

Enhanced recovery after surgery: key principles for implementation of models

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Introduction

Enhanced recovery after surgery (ERAS) models are multi-modal perioperative care pathways. They are designed to achieve early recovery after surgical procedures by maintaining preoperative organ function and reducing the profound stress response following surgery. There are three key elements of ERAS models: preoperative, intraoperative and postoperative.

These models attempt to modify the physiological and psychological responses to a major surgery. They have been shown to lead to:

- reduction in complications and length of hospital stay
- improved cardio-pulmonary function
- earlier return of bowel function
- earlier resumption of baseline activities.

Aims of the initiative

- Improve patient and carer participation in health-related decisions and engagement with care
- Reduce the length of stay in hospital without compromising morbidity
- Optimise the use of health system resources

Specialties

ERAS models can be applied to various types of surgery, whether minimally invasive or open. In NSW public hospitals, ERAS models have been implemented for colorectal, orthopaedics, urology, vascular, gynaecology,

breast and upper gastrointestinal surgeries. ERAS models should be considered and implemented alongside other relevant clinical guidance.

Methods

A two-round modified e-Delphi technique¹ was used to draw consensus (95%) on the overarching ERAS subspecialty principles to support implementation in NSW. The panel included 27 members from across multiple ERAS specialties and multidisciplinary teams, and ran between 7 November 2022 and 23 November 2022. The panel members were recruited through the ACI Anaesthesia and Perioperative Care Network and the Surgical Services Taskforce. In both e-Delphi rounds, the panel members revised the definitions and explanations of each principle to reflect the local NSW context. The principles were drawn from the ERAS Society guidelines and a systematic review published in 2017.² Feedback and revisions were consolidated and returned to the panel between the e-Delphi rounds.

Panel members also identified barriers to and enablers of the local implementation of ERAS models and principles. A qualitative framework analysis was completed using the Consolidated Framework for Implementation Research (CFIR). The CFIR is a determinant framework, used to assess contextual factors and inform choice of implementation strategies.³

The experiential evidence leveraged through the e-Delphi process supplemented an evidence check of peer-reviewed and grey literature, completed on 27 June 2020, for the [Resuming elective surgery – post-surgery innovations: enhanced recovery after surgery, early mobilisation and discharge, Enhanced recovery after surgery: key principles for colorectal surgery](#)^{4,5} and ERAS Society guideline elements.²

The ERAS principles and proposed implementation strategies were open for statewide review between 11 January 2023 and 10 February 2023. Thirty respondents, including surgeons, anaesthetists, nursing, allied health representatives and hospital executives, provided feedback.

Key principles

The e-Delphi process resulted in the identification of seven key principles to support the implementation of ERAS models in NSW.

Structured preoperative information, engagement and counselling of the patient and carers

Engage patients and their carers in treatment and discharge planning early and provide comprehensive preoperative education to patients to improve their experience; reduce the length of hospital stay and readmission rates; and prevent complications.⁶

Patient education should be:

- detailed
- procedure-specific
- tailored to the basic and functional literacy level.

It should also include information on how patients can optimise their health in preparation for surgery (e.g. alcohol cessation and increasing aerobic exercise).

Education can be provided by the multidisciplinary team at the pre-admission clinic, and resources should be made available in different formats, such as print and online. Opportunities for using alternative pre-admission pathways, such as telehealth and general practitioners, should also be considered where a multidisciplinary team is not available.

Postoperative information to set a patient's expectations after surgery should also be outlined and provided at this stage to enable the patient to play a more active role in their recovery. This can include:

- information on what to expect after surgery
- basic details on return to work and driving
- contact details if they experience any issues after discharge.

It is important to provide information to patients in a manner that supports health literacy and builds trust.

Minimal invasive surgical techniques

Use a minimally invasive approach to surgery, where expertise is available, to:

- improve and speed up recovery
- reduce surgical and wound-related complications
- reduce length of hospital stay.⁷

Minimally invasive surgical techniques can support the implementation of other ERAS principles such as early mobilisation and intake of fluids and solids.⁸

Early mobilisation (commencing the day of surgery)

Facilitate early mobilisation through patient education and encouragement, and provide appropriate equipment and resources. Early mobilisation can:

- reduce the risk of complications
- reduce the length of hospital stay
- speed up recovery of functional walking capacity
- positively impact several patient-reported outcomes.⁷

Early mobilisation is supported by good pain management and managing nausea and vomiting. The removal of indwelling catheter (IDC) drains and intravenous (IV) fluids also enables early mobilisation. Clinical decision-making tools can improve clinician compliance with mobilisation recommendations.⁷

When developing a local ERAS protocol, the definition of early mobilisation should be agreed upon by all stakeholders, i.e. patients are mobilised if they have performed either of the following: ambulated a distance of around three metres or more or ambulated for a time of two minutes or more.

Early intake of oral fluids and solids (offered from the day of surgery)

Avoid delays in resuming oral fluids and diet after most types of surgery. Delays in resuming a normal (or baseline) diet are associated with increased rates of complications and can slow recovery.⁹ If appropriate, commence oral intake from the day of surgery, after discussions with the surgeon. Where oral intake is not possible, enteral (or where needed parenteral with slow rate enteral) feeding should be started without delay.

Early removal of urinary catheters and intravenous fluids (morning after surgery)

Encourage early removal of IDC unless needed for fluid balance or tissue healing and depending on the nature of the surgery. The duration of catheterisation is directly related to a risk of urinary tract infection, and may hinder post-operative mobilisation and recovery.⁹

IV fluids should be removed or reduced as soon as practicable. Oral fluid intake should also be encouraged as tolerated to reduce the use of post-operative IV fluids.

Any reasons to not remove an IDC or IV fluids should be documented in the medical record.

Minimise dose and duration of postoperative opioid prescriptions

Use multimodal analgesics, including non-opioid and atypical opioid, and avoid routine use of sustained-release opioids. Assess the patient's pre-existing opioid use and aim to limit postoperative opioid dose and duration.

This will also depend on the surgical specialty.

Audit outcomes and processes in a multiprofessional and multidisciplinary team regularly

Ensure data are collected and audited every three months to facilitate the implementation and monitoring of compliance with ERAS protocols. Use existing audit tools, if available, to provide benchmarking capability with other hospitals, nationally and internationally.¹⁰

Enablers for implementation

A systematic review¹⁰ identified key enablers for implementing ERAS. These include:

- adapting the model to fit local contexts
- achieving and demonstrating early wins
- gaining buy-in from both frontline clinicians and hospital leadership
- having a strong enhanced recovery team that meets regularly
- leveraging supporters and full-time enhanced recovery pathway staff.¹¹

In addition, the CFIR was used to identify local, high-priority implementation strategies to support the uptake of ERAS principles and models in NSW.³ The CFIR includes five domains that can explain implementation barriers and enablers and can be used to inform choice of implementation strategies.

These domains are innovation (e.g. the 'thing' being implemented such as the ERAS protocol), outer setting (e.g. the setting in which the inner setting exists, such as the broader hospital or community setting), inner setting (e.g. the setting where implementation is happening), individuals (e.g. the roles and characteristics of individuals) and implementation (e.g. activities and strategies to implement the innovation³).

The CFIR has demonstrated applicability to data collection, analysis and implementation for ERAS.^{12,13}

Panel members identified local barriers and enablers, and these were mapped across the CFIR domains:

Barrier/enabler	CFIR domain
Promoting the evidence base for ERAS and its effectiveness	Innovation
Leveraging performance measurement pressure	Outer setting
Drawing on shared values and continual improvement Providing access to resources to implement and deliver ERAS principles and models locally Accessing guidance and training to implement and deliver Communicating with high-quality formal and informal information-sharing practices	Inner setting
Gaining sponsorship from high-level leaders, leveraging influence from opinion leaders and individuals	Individual
Teaming up and internationally coordinating and collaborating to develop and implement ERAS principles and models, engaging and adapting to support integration into local work processes	Implementation

The following strategies can be used to support the implementation of ERAS principles and models in NSW. [Redesign and change management resources](#) available through the ACI can further support the local implementation of ERAS principles.

Governance and clinical and opinion leaders

Gaining sponsorship from high-level leaders and leveraging influence from clinical and opinion leaders will likely support local ERAS implementation in NSW. High-level leaders, such as executives and heads of departments, are key decision-makers, and opinion leaders are individuals who will likely have informal influence over others.³ Building a coalition of support through clinical and non-clinical staff and conducting local consensus discussions (e.g. to agree on the clinical pathway) will support implementation locally.

A local plan to support implementation should outline:

- clear roles and responsibilities
- specific steps and milestones
- goals and measures for success.

Steering committees or working groups should represent surgical specialties and multidisciplinary teams, such as nursing and allied health, to ensure a cross-organisational response. An ERAS coordinator (with subject matter expertise) can support implementation efforts.

Resourcing

Consider developing a local business case and leverage resources such as funding, materials and equipment to support implementation efforts locally. Consider how ERAS components are designed and packaged, including how they are assembled, bundled and presented (e.g. patient education booklets). Assess infrastructure needs, such as information technology (e.g. access to telehealth or eMR requirements), and the workforce (e.g. responsibilities within and between individuals and teams, who is best to lead various components of the implementation and the flow-on effect on other teams in pre-and post-operative phases).

Learning and knowledge-sharing

Coordinate and deliver guidance and training to implement ERAS locally. It is acknowledged that new graduates, staffing turnover and junior medical officer changeover may impact the implementation of ERAS. Timely on-the-job training about ERAS effectiveness and local protocols is required at the team level. This can be delivered locally by knowledgeable surgical specialties and multidisciplinary teams.

Data collection and audit

Collect and audit data to facilitate implementing and monitoring compliance with ERAS. Specific data points may include:

- percentage of patients completing the ERAS pathway
- length of hospital stay
- complication rates
- readmission rates
- staff experience
- patient-reported measures.

An [audit and feedback guide for colorectal ERAS](#) is available as an example.

List of ERAS interventions

The seven key principles outlined above to support uptake and implementation of ERAS in NSW were drawn from the list in Figure 1, following a consensus among the panel members through the e-Delphi process. The explanation for each principle has been revised to reflect the local NSW context.

Figure 1. Guideline elements adapted from Ljungqvist et al, 2017²

	Interventions	Target effect and/or comment
Pre-admission	Cessation of smoking and excessive intake of alcohol	Reduce complications
	Preoperative nutritional screening and, as needed, assessment and nutritional support	Reduce complications and optimise nutritional status
	Medical optimisation of chronic disease	Reduce complications
Preoperative	Structured preoperative information and engagement of the patient and carers	Reduce anxiety, involve the patient to improve compliance with protocol
	Preoperative carbohydrate treatment	Reduce insulin resistance, improve wellbeing, minimise preoperative fasting and possibly faster recovery
	Preoperative prophylaxis against thrombosis	Reduce thromboembolic complications
	Preoperative prophylaxis against infection	Reduce infection rates
	Prophylaxis against nausea and vomiting	Minimise post-operative nausea and vomiting
Intra-operative	Minimal invasive surgical techniques	Reduce complications, faster recovery, reduce pain
	Intraoperative prophylaxis against thrombosis (adapted for the NSW context)	Reduce thromboembolic complications
	Standardised anaesthesia, avoiding long-acting opioids (multimodal analgesia with standardised pain management processes and avoidance of long-acting opioids; adapted for the NSW context)	Avoid or reduce post-operative ileus
	Maintaining fluid balance to avoid over- or under-hydration, administer vasopressors to support blood pressure control	Reduce complications, reduce post-operative ileus
	Epidural anaesthesia for open surgery (regional anaesthesia, which may include epidural anaesthesia, TAP blocks, preperitoneal catheters or paravertebral/erector spinal blocks; adapted for the NSW context)	Reduce stress response and insulin resistance, basic postoperative pain management
	Restrictive use of surgical site drains	Support mobilisation, reduce pain and discomfort, no proven benefit of use
	Removal of nasogastric tubes before reversal of anaesthesia	Reduce the risk of pneumonia, support oral intake of solids
	Control of body temperature using warm air flow blankets and warmed intravenous infusions	Reduce complications

	Interventions	Target effect and/or comment
Postoperative	Early mobilisation (day of surgery)	Support return to baseline movement
	Early intake of oral fluids (or enteral where oral is not possible) and solids (offered the day of surgery)	Support energy and protein supply, support return to gut function, reduce starvation-induced insulin resistance and reduce risk of complications
	Early removal of urinary catheters and intravenous fluids (morning after surgery)	Support ambulation and mobilisation
	Postoperative prophylaxis against thrombosis	Reduce thromboembolic complications
	Use of chewing gums and laxatives and peripheral opioid-blocking agents (when using opioids)	Support return of gut function
	Intake of protein and energy-rich nutritional supplements or diet using diet fortification	Increase energy and protein intake in addition to normal (baseline) food and reduce risk of malnutrition related complications
	Multimodal approach to opioid-sparing pain control	Pain control reduces insulin resistance, supports mobilisation
	Multimodal approach to control of nausea and vomiting	Minimise postoperative nausea and vomiting and support energy and protein intake
	Prepare for early discharge	Avoid unnecessary delays in discharge
	Audit of outcomes and process in a multi-professional, multidisciplinary team on a regular basis	Control of practice (a key to improve outcomes)

Limitations

The key principles for implementation of ERAS models are for various subspecialties and do not reflect the nuance for every clinical condition. The information in this document should not replace a clinician's professional judgement and should be used in conjunction with the relevant clinical guidance.

A review of the peer-reviewed literature has not been completed for each individual ERAS principle identified in this document.

The current scope of principles covered by the ERAS Society does not incorporate post-discharge care, and, as such, has not been incorporated into [Figure 1](#).

References

- Francis NK, Walker T, Carter F, et al. Consensus on training and implementation of enhanced recovery after surgery: a Delphi study. *World J Surg.* 2018 Jul;42(7):1919-1928. Available from: <https://link.springer.com/article/10.1007/s00268-017-4436-2> DOI: 10.1007/s00268-017-4436-2
- Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: a review. *JAMA Surg.* 2017 Mar 1;152(3):292-298. Available from: <https://jamanetwork.com/journals/jamasurgery/article-abstract/2595921> DOI: 10.1001/jamasurg.2016.4952
- Damschroder LJ, Reardon CM, Widerquist, MAO, et al. The updated Consolidated Framework for Implementation Research based on user feedback. *Implementation Sci.* 2022;17(75). Available from: <https://implementationscience.biomedcentral.com/articles/10.1186/s13012-022-01245-0> DOI: 10.1186/s13012-022-01245-0
- Agency for Clinical Innovation (ACI). Evidence check – Post-surgery innovations: enhanced recovery after surgery, early mobilisation and discharge [Internet]. Sydney: ACI; 2020 [cited: 6 Dec 2022]. Available from: https://aci.health.nsw.gov.au/_data/assets/pdf_file/0007/594520/Evidence-Check-Resuming-elective-surgery-post-surgery-innovations-enhanced-recovery-early-mobilisation-and-discharge.pdf
- Agency for Clinical Innovation (ACI). Enhanced recovery after surgery: key principles for colorectal surgery [Internet]. Sydney: ACI; 2022 [cited: 6 Dec 2022]. Available from: https://aci.health.nsw.gov.au/_data/assets/pdf_file/0003/736617/ERAS-Key-principles-for-colorectal-surgery.pdf
- Poland F, Spalding N, Gregory S, et al. Developing patient education to enhance recovery after colorectal surgery through action research: a qualitative study. *BMJ Open.* 2017;7:e013498. Available from: <https://bmjopen.bmj.com/content/7/6/e013498> DOI:10.1136/bmjopen-2016-013498
- Tazreean R, Nelson G, Twomey R. Early mobilization in enhanced recovery after surgery pathways: current evidence and recent advancements. *J Comp Eff Res.* 2022 Feb;11(2):121-129. Available from: <https://becarispublishing.com/doi/10.2217/cer-2021-0258> DOI: 10.2217/cer-2021-0258
- White D, Rockall TA. ERAS and minimally invasive surgical techniques. In: Ljungqvist O, Francis N, Urman R (eds). *Enhanced recovery after surgery.* Springer, Cham; 2020. Available from: https://doi.org/10.1007/978-3-030-33443-7_19
- Gustafsson UO, Scott MJ, Hubner M, et al. Guidelines for perioperative care in elective colorectal surgery: Enhanced Recovery After Surgery Society recommendations. *World J Surg.* 2018;43:659–695. Available from: <https://link.springer.com/article/10.1007/s00268-018-4844-y> DOI: 10.1007/s00268-018-4844-y
- Currie A, Soop M, Demartines N, et al. Enhanced Recovery After Surgery Interactive Audit System: 10 years' experience with an international web-based clinical and research perioperative care database. *Clin Colon Rectal Surg.* 2019 Jan;32(1):75-81. Available from: <https://pubmed.ncbi.nlm.nih.gov/30647549> DOI: 10.1055/s-0038-1673357
- Stone AB, Yuan CT, Rosen MA, et al. Barriers to and facilitators of implementing enhanced recovery pathways using an implementation framework: a systematic review. *JAMA Surg.* 2018;153(3):270-9. Available from: <https://jamanetwork.com/journals/jamasurgery/article-abstract/2669915> DOI: 10.1001/jamasurg.2017.5565
- Drew S, Judge A, Cohen R, et al. Enhanced Recovery after Surgery implementation in practice: an ethnographic study of services for hip and knee replacement. *BMJ Open.* 2019 Mar 5;9(3):e024431. Available from: <https://bmjopen.bmj.com/content/9/3/e024431> DOI: 10.1136/bmjopen-2018-024431
- Judge A, Carr A, Price A, et al. The impact of the enhanced recovery pathway and other factors on outcomes and costs following hip and knee replacement: routine data study. *Health Serv Deliv Res.* 2020;8.4. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK553561/>