op	41	Prophylactic antibiotics are administered within 60 min before start of surgery	1a, 1b, 2b, 3b, 4, 5	EC
50	Intra op	32	Adults having surgery under General or Regional anaesthesia have normothermia (temp >36.0 Celsius) maintained before, during and after surgery	1a, 1b, 2b, 3b, 5	EC
51	Intra op	24	Proportion of patients who have had appropriate prophylactic antibiotic selection for surgical patients	1a, 1b, 2b, 3a, 3b, 4, 5	EC
52	Intra op	11	An appropriately trained and experienced anaesthetist is present throughout the conduct of all general and regional anaesthesia for operative procedures.	1a, 3b, 5	S, EC, EN
53	Intra op	11	If hair removal is required, it should not be performed with a razor but with clippers	1a, 1b, 3b, 5	EC
54	Intra op	11	A multimodal approach for postoperative nausea and vomiting prophylaxis should be adopted in all patients with ≥ 2 risk factors	1b, 3b, 4, 5	EC
55	Intra op	11	The WHO Surgical Safety Checklist (or a local variant thereof) is used for all surgical procedures in theatre.	2b, 3b, 5	S
56	Intra op	11	Number of cancelled planned operations	4, 5	EN
57	Intra op	9	Percentage of patients receiving a blood transfusion in accordance with National Health and Medical Research Council guidelines during the surgical procedure	2a, 2b, 3b, 5	EC
58	Intra op	9	Duration of surgery measured and documented	2b, 3b, 5	T
59	Intra op	9	Surgical procedures with a predicted mortality >10% should be conducted under direct supervision of consultant surgeon and anaesthetist	3b	EN
60	Intra op	8	Recommended standards of monitoring are met for each patient. This should be visible on the anaesthetic chart	NA	S
61	Intra op	8	Appropriate Surgical Approach for current operative procedure used	2b	EC
62	Intra op	7	Optimised perioperative fluid management: targeting cardiac output, avoiding over-hydration, and judicious use of vasopressors. Targeted fluid therapy using the Doppler is recommended	1b, 2a, 2b, 3b	EC
63	Intra op	7	Patients for whom a central venous catheter was inserted with all elements of sterile barrier technique followed, Documentation of daily examination of line site for signs of infection and continued need for central line	1a, 3b	S
64	Intra op	6	Mechanical thromboprophylaxis used intraoperatively	5	S, EC
65	Intra op	5	Percentage of 1 st cases starting on time measured and recorded	3b, 4, 5	T
66	Intra op	5	Operating room turnover time (min) measured	3b, 5	T
67	Intra op	5	Epidural analgesia used intraoperatively	1b, 2b, 3b	EC
68	Intra op	5	Intraoperative blood loss is measured and recorded	2b, 3b, 5	EC
69	Intra op	5	Critically ill patients in the recovery area are cared for by appropriately trained staff and have appropriate monitoring and support	NA	S, EC
70	Intra op	4	Post-Anaesthetic Transfer of Care: Use of a checklist or protocol for Direct Transfer of Care from Procedure Room to Intensive Care	NA	S
71	Intra op	3	Surgical field preparation with chlorhexidine-alcohol	1b, 2b, 3b	EC
72	Intra op	3	What proportion of patients received goal directed fluid therapy during surgery	2b	EC
73	Intra op	3	Maintenance of euglycaemia perioperatively: use of standardised protocol to maintain serum glucose <200 mg/d	2b, 3b	EC
74	Intra op	3	Measures to ensure proper positioning on table documented to prevent peripheral nerve damage and maintain skin integrity.	3b, 5	S, EC
75	Intra op	3	Number of patients receiving light or moderate sedation	NA	EC
76	Intra op	2	Adequate perioperative management of patient's current medications	1b, 2b	EC
77	Intra op	2	Induction time (min) and Emergence time (min) are recorded	3b	T

78	Intra op	2	Measurement and documentation of pain intensity scores after major surgery	NA	EC
79	Intra op	2	Elapsed time between admission and first dose of antibiotics in theatre	NA	T
80	Intra op	2	Intraoperative use of forced air warming	4	EC
81	Intra op	2	Surgical pathology specimens are correctly labelled: Labelled, filled container, correct laterality, correct tissue type, patient name, correct patient name	2b, 5	EN
82	Intra op	1	Wound catheters or Transversus Abdominis Plane (TAP) block used for intraoperative analgesia	2b	EC
83	Intra op	1	Multimodal approach to optimising postoperative gut function is used	2b	EC
84	Intra op	1	Surgeons use explicit procedure specific intraoperative checklists	3b	S, EC
85	Intra op	1	Intravenous analgesia (Patient Controlled Analgesia or iv lidocaine)	4	EC
86	Intra op	1	Perioperative urine output monitored carefully in patients with renal failure	5	EC
87	Intra op	1	All anaesthetic equipment is checked before use according to AAGBI published guidelines and the checks are documented	NA	S
88	Intra op	1	Type of Anaesthesia administered documented	NA	EC
89	Intra op	1	PQRS / SCIP Documentation available and completed	NA	EN
90	Intra op	1	People with hip fracture have their schedule on a planned trauma list, with consultant or senior staff supervision	NA	EN
91	Intra op	1	No systemic morphine used intraoperatively	1a	EC
92	Post op	25	Proportion of surgical patients who had an order for venous thromboembolism prophylaxis to be given within 24h before incision / after surgery end	1a, 1b, 2b, 3b	S, EC
93	Post op	22	Proportion of patients whose prophylactic antibiotics were discontinued within 24 hours after surgery end time	1a, 1b, 2b, 3b, 4, 5	T, EC
94	Post op	21	Patients should be encouraged to sit out of bed and begin mobilising the day after surgery, within 24 hours or as determined by the surgeon.	1a, 3a, 3b, 5	EC
95	Post op	19	Discharge needs assessment, VTE prophylaxis, rehab, and follow up are organised postoperatively for patients	1a, 2a, 2b, 3a, 3b, 5	S, P, EC, EN
96	Post op	13	Urinary catheter removed on Postoperative Day 1 or Postoperative Day 2 with day of surgery being day zero, or reason for continuing use documented	1b, 2a, 2b, 3b	EC
97	Post op	10	Postoperative treatment of Diabetes Mellitus (or documentation of attempt) to keep BM <10mmol/l on day of surgery and the first 2 postop days	1b, 3b, 4, 5	EC
98	Post op	8	Postoperative nasogastric tubes should not be used routinely	1a, 1b, 3a, 5	EC
99	Post op	7	Pain should be controlled with oral or non-parenteral medications on the day of surgery and before discharge, and be adequate enough to allow acute rehabilitation	3b, 5	EC
100	Post op	6	Postoperative pain assessments should be performed with each set of vital signs	5	EC
101	Post op	6	Enteral route for postoperative fluid used as soon as possible, iv fluids discontinued as soon as is practicable	1a, 1b, 3b	EC
102	Post op	4	Postoperative delirium screening for all patients.	1a, 3b, 5	EC
103	Post op	4	Postoperative normothermia maintained at: 36-38 degrees celsius	1b, 2b	EC
104	Post op	3	People having surgery and their carers receive information and advice on wound and dressing care	2a	P
105	Post op	3	Cognitive and functional assessment performed daily postoperatively and at discharge	3b, 5	EC
106	Post op	3	Official PACU to ward handover undertaken for all patients	5	S, EC, EN
107	Post op	3	Patient's condition and vital signs evaluated continuously in the PACU	5	S
108	Post op	2	PACU length of stay measured	3b, 5	T
109	Post op	2	Documentation of a systematic, MDT approach to supported discharge of suitable patients	3b	EC
110	Post op	2	Stimulation of bowel movements using an even fluid balance, laxatives and chewing gum	1b, 2a	EC

111	Post op	2	Percentage of recovery nurses following acute pain protocols	5	S
112	Post op	2	Early warning system used on postoperative wards	2b	S, EC
113	Post op	2	Patients with a risk of death >10% should be admitted to a critical care location postoperatively	NA	EC
114	Post op	2	Immediately post-surgery a member of the medical/nursing team updates the patient's supporter(s) of the outcome of surgery.	NA	P
115	Post op	2	Postanaesthesia documentation is documented to the agreed national standard	NA	EC, EN
116	Post op	1	Visual phlebitis scores are measured daily postoperatively	2b	EC
117	Post op	1	The head of the bed is elevated postoperatively	2b	EC
118	Post op	1	Hydration, pressure care, assessment and treatment of pain, and attention to nutrition and continence are begun in the emergency room and are continued in the orthopaedic ward postoperatively	3b	EC
119	Post op	1	Patients having a postoperative physician review (not critical care)	3b	EC, EN
120	Post op	1	Waiting time from time appointed for surgical procedure until discharge	3b	T
121	Post op	1	Days from surgery until discharge from hospital	3b	T, EC
122	Post op	1	Patients receiving prescribed antiemetic treatment when nausea and vomiting are present during acute pain management	4	EC
123	Post op	1	Time from operation until adjuvant chemotherapy	5	T
124	Post op	1	All patients given supplemental oxygen as required	5	S
125	Post op	1	At the end of surgery, was the decision made to place the patient on an end of life pathway; was this documented	NA	EC
126	Post op	1	Review by a specialist from Elderly Medicine in the post-operative period	NA	EC
127	Post op	1	What proportion of patients were admitted directly to an HDU or ITU following surgery	NA	EN
128	Post op	1	After fracture surgery there is communication with the physicians responsible for post surgical care	NA	EN
129	Post op	1	Patients undergoing a procedure with an Anaesthetist who have a documented evidence of a postanesthesia review	NA	EC
130	Post op	1	Structured assessment of patient mortality & morbidity risk, carried out at the end of surgery	NA	EC
131	Post op	1	Daily Anaesthetist review following epidural analgesia	NA	S, EC
132	All	19	Chronic beta blocker use is continued in perioperative period (24h before incision to first 2 postoperative days)	1a, 1b, 2a, 2b, 3b	EC
133	All	6	Percentage of surgery patients who received appropriate venous thromboembolism prophylaxis within 24 hours prior to surgery to 24 hours after surgery	1a, 2b, 3b	S, EC
134	All	3	Surgery takes place during standard daytime working hours (including weekends) except in exceptional circumstances	3b	EN, S
135	All	2	Documentation of oral intake during the hospitalisation	3b	EC
136	All	2	Cooperation between orthopaedic, physicians and anaesthetists in preoperative, operative and postoperative medical management, and in the rehabilitation of hip fracture patients.	3b, 2b	EC
137	All	2	Perioperative continued use of Aspirin for patients with drug-eluting coronary stents	NA	EC
138	All	2	Information is provided to patients and supporters at each stage of the care pathway. Communication with patients and supporters is consultant-led.	NA	P
139	All	2	Clinical audit of all emergency surgical procedures whether undertaken in an operating theatre or another area (eg emergency resus room) is regularly undertaken	NA	EN
140	All	2	Named supervisory consultants are available to all non-consultant anaesthetists. Those they are supervising know their identity, location and how to contact them. In situations where a trainee is remotely supervised, the trainee must contact their supervising consultant immediately who should attend as soon as is possible.	NA	S
141	All	1	The perioperative anaesthetic care of all patients is, at all times, led by a consultant anaesthetist. Clinical care may be delegated to a supervised, clinically competent trainee of sufficient seniority.	NA	EC
142	All	1	Perioperative care following GIFTASUP fluid guidelines	NA	EC
143	All	1	Patient transfer is carried out to standards described by the AAGBI	NA	S
144	All	1	A consultant in intensive care medicine reviews all emergency surgical admissions to the ICU within 12 hours.	NA	EC, S, T

145	All	1	A geriatrician assesses hip fracture patients within 72 hours of admission.	NA	T, S, EC
146	All	1	National policy for patient identification is followed: Evidence that patients are labelled, that labels are replaced and that patient name and number are both used at every stage of the WHO process should be seen	NA	S
147	All	1	Enhanced recovery used perioperatively	1a	EC
148	All	1	Anaesthetists offering perioperative analgesia services should provide, in collaboration with others as appropriate, patient and family education regarding their important roles in achieving comfort, reporting pain, and in proper use of recommended analgesic methods.	3b	P
149	All	1	Percentage of patients whose anaesthesia provider is the same during pre, intra, and postoperative care	4	EC

Table 3: Aggregated process indicators arranged in the timing of perioperative care, from preoperative (pre op), intraoperative (intra op), postoperative (post op) or spanning the whole perioperative pathway (all). Within these subsections, they are arranged in descending order by the highest level of evidence available, presented in the shortlisted publications of our review. We map the aggregated indicators to the IOM quality domains: Effectiveness (EC), Efficiency (EN), Patient centredness (P), Equity (EQ), Safety (S), and Timeliness (T).

Appendices

Appendix 1

Search Strategy

Systematic Review of:

1. Database literature search (2005 - 2016)
2. Grey Literature search (2005 – 2016)
3. Websites / Documents (2005 – 2016)

1. Database literature search (2005 – 2016)

- A. Medline (Ovid)
- B. Embase (Ovid)
- C. CINAHL
- D. Cochrane Library

2. Grey Literature Search

- A. Google Scholar
- B. SIGLE – System for Information on Grey Literature in Europe
- C. Expert opinion on unpublished indicators developed by quality initiatives and professional organisations
- D. Databases and sources of international indicators:
 - a. www.rand.org
 - b. www.ahcpr.gov
 - c. www.newcastle.ac.uk/qip
 - d. <http://nprdc.man.uk>

3. Websites / Documents

- A. United Kingdom
- B. United States
- C. Canada
- D. Australia / New Zealand

Database literature search (2005 – 2016)

A. Medline (Ovid) – 25,644 articles

Limits, 10 years (2005-2016), Humans, English

(exp "Quality Indicators, Health Care"/[MeSH] OR foc "Quality of health care/" [MeSH] OR Quality indi*.mp OR exp "Quality Assurance, Health Care/" [MeSH] OR exp "Outcome and Process Assessment (Health Care)"/ [MeSH] OR exp "Process Assessment (Health Care) [MeSH] OR Quality measure*.mp OR Performance measure*.mp OR Structure meas*.mp OR Structure indicator.mp OR Structure criter*.mp OR Structure quality indicators.mp OR Structure quality.mp OR Structure assessment.mp OR Structure health care.mp OR Quality criter*.mp OR Process measure*.mp OR exp "Standard of Care/" [MeSH] OR process assessment.mp OR health care quality.mp OR health care quality indicators.mp OR quality performance.mp OR quality assessment.mp) AND (exp "Perioperative Care/" [MeSH] OR periop*.mp OR perop*.mp OR peri-op*.mp OR per-op*.mp OR preop*.mp OR pre-op*.mp OR postop*.mp OR post-op*.mp OR intraop*.mp OR Intra-op*.mp OR exp "Perioperative Period/" [MeSH] OR perioperative complications.mp OR exp "Preoperative Care/" [MeSH] OR exp "Preoperative Period/" OR exp "Intraoperative Care/" [MeSH] OR exp "Intraoperative Period/" [MeSH] OR exp "Intraoperative Complications/" [MeSH] OR anaesth*.mp OR anesth*.mp OR exp "Anesthesia/" [MeSH] OR exp "Anesthesia, General/" [MeSH] OR exp "General Surgery/" [MeSH] OR exp "Postoperative Period/" [MeSH] OR exp "Postoperative Care/" [MeSH] OR surg*.mp OR operat*.mp OR exp "Specialties, surgical/" [MeSH] OR foc "Surgical procedures, operative/" [MeSH])

B. CINAHL Plus – 1,424 articles

Limits:10 years (2005-2016), Adult, English

("Quality Indicators, Health Care/" OR "Quality of health care/" OR Quality indi*.mp OR Quality indicators in healthcare OR Quality indicators: a tool for quality monitoring and improvement OR Quality assurance in healthcare OR "Outcome and Process Assessment"/ OR "Process Assessment (Health Care) OR Quality measure*.mp OR Performance measure* OR Structure meas* OR Structure indicator OR Structure criter* OR Structure quality OR Structure assessment OR Structure health care OR Quality criter* OR Process measure OR "Standard of Care/" OR process assessment OR health care quality OR health care quality indicators OR quality performance OR quality assessment) AND ("Perioperative Care/" OR periop* OR perop* OR peri-op* OR per-op* OR preop* OR pre-op* OR postop* OR post-op* OR intraop* OR Intra-op* OR "Perioperative Period/" OR perioperative complications = OR "Preoperative Care/" OR "Preoperative Period/" OR "Intraoperative Care/" OR "Intraoperative Period/" OR "Intraoperative Complications/" OR anaesth*.mp OR Anesth\$.mp OR "Anesthesia/" OR "General Surgery/" OR "Postoperative Period/" OR "Postoperative Care/" OR surg*.mp OR operat*.mp OR "Specialties, surgical/")

C. EMBASE (Ovid) – 8,374 articles

Limits:10 years (2005-2016), Humans, English

(foc "Health Care Quality"/[MeSH] OR Quality indi*.mp OR Quality measure*.mp OR Performance measure*.mp OR Structure meas*.mp OR Structure indicator.mp OR Structure criter*.mp OR Structure quality indicators.mp OR Structure quality.mp OR Structure assessment.mp OR Structure health care.mp OR Quality criter*.mp OR Process measure*.mp OR process assessment.mp OR health care quality.mp OR health care quality indicators.mp OR quality performance.mp OR quality assessment.mp) AND (Perioperative Care.mp OR periop*.mp OR perop*.mp OR peri-op*.mp OR per-op*.mp OR preop*.mp OR pre-op*.mp OR post-op*.mp OR intraop*.mp OR Intra-op*.mp OR exp "Perioperative Period"/ [MeSH] OR perioperative complications.mp OR exp "Preoperative Care"/ [MeSH] OR foc "Preoperative Period"/ [MeSH] OR Intraoperative Care.mp OR foc "Intraoperative Period"/ [MeSH] OR exp "Peroperative Complications"/ [MeSH] OR anaesth*.mp OR anesth*.mp OR exp "Anesthesia"/ [MeSH] OR exp "Anesthesia, General"/ [MeSH] OR exp "General Surgery"/ [MeSH] OR foc "Postoperative Period"/ [MeSH] OR exp "Postoperative Care"/ [MeSH] OR foc Surgery/ OR Surgical procedures, operative.mp)

D. Cochrane Library – 8,418 articles

Limits: 10 years (2005-2016)

("Quality Indicators, Health Care"/ OR "Quality of health care"/ OR Quality indi*.mp OR "Quality Assurance, Health Care"/ OR "Outcome and Process Assessment" OR "Process Assessment (Health Care) OR Quality measure*.mp OR Performance measure*.mp OR Structure meas*.mp OR Structure indicator.mp OR Structure criter*.mp OR Structure quality indicators.mp OR Structure quality.mp OR Structure assessment.mp OR Structure health care.mp OR Process measure*.mp OR "Standard of Care"/ OR process assessment.mp OR health care quality.mp OR health care quality indicators.mp OR Quality performance.mp OR quality assessment.mp) AND ("Perioperative Care"/ OR periop*.mp OR perop*.mp OR peri-op*.mp OR per-op*.mp OR preop*.mp OR pre-op*.mp OR postop*.mp OR post-op*.mp OR intraop*.mp OR Intra-op*.mp OR "Perioperative Period"/ OR perioperative complications.mp OR "Preoperative Care"/ OR "Preoperative Period"/ OR "Intraoperative Care"/ OR "Intraoperative Period"/ OR "Intraoperative Complications"/ OR anaesth*.mp OR anesth*.mp OR "General Surgery"/ OR "Postoperative Period"/ OR "Postoperative Care"/ OR surg*.mp OR operat*.mp)

Grey Literature Search (2005 – 2016)

- A. Google Scholar
- B. SIGLE – System for Information on Grey Literature in Europe
- E. Expert opinion on unpublished indicators developed by quality initiatives and professional organisations
- F. Databases and sources of international indicators:
 - a. www.rand.org
 - b. www.ahcpr.gov
 - c. www.newcastle.ac.uk/qip
 - d. <http://nprdc.man.uk>

Websites / Documents (2005 – 2016)

1. United Kingdom
2. United States
3. Canada
4. Australia / New Zealand

1. United Kingdom

- **RCoA**
 - o 91. ACSA
 - o GPAS
- **RCoS**
 - o 94. The higher risk general surgical patient
 - o 95. Emergency Surgery: Standards for unscheduled surgical care
 - o 112. Getting it right first time
- **NICE**
 - o 96. Hip fracture
 - o 97. Inflammatory bowel disease
 - o 98. Surgical site infection
 - o 108. VTE prophylaxis
 - o 109. UGRA
- **ISD Scotland**
 - o 110. Colorectal Cancer Quality Performance Indicators
 - o 111. Cancelled planned operations
- **NELA**
 - o 89. Organisational report of the national emergency laparotomy audit (NELA) – RCoA
 - o 90. The first patient report of the national emergency laparotomy audit - RCoA
- **NCEPOD**
 - o 92. Knowing the Risk

- 93. An age old problem
- **HQIP datasets**

2. United States

- **American Society of Anesthesiologists (ASA) www.asahq.org**
 - Standards, Guidelines and Practice Parameters
 - 119. ASA standards for basic monitoring
 - 120. ASA Basic standards for preanesthesia care
 - 121. ASA Documentation of anesthesia care
 - 122. ASA Standards for postanesthesia care
 - ASA Committee on Performance and Outcome Program
- **Anaesthesia Quality Institute (AQI): National Anesthesia Clinical Outcomes Registry (NACOR)**
 - 114. AQI – Intraoperative
 - 115. AQI – PACU Discharge
 - 116. AQI QCDR Measure Specification
 - 117. AQI – Procedural sedation
 - 118. AQI – Recommended indicators
- **American Medical Association (AMA)**
 - AMA Physician Consortium for Performance Improvement Program
 - AMA Clinical Practice Improvement and Patient Safety
- **Ambulatory Care Quality Alliance (ACA)**
 - 125. ACA Approved measures chart 2009
- **National Quality Forum (NQF)**
 - 124. Endorsement Summary: Surgery
- **(CMS/CDC (SCIP)) – Centers for Disease Control and Prevention – Surgical Care Improvement Project**
- **Centers for Medicare and Medicaid Services (CMS): PQRS (Physician Quality Reporting System) : Qualified Clinical Data Registry (QCDR). HIQR**
 - 123. PQRS Measures Dataset
- **The Joint Commission (TJC) / SCIP**
- **Agency for Healthcare Research and Quality (AHRQ)**
- International Quality Indicator Project – Maryland
 - SCIP Measures
- Hospital Association (MHA/IQIP)
- **Veterans Health Administration (VHA)**
- **SCIP**
 - 113. SCIP Core Measure Set

3. Canada

- Canadian Anesthesiologist Society Guidelines

4. Australia and New Zealand

- Australian Council on Healthcare Standards (ACHS)-Care Evaluation Program – need help and a bit more
- National Health and Medical Research Council (NHMRC)
- Australian Commission on Safety and Quality in Healthcare Initiative (ACSHQ)
- Australian New Zealand College of Anaesthetists (ANZCA)

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Appendix 2

Data extraction form

Structure and Process Indicators in Perioperative Care

Article First Author: Last name, Initial	
Journal Name	
Publication Year	
Article Type	<ol style="list-style-type: none"> 1. Audit (A) 2. Clinical Practice Guideline (CPG) 3. Case Study (CS) 4. Expert Consensus (EC) 5. Literature Review (LR) 6. Review (R) 7. Survey (S) 8. Service Evaluation (SE) 9. Systematic Literature Review (SLR) 10. Validation Study (VS)
Developer Name	
Developer Description	<ol style="list-style-type: none"> 1. Accreditation Body (AB) 2. Hospital (H) 3. Other (O) 4. Professional Organisation (PO) 5. Quality Initiative (QI) 6. University (U)
Number of Developer sites used for Indicator validation	<ol style="list-style-type: none"> 1. Single site (S) 2. Multi site (M) 3. NA
Developer Country	<ol style="list-style-type: none"> 1. UK 2. USA 3. Canada 4. Australia 5. New Zealand 6. Europe, Country
Indicator Area	<ol style="list-style-type: none"> 1. Structure 2. Process
Type of Care	<ol style="list-style-type: none"> 1. Elective (EL) 2. Emergency (EM) 3. Both (B)
Indicator Name	
Indicator Definition	
Indicator Origin	
Indicator Disease/Surgery Specific	<ol style="list-style-type: none"> 1. Yes 2. No
Disease/Surgery Name	<ol style="list-style-type: none"> 1. Breast (B) 2. Colorectal (C) 3. Elderly (E) 4. General Surgery (G) 5. Hip Fracture (H) 6. Orthopaedic (O) 7. Oesophageal Cancer (OC) 8. Pancreas (P) 9. Urology (U) 10. Vascular (V)
Timing of Indicator	<ol style="list-style-type: none"> 1. All (A) 2. Preoperative (PR) 3. Intraoperative (I) 4. Postoperative (PO)
Level of Evidence for Indicator	<ol style="list-style-type: none"> 1. Level 1a, 1b, 1c 2. Level 2a, 2b, 2c 3. Level 3a, 3b 4. Level 4 5. Level 5 6. None 7. NA
Number of Patients in Evidence	
Dimensions of Quality	<ul style="list-style-type: none"> ▪ Safe (S): Avoiding harm to patients from the care that is intended to help them. ▪ Effective (EC): Providing services based on scientific

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Data Extractor Comments

knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and misuse, respectively).

- **Patient-centered (P):** Providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.
- **Timely (T):** Reducing waits and sometimes harmful delays for both those who receive and those who give care.
- **Efficient (EN):** Avoiding waste, including waste of equipment, supplies, ideas, and energy.
- **Equitable (EQ):** Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.

For Peer Review