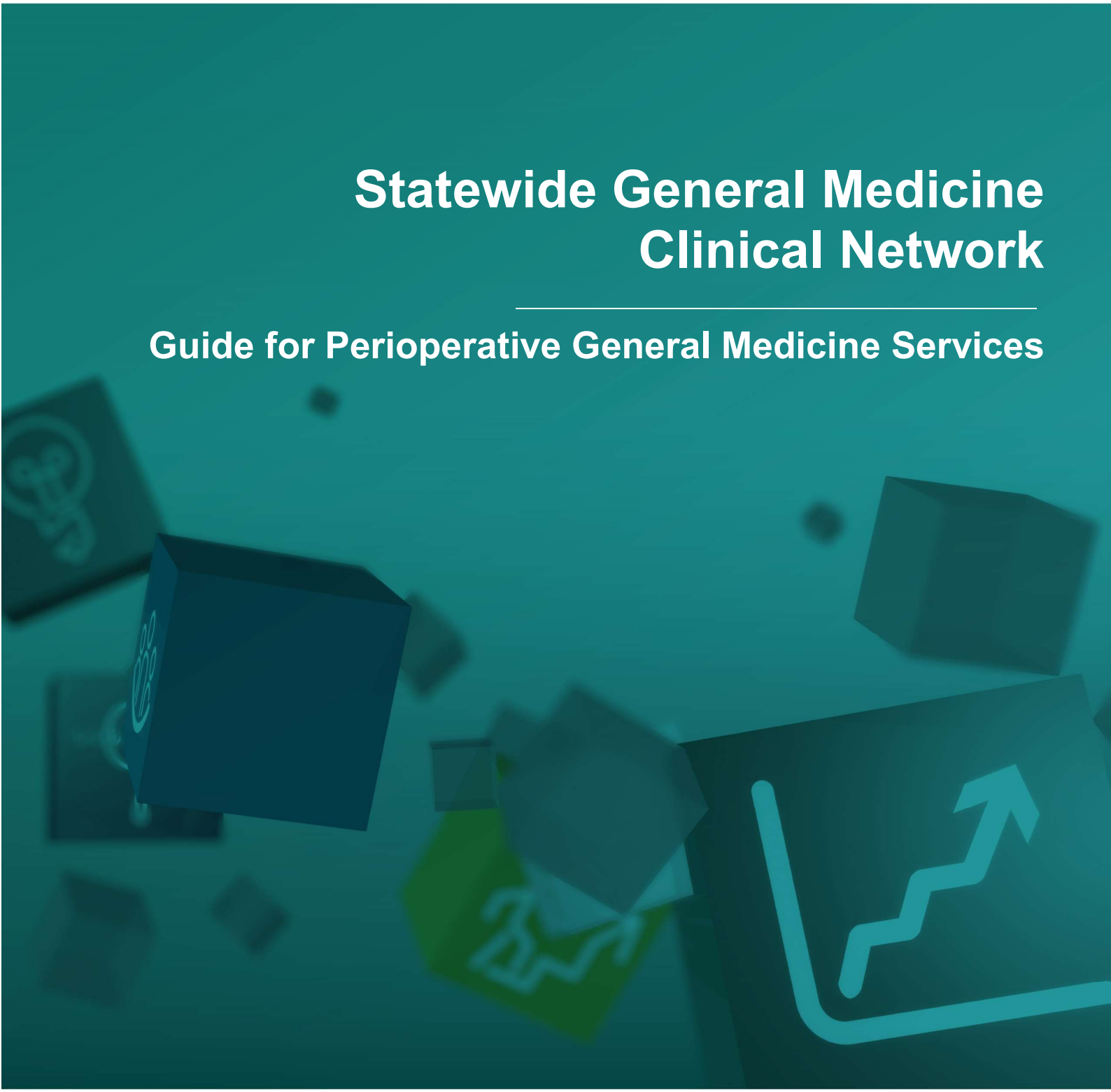
Queensland Health

Clinical **Excellence** Queensland

Statewide General Medicine Clinical Network

Guide for Perioperative General Medicine Services



Improvement | Transparency | Patient Safety | Clinician Leadership | Innovation

Queensland Government

Guide for Perioperative General Medicine Services

Statewide General Medicine Clinical Network

Xenia Caney MBBS, FRACP

Staff physician in perioperative medicine

Ian Scott MBBS, FRACP, MHA, MEd

Director, Department of Internal Medicine and Clinical Epidemiology

Princess Alexandra Hospital, Brisbane

Chair, Statewide General Medicine Clinical Network

On behalf of the Statewide General Medicine Clinical Network Perioperative Medicine Working Group

Published by the State of Queensland (Queensland Health), August 2019

For more information contact:
Statewide General Medical Clinical Network, Healthcare Improvement Unit, Department of Health, GPO Box 48, Brisbane QLD 4001, email Statewide-GeneralMedicine-Network@health.qld.gov.au, phone 33289184.

An electronic version of this document is available at:
https://qheps.health.qld.gov.au/caru/networks/general-medicine

Executive Summary

This guide has been produced by the Perioperative Medicine Working Group of the Statewide General Medicine Clinical Network (SGMCN). It aims to assist general physicians in participating in the delivery of multidisciplinary, patient-centered perioperative medical care. The guide considers both organisational themes in the design and operations of a perioperative medicine service as well as clinical themes pertaining to optimal assessment and management of patients from the time a decision is being made to proceed to surgery to the time of full recovery following surgery. After a scene-setting introduction, the guide describes the role of physicians in perioperative medicine, the benefits of integrated perioperative medicine, the central importance of shared decision-making, and the resource and training requirements of perioperative medicine practice.

On the basis of available evidence (elaborated in various appendices) and expert opinion, several recommendations are then discussed in detail, summarized as follows:

- Formulation of management plans should be centered on what matters most to patients
- When appropriate, advanced care planning should be initiated during the pre-operative medical clinic visit
- Good communication is required between the patient and the multidisciplinary perioperative care team and between all members of the team
- Establish multi-specialty teams who adopt a holistic approach to care of the high risk surgical patient
- Promote continuity of care by appointing a dedicated consultant lead that remains constant pre- and post-operatively
- Establish procedures to identify high risk patients prior to surgery
- Elective surgical patients at increased risk should be referred to a perioperative medical clinic in a timely manner and receive a comprehensive pre-operative review
- Pre-operative testing should be conservative and based on defined indications
- Establish protocols that ensure early and ongoing medical specialist involvement in cases where patients present with conditions requiring emergency surgical intervention
- High risk surgical patients should receive an early post-operative review by the perioperative medical team with ongoing close monitoring
- In tertiary hospitals and larger regional centers, establishment of week-end medical review of all high risk surgical patients is desirable
- Perioperative assessment, advice and management should be based on best available evidence-based guidelines
- Interventions for reducing perioperative risk should be evidence-based and consistently applied

In producing this guide, the authors wish to kindly acknowledge the input and endorsement received from members of the steering committees of the Statewide Anaesthesia and Perioperative Care Clinical

Network (SWAPNET), the Surgical Advisory Committee (SAC) and the Older Persons Health Clinical Network (OPHCN). As this guide contains recommendations and other forms of guidance based on currently available evidence, it is the intention of the SGMCN Perioperative Medicine Working Group to update this document by mid-2021, or earlier if there are major new developments in the field, or in response to feedback from SGMCN members who have assumed responsibility for enacting the recommendations contained in the guide.

Introduction

The discipline of perioperative medicine is a relatively recent and developing field in modern healthcare. While its definition and scope are subject to debate, a useful description is that of a patient focused multi-disciplinary and integrated approach to delivering the best possible healthcare throughout the perioperative journey, from the moment of contemplation of surgery until full recovery.[1] It aligns with the updated National Safety and Quality Health Service Standards, specifically the Comprehensive Care Standard (Standard 5).[2] The design and operationalisation of the model of perioperative care are likely to vary according to healthcare setting and available resources, and may not be easy to achieve within traditional models of surgical care.[3] However, there are basic principles that can help guide progress in this emerging field and a growing body of evidence that can be used to direct specific practices, all underpinned by the need for shared decision making with patients that takes full account of their values and preferences and ensures their choices and goals are considered and clearly documented, once capacity to consent has been confirmed.

Over 2.7 million surgeries are performed in Australia annually[4] with most pursuing a complication-free perioperative journey to full recovery.[5] However, evidence from overseas indicates there is an enlarging group of high risk surgical patients with increasingly complex chronic diseases whose needs are not being adequately met.[6] Typically, this patient group includes those undergoing emergency procedures, the frail and/or elderly, and those with multiple medical co-morbidities. The numbers of older patients will continue to increase as the proportion of Australians over the age of 65 and 85 years will double and triple respectively over the next few decades[7] in response to improved health care of chronic diseases which results in more people ageing *with* their co-morbidities.[8,9] This coupled with technical advances in surgical and anaesthetic perioperative care has resulted in higher risk, multi-morbid patients being offered surgery as a matter of routine with the same expectation of success as the wider surgical population.[5]

Elective surgical admissions in the older adult population increased on average by 4.6% per year between 2004/5 and 2013/4.[10] In a prospective study of 4158 non-cardiac surgical patients aged 70 years or more in 23 hospitals in Australia and New Zealand, of whom 68% had pre-existing comorbidities, 5% had died and 20% had suffered complications by day 30.[11] Pre-operative factors

associated with mortality included increasing age (while noting the distinction between biological and chronological age), worsening physical status, malnutrition and emergency surgery. Importantly, patient factors often had a stronger association with mortality than the type of surgery. A large retrospective audit of charts of 11,201 surgical deaths across 111 public and 61 private hospitals in Australia from January 2009 to December 2012 indicated that levels of post-operative care declined with advancing age.[12] The authors opined that while surgeons may be willing to offer an operation on presentation, they may be more likely to withdraw care at an earlier time in older patients once complications ensure because of expectations of poor outcomes, concerns of futility of care, or settings of competing comorbidities. If so, this suggests a need for better patient selection prior to surgery and/or earlier institution of palliative care, both potentially mediated by earlier or more proactive physician input.

The role of physicians in perioperative medicine

Decisions to proceed to surgery and its aftercare ultimately rest with the surgeon, patient and family, and surgeons are ultimately responsible for the outcomes of surgical care. The role of physicians is to optimise perioperative management of high risk surgical patients through the medium of a multidisciplinary team of experts – physicians, surgeons, anaesthetists, general practitioners, allied health professionals - who span the continuum from first contemplation of surgery through to complete recovery.[5,13] General physicians and geriatricians are well placed to make significant contributions to management as high risk surgical patients typically have multiple chronic medical diseases and/or are frail and elderly. They are specifically trained in the holistic management of patients with multi-system diseases, are adept in recognising and managing acute medical and physiological deterioration and are proficient in shared decision making when confronted with several treatment options that entail varying risks and benefits. Balancing the competing risks from different chronic diseases is a common challenge, as is the need to limit and reconcile differing, sometimes conflicting opinions, of other single organ-system or single-disease specialists. Difficult discussions that aim to ensure end of life care is concordant with patient preferences and values is a further function that the holistic person-centered approach of physicians can provide.

The benefits of integrated perioperative medicine

Perioperative medicine services comprise both pre-operative assessment and optimisation performed by physicians in outpatient clinics, and perioperative consultation and co-management conducted as in-patient programs. In regards to pre-operative assessment, a recent systematic review that comprised only 4 studies (one randomised controlled trial [RCT] and 3 observational studies) yielded equivocal findings.[14] While pre-operative assessment in the RCT reduced unnecessary admissions, surgical cancellations following admission for surgery, and length of stay,[15] the remaining studies suggested, counterintuitively, increased lengths of stay, costs and postoperative complications in patients who

received preoperative assessment.

Evidence for in-patient perioperative management appears more positive, although derived from observational studies with no RCTs. Several studies show that having general physicians and geriatricians co-ordinate and oversee care of surgical patients within integrated models of regular consultation or co-management optimises perioperative care in both pre-operative and post-operative periods and lowers risk of complications and adverse outcomes, reduces length of stay and save costs.[16,17,18,19,20,21,22,23,24,25] Models of medical co-management of older orthopaedic patients by orthogeriatricians, especially patients with neck of femur fractures, have also resulted in earlier detection of deterioration and earlier mobilisation, with consequent reductions in mortality and length of stay and improved functional performance.[26,27]

Enhanced Recovery After Surgery (ERAS) programmes have been used successfully for over a decade to reduce length of stay and rates of complications in colorectal surgery, and which are now being extended to other surgical specialties.[28,29] Such programmes feature multiple interventions incorporated into all 3 phases of surgery – pre-operative, intra-operative and post-operative, with the overall aim of maintaining physiological function and reducing surgery-induced stress. Medical co-management of surgical patients has the potential to augment the effectiveness of such programmes, and recent guidelines[28] stress the importance of a multidisciplinary team approach — including family physicians before patients are admitted for surgery and after discharge — in ensuring the successful implementation of an ERAS approach.

Shared decision making

Appropriate patient selection for surgery, particularly where risk/benefit ratios are narrow, is vitally important, both to the individual patient and the healthcare system as a whole. In the pre-operative setting, establishing realistic expectations of surgical outcomes, in terms of both morbidity and functional capacity, assists patients to make informed decisions about their care that are consistent with their values and preferences.[30] Health professionals have a responsibility to ensure that patients are aware of and fully understand the risks and possible outcomes of any proposed surgery and any alternative care options. This may require providing patients from culturally and linguistically diverse backgrounds and Aboriginal and Torres Strait Islander people with access to written instructions in different languages, multimodal format with pictures, or interactions involving nominated family spokespersons or liaison officers who can assist in translation and interpretation. This shared decision-making approach helps to avoid potentially futile or unwanted surgery which harms patients and wastes resources and assists in establishing ceilings of care when appropriate. Various tools[31] and decision aids[32,33,34] are available that can facilitate this process.

Resource considerations

Funding models for perioperative medicine are likely to vary between sites, but in many cases, due to constrained budgets, will rest on the reallocation of existing resources.[35] Joint funding arrangements between medicine and surgery are appropriate given the benefits to both parties of minimising complications and length of stay that would otherwise limit access to both surgical and medical beds. Post-operative complications, which are frequently medical in nature, are associated with longer length of stay. Not surprisingly, the health care costs associated with such events balloon by several fold, even without considering the cost of longer term consequences.[5,36] Evidence suggests that surgical co-management arrangements in USA are either cost neutral or cost effective.[11,18] Given the sheer volume of surgical procedures performed each year in Australia, even small reductions in adverse events could translate into a large net benefit in terms of cost savings. Similarly, rationalisation of frequently performed pre-operative investigations, many of which are of low value, could result in considerable savings, even if decreased individually by a small amount.[37]

Training requirements

Given the complexity of perioperative medicine, the need for formal training in the discipline is becoming increasingly recognised. Surveys undertaken by the Australian and New Zealand College of Anaesthetists (ANZCA) have strongly suggested that perioperative medicine specialists must understand intraoperative anaesthetic management, gain knowledge and skills in perioperative management of surgical stress responses, fluid status, acute and persistent pain, and delirium, and be proficient in discharge planning and rehabilitation. ANZCA has developed a post-graduate training curriculum and formal qualification in perioperative medicine which is available as a conjoint degree to all other disciplines (physicians, surgeons, intensivists, general practitioners) – more details are available at: http://www.anzca.edu.au/fellows/special-interest-groups/perioperative-medicine. Physicians wanting to make perioperative medicine a substantive part of their practice are strongly encouraged to undertake such training. The Internal Medicine Society of Australia and New Zealand has a Perioperative Medicine Subcommittee which is a partner in the Perioperative Medicine Special Interest Group, formed under the auspices of ANZCA, and which seeks to develop an integrated and collaborative perioperative care model involving all specialties and craft groups that have a role in delivering perioperative care – more details are available at: https://www.imsanz.org.au/.

Recommendations for perioperative medicine services

The Perioperative Medicine Working Group of the Statewide General Medicine Clinical Network (SGMCN) contends that perioperative medicine services involving physicians should be established in all hospitals with more than 250 beds and on-site surgical facilities undertaking surgery of intermediate

to high risk. Such services should aim to provide medical consultant care to all surgical patients who may benefit from such care, recognising that in this country, as occurs elsewhere,[38] the deployment of such services will vary widely across hospitals according to perceived clinical need and resource availability.

Studies have shown that hospitals demonstrating exceptional surgical outcomes are underpinned by high volume practice, high functioning multidisciplinary teams centered around disease entities and types of surgery, process driven pre-operative fitness optimisation, ERAS programs, closed loop audits of care and continuous quality improvement, and strong clinician engagement.[39] The Working Group has formulated a number of recommendations (see below) which aim to assist SGMCN members in establishing or augmenting perioperative services. These recommendations are based on literature reviews, perioperative medicine guidelines from reputable authorities, expert opinion and group discussions, and reference to the 2018 Collaborative Older Persons' Elective Surgery Risk Assessment for Treatment Efficacy (COOPERATE) Recommendations,[40] and relevant pre-operative evaluation documents produced by the Statewide Anaesthesia and Perioperative Care Clinical Network (SWAPNET).[41] The draft document was reviewed by the steering committees of SWAPNET, the Older Persons Clinical Network and the Surgical Advisory Committee, and amendments made in response to feedback received. The revised document was then forwarded to these three agencies for endorsement, and the final draft endorsed by the SGMCN Steering Committee on July 9th, 2019.

1. Formulation of management plans should be centered on what matters most to patients

Whilst the majority of literature focuses on risk prediction scores and event rates, it is also vitally important to acknowledge that for most patients, death or complications are not the only healthcare outcomes of interest.[42] While operations may be technically successful in avoiding death and complications in the immediate perioperative period, regaining or preserving health, function and quality of life over the longer term are key priorities for patients in deciding whether to pursue surgery or an alternative treatment.[27] This highlights the importance of *patient centered care* - defined as healthcare that is respectful of, and responsive to, the preferences, needs and values of patients.[43] Such an approach improves quality and safety, decreases operational costs and increases both patient and provider satisfaction.[60,44] In Australia patient-centered care is supported by the *Australian Charter of Health Care Rights*, the *Australian Safety and Quality Framework for Healthcare Standards* and the *National Safety and Quality Framework*[2] and is promoted by organisations such as *Planetree.*

In the USA, a third of people undergo a major operation during their last year of life.[45] A recent retrospective analysis of decedents in three Australian hospitals showed a third had undergone futile treatments, including surgical procedures, in the last 6 months of life.[46] In contrast, three quarters of seriously ill people say they would not choose life-sustaining interventions if there was a significant chance that the outcome would be severe cognitive or functional impairment.[47] Many consider certain

health states to be fates worse than death.[48] It is incumbent on doctors to ensure that surgical interventions provided to extend life do not leave patients in health states they regard as intolerable. For any given scenario, there needs to be realistic discussions about the risks and benefits of each viable treatment option including, as appropriate, definitive surgery, less invasive palliative surgical procedures, other medical therapies, supportive care or hospice care.[49,50]

2. ***When appropriate, advanced care planning should be initiated during the pre-operative medical clinic visit.***

Discussions focused on advanced care planning may be challenging but should be considered for any patient who is contemplating or undertaking major surgery, especially elderly, frail or multi-morbid patients. The timing of such discussions is critical and needs to be well ahead of any proposed date of surgery.[51,52] Clear documentation of the agreed outcomes of these discussions helps to guide decision making and help alleviate the burden borne by family members and other surrogate decision makers if they are called upon to make decisions on behalf of patients who no longer have capacity to make or voice their preferences.[53] Advance care planning also helps ensure doctors and other health care professionals act in accordance with a patient's wishes and avoid unwanted or futile treatment which may, in certain cases, attract medicolegal action. The 'Statement of Choices' form is recommended for use in Queensland hospitals, available on-line at: https://metrosouth.health.qld.gov.au/acp/queensland-advance-care-planning-forms

3. ***Good communication is required between the patient and the multidisciplinary perioperative care team and between all members of the team***

Safe and effective perioperative care relies on good communication, collaboration, respect and trust involving all interactions between the patient and the attending multidisciplinary team, and between members of the team itself. By multidisciplinary team we mean all disciplines involved in the patient's care throughout the period from first surgical review to full recovery – physicians of all specialties, surgeons, anaesthetists, general practitioners, nurses and allied health professionals. Good communication skills facilitate fully informed consent and have been linked to higher patient satisfaction, greater patient adherence to clinical advice, better patient health outcomes, reduced patient anxiety, increased recall and improved understanding.[54] Employing multiple conversation support tools amplifies the understanding and usefulness of risks for patients and clinicians.[55] The process and adequacy of informed consent in the perioperative setting is currently undergoing review in Queensland and other jurisdictions, and has been receiving increasing attention globally. Three fundamental criteria are needed for clinical informed consent: the patient must be competent, adequately informed and not coerced.[56] In high risk, medically complex surgical patients, findings and management plans arising from comprehensive perioperative medical review must be fully communicated to all relevant members of the multidisciplinary team to ensure everyone is on the same page with respects to the intended care plans.

4. ***Establish multi-specialty teams who adopt a holistic approach to care of the high risk surgical patient.***

With increasing surgical specialisation and need for mastery of a wider range of technical skills, coupled with increasing medical complexity of patients undergoing surgery, it is no longer reasonable or feasible to expect surgeons to singlehandedly meet all the required patient care needs, particularly when medical complications develop. Instead a multi-specialty approach is required. Surgeons, in addition to their unique operating skills, are experts in predicting homeostatic responses of relevant organs to the procedure. On the other hand, perioperative physicians and anaesthetists may be better able to predict risks of adverse operative impacts on functional status, chronic health, co-morbidities and acute physiological deterioration.[26] A multi-specialty team approach necessitates the need for a dedicated clinical consultant lead to co-ordinate care and ensure clear communication between members of the team, the patient and their family. Various strategies can be considered towards optimising teamwork including: running concurrent anaesthetic and perioperative medical clinics; multi-specialty team meetings to discuss selected high-risk patients in the pre-operative setting; and joint ward rounds of surgical and perioperative medical teams in the post-operative setting.

5. ***Promote continuity of care by appointing a dedicated consultant lead that remains constant pre- and post-operatively.***

Outside the perioperative setting, it is widely appreciated that the single-disease framework on which most of our healthcare provision, research and medical education is configured is not ideally suited to the care of multi-morbid patients.[8] Such people have to contend with fragmentation of care and medical error because of subspecialty focus on one disease. Ensuring continuity and co-ordination of care for such patients demands that there be a dedicated consultant to take overall responsibility for that person's care.[8,57]

6. ***Establish procedures to identify high risk patients prior to surgery***

Accurate prediction of perioperative risk is important in facilitating informed consent and deciding appropriate clinical management. National and international audits confirm that surgical mortality predominantly occurs in individuals who are elderly, very frail, chronically ill and have major pre-existing co-morbidities.[58] Such patients are also at higher risk of delirium and other major complications that prolong hospital stay, increase readmission rates and predispose to discharge to institutional care.[59] The overall risk for serious medical complications from surgery is less than 0.1% in healthy patients. Comorbid conditions that increase this risk include ischemic heart disease, cerebrovascular disease, heart failure, diabetes mellitus, chronic kidney disease, bleeding disorders, and liver disease. Poor nutritional status, obesity, smoking, depressive symptoms, hazardous alcohol use, and illicit substance

use also affect perioperative risk. Poor exercise tolerance is associated with perioperative cardiopulmonary and neurologic complications. Increasing American Society Anaesthesiologists (ASA) class (**Appendix 1**) is associated with increasing morbidity and mortality.[60] Overall, perioperative mortality is very low in ASA class I and II patients (<0.1%) but increases significantly in class III and IV patients.

The type of the surgery influences the risk for complications independent of other patient factors. **Appendix 2** lists surgical procedures of intermediate to high risk of complications including death and myocardial infarction at 30 days after surgery, with emergency surgery in acute life-threatening conditions and major surgery involving highly invasive, intra-cavity procedures having the highest risk.[61,62,63] Although these complications occur in only a minority of patients undergoing surgery, this group accounts for four out of five surgical deaths and the majority of complications.[4]

Worsening frailty with associated functional impairment has become increasingly recognised as the most predictive risk marker for higher rates of death, post-operative complications and readmissions, and longer lengths of stay.[64,65,66,67,68] Frail patients are also more likely to experience discharge to an institution, functional decline and lower quality of life post-operatively.[30,69] While a plethora of frailty measures exist,[70,71] the easy to use Clinical Frailty Scale pictogram **(Appendix 3**)[72] has a high degree of accuracy and predictive value in regards to in-hospital mortality.[73] Several other patient attributes also need to be considered when assessing surgical risk in older patients, as outlined in Appendix 3.[35]

In regard to stratifying patient risk according to type of surgery or specific post-operative medical complications, multiple risk prediction tools have been published with varying levels of validity, ease of use and strength of recommendations.[74] Whilst an in-depth discussion of this topic is out of scope of this position statement, several points deserve emphasis. Risk stratification tools fall into 2 categories: 'risk scores' that utilise independent predictors of outcomes and provide general information about patient outcomes; and 'risk prediction models' that use patient data to provide individualised estimates of risk. Some risk prediction tools have been developed for use in specific types of surgery (eg colorectal surgery) or for specific types of outcomes (eg cardiac complications). **Appendix 4** lists some commonly used and validated tools for estimating risk of cardiorespiratory complications relevant to non-cardiac, non-transplant surgery in general. Importantly, the recent recognition of 'urgent' surgery as a distinct category carrying different risks of death and complications compared to 'elective' or 'emergency' surgery has implications for risk stratification that is not typically recognised in current risk stratification tools.[48]

In the case of older patients, in addition to surgery or complication specific risk prediction tools, comprehensive geriatric assessment (CGA) and evaluation of frailty are essential in providing more

reliable estimates of the risk of post-operative death, morbidity, loss of function and length of stay.36-40 In particular, older patients at risk of post-operative delirium should be identified on the basis of the following risk factors: cognitive impairment, older age, functional impairment, sensory impairment, depression and other psychological disorders, preoperative psychotropic drug use, sleep deprivation, institutional residence, multiple comorbidity, and past episodes of delirium[75].

We would argue that perioperative medical teams would be advised to try to identify patients at high risk, using the criteria described above, among patients undergoing pre-operative assessment and those who have been recently admitted, either acutely or electively, and ensure such patients are reviewed and monitored throughout their hospital stay.

7. ***Elective surgical patients at increased risk should be referred to a perioperative medical clinic in a timely manner and receive a comprehensive pre-operative review***

For patients undergoing elective procedures, the opportunities presented by early pre-operative patient engagement include: shared decision making; collaborative behavioural change in the form of lifestyle modification; assessment and optimisation of medical fitness and comorbidities; and calibration of outcome expectations along with psychological preparedness.[26] Most perioperative complications are not due to technical problems relating to the surgery or the anaesthetic but to medical causes.[4,30] Analysis of non-cardiac surgery mortality in Australia and New Zealand shows the most common causes of death are equally attributed to either acute cardiovascular or respiratory complications, each accounting for 20% of cases.[30] Perioperative bleeding can be a proximal cause for myocardial infarction, stroke and acute kidney injury in up to 25% of deaths.[76] Thorough pre-operative medical assessment and optimisation of co-morbidities and functional capacity is essential. **Appendix 5** outlines the essential components of a perioperative risk assessment and management plan.

Pre-operative reviews of patients in anaesthetic pre-admission clinics (PACs) are effective in reducing unscheduled day of surgery cancellations due to patient misadventure or undertreated active medical diseases.[77] Pre-operative medical review is of benefit for patients with complex co-morbidities, unstable medical conditions, or moderate to severe frailty, or who are undergoing major complex surgery. Such patients should be referred from PACs or surgical teams to pre-operative medical clinics in a timely fashion. In reducing risk of perioperative complications, sufficient time – at least 4 to 6 weeks and preferably longer according to need – should be allowed for medical optimisation to be fully achieved.[78] It is therefore essential that referral of high risk patients to preoperative medical clinics are made as soon as possible after the patient and surgeon have signaled their intention to proceed to surgery. In some cases, upon medical review, surgery may be deemed unjustifiable, as was the case in 20% of surgical deaths in Australian and New Zealand audit data. Inadequate pre-operative assessment or post-operative care were identified as being issues in a further 10% of cases.[30]

Certain patients will require mandatory review by consultant anaesthetists prior to the day of surgery, in keeping with SWAPNET guidelines and other criteria:[79] personal or family history of anaesthetic complications (such as suxamethonium apnoea or malignant hyperthermia), undergoing major or complex surgery; past ventricular tachycardia or cardiac arrest; hospitalisation for acute coronary syndrome, pulmonary thromboemboli, asthma or decompensated heart failure within past 3 months, or frequent epileptic seizures.

8. *Pre-operative testing should be conservative and based on defined indications*

Randomized controlled trials are lacking in determining the indications for many pre-operative tests. As a general rule, no tests should be ordered unless their results are expected to have therapeutic consequences. The frequency of abnormal test results that alter perioperative care ranges from 0% to 2.6% across multiple observational studies when tests were ordered for all patients, irrespective of past or current history or physical examination findings.[80] When history and examination findings guide the choice of tests, the yield of abnormal results increases from 4% to 81%.[81] As a general rule, healthy patients with normal history and examination, especially those undergoing minor or ambulatory procedures,[82] and patients whose test results in the past 4 months have been normal and whose clinical status has remained stable,[83] do not need testing before surgery. **Appendix 6** lists indications for pre-operative laboratory tests over and above those already listed in appendix 3, in accordance with guidelines, including the SWAPNET Preoperative Investigations Guideline.[37]

Indications for non-invasive cardiac testing are generally the same for patients undergoing surgery as for those who are not. Patients at high risk such as those with worrisome symptoms, known triple vessel coronary artery disease, or undergoing vascular surgery may need to be evaluated for significant ischemic burden using some form of cardiac stress testing. However, evaluation is unnecessary in most patients with chronic stable angina and reasonable exercise tolerance.[84] In patients at elevated cardiac risk with poor functional status, non-invasive cardiac testing should be considered only if the results are likely to change management (**Appendix 7**).

9. *Establish protocols that ensure early and ongoing medical specialist involvement in cases where patients present with conditions requiring emergency surgical intervention.*

The majority of surgical deaths occur in patients with acute life-threatening conditions undergoing emergency procedures.[30] When performed in an emergency setting, the same procedure in an individual may carry a mortality risk three times higher compared to an elective setting. Risks of serious surgical and medical complications also increase significantly.[85] Clearly, in the emergency setting, there is usually very limited opportunity to optimise chronic medical co-morbidities. However, reversal or stabilisation of acute medical conditions, such as rapid atrial fibrillation, acute kidney injury or

septicaemic shock may be possible and render surgery safer, if it can be delayed long enough to allow such intervention to occur. In patients at high risk of poor outcomes, discussions should be initiated, as early as practicable, to decide appropriate ceilings of care within the context of any previously documented advance care plans or directives. Post-operatively, such patients warrant ongoing close monitoring and early medical intervention in the event of emerging complications, particularly after discharge from intensive care units (ICUs).

10. High risk surgical patients should receive an early post-operative review by the perioperative medical team with ongoing close monitoring.

The adverse consequences of post-operative complications are not just short term. Even after adjusting for patient characteristics and operation type, the occurrence of almost any type of post-operative complication is a significant and independent risk factor for both short *and* longer term mortality out to 5 years.[41] Patients who have undergone emergency surgery, demonstrate intraoperative hemodynamic instability or significant blood loss, or have had major surgical tissue excisions are at particular high risk,[86] with complication rates as high as 50%.[5] A proactive approach to preventing such complications in such patients would appear justified, although there is limited evidence of efficacy.[4] Surgical patients stepping down from ICU, those that have activated rapid response team calls, and those previously identified as being at high risk of complications require regular review by the perioperative medical consultant. Such reviews should ensure adequate analgesia, early mobilisation, prompt re-establishment of oral intake, and prescribing of all indicated prophylactic regimens for venous thromboembolism, acute kidney injury, nosocomial infections, delirium and constipation.[5,26] Importantly it is vital to acknowledge, support and augment the skills and capacity of nursing and allied health staff in the daily care of such patients and their important role in early prevention and rehabilitation.

11. In tertiary hospitals and larger regional centers, establishment of week-end medical review of all high risk surgical patients is desirable.

On weekends and public holidays, staff and services are generally reduced compared to working week-days. A recent systematic review revealed that postoperative mortality rises as the day of the week of elective surgery approaches the weekend (from 8% to 24% increase from Wednesday to Friday), and is higher (27% increase) after admission for urgent/emergent surgery on the weekend compared with weekdays.[87] Another large matched cohort study from Ontario revealed elective admissions on weekends had a significantly increased adjusted risk of all-cause death at 30 days, both when surgery was performed on the weekend (adjusted odds ratio [OR] 3.30) and when surgery was performed on a subsequent weekday (adjusted OR 2.70).[88] Other studies have shown increased risk of postoperative complications and longer duration of stay.[89] Whether these findings are a function of patient-level factors and acuity or complexity of surgery, or represent a true weekend effect, needs to be further elucidated. However, failures of rescue and stabilisation of sick patients, suboptimal monitoring and response to

deterioration, delayed diagnostic and therapeutic management and errors in care have been postulated as possible explanations for excess week-end mortality among acute medical patients.[90,91] We would argue that the same could well apply to surgical patients and hence consider medical review of all high risk surgical patients on week-ends to be highly desirable, while conceding evidence of effect on outcomes is currently lacking.

12. Perioperative assessment, advice and management should be based on best available evidence-based guidelines.

Evidence-based guidelines should be used in ensuring standardised high-quality care. **Appendix 8** lists recently published guidelines and evidence summaries that can guide care. While more clinical trials are being undertaken, many areas of perioperative medicine have, as yet, insufficient research evidence to definitively inform care decisions. In addition, certain patient groups such as older, frail patients with multiple medical issues are often under-represented in trials and their needs may not match trial-derived guideline recommendations. Clinical decisions in such cases need to be made on an individual basis taking into account patient values and preferences, especially when risks and benefits of surgery are finely balanced.[92] Variations in the use of surgical procedures across different populations have been reduced, with greater use of less invasive procedures, when evidence-based patient decision aids and practice guidelines are systematically used.[93]

13. Interventions for reducing perioperative risk should be evidence-based and consistently applied

While the evidence base is limited, interventions that have been shown in clinical studies to reduce risk of perioperative complications should be used preferentially and consistently. Trials have shown that much of what were once considered appropriate prophylactic interventions (such as pre-operative coronary artery revascularisation in all patients with inducible ischemia,[94] or b-blockers in all patients considered to be at risk of cardiac complications[95]) do not necessarily confer benefit and may induce harm. While exhaustive guidance relating to all possible scenarios is beyond this position statement, **Appendix 9** lists key recommendations for the most frequently encountered scenarios and supplements guidelines listed in Appendix 6. A common challenge is how to manage anticoagulants and bleeding risk in patients undergoing more than minor surgery. A suggested framework in outlined in **Appendix 10.**

Older at-risk patients

For older, frail patients, clinical trials have shown that, in certain surgical populations, CGA helps to guide pre-operative optimisation of fitness and reduces perioperative deaths, complications and length of stay.[96,97,98]

In the *preoperative period*, the concept of 'prehabilitation' whereby physical reserve and function are maximised in the weeks prior to surgery has face validity and some randomised evidence of benefit.[99,100,101]

In the *post-operative period*, the recommended approach for returning patients to their previous level of functioning as quickly and safely as possible comprises the following: early mobilization; freedom from tethers (indwelling urinary catheters and other devices); effective pain control; adequate nutrition and hydration; prevention of pressure ulcers and pulmonary, urinary, and wound infections; avoidance of unnecessary polypharmacy, especially psychoactive drugs; and optimal sleep hygiene.[102] All these strategies decrease risk of delirium which, if it does ensue, must be promptly recognised and managed aggressively. Pre-operative CGA, light anaesthesia and institution of a multi-component prevention program in the immediate post-operative period decrease the risk of delirium.[103,104] These programs are implemented by a trained multidisciplinary team coupled with specialist nursing interventions which assess and change medication, encourage mobilisation and improve the physical and sensory environment of the patient. There is no clear evidence that cholinesterase inhibitors, antipsychotic medication, melatonin or other drugs reduce the incidence of delirium and hence should be avoided given their risk of harm, with possible exception of antipsychotics (but at a low dose) in orthopaedic patients with hyperactive delirium and severe agitation.[105]

In the post-operative period, myocardial infarctions mostly occur within the first 48 hours of operation and up to 65% are asymptomatic and undetectable without regular ECG and troponin testing.[106] Even in the absence of unequivocal features of infarction, an elevated troponin level signalling myocardial injury within the first 48 to 72 hours after operation is a strong predictor of 30-day mortality.[107] However, it remains unclear what, if any, preventive measures can be taken to reduce risk of death. While some guidelines recommend daily troponin monitoring for 48-72 hours post-operatively in patients with elevated BNP prior to surgery and those at high cardiovascular risk in the absence of pre-operative BNP measurement (Revised Cardiac Risk Index ≥1, aged 45-64 years with established cardiovascular disease, or aged 65 years or older), [108] there is no randomised evidence that such monitoring and any downstream interventions that follow, such as transfer to coronary care units, alter outcomes. Similarly, daily ECGs or telemetry in such patients is not warranted based on current evidence.[104]

Appendix 1. American Society of Anaesthesiologists classification of physical status

Grade	*Classification*
I	Healthy – no medical co-morbidities
II	Mild systemic disease—no functional limitations; mild, controlled systemic disease
III	Severe systemic disease—poorly controlled or advanced co-morbidities; definite functional limitation
IV	Severe systemic disease that is a constant threat to life- severe valvular heart disease; recent CVA or MI
V	Moribund patient not expected to survive despite surgery

Appendix 2. Risk of complications for different types of surgery

Low (<1%)

Superficial surgery

Breast

Dental

Cataract

Endoscopic

Thyroid

Gynaecologic, minor

Orthopaedics, minor

Urologic, minor (TURP, TURBT)

Reconstructive/cosmetic

Intermediate (1%–5%)

Intrathoracic (nonmajor)

Intraperitoneal (splenectomy, cholecystectomy)

Carotid (carotid endarterectomy or carotid artery stenting)

Endovascular aneurysm repair (stents/coils)

Head and neck surgery

Neurologic or orthopaedic, major (hip and spine surgery)

Urologic or gynaecologic, major

Renal transplantation

High (>5%)

Aortic, major vascular surgery, peripheral vascular surgery

Major abdominal surgery and prolonged procedures with large fluid shifts or blood loss (duodenopancreatic, liver resection, bile duct surgery, perforated bowel, total cystectomy)

Esophagectomy

Pneumonectomy

Lung, liver, or pancreas transplantation

Adrenal resection

TURBT = transurethral resection of a bladder tumour; TURP = transurethral resection of the prostate.

References

Glance LG, Lustik SJ, Hannan EL, et al. The Surgical Mortality Probability Model: derivation and validation of a simple risk prediction rule for noncardiac surgery. Ann Surg 2012; 255: 696-702.

Kristensen SD, Knuuti J, Saraste A, et al. 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management. Eur Heart J 2014; 35:2383-2431.

Eagle KA, Berger PB, Calkins H, et al. ACC/AHA guideline update for perioperative cardiovascular evaluation for noncardiac surgery—executive summary. J Am Coll Cardiol 2002; 39:542-53.

Appendix 3. Assessment of surgical risk in older patients

Clinical Frailty Scale*

1 Very Fit – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.

2 Well – People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g. seasonally.

3 Managing Well – People whose medical problems are well controlled, but are not regularly active beyond routine walking.

4 Vulnerable – While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up", and/or being tired during the day.

5 Mildly Frail – These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.

6 Moderately Frail – People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.

7 Severely Frail – Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).

8 Very Severely Frail – Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.

9 Terminally Ill – Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise evidently frail.

*Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173(5):489–495.

Other preoperative geriatric risk factors

Risk factor	***Assessment tools***
Cognitive impairment	Mini-Cog as rapid screening tool MoCA, MMSE, RUDAS
Pre-operative cognitive impairment is the strongest predictor of postoperative delirium which can be reduced by multifaceted prophylactic interventions (	
Functional impairment	5 point Abbreviated Functional Status* Katz Activities of Daily Living Instrumental ADL
Malnutrition	Malnutrition Screening Tool (MST)**
Polypharmacy	5 or more medications CEASE protocol***

*American College of Surgeons NSQIP/American Geriatrics Society. Optimal Perioperative Management of the Geriatric Patient: Best Practice Guidelines, 2016 (see Appendix 2 of reference 34)

**Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. Nutrition 1999; 15: 458-464 (see Appendix 3 of reference 34)

*** McKean M, Pillans P, Scott IA. A medication review and deprescribing method for hospitalised older patients receiving multiple medications. Intern Med J 2016; 46: 35-42.

Appendix 4. Tools for estimating perioperative risk

For risk calculators which comprise small number of variables with simple scoring systems, we have reproduced the calculator in full where possible; for those calculators that are more complex, or where the cited article did not provide a scoring system or risk estimation nomogram, we refer the reader to the cited web-link.

Cardiac risk

Revised Cardiac Risk Index

(www.mdcalc.com/revised-cardiac-risk-index-for-pre-operative-risk/)

Original index: Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. Circulation 1999; 100:1043-9.

Risk estimates of the original index have been revised, based on more recent high quality external validation studies which monitored troponin levels and which included emergency surgery patients. For more information see Duceppe E, et al. Canadian Cardiovascular Society guidelines on perioperative cardiac risk assessment and management for patients who undergo noncardiac surgery. Can J Cardiol 2017; 33: 17-32.

Variable	*Points*
High-risk surgery (3 categories – low/intermediate/high)	1
Renal insufficiency (Cr >177 umol/l)	1
Congestive heart failure	1
Diabetes treated with insulin	1
Ischemic heart disease	1
Cerebrovascular disease	1

Total RCRI points	*Risk estimate**	*95%CI*
0	3.9%	2.8% - 5.4%
1	6.0%	4.9% - 7.4%
2	10.1%	8.1% - 12.6%
≥3	15.0%	11.1% - 20.0%

*These risk estimates of cardiac events (myocardial infarction, cardiac arrest or death are higher than those based on the original data used to derive the RCRI which monitored creatinine kinase levels and excluded emergency surgery patients.

Myocardial infarction or cardiac arrest calculator

(www.surgicalriskcalculator.com/miorcardiacarrest)

Gupta PK, Gupta H, Sundaram A, et al. Development and validation of a risk calculator for prediction of cardiac risk after surgery. Circulation 2011; 124:381-7.

Type of surgery (21 categories)

Renal insufficiency (Cr >1.5 mg/dL)

Age

Functional status

American Society of Anesthesiologists class (5 categories)

American College of Surgeons National Surgical Quality Improvement Program surgical risk calculator

http://oldriskcalculator.facs.org/

Bilimoria KY, Liu Y, Paruch JL, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. J Am Coll Surg 2013; 217:833-42.e 1-3

The calculator assigns different numbers of points (or weights) to each of the following criteria.

Surgical procedure (CPT codes)	Ventilator dependent
Acute renal failure	Disseminated cancer
Dialysis	BMI
Congestive heart failure (<30 d)	Hypertension requiring
Diabetes	medication
Age	Severe COPD
Functional status	Dyspnea
American Society of Anesthesiologists class	Smoker (within past year)
Steroid use	Sex
Ascites	Wound class
Sepsis	Emergency surgery

BMI = body mass index; COPD=chronic obstruction pulmonary disease; CPT = Current Procedural Terminology

Respiratory risk

Risk score for postoperative respiratory failure

Canet J, Sabaté S, Mazo V, et al. Development and validation of a score to predict postoperative respiratory failure in a multicenter European cohort: A prospective, observational study. Eur J Anaesthesiol 2015; 32(7):458-70.

Low preoperative SpO2

At least one preoperative respiratory symptom

Preoperative chronic liver disease

History of congestive heart failure

Open intrathoracic or upper abdominal surgery

Surgical procedure lasting at least 2 h

Emergency surgery

Assess Respiratory Risk in Surgical Patients in Catalonia (ARISCAT) score

Mazo V, Sabaté S, Canet J, et al. Prospective external validation of a predictive score for postoperative pulmonary complications. Anesthesiology 2014;121(2):219-31.

Variable	*Value*	*Points*
Age	≤50	0
	51–80	3
	>80	16
Preoperative Spo2	≥96%	0
	91–95%	8
	≤90%	24
Respiratory infection in the last month	No	0
	Yes	17
Preoperative anaemia (Hb ≤10 g/dl)	No	0
	Yes	11
Surgical incision	Peripheral	0
	Upper abdominal	15

	Intrathoracic	24
Duration of surgery		
(h)	<2	0
	2–3	16
	>3	23
Emergency procedure		
	No	0
	Yes	8

Three levels of risk defined by the following cut-offs: <26 points, low risk (~3.5%); 26–44 points, moderate risk (~13.0%); and ≥45 points, high risk (~38%). Hb = haemoglobin; Spo2 = arterial oxyhaemoglobin saturation by pulse oximetry

Appendix 5. Components of a comprehensive pre-operative assessment and management plan

Assessment

- Establishing an accurate past medical history
- Performing physical examination
- Assembling background documentation, including any recent investigations of vital organ function, current medication list (including herbal medicines and over the counter medicines), and advance care plans
- Identification of any undiagnosed or under-treated medical conditions
- Eliciting history of reactions to previous anaesthesia and surgery or any past or family history of bleeding problems
- Assessment of exercise tolerance and ability to perform activities of daily living
- Assessment of frailty using the Clinical Frailty Scale (Appendix 3)
- Assessment of other geriatric risk factors (cognitive impairment, functional status, malnutrition) (Appendix 3)
- Assessment and documentation of baseline physical, mental and psychosocial function
    - Basic: blood pressure, height, weight (BMI), blood sugar, spirometry (in those with history of COPD), STOP-BANG questionnaire* (www.sleepassociation.org/sleep-apnea-screening-questionnaire-stop-bang/) (in those with clinical features suggestive of obstructive sleep apnoea)
    - Extended: 6-minute walk test, grip strength, nutritional (MUST score), cognitive function assessment (MMSE)
- Stratification of risk of complications using relevant risk scoring tools (see appendix 6)
- Evaluation of tobacco use, alcohol consumption/other illicit drug use or prescription drug overuse
- Elicitation of patient understanding, questions and concerns around impending surgery

Management plan

- Ordering and follow-up of any preoperative investigations that may be indicated
- Medical optimisation of chronic (or acute) medical conditions
- Treatment of medical risk factors (eg iron infusion for iron-deficiency anaemia, b-blockers for patients with exertional angina)
- Life style modifications (weight loss, smoking cessation, alcohol reduction, etc)
- Appropriate discussion of all treatment options, outlining risks and benefits of each along with likely outcomes
- Discussion around realistic expectations and limits of surgery

- Establishment of individual patient preferences and values
    - focusing on outcomes identified by the patient as being important (for example, functional capacity, cognitive status, independence etc)
- Revision or finalisation of advance care planning and goals/ceilings of care
- Finalisation of perioperative medication regimen
- Communicating risk assessment and management plan to other subspecialty teams
- Referral to relevant allied health professionals for pre-operative optimisation
- Discharge planning

* Chung F, Elsaid H. Screening for obstructive sleep apnea before surgery: why is it important? Curr Opin Anaesthesiol 2009; 22: 405-11

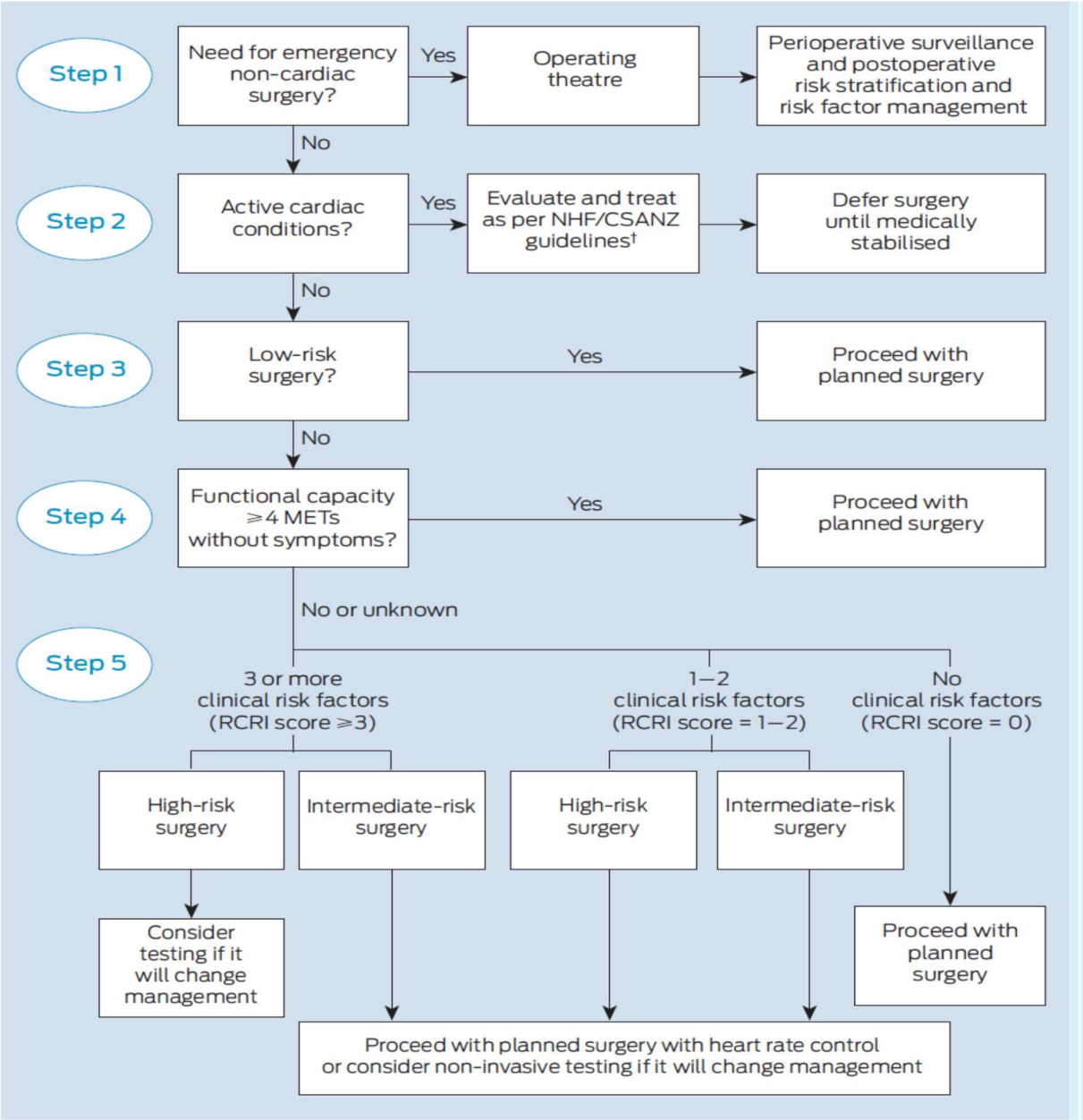
Appendix 6. Guideline-directed laboratory testing before elective noncardiac surgery*

Laboratory Test	Indication
Haemoglobin	Anticipated major blood loss, symptoms of anaemia, major or complex surgery
Leukocyte count	Symptoms suggesting infection, myeloproliferative disorder, or myelotoxic medications, major or complex surgery
Platelet count	History of bleeding diathesis, myeloproliferative disorder, or myelotoxic medications; liver disease; major or complex surgery
Coagulation screen	History of bleeding diathesis, liver disease, malnutrition, recent or long-term antibiotic use, warfarin use
U+Es/Cr	Known renal insufficiency, congestive heart failure, diabetes, major surgery, medications that affect electrolytes or renal function
Glucose	Known diabetes, obesity
Liver function tests	Cirrhosis
Urinalysis	Symptoms suggestive of urinary tract infection, instrumentation of the genital-urinary tract (not indicated before total joint replacement)
ECG	Known coronary artery disease, diabetes, uncontrolled hypertension, chronic kidney disease
Spirometry	Scheduled lung resection surgery or active wheezing or impaired exercise tolerance which remains unexplained after careful history and physical examination.
Chest X-ray	Symptoms or examination findings suggestive of active pulmonary disease
BNP	Patients 65 years of age or older undergoing major or emergent surgery, or 45-64 years of age with established cardiovascular disease, or patients who have a Revised Cardiac Risk Index score ≥ 1[109]
HbA1c	Diabetic patients with no test within the previous 4 months
Pregnancy test	Women who could possibly be pregnant with their consent

Resting echocardiography, coronary computed tomography angiography, exercise or cardiopulmonary exercise testing, or pharmacological stress echocardiography or radionuclide imaging to enhance perioperative cardiac risk estimation **unless** patient is at high cardiac risk, undergoing high risk surgery

and where results of such testing will change management, including deferment of surgery or switch to medical management only.

Appendix 7. Algorithm for evaluating cardiac risk before non-cardiac surgery*



NHF/CSANZ=National Heart Foundation and Cardiac Society of Australia and New Zealand.

RCRI= Revised Cardiac Risk Index. METs=metabolic equivalents. *Reproduced from Scott et al. Med J Aust 2013

† The 2016 NHF/CSANZ guidelines for acute coronary syndromes (Chew et al Med J Aust 2016) and the 2018 NHF/CSANZ guidelines for congestive heart failure (Atherton et al Med J Aust 2018)

Appendix 8. Contemporary evidence-based guidance in perioperative medicine

Talmor D, Kelly B. How to better identify patients at high risk of postoperative complications? Curr Opin Crit Care 2017;23(5):417-423.

Duceppe E, Parlow J, MacDonald P, et al. Canadian Cardiovascular Society guidelines on perioperative cardiac risk assessment and management for patients who undergo noncardiac surgery. Can J Cardiol 2017; 33(1):17-32.

Boehm O, Baumgarten G, Hoeft A. Preoperative patient assessment: Identifying patients at high risk. Best Pract Res Clin Anaesthesiol 2016; 30: 131-143.

Diaz-Fuentes G, Hashmi HRT, Hashmi, Venkatram S. Perioperative evaluation of patients with pulmonary conditions undergoing non-cardiothoracic surgery. Health Serv Insights 2016; 9(Suppl 1): 9–23.

2016 guidelines from the National Institute for Health and Care Excellence. United Kingdom

www.nice.org.uk/guidance/ng45/chapter/recommendations

Eagle KA, Vaishnava P, Froehlich JB. Perioperative cardiovascular care for patients undergoing noncardiac surgical intervention. JAMA Intern Med 2015;175 (5): 835-9.

Oresanya LB, Lyons WL, Finlayson E. Preoperative assessment of the older patient. A narrative review. JAMA 2014;311(20):2110-2120.

Kristensen SD, Knuuti J, Saraste A, et al. 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management: The Joint Task Force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA). Eur J Anaesthesiol 2014;31(10):517-73.

Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2014; 64 (22): e77-e137.

Scott IA, Shohag HA, Kam PCA, Jelinek MV, Khadem GM. Preoperative evaluation and management of cardiac risk in patients undergoing elective non-cardiac surgery. Med J Aust 2013; 199: 667-673.

Qaseem A, Snow V, Fitterman N, et al. Risk assessment for and strategies to reduce perioperative pulmonary complications for patients undergoing noncardiothoracic surgery: a guideline from the American College of Physicians. Ann Intern Med 2006;144(8):575-80.

Appendix 9. Prophylactic interventions for reducing risk of perioperative complications

The following recommendations are general in nature, are not intended to be exhaustive, are focused on frequently encountered scenarios, and do not override local institutional guidance.

General principles of medication management

- Advice should be sought from anaesthetists, surgeons and treating specialist(s) if there is any concern about potential risk of continuing a medication prior to surgery. Every hospital should have their own detailed perioperative medication management guidelines which have been reviewed by key medical stakeholders and endorsed by a Drugs and Therapeutics Committee, Medical Advisory Committee or similar. A comprehensive resource is the Medication – Pre-operative Medication Management guideline produced by Metro North HHS (available at: https://qheps.health.qld.gov.au/__data/assets/pdf_file/0019/2205514/004542.pdf
- *Essential medications*, such as cardiac drugs, most antihypertensive agents, and steroids, should be continued in most cases because an untreated or poorly controlled medical condition may have a more harmful effect on surgical outcome than the medications used to treat it.

Antithrombotic agents

- Patients should preferably stop taking *aspirin and other anti-platelet agents* 5 to 7 days before surgery (ticagrelor and clopidogrel 5 days before, prasugrel 7 days before) if the bleeding risk outweighs the risk for thrombosis from abrupt cessation. In most cases of minor or superficial surgery, trials suggest these agents can be safely continued if required for other strong cardiovascular indications.
    - If antiplatelet agents are being prescribed for *primary prevention only*, then cease all agents.
    - If antiplatelet agents are being prescribed for *secondary prevention in the absence of PCI,* then continue aspirin but cease other agents
    - If antiplatelet agents are being prescribed *following PCI*, then seek cardiologist opinion – in most cases, if patient has had bare metal stent more than 6 weeks previously or drug eluting stent more than 6 months previously, then aspirin can be continued and other agents ceased.

Anticoagulants

- Should be withheld or discontinued prior to surgery if bleeding risk (see **Appendix 10**) is high. A management protocol on when to interrupt and resume DOACs in patients with atrial fibrillation which has recently been validated in a large cohort study[110] is reproduced in Appendix 11.

Hypoglycaemic agents

- *Oral hypoglycemic agents* should be withheld or discontinued on the morning of surgery, and glucose control should be maintained perioperatively with insulin.
- *SGLT-2 inhibitors* should be withheld in advance up to 3 days due to avoid potential risk of euglycaemic ketoacidosis.
- In patients already receiving *insulin*, one common practice is to continue basal insulin but decrease the dose of intermediate-acting insulin to one half or two thirds the usual dose on the morning of surgery and not administer short-acting insulin unless testing indicates it is needed (see **Appendix 12**).[111]

Cardiac medications

- *Diuretics and angiotensin-converting enzyme inhibitors/angiotensin-receptor blockers* are frequently withheld on the day of surgery because of concerns for intraoperative hypotension, although evidence to support this practice is weak but growing.
- *Prophylactic b-blockers* have been associated with reduced myocardial ischemia and nonfatal MI at the expense of increased bradycardia, hypotension, and stroke. The effect on total mortality is unclear but seems to be increased. Current advice is to continue b-blockers in patients with known coronary artery disease already receiving them, and to commence b-blockers only in those patients at high cardiac risk (RCRI ≥3) more than 24 hours before surgery (although the optimum length of time is unknown), preferably using a cardio selective agent (such as bisoprolol and atenolol), at a dose that maintains resting heart rate between 60 and 80 bpm.
- *Statins* should be continued in patients already receiving them and consideration given to commencing them in statin-naïve patients who have established cardiovascular disease, diabetes or hyperlipidaemia
- Patients at high risk for *postoperative atrial fibrillation* (undergoing cardiac or thoracic surgery) may be considered for pre-surgical b-blocker or amiodarone therapy.
- *Hypertension* with systolic pressure <180mmHg and diastolic pressure <110mmHg and with no other cardiovascular disease or hypertensive end-organ damage does not increase risk among patients undergoing noncardiac surgery and does not warrant cancellation of surgery.

Anti-rheumatic medications

- *Rheumatologic treatments* may potentially increase risk for perioperative infection. Methotrexate is usually continued, but leflunomide, etanercept, and infliximab should be discontinued 1 to 2 weeks before surgery and not restarted for 1 to 2 weeks after the procedure.[112]
- *Non-steroidal inflammatory drugs* (including COX-2 inhibitors) which inhibit platelet function should also be ceased at least 3 days prior to surgery for any procedure which carries significant bleeding risk.

Complementary and alternative medicines

- *CAMs* should be withheld 2 weeks prior to surgery as some (eg gingko) are known to increase perioperative bleeding risk.

Prophylactic medications

- *Appropriate prophylaxis to prevent venous thromboembolism*, pharmacologic or mechanical, should be instituted prior to surgery and early postoperative ambulation encouraged aided by sufficient levels of post-operative analgesia
- *Appropriate antibiotic prophylaxis* should be administered in s timely fashion pre-operatively according to contemporary guidelines and discontinued within 48 hours of surgery unless otherwise indicated
- *Iron infusions* are required for patients with iron deficiency anaemia; blood transfusions are not required unless Hb <80 gm/l or, for patients undergoing operations with significant anticipated blood loss, Hb <100.[113]

Post-operative analgesia

- *An appropriate analgesic/aperient* regimen should be formulated to control post-operative pain. For patients being discharged, a limited supply of opiates should be dispensed and the analgesia plan communicated to patients and primary care givers, with instructions regarding down-titration as pain resolves in order to prevent adverse drug reactions, over-prescribing of opiates and risk of opioid dependence.

Other drug classes

- *Hormonal contraceptives and hormonal replacement therapy* are best avoided for 2 weeks prior to surgery because of increased risk of venous thromboembolism.
- *Phosphodiesterase 5 inhibitors* (eg Viagra) should be avoided within 24 to 48 hours of surgery due to risk of hypotension and drug interactions with nitrates.
- *Monoamine oxidase inhibitors, moclobemide and opioid antagonists* should be reviewed and assessed for risk of interactions with anaesthetic or analgesic agents.

Special considerations

- To minimize risk for *pulmonary complications*, patients should cease smoking at least 4 to 8 weeks before surgery. Lung expansion maneuvers (deep breathing exercises or incentive spirometry) reduce the risk for postoperative pulmonary complications and are more effective in the postoperative period if taught to patients before surgery.[114]
    - Preoperative efforts to reduce airflow obstruction and treat respiratory infection in patients with asthma or COPD will also reduce pulmonary complications

- Preoperative chest physiotherapy (30 mins within 2 weeks of surgery)[115] and inspiratory muscle training are other options in selected patients[116,]
- Patients with obstructive sleep apnoea should ensure their CPAP machine is brought to hospital and during and after surgery certain precautionary measures, such as pulse oximetry or carbon dioxide monitoring, minimal narcotics, and elevation of the head of the bed should be instituted

- Patients who are *severely malnourished* with low serum albumin demonstrate poor wound healing and higher risk of postoperative wound infections and efforts should be made, including enteral feeding if needed, to optimise nutritional status well prior to surgery. Long periods of pre-operative fasting should be avoided, oral feeding should be re-established as early as possible after surgery, factors which exacerbate stress-related catabolism or impair gastrointestinal function should be mitigated and early mobilisation should be promoted to facilitate protein synthesis and muscle function.[117]

- *Preoperative cardiopulmonary exercise testing* is not recommended as routine care due to the paucity of evidence showing it improves outcomes, despite its potential to more accurately predict survival, need for intensive care and length of stay for selected types of surgery.[118,119] *Preoperative aerobic exercise training* helps to maximise physical fitness and reserve although evidence of improved postoperative clinical outcomes is also lacking.[120]

- Older patients at risk of *postoperative delirium* should have the following multifaceted intervention package instituted immediately after surgery[70,71]:

  - Avoid sleep deprivation by instituting normal sleep-wake cycle using appropriate lighting, early mobilisation and physical exercise
  - Avoid visual or hearing impairment by ensuring glasses and hearing aids are within reach and working
  - Avoid social isolation by having family/carers/volunteers/nursing and allied health staff engage actively with patients in conversation and shared activities
  - Avoid physical restraints for controlling aberrant behaviour; use de-escalation techniques and re-orientation maneuvers, including videoclips of family members
  - Remove IV lines, drains, bladder catheters and other devices that tether patients to beds, act as noxious stimuli and prevent early mobilisation
  - Minimise use of CNS-acting drugs, especially sedatives, opiates and psychoactive drugs as much as possible
  - Ensure adequate hydration and nutrition

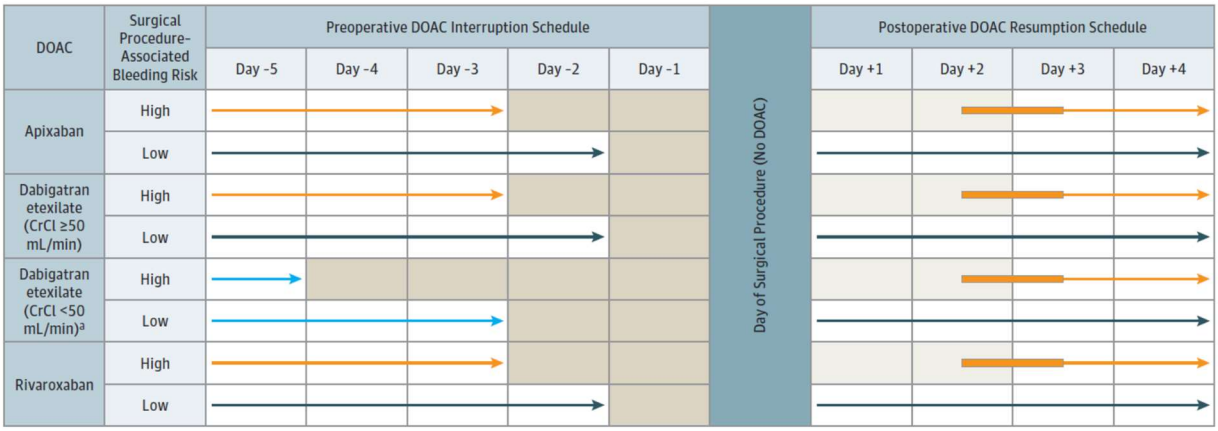
- Prevent constipation, urinary retention and bladder/bowel incontinence by appropriate toileting regimens, aperients, avoidance of anti-cholinergic drugs
- Prevent post-operative infections by removing intravascular or intra-cavity devices as soon as possible
- Promptly manage post-operative infections, urinary retention, constipation, incontinence, electrolyte abnormalities, postural hypotension, pressure sores

Appendix 10. Suggested risk stratification for perioperative thromboembolism and bleeding*

Risk of thromboembolism			
Risk level	**Mechanical heart valve**	**Atrial fibrillation**	**Venous thromboembolism**
High	• Any mitral valve prosthesis • Any caged-ball or tilting disc aortic valve prosthesis • Recent (< 6 months) stroke or TIA • Prior stroke or TIA during temporary interruption of anticoagulants	• $CHADS_2$ score of 5–6 • Recent (< 3 months) stroke or TIA • Rheumatic valvular heart disease • Prior stroke or TIA during temporary interruption of anticoagulants	• Recent (< 3 months) VTE • Severe thrombophilia (eg, deficiency of protein C, protein S, or antithrombin; antiphospholipid antibodies; multiple abnormalities) • Prior VTE during temporary interruption of anticoagulants • VTE > 12 months previously associated with pulmonary hypertension
Moderate	• Bileaflet aortic valve prosthesis and one or more of the following risk factors: atrial fibrillation, prior stroke or TIA, hypertension, diabetes, congestive heart failure, age >75 years	• $CHADS_2$ score of 3–4	• VTE within past 3–12 months • Non-severe thrombophilia (eg, heterozygous factor V Leiden or prothrombin gene mutation) • Recurrent VTE • Active cancer (treated within 6 months or palliative)
Low	• Bileaflet aortic valve prosthesis without atrial fibrillation and no other risk factors for stroke	• $CHADS_2$ score of 0–2 (assuming no prior stroke or TIA)	• VTE > 12 months previously and no other risk factors
Risk of major bleeding			
High	• Urological surgery and procedures comprising transurethral resection of prostate, bladder resection or tumour ablation; nephrectomy; kidney biopsy • Implantation of pacemaker or implantable cardioverter defibrillator device (risk of pocket haematoma) • Colonic polyp resection, typically of large (> 1–2 cm) sessile polyps • Surgery or procedures in highly vascular organs such as kidney, liver and spleen • Bowel resection (with risk of bleeding at anastomosis site) • Major surgery with extensive tissue injury (eg, cancer surgery, joint arthroplasty, reconstructive plastic surgery) • Intracranial or spinal surgery		
Low	• Cataract surgery, arthrocentesis, dental procedures, diagnostic endoscopic procedures • Excisional skin surgery and superficial surgery with easily compressible wounds		

*Reproduced from Scott et al Med J Aust 2013; TIA=transient ischaemic attack. CHADS2 =congestive heart failure, hypertension, age _75 years, diabetes mellitus, stroke or TIA. VTE=venous thromboembolism. Adapted from Douketis et al. Chest 2012; 141 (2 Suppl): e326S-e350S with additional data from Dunn, Turpie Arch Intern Med 2003; 163: 901-908.

Appendix 11. Perioperative Direct Oral Anticoagulant (DOAC) Management Protocol

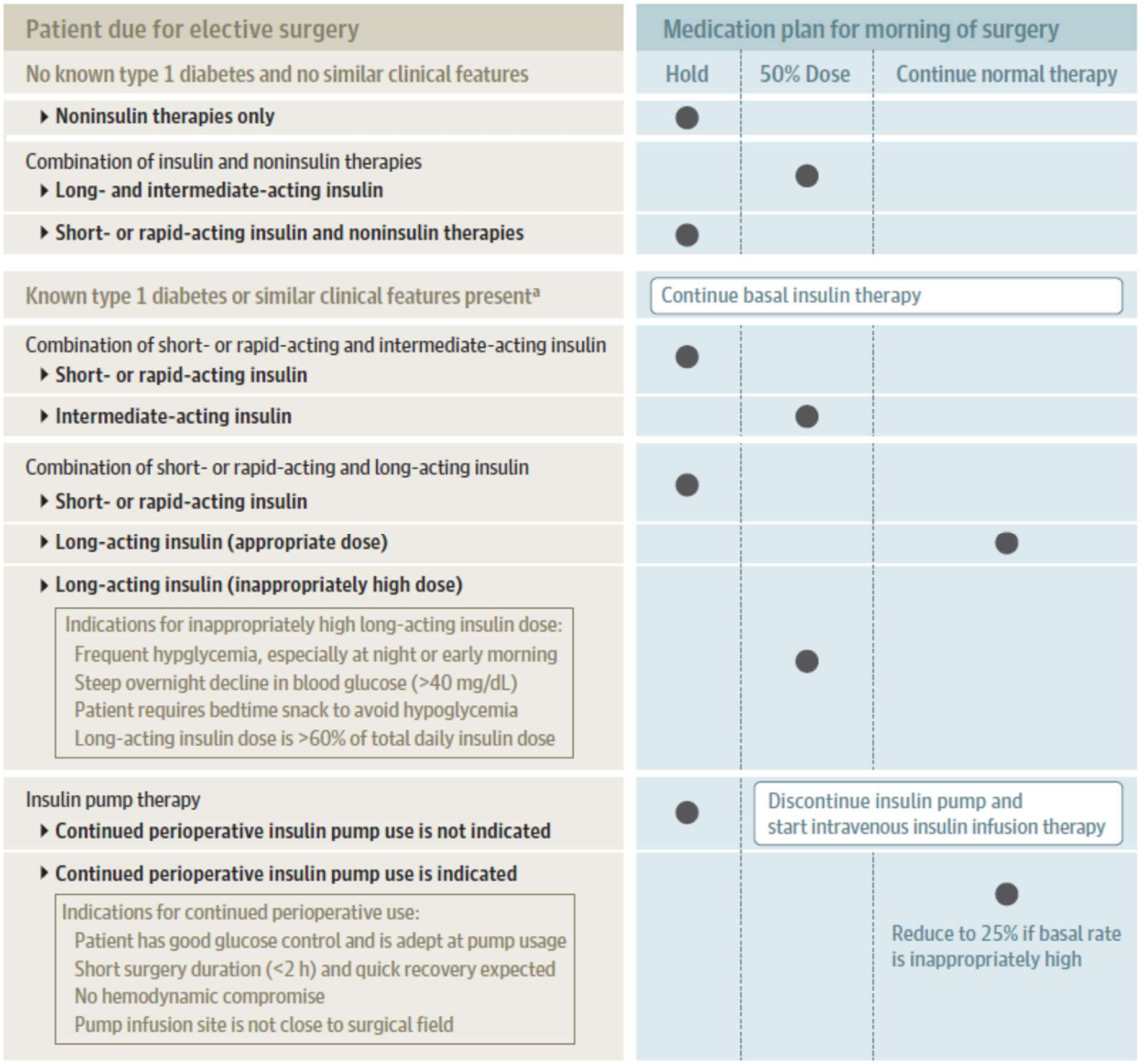


No DOAC was taken on certain days (shaded) and on the day of the elective surgery or procedure. The light blue arrows refer to an exception to the basic management, a subgroup of patients taking dabigatran with a creatinine clearance (CrCl) less than 50 ng/mL. The orange arrows refer to patients having a high-bleed-risk surgical procedure. Dark blue arrows refer to patients having a low-bleed-risk surgical procedure. The thickened orange part of arrows refer to flexibility in the timing of DOAC resumption after a procedure.

[a] Cancer diagnosed within 3 months or has been treated within 6 months or metastatic.

Reproduced from Douketis et al JAMA Intern Med 2019.

Appendix 12. Suggested guide to perioperative glucose control in diabetic patients



a Examples of patient characteristics: needing multiple doses of insulin and if one dose of insulin is skipped, the next monitored glucose level is very high; small changes in insulin doses lead to big changes in glucose concentration; history of severe hyperglycaemia or ketoacidosis without a major stress; high within-day glucose variability; recurrent hypoglycaemic episodes; patients with post-pancreatectomy diabetes.

Reproduced from Simba et al JAMA 2019.

References

[1] Grocott MP, Mythen MG. Perioperative medicine: The value proposition for anesthesia?: A UK perspective on delivering value from anesthesiology. Anesthesiol Clin 2015;33(4):617-28.
[2] Australian Commission on Safety and Quality in Heath Care. National Safety and Quality Health Service Standards. 2nd ed. Sydney: ACSQHC: 2017.
[3] Morris RS, Ruck JM, Conca-Cheng AM, et al. Shared decision-making in acute surgical illness: The surgeon's perspective. J Am Coll Surg 2018;226(5):784-95.
[4] The Australian Institute of Health and Welfare. Australia's Hospitals 2015-16 at a glance. Canberra: 2017.
[5] Royal College of Anaesthetists. *Perioperative Medicine: The pathway to better surgical care.* London: 2015.
[6] The College of Surgeons England. *The Higher Risk General Surgical Patient - Towards Improved Care for a Forgotten Group*. 2011.
[7] Australian Bureau of Statistics. Population Projections, Australia, 2012 to 2013 [cited 2018 2 October]. Available from: https://www.abs.gov.au/ausstats/abs@.nsf/mediareleasesbyCatalogue/7DB4DD841EA3A2A5CA2574B9001E26F6?Opendocument
[8] Newton JN, Briggs ADM, Murray CJL, et al. Changes in health in England, with analysis by English regions and areas of deprivation, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015;386(10010):2257-74.
[9] Barnett K, Mercer SW, Norbury M, et al. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet 2012;380(9836):37-43.
[10] Australian Institute of Health and Welfare. Australia's Health 2016. Canberra: AIHW: 2016.
[11] Story DA, Leslie K, Myles PS, et al. Complications and mortality in older surgical patients in Australia and New Zealand (the REASON study): a multicentre, prospective, observational study. Anaesthesia 2010;65(10):1022-30.
[12] Allen J, North JB, Wysocki AP, et al. Surgical care for the aged: a retrospective cross-sectional study of a national surgical mortality audit. BMJ Open 2015; 5: e006981.
[13] Thompson RE, Pfeifer K, Grant PJ, et al. Hospital medicine and perioperative care: A framework for high-quality, high-value collaborative care. J Hosp Med 2017;12(4):277-282.
[14] Pham CT, Gibb CL, Fitridge RA, et al. Effectiveness of preoperative medical consultations by internal medicine physicians: a systematic review. BMJ Open 2017;7:e 018632.
[15] Macpherson DS, Lofgren RP. Outpatient internal medicine preoperative evaluation: a randomized clinical trial. Med Care 1994; 32:498–507.
[16] McEvoy MD, Wanderer JP, King AB, et al. A perioperative consult service results in reduction in cost and length of stay for colorectal surgical patients: evidence from a healthcare redesign project. Periop Med 2016; 5: 3.
[17] Hammersley M, Jones H, Singh S, et al. Can a perioperative physician improve care and reduce length of stay in a surgical emergency admission unit? Clin Med 2015; 15(3): s22.
[18] Hinami K, Feinglass J, Ferranti DE, et al. Potential role of co-management in 'rescue' of surgical patients. Am J Manag Care 2011; 17(9): e333-e339.
[19] Auerbach AD, Wachter RM, Cheng HQ, et al. Co-management of surgical patients between neurosurgeons and hospitalists. Arch Intern Med 2010; 170(22): 2004-2010.
[20] Rohatgi N, Loftus P, Grujic O, et al. Surgical co-management by hospitalists improves patient outcomes: A propensity score analysis. Ann Surg 2016;264(2):275-82.
[21] Soong C, Cram P, Chezar K, et al. Impact of an integrated hip fracture inpatient program on length of stay and costs. J Orthop Trauma 2016; 30(12):647-652.
[22] Shenouda M, Silk Z, Radha S, et al. The introduction of a multidisciplinary hip fracture pathway to optimise patient care and reduce mortality: A prospective audit of 161 patients. Open Orthop J 2017; 11:309-315.
[23] Bracey DN, Kiymaz TC, Holst DC, et al. An orthopedic-hospitalist comanaged hip fracture service reduces inpatient length of stay. Geriatr Orthop Surg Rehabil 2016; 7(4):171-177.
[24] Montero RE, Rebollar MA, Castejon CMA, et al. Effect of co-management with internal medicine on hospital stay in ophthalmology. Arch Soc Esp Oftalmol 2015; 90(6): 253-6.
[25] Montero RE, Rebollar MA, Rivera RI, et al. Effect of co-management with internal medicine on hospital stay of patients admitted to the service of otolaryngology. Acta Otorrinolaringol Esp 2015; 66(5): 264-8.
[26] Grigoryan KV, Javedan H, Rudolph JL. Orthogeriatric care models and outcomes in hip fracture patients: a systematic review and meta-analysis. J Orthop Trauma 2014;28(3):e49-55.

[27] Gosch M, Hoffmann-Weltin Y, Roth T, et al. Orthogeriatric co-management improves the outcome of long-term care residents with fragility fractures. Arch Orthop Trauma Surg 2016; 136(10):1403-9.
[28] Nicholson A, Lowe MC, Parker J, et al. Systematic review and meta-analysis of enhanced recovery programmes in surgical patients. Br J Surg 2014;101(3):172-88.
[29] Altman AD, Helpman L, McGee J, et al. Enhanced recovery after surgery: implementing a new standard of surgical care. CMAJ 2019;191(17):E469-E475.
[30] Kruser JM, Nabozny MJ, Steffens NM, et al. "Best Case/Worst Case": Qualitative evaluation of a novel communication tool for difficult in-the-moment surgical decisions. J Am Geriatr Soc 2015;63(9):1805-11
[31] Agency for Clinical Innovation, NSW. The Perioperative Toolkit. 2016. Available at: https://www.aci.health.nsw.gov.au/resources/anaesthesia-perioperative-care/the-perioperative-toolkit/the-perioperative-toolkit-webpage
[32] National Institute for Health and Care Excellence. Patient Decision Aids. Available at: https://www.evidence.nhs.uk/
[33] Dworsky JQ, Russell MM. Surgical decision making for older adults. JAMA 2019; 321 (7): 716.
[34] Livingston EH. What to ask your surgeon before an operation. JAMA 2015; 313 (5): 536.
[35] Grocott MPW, Plumb JOM, Edwards M, et al. Re-designing the pathway to surgery: better care and added value. Perioper Med (Lond) 2017; 6:9.
[36] Manecke GRA, Michard, F. Tackling the Economic Burden of Postsurgical Complications: Would Perioperative Goal-directed fluid therapy help? Crit Care 2014; 18:566.
[37] Roizen MF. The Surgical burden - how to prevent crisis in perioperative medicine. Cleve J Med 2006;73(s1): S8-12
[38] Chen LM, Wilk AS, Thumma JR, et al. Use of medical consultants for hospitalised surgical patients. An observational cohort study. JAMA Intern Med 2014; 174(9):1470-7.
[39] Cohen ME, Liu Y, Ko CY, Hall BL. Improved surgical outcomes for ACS NSQIP hospitals over time: Evaluation of hospital cohorts with up to 8 years of participation. Ann Surg 2016;263(2):267-73.
[40] Queensland Health Clinical Excellence Division. Collaborative Older Persons' Elective Surgery Risk Assessment for Treatment Efficacy (COOPERATE) Recommendations. June 2018, Brisbane. Available at: https://clinicalexcellence.qld.gov.au/sites/default/files/2018-08/cooperate-project-final-report.pdf
[41] Statewide Anaesthesia and Perioperative Care Clinical Network (SWAPNET) guidelines 2017. Available at: https://clinicalexcellence.qld.gov.au/resources/pre-anaesthetic-evaluation-framework.
[42] Kellett J. Death is not the only healthcare outcome important to patients. Eur J Intern Med 2016;32: e11-2.
[43] The Australian Commission on Safety and Quality in Health Care. Patient Centred Care: Improving Quality and Safety through Partnerships with Patients and Consumers. ACSQHC Sydney, 2011.
[44] Carmel PA, Frampton SB. Building the business case for patient-centered care. Healthc Financ Manage 2008 (March):80-5.
[45] Kwok AC, Semel ME, Lipsitz SR, et al. The intensity and variation of surgical care at the end of life: a retrospective cohort study. Lancet 2011;378(9800):1408-13.
[46] Carter HE, Winch S, Barnett AG, et al. Incidence, duration and cost of futile treatment in end-of-life hospital admissions to three Australian public-sector tertiary hospitals: a retrospective multicentre cohort study. BMJ Open 2017;7: e017661.
[47] Fried TR, Bradley EH, Towle VR, Allore, H. Understanding treatment preferences of seriously ill patients. N Engl J Med 2002; 346:1061-66.
[48] Rubin EB, Buehler AE, Halpern SD. States worse than death among hospitalized patients with serious illnesses. JAMA Intern Med 2016;176(10):1557-9.
[49] Glance LG, Osler TM, Neuman MD. Redesigning surgical decision making for high-risk patients. N Engl J Med 2014;370(15):1379-81.
[50] Winzelberg GS, Hanson LC, Tulsky JA. Beyond autonomy: diversifying end-of-life decision-making approaches to serve patients and families. J Am Geriatr Soc 2005;53(6):1046-50.
[51] Sudore RL, Fried TR. Redefining the "planning" in advance care planning: Preparing for end-of-life decision making. Ann Intern Med 2010; 153:256-61.
[52] Scott IA, Mitchell GK, Reymond EJ, Daly MP. Difficult but necessary conversations — the case for advance care planning. Med J Aust 2013; 199: 662-666.
[53] Brinkman-Stoppelenburg A, Rietjens JA, van der Heide A. The effects of advance care planning on end-of-life care: a systematic review. Palliat Med 2014; 28: 1000–25.

[54] Street RL, Makoul G, Arora NK, Epstein RM. How does communication heal? Pathways linking clinician–patient communication to health outcomes. *Patient Educ Counsel* 2009;74(3):295–301.
[55] Mayo Clinic. Mayo Clinic Shared Decision Making National Resource Center. http://shareddecisions.mayoclinic.org/
[56] Cocanour CS. Informed consent - It's more than a signature on a piece of paper. Am J Surg 2017;214(6):993-997.
[57] Guthrie B, Saultz JW, Freeman GK, Haggerty JL. Continuity of care matters. BMJ 2008;337:a867.
[58] The Royal Australasian College of Surgeons. Australian and New Zealand Audit of Surgical Mortality National Report 2015.
[59] Gleason LJ, Schmitt EM, Kosar CM, et al. Effect of delirium and other major complications on outcomes after elective surgery in older adults. JAMA Surg 2015;150(12):1134-40.
[60] Dripps RD, Lamont A, Eckenhoff JE. The role of anesthesia in surgical mortality. JAMA. 1961; 178:261-6.
[61] Glance LG, Lustik SJ, Hannan EL, et al. The Surgical Mortality Probability Model: derivation and validation of a simple risk prediction rule for noncardiac surgery. Ann Surg 2012; 255:696-702.
[62] Kristensen SD, Knuuti J, Saraste A, et al. 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management. Eur Heart J 2014; 35:2383-2431.
[63] Eagle KA, Berger PB, Calkins H, et al. ACC/AHA guideline update for perioperative cardiovascular evaluation for noncardiac surgery—executive summary. J Am Coll Cardiol 2002; 39:542-53.
[64] Lin HS, Watts JN, Peel NM, Hubbard RE. Frailty and post-operative outcomes in older surgical patients: a systematic review. BMC Geriatr 2016;16(1):157.
[65] McIsaac DI, Bryson GL, van Walraven C. Association of frailty and 1-year postoperative mortality following major elective noncardiac surgery: A population-based cohort study. JAMA Surg 2016;151(6):538-45.
[66] Wahl TS, Graham LA, Hawn MT, et al. Association of the Modified Frailty Index with 30-day surgical readmission. JAMA Surg 2017;152(8):749-57.
[67] Dasgupta M, Rolfson DB, Stolee P, et al. Frailty is associated with postoperative complications in older adults with medical problems. Arch Gerontol Geriatr 2009;48(1):78-83
[68] Watt J, Tricco AC, Talbot-Hamon C, et al. Identifying older adults at risk of harm following elective surgery: a systematic review and meta-analysis. BMC Medicine 2018; 16: 2.
[69] Moonesinghe SR, Harris S, Mythen MG, et al. Survival after postoperative morbidity: a longitudinal observational cohort study. Br J Anaesth 2014;113(6):977-84.
[70] Dent E, Kowal P, Hoogendijk EO, et al. Frailty measurement in research and clinical practice: A review. Eur J Intern Med 2016; 31: 3-10.
[71] Kim DH, Kim CA, Placide S, et al. Preoperative frailty assessment and outcomes at 6 months or later in older adults undergoing cardiac surgical procedures: A systematic review. Ann Intern Med 2016; 165(9):650-660.
[72] Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173(5):489–495.
[73] Chong E, Ho E, Baldevarona-Llego J, et al. Frailty in hospitalized older adults: Comparing different frailty measures in predicting short- and long-term patient outcomes. J Am Med Dir Assoc 2018;19(5):450-457.e37.
[74] Moonesinghe SR, Mythen MG, Das P, et al. Risk stratification tools for predicting morbidity and mortality in adult patients undergoing major surgery. Anesthesiology 2013;19(4):959-81.
[75] Dasgupta M, Dumbrell AC. Preoperative risk assessment for delirium after noncardiac surgery: a systematic review. J Am Geriatr Soc 2006; 54(10):1578-89.
[76] Kamel H, Johnston SC, Kirkham JC, et al. Association between major perioperative haemorrhage and stroke or Q-wave myocardial infarction. Circulation 2012;**126**(2):207-12.
[77] Emanuel A, Macpherseon R. The anaesthetic pre-admission clinic is effective in minimising surgical cancellation rates. Anaesth Intensive Care 2013; 41(1):90-4.
[78] Snowden CP, Anderson H. Preoperative optimization: rationale and process: is it economic sense? Curr Opin Anaesthesiol 2012; 25(2):210-6.
[79] Hilditch WG, Asbury AJ, Crawford JM. Pre-operative screening: criteria for referring to anaesthetists. Anaesthesia 2003; 58(2): 117-124.
[80] Smetana GW, Macpherson DS. The case against routine preoperative laboratory testing. Med Clin North Am 2003;87: 7-40.
[81] Charpak Y, Blery C, Chastang C, et al. Usefulness of selectively ordered preoperative tests. Med Care 1988; 26:95-104.

[82] Johansson T, Fritsch G, Flamm M, et al. Effectiveness of non-cardiac preoperative testing in non-cardiac elective surgery: a systematic review. Br J Anaesth 2013;110(6):926-39.
[83] Macpherson DS, Snow R, Lofgren RP. Preoperative screening: value of previous tests. Ann Intern Med 1990; 113:969-73.
[84] Scott IA, Shohag HA, Kam PCA, et al. Preoperative evaluation and management of cardiac risk in patients undergoing elective non-cardiac surgery. Med J Aust 2013; 199: 667-673.
[85] Mullen MG, Michaels AD, Mehaffey JH, et al. Risk associated with complications and mortality after urgent surgery vs elective and emergency surgery: Implications for defining "quality" and reporting outcomes for urgent surgery. JAMA Surg 2017;152(8):768-74
[86] Talmor D, Kelly B. How to better identify patients at high risk of postoperative complications? Curr Opin Crit Care 2017;23(5):417-423.
[87] Smith SA, Yamamoto JM, Roberts DJ, et al. Weekend surgical care and postoperative mortality: A systematic review and meta-analysis of cohort studies. Med Care 2018;56(2):121-129.
[88] O'Leary JD, Wunsch H, Leo AM, et al. Hospital admission on weekends for patients who have surgery and 30-day mortality in Ontario, Canada: A matched cohort study. PLoS Med 2019;16(1): e1002731.
[89] Zapf MA, Kothari AN, Markossian T, et al. The "weekend effect" in urgent general operative procedures. Surgery 2015;158(2):508-14.
[90] Sutton E, Bion J, Aldridge C, et al. Quality and safety of in-hospital care for acute medical patients at weekends: a qualitative study. BMC Health Serv Res 2018;18(1):1015.
[91] Panis LJ, Gooskens M, Verheggen FW, Pop P, Prins MH. Predictors of inappropriate hospital stay: a clinical case study. Int J Qual Health Care 2003; 15(1):57–65.
[92] Montori VM, Brito JP, Murad MH. The optimal practice of evidence-based medicine: incorporating patient preferences in practice guidelines. JAMA 2013;310(23):2503-4.
[93] Reames BN, Shubeck SP, Birkmeyer JD. Strategies for reducing regional variation in the use of surgery: a systematic review. Ann Surg 2014; 259(4):616-27.
[94] McFalls EO, Ward HB, Moritz TE, et al. Coronary-artery revascularization before elective major vascular surgery. N Engl J Med 2004;351(27):2795-804.
[95] Wijeysundera DN, Duncan D, Nkonde-Price C, et al. Perioperative beta blockade in noncardiac surgery: a systematic review for the 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation 2014;130(24):2246-64.
[96] Partridge JS, Harari D, Martin FC, Dhesi JK. The impact of pre-operative comprehensive geriatric assessment on postoperative outcomes in older patients undergoing scheduled surgery: a systematic review. Anaesthesia 2014; 69 Suppl 1:8-16.
[97] Harari D, Hopper A, Dhesi J, et al. Proactive care of older people undergoing surgery ('POPS'): designing, embedding, evaluating and funding a comprehensive geriatric assessment service for older elective surgical patients. Age Ageing 2007;36(2):190-6.
[98] Partridge JS, Harari D, Martin FC, et al. Randomized clinical trial of comprehensive geriatric assessment and optimization in vascular surgery. Br J Surg 2017;104(6):679-687.
[99] Gillis C, Li C, Lee L, et al. Prehabilitation versus rehabilitation: a randomized control trial in patients undergoing colorectal resection for cancer Anesthesiology 2014; 121; 937-947.
[100] Sebio Garcia R, Yáñez Brage MI, Giménez Moolhuyzen E, et al. Functional and postoperative outcomes after preoperative exercise training in patients with lung cancer: a systematic review and meta-analysis. Interact Cardiovasc Thorac Surg 2016; 23(3):486-97.
[101] Pouwels S, Hageman D, Gommans LN, et al. Preoperative exercise therapy in surgical care: a scoping review. J Clin Anesth 2016; 33:476-90.
[102] Sanguineti VA, Wild JR, Fain MJ. Management of postoperative complications: general approach. Clin Geriatr Med 2014; 30(2):261-70.
[103] Siddiqi N, Harrison JK, Clegg A, et al. Interventions for preventing delirium in hospitalised non-ICU patients. Cochrane Database Syst Rev 2016;3:CD005563.
[104] Moyce Z, Rodseth RN, Biccard BM. The efficacy of peri-operative interventions to decrease postoperative delirium in non-cardiac surgery: a systematic review and meta-analysis. Anaesthesia 2014; 69(3):259-69.
[105] Fok MC, Sepehry AA, Frisch L, et al. Do antipsychotics prevent postoperative delirium? A systematic review and meta-analysis. Int J Geriatr Psychiatry 2015; 30(4):333-44.

[106] Devereaux PJ, Xavier D, Pogue J, et al. Characteristics and short-term prognosis of perioperative myocardial infarction in patients undergoing noncardiac surgery: a cohort study. Ann Intern Med 2011; 154: 523-528.
[107] Devereaux PJ, Chan MT, Alonso-Coello P, et al. Association between postoperative troponin levels and 30-day moratlity among patients undergoing noncardiac surgery. JAMA 2012; 307: 2295-2304.
[108] Duceppe E, Parlow J, MacDonald P, et al. Canadian Cardiovascular Society guidelines on perioperative cardiac risk assessment and management for patients who undergo noncardiac surgery. Can J Cardiol 2017; 33: 17-32.
[109] Rodseth RN, Biccard BM, Le Manach Y, et al. The prognostic value of pre-operative and post-operative B-type natriuretic peptides in patients undergoing noncardiac surgery: B-type natriuretic peptide and N-terminal fragment of pro-B-type natriuretic peptide: a systematic review and individual patient data meta-analysis. J Am Coll Cardiol 2014; 63: 170-180.
[110] Douketis JD, Spyropoulos AC, Duncan J, et al. Perioperative management of patients with atrial fibrillation receiving a direct oral anticoagulant. JAMA Intern Med 2019 (on line Aug 5, 2019: doi: 101.1001/jamainternmed.2019.2431.
[111] Simha V, Shah P. Perioperative glucose control in patients with diabetes undergoing elective surgery. JAMA Published online January 7, 2019.
[112] Goodman SM, Springer B, Guyatt G. 2017 American College of Rheumatology/American Association of Hip and Knee Surgeons guideline for the perioperative management of antirheumatic medication in patients with rheumatic diseases undergoing elective total hip or total knee arthroplasty. Arthritis Care Res 2017; 69 (8): 1111–1124.L
[113] Carson JL, Stanworth SJ, Roubinian N, et al. Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion. Cochrane Database Syst Rev 2016;10:CD002042.
[114] Tyson AF, Kendig CE, Mabedi C. The effect of incentive spirometry on postoperative pulmonary function following laparotomy: a randomized clinical trial. JAMA Surg 2015; 150(3):229-36.
[115] Boden I, Skinner EH, Browning L, et al. Preoperative physiotherapy for the prevention of respiratory complications after upper abdominal surgery: pragmatic, double blinded, multicenter randomised controlled trial. BMJ 2018;360: j5916.
[116] Katsura M, Kuriyama A, Takeshima T, et al. Preoperative inspiratory muscle training for postoperative pulmonary complications in adults undergoing cardiac and major abdominal surgery. Cochrane Database Syst Rev 2015;10:CD010356.
[117] Weimann A, Braga M, Carli F, et al. ESPEN guideline: Clinical nutrition in surgery. Clin Nutr 2017; 36(3):623-650.
[118] Young EL, Karthikesalingam A, Huddart S, et al. A systematic review of the role of cardiopulmonary exercise testing in vascular surgery. Eur J Vasc Endovasc Surg 2012;44(1):64-71.
[119] Moran J, Wilson F, Guinan E, et al. Role of cardiopulmonary exercise testing as a risk-assessment method in patients undergoing intra-abdominal surgery: a systematic review. Br J Anaesth 2016;116(2):177-91.
[120] O'Doherty AF, West M, Jack S, Grocott MP. Preoperative aerobic exercise training in elective intra-cavity surgery: a systematic review. Br J Anaesth 2013;110(5):679-89.