

The hidden pandemic of postoperative complications: a discussion paper

Summary

Although surgery is, and is likely to remain, one of the mainstays of healthcare, it is recognised that postoperative complications are common and affect as many as 1:4 patients, with far reaching consequences on the individual patient; families; clinicians; healthcare institutions; fund holders; and employers. Based on projected aging of the population, with increasing comorbid disease, over the next thirty years, we can expect these impacts to increase substantially.

Complications fall into different groups, but non-procedural ('medical') issues related to the physiological insult of surgery and anaesthesia are the prime focus of the growing field of perioperative care, or perioperative medicine (POM). Two key drivers are variable care delivery and modifiable risk in patients. The latter is illustrated by 3-5 fold higher complication rate in deconditioned patients.

Management and treatment options broadly relate to preparation for surgery, intraoperative care, and recovery and return to optimal functioning. These specific medical and allied health interventions have evolved over time, and have often been added to standard care pathways and processes. However, it is increasingly recognised in organisational and medical analysis that repeated 'patches' are usually inadequate to address quality and sustainability when there are major shifts in the industry, and these major shifts (e.g. age, co-morbidities, management options) are now evident in surgery and perioperative care.

Systems thinking and systems redesign is essential to underpin sustainable high quality performance and improvement in care delivery. Systems must include identification of current best practices, and the capacity and processes needed to deliver these consistently and reliably. Critical to such a systems approach is identification of relevant, practical, measurable outcomes and goals, linked to mechanisms for ongoing learning and quality improvement. Quality in healthcare relates to the broader STEEEP™ principles of safe, timely, effective, efficient, equitable and patient-centred care.

To manage the increasing risk postoperative complications, substantial work has been undertaken within Australia and overseas on some elements that might constitute part of a high functioning system.

This summit will consider the nature and scope of the quality and sustainability challenge, the principles which should underlie a high quality systems approach, what elements and processes are required to deliver a solution, and how this could be implemented. By bringing together a diverse group of high calibre stakeholders we aim to provide an opportunity to collectively determine a strategic and implementation plan, to provide jurisdictions throughout Australia with guidance and options on how to deliver sustainable best practice surgical and perioperative care.

The Hidden Pandemic

Surgery is, and is likely to remain, one of the mainstays of medical care. It is estimated that one third of the global burden of disease is amenable to surgery, while two thirds of patients suffering trauma or a cancer diagnosis require surgery. Given the aging population and increase in cancer burden it is estimated that surgical services will need to double in capacity worldwide over the next 20 years.¹ Inability to deliver essential surgical services accounts for 17% loss in GDP, which in itself creates a dilemma for poorer countries who cannot deliver such services with dire consequences on the socioeconomic status of their populations.

Major postoperative complications are common, occurring in around 20% of patients,^{2,3} and the risk increases with factors such as surgery type, and patient co-morbidities and age. In practice, many serious complications may go unrecorded.⁴ These complications have clear sequelae, in terms of events of direct importance to patients and their lives, such as length of hospital stay and re-admissions,^{5,6} and days at home after surgery (now a recognised indicator of quality of care).⁷ Patients suffering postoperative complications also have poorer long-term survival, which in cancer patients may relate to inability to access timely adjuvant chemoradiotherapy after surgery. Further, these events have direct relevance to healthcare costs (with two to seven fold increase in expenditure in patients that suffer 2 or 3 postoperative complications, respectively) and hence negatively impacts on overall healthcare sustainability.⁸

Recent estimations, based on the population changes predicted for Australia, including ageing and associated chronic disease, suggest that with no changes to current practice, complications and their sequelae will increase in frequency at around 10% per year.⁹ This has been termed “the hidden pandemic of postoperative complications”, based on predicted growth and frequent under-estimation.¹⁰ This pandemic is not inevitable. It is clear from large data sets that there are two major drivers that are modifiable, namely substantial inter-practitioner and inter-institutional variation in clinical performance, suggesting significant opportunities for improvement (e.g. interactive audit and benchmarking).^{8,3,11,12} Secondly, many patients present with modifiable risk factors that can be optimised before surgery (e.g. risk stratification and prehabilitation).

This is the problem we are trying to solve.

Foundations for solutions

Defining complications

Post-operative complications can be classified as procedure-specific ('surgical') or non-procedural ('medical') complications. Non-surgical (medical) complications are the focus of this meeting.

Procedure-specific complications are mostly related to the initial operative goals of the surgery (e.g. removal of mass, anastomosis, successful implantation of a device) and may be early or delayed (e.g. implant failure, disease recurrence). These are usually technical and skill- and volume-based in nature which means the influence of ‘non-surgical’ management on these complications is modest.

Non-surgical complications, however, relate to recovery and healing from the physiological insult of surgery and anaesthesia. This extends from immediate recovery through to optimal functioning with societal re-integration of the patient. Many of these complications can be prevented or ameliorated through specific non-surgical treatments and care and are the prime intent of the growing multidisciplinary field of perioperative medicine (POM). The range of potential complications is large, but those commonly targeted in perioperative medicine are listed in Appendix 1, and seen in risk prediction tools (Appendix 2).

Non-surgical complications – pattern and risk

Complications follow common patterns of incidence, severity and sequelae. The likely patterns of these can be determined from large databases and modelling. Multiple models exist looking at the impact on risk of patient factors (many of which are modifiable preoperatively) and surgical factors,¹⁴ with varying factor inclusion, outcomes and performance. Systems thinking though has the potential for large gains with awareness of the risks from system factors such as capacity, case volume, structure, expertise and process.¹⁵ One of the larger and better performing models is the risk prediction tool in the American College of Surgeons National Surgical Quality Improvement Program (NSQIP; Appendix 2). While NSQIP has a US focus, there is international participation, including seven Australian hospitals. This tool includes a specific checkbox on non-surgical options, acknowledging that when a high-risk patient is identified, conservative management options, through shared decision making, should be considered.

Complications, events and consequences

Specific medical, nursing and allied health responsibilities are often the clinical focus. However, the consequences of post-operative complications affect a wide range of groups within the system and can be broadly grouped into: (i) patient/family/carer-centred; (ii) hospital healthcare-centred; (iii) non-hospital care-centred. What is measurable, or measured is highly relevant to each group, and may be highly specific. Their use in quality management may be practice- or research-focused. Some of the measurable events are outlined in Appendix 3.

'Non-surgical' management to reduce the risk, or severity, of complications

Perioperative medicine has highlighted specific interventions which have the potential to alter complications and outcomes. They fall into:

- Pre-operative risk assessment and preparation (identification of and optimising modifiable patient risk e.g. prehabilitation);
- Intra-operative management (e.g. less variability in care - enhanced recovery after surgery pathways with interactive audit systems; and
- Postoperative care (e.g. extended high acuity care into the postoperative period).

Not all apply to all patients, emphasising the importance of timely patient risk- and needs-assessment, and triage to appropriate care.

Levels of evidence for specific interventions vary. Each on its own may have only a small or (scientifically) immeasurable effect, or may be context-specific.¹⁰ They may, however, be additive or synergistic effects, emphasising the need for a systems approach to ensure sub-

optimal care is avoided [Systems; Perioperative Surgical Home (PSH); Centre for Perioperative Care (CPOC)]. Some examples of specific management are outlined in Appendix 4.

The need for systems thinking

In the UK, a multidisciplinary coordinated approach in perioperative medicine is advocated through the Centre for Perioperative Care (<https://cpoc.org.uk>) –

“Sharing examples of good practice provides an opportunity for colleagues to review their own pathways in light of the importance of integrated and person-centred care. It will also provide commissioners with the information they need to support the commissioning of high quality care.”

Similarly, the USA’s Perioperative Surgical Home concept (<https://www.asahq.org/psh>) is

“a patient-centric, team-based model of care created by leaders within the American Society of Anesthesiologists to help meet the demands of a rapidly approaching health care paradigm that will emphasize gratified providers, improved population health, reduced care costs and satisfied patients.”

In Europe, with a number of centres participating in Australia, the Enhanced Recovery After Surgery (ERAS) society publishes best practice pathways based on evidence-based medicine and uses an ERAS interactive audit system (EIAS) for institutions to measure compliance rates with best practice pathways and also capture their institutional complication rates (<https://erassociety.org/interactive-audit/>).

In Australia and New Zealand, substantial progress has been made in the development of a multi-disciplinary “effective, integrated and collaborative perioperative care model”. (http://www.anzca.edu.au/documents/sau_bulletin-peri-article_20190528.pdf). The effectiveness of this model hinges on identification of needs at each step in the patient journey, from initial decision to consider surgery to the return to optimal function, with management options available (Appendix 5).

However, we need to move beyond the multidisciplinary model to a systems based approach to avoid post-operative complications.

Development of mechanisms to address the evolving perioperative challenge has often been incremental, adding layers or elements to conventional processes. A more systems-based approach is likely to solve deeper problems and facilitate more effective and sustainable solutions. It has been recognised that

“healthcare systems fail to provide treatments that are known to work, persist in using treatments that don’t work, enforce delays, and tolerate high levels of error. Healthcare leaders are now recognising . . . that the healthcare system needs radical redesigning.... Healthcare redesign can be broadly defined as thinking through from scratch the best process to achieve speedy and effective care from a patient perspective, identifying where delays, unnecessary steps or potential for error are built into the process, and then redesigning the process to remove them and dramatically improve the quality of care.”¹⁶

Consistency and reduction in unnecessary variation, are intrinsic to quality outcomes in systems. Identification and management of unwanted variation can be an opportunity for the health system to improve and may reflect one or more of: access inequity, uncertainty around optimal care, evidence gaps, inadequate systems support, and a need for incentivisation.^{17,18,19}

A system with a quality focus can be considered as:

“the organizational structure, responsibilities, procedures, processes and resources for implementing quality management”. It should “define and cover all facets of an organization’s operation, from identifying and meeting the needs and requirements of customers, design, planning, purchasing, manufacturing, packaging, storage, delivery and service, together with all relevant activities carried out within these functions. It deals with organization, responsibilities, procedures and processes. Put simply [it] is good management practice.”²⁰

Importantly, this recognises that a coordinated system as a whole, rather than individual elements, however excellent, maximises output.¹⁰

Implementation of a systems-based approach is not without challenges. For example, Enhanced Recovery After Surgery (ERAS) is a program that has been developed in perioperative medicine with the aim to:

“reduce the patient’s surgical stress response, optimize their physiologic function, and facilitate recovery by incorporating evidence-based interventions into patient management”.²¹

Yet, despite the compelling evidence in support of ERAS, it has not been adopted widely. Results from a Canadian qualitative study suggest that although clinicians see the value in implementing an ERAS program, lack of nursing staff, lack of financial resources, resistance to change, and poor communication and collaboration are among the barriers to its adoption.²²

Value based care

The Baylor STEEEP™ principles (safe, timely, effective, efficient, equitable, patient-centred) emphasise that considering what constitutes high value care (cost versus outcome)²² is intrinsic to quality.

In general, there is a paucity of good evidence regarding high value care in perioperative medicine, with analyses ranging from simple estimates to formal cost-effectiveness calculations. The perspective of return on investment is critical to the creation of true value, as short-term goals may create false economies or cost-shifting. For example, reduced length of stay may be associated with improved care,²⁴ or create downstream adverse effects on re-admissions and costs.²⁵

Some available data do suggest creation of higher value care, especially with systems-based approaches, which include:

- Enhanced Recovery After Surgery (ERAS): An economic evaluation of the ERAS multisite implementation program for colorectal surgery in Alberta estimated that through improved compliance with best practice pathways that they achieved net

health system savings of \$1,768 per patient, or, in terms of return on investment, for every \$1 invested in ERAS, \$3.80 could be expected in return.²⁶

- National Surgical Quality Improvement Program (NSQIP; Risk stratification and Benchmarking): This American College of Surgeons NSQIP program has a dynamic database that allows risk stratification for each individual patient and also allows institutional benchmarking, with ability to identify areas where institutions are outliers and implement programs to improve care. An introduction of NSQIP into a Canadian province concluded that every \$1 invested in NSQIP resulted in a ROI = \$4.3.²⁶
- Prehabilitation: Identifying modifiable patient risk factors and implementing strategies to reduce their risk e.g. anaemia, physical deconditioning, quit smoking, malnutrition before surgery. Small RCTs suggest a large (50%) reduction in complications, and good return on investment;²⁷ Medicare data from Michigan suggest improved discharge patterns, lower hospital and post-discharge costs, and per patient savings of approx. \$3,200.²⁸
- High acuity postoperative care: This model allows higher risk patients to have extended care into the "golden hours" of the postoperative period e.g. inotrope support. This prevents deterioration of physiology postoperative with reduction in postoperative complications. Mixed data, ranging from no clinical overall improvement to substantial cost and outcome benefits, exist in the literature,^{29,30,4} but there is a paucity of high quality data on systems design.³⁵

Conclusion

In the face of an existing and rapidly growing risk of postoperative complications with broad adverse impacts within and without the healthcare sector, there is an opportunity to collectively determine systems-based solution through a strategic and implementation plan to provide jurisdictions throughout Australia with guidance and options on how to deliver sustainable best practice care.

Areas to consider in the Summit include:

Systems approach: The framework for a system which addresses the necessary clinical and non-clinical elements, and is aimed at addressing all the STEEEP principles of quality.

Value-based care elements: Identification, implementation and tracking of high quality, high value activities, to be placed within an appropriate system. Examples include, but are not limited to: ACS-NSQIP, ERAS-EIAS, Prehabilitation, Advanced Recovery.

Identification, collection and analysis of relevant measurable risk-adjusted datasets on outcomes and processes, including patient-reported outcomes.

A centre to coordinate activity and change.

Principles:

In complex systems, strategies are more likely to be successful if there is a simple set of rules or principles which can be applied at all levels including the clinic and bedside. Principles need to be (i) tough; (ii) constrain us so that the rules can be adapted to local strategies; (iii) evidenced-based; (iv) patient-based; (v) applicable to public and private systems of health in Australia.

What follows is a suggested set of principles for discussion and modification at the meeting.

- 1. All planning must be based around the patient (their family, their expectations and needs)**
 - Goals are pre-defined at each step, and agreed to by all clinicians and the patient
 - Goals align with patients stated wishes, including Shared Decision Making and Advanced Care Directive.
 - A coordinated perioperative plan of all aspects of care should be completed prior to the day of surgery
 - This should be available to all relevant clinicians and institutions
 - It should be agreed to by all, clinicians and institutions, and the patient and family
 - It should align with the patients' pre-defined expectations and goals
- 2. Risk assessment should be formally determined when surgery is considered**
 - It should be re-evaluated by clinicians and patient and family prior to a final decision to proceed with surgery
 - Risk should be re-evaluated at all points in the patient journey.
 - Identified risk must always be matched to available management capacity, and the patient's goals. Modifiable risk requires this to be reversed in a timely manner and therefore systems redesign may be needed to ensure primary care physicians and/or anaesthetists with allied health clinicians see patients weeks before surgery to enact a management plan.
- 3. System thinking for perioperative care should apply for all surgery and procedures**
 - Design the pathways with available evidence (as much as possible)
 - Pathways and processes should minimise variation, and maximise consistency, in care. Evidence-based pathways should be implemented and compliance audited and feedback at clinician level rather than administrative level.
 - Evaluation loops are inbuilt in the system (to improve the quality of evidence)
 - Evaluation should be based on the STEEP principles of healthcare
- 4. The pathway for managing surgical complications starts with primary care**
 - This is first and foremost in the patients home.
 - Roles and responsibilities of each member team must be clearly defined and performed
 - Evaluation must be built into the system
- 5. The business case for quality should accompany all activities, initiatives and improvements in the system**

6. **Evidence-based approaches should be used within all elements of the system**
Evidence gaps should be identified and addressed in a structured robust manner,
Evidence should be regularly reviewed

7. **Appropriate performance measures should be in place, and guide quality**
Performance measures will include structural, process and outcomes elements
Performance measures should include patient-centred and institution-focused measures
Risk-adjustment should be factored into all performance measures
Performance should be shared openly

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Appendix 1

Some specific common (preventable) complications

Death: 30-day; 90-day

Cardiovascular:

hypo/hypertension; AF; cardiac failure/fluid overload; myocardial infarction, thromboembolism

Respiratory:

atelectasis, infection, respiratory depression or failure (types 1 and 2)

Renal:

acute kidney injury

Neurological:

over-sedation; delirium; stroke; cognitive impairment

Gastro-intestinal:

nausea and vomiting; ileus

Metabolic:

hyper/hypoglycaemia

Infective:

infection; pneumonia, UTI, sepsis,

Surgical site:

surgical site infection (SSI); anastomotic breakdown

Other:

skin injury;

failure to achieve Return to Intended Oncologic (adjuvant) Therapy (RIOT) for cancer patients

ACSQHC: Hospital-acquired complications <https://www.safetyandquality.gov.au/our-work/indicators-measurement-and-reporting/complications/hacs-information-kit>

Pressure injury

Falls

Infection (healthcare-associated)

Surgical complications requiring unplanned return to theatre

ICU admission (unplanned)

Respiratory (failure, aspiration, pulmonary oedema)

Venous thromboembolism

Renal failure

GI bleed

Medication complications

Delirium

Incontinence

Endocrine (malnutrition, hypoglycaemia)

Cardiac (failure, rhythm, ACS, endocarditis)

Perineal laceration (severe)

Neonatal birth trauma

Appendix 2a

Risk factors and common outcomes and events from the NSQIP risk calculator

(<https://riskcalculator.facs.org>)

Patient and surgical factors

Procedure 44206 - Laparoscopy, surgical; colectomy, partial, with end colostomy and closure of distal segment (Hartmann type procedure) Clear

Begin by entering the procedure name or CPT code. One or more procedures will appear below the procedure box. You will need to click on the desired procedure to properly select it. You may also search using two words (or two partial words) by placing a '+' in between, for example: "cholecystectomy + cholangiography"

Reset All Selections

Are there other potential appropriate treatment options? Other Surgical Options Other Non-operative options None

Please enter as much of the following information as you can to receive the best risk estimates. A rough estimate will still be generated if you cannot provide all of the information below.

Age Group 85 years or older	Diabetes Insulin
Sex Male	Hypertension requiring medication Yes
Functional Status Independent	Congestive Heart Failure in 30 days prior to surgery No
Emergency Case No	Dyspnea No
ASA Class Severe systemic disease	Current Smoker within 1 Year No
Steroid use for chronic condition No	History of Severe COPD No
Ascites within 30 days prior to surgery No	Dialysis No
Systemic Sepsis within 48 hours prior to surgery None	Acute Renal Failure No
Ventilator Dependent No	BMI Calculation: Height: 69 in / 175 cm Weight: 243 lb / 110 kg
Disseminated Cancer No	

Geriatric factors

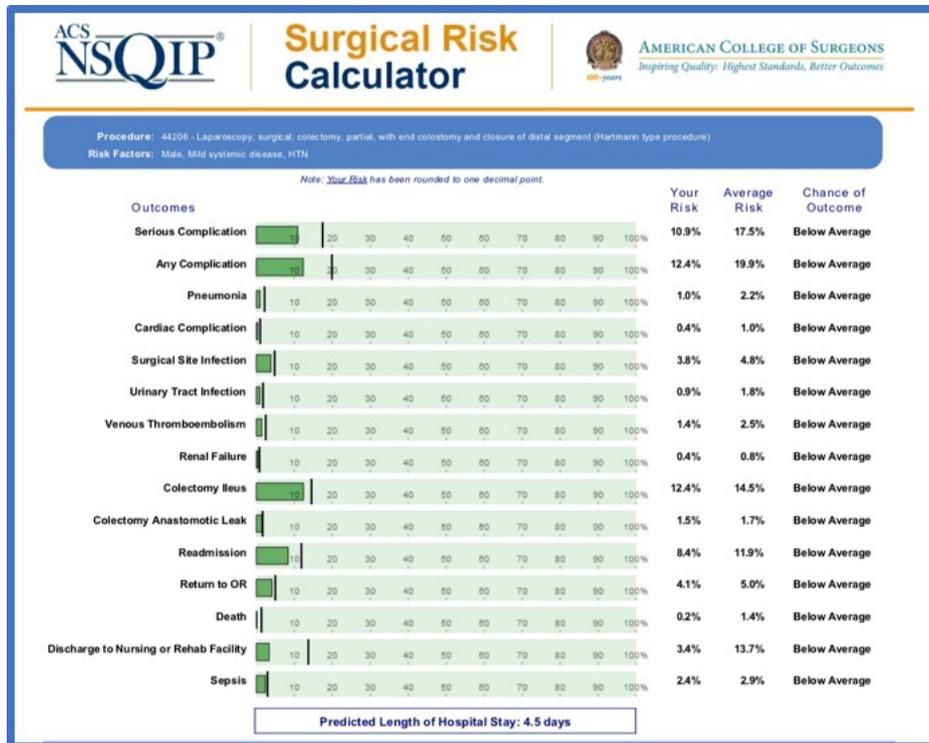
Please enter as much of the following information as you can to receive the best risk estimates. A rough estimate will still be generated if you cannot provide all of the information below.

Use Mobility Aid Yes	Cognitive Status at Admit No
Origin Status from Home Supported at home	Palliative Care at Admit No
Fall History Yes	Competency at Admit No, Patient signed his/her own consent

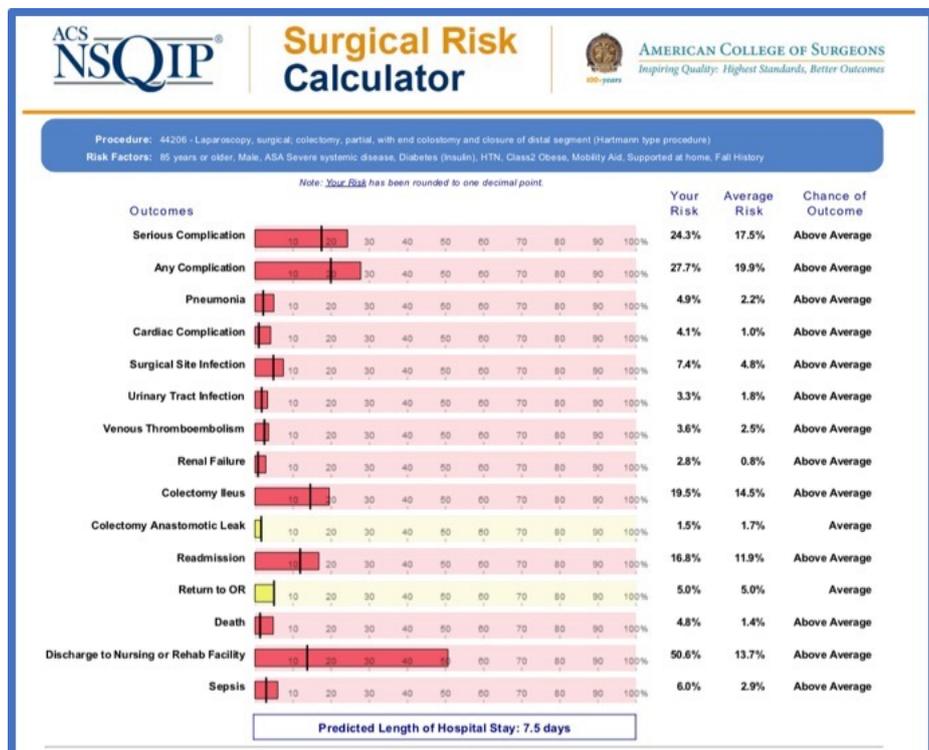
Appendix 2b

NSQIP outcomes and events for a low and higher risk patients following laparoscopic hemicolectomy and anastomosis (Hartmann's procedure)

'Low risk': <65 years, male, ASA 2, H/T



'Moderate risk': >85 yrs, H/T, ASA3, Diabetes, Obesity, Walking frame, Home Support, Falls



Appendix 3

Specific outcomes and events, which may be measurable associations with specific complications

Serious inpatient adverse events:

Cardiac arrest; Medical Emergency Response (MER) calls; ICU consultation

Inpatient stay:

Recovery room length of stay; hospital length of stay; ICU/HDU stay;

Hospital re-admissions (30-day; 90-day);

Post-discharge:

Rehabilitation length of stay; home nursing care

Days at home after surgery (30-days, 90-days)

Quality of life (30 to 365 days)

Time to return to previous state of (in)dependency and functioning

Need for family/carer support

Time to return to employment

Primary care consultations; Prescriptions

Clinical (research) outcomes^{31,33}

(rated by the majority of experts as valid, reliable, easy to use, and clearly defined)

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 hospital within 30 days of surgery,

Length of hospital stay (with or without in-hospital mortality).

Patient-centred (research) outcomes³³

One health-related quality-of-life measure (e.g. EuroQol 5 Dimension)

One functional-status measure (e.g. WHO Disability Assessment Schedule)

One life-impact measure (e.g. days out of hospital at 30 days after surgery).³⁴

Pain intensity (at rest and during movement) at 24 h postoperatively

Nausea and vomiting (0-6 h, 6-24 h, and overall)

Quality-of-recovery (QoR) scales (QoR score or QoR-15)

Time to gastrointestinal recovery

Time to mobilisation

Sleep quality

ACHS Clinical Indicators

Datasets are regularly reviewed to ensure: (i) they are relevant for clinicians; (ii) they continue to reflect today's healthcare environment; (iii) there is consensus on collection and reporting requirements; (iv) they are regarded as useful for quality improvement.

Reporting Healthcare organisations, 2018

Public: 348

Private: 308

Total: 656

HCOs providing data for one or more CIs within each CI set in 2018

Anaesth and Perioperative Care: 242

Intensive care: 89

Day patient: 277

Infection control: 343

Internal medicine: 25

Rehabilitation medicine: 121

Appendix 5

ANZCA Perioperative Care Working Group— extracts and in working draft form

Definition of Perioperative Medicine

Perioperative medicine (POM) is the multidisciplinary, integrated care of patients from the moment surgery is contemplated through to recovery.

Explanation:

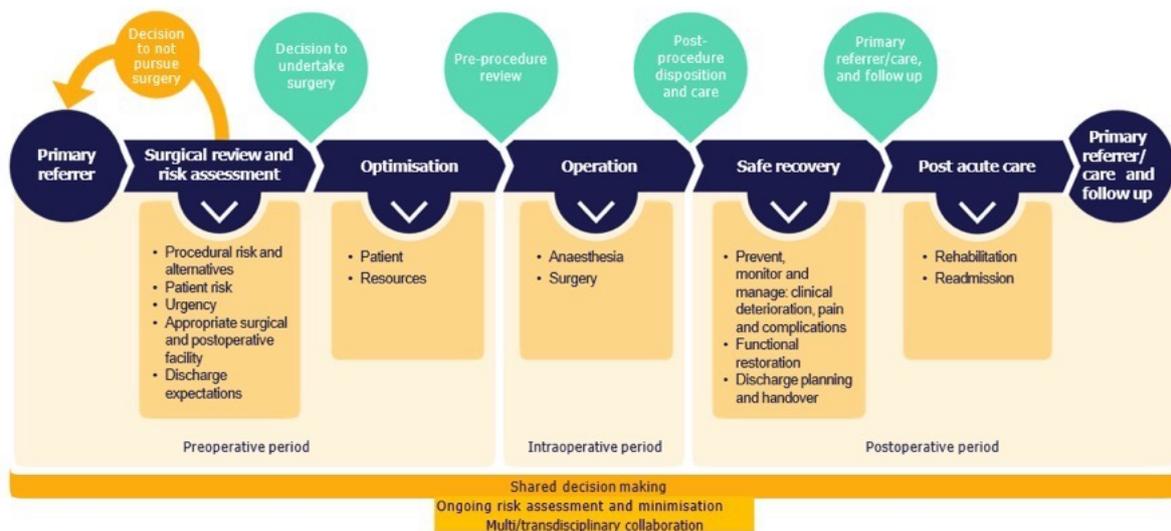
PoM involves -

- Preoperative evaluation
- Risk assessment and preparation
- Intraoperative care
- Postoperative care (including monitoring, rehabilitation and post-discharge)
- Communication and handover to primary care or referrer
- Coordination of personnel and systems
- Shared decision making

Approved by the POM Steering Committee on 1.4.19

The perioperative care framework

From the contemplation of surgery to recovery



Underlying Principles

1. Shared decision making is a fundamental principle of high-quality perioperative care and is addressed at each step of the perioperative pathway.
2. Risk is reassessed throughout the perioperative pathway in order to prompt referral to the PoMT, inform shared decision making and direct appropriate use of resources. High-risk or vulnerable surgical patients may be identified using clinical judgement, risk assessment tools and recognition of geriatric syndromes such as frailty.
3. The perioperative care of high-risk surgical patients is best managed collaboratively by a multidisciplinary PoMT. The leader and members of the team should be individualised to the needs of the patient.