IMPLEMENTATION OF ERAS

AORN
SAFE SURGERY TOGETHER

TABLE OF CONTENTS

P *indicates a recommendation or evidence relevant to pediatric care.*

MEDICAL ABBREVIATIONS & ACRONYMS

ACS – American College of Surgeons
ASA – American Society of Anesthesiologists
CRP – C-reactive protein
dIVCmax – Maximum inferior vena cava diameter
dIVCmin – Minimum inferior vena cava diameter
EDM – Esophageal Doppler monitor
ERAS – Enhanced recovery after surgery
GDFT – Goal-directed fluid therapy
HPI – Hypotension prediction index
hsTnT – High-sensitivity troponin levels
ICU – Intensive care unit
IVC-CI – Inferior vena cava collapse index
LB – Liposomal bupivacaine
MACE – Major adverse cardiac events
MINS – Myocardial injury after noncardiac surgery
NICOM – Noninvasive cardiac output monitoring
NSQIP – National Surgical Quality Improvement Program
PONV – Postoperative nausea and vomiting
PROM – Patient reported outcome measure
RCRI – Revised Cardiac Risk Index
RCT – Randomized controlled trial
RN – Registered nurse
SSI – Surgical site infection
TAP – Transverse abdominal plane
VTE – Venous thromboembolism

GUIDELINE FOR THE IMPLEMENTATION OF ENHANCED RECOVERY AFTER SURGERY

The Guideline for the Implementation of Enhanced Recovery After Surgery was approved by the AORN Guidelines Advisory Board and became effective as of November 21, 2024. including the PROSPERO registration number, systematic review questions, description of the search strategy and evidence review, PRISMA 2020 flow diagram, evidence rating model, and evidence summary table is available at https://www.aorn.org/evidencetables/.

Purpose

Enhanced recovery after surgery (ERAS) is an interdisciplinary approach to surgical care that aims to optimize patient outcomes and accelerate recovery following surgery. It involves the implementation of evidence-based protocols and guidelines to enhance the patient's physiological and psychological condition before, during, and after surgery. ERAS protocols aim to minimize the physiological stress response to surgery. This can be achieved through methods described in this guideline.

This document provides guidance to perioperative teams for implementing ERAS components for every patient population. Some patients might not be good candidates for all ERAS components, but most **ERAS principles** can be safely implemented in most patient populations. These recommendations, which are based on a systematic review of the literature, are intended to support perioperative registered nurses (RNs) and other clinicians in implementing ERAS evidence-based interventions for patients undergoing operative and other invasive procedures in any setting. Additional guidance for specific procedures is outside the scope of this document, and clinicians are encouraged to follow the ERAS Society's procedure-specific guidance.

1. ERAS Program Planning

1.1 **Health care organizations should be aware of specialty ERAS guidelines and implement the protocols in these specialties.** *[Recommendation]*

The ERAS Society is a global interdisciplinary organization dedicated to promoting and advancing the principles of ERAS protocols in surgical care. The society brings together health care professionals, researchers, educators, and policymakers to collaborate, share knowledge, and advocate for the widespread adoption of ERAS practices. The ERAS Society develops evidence-based ERAS guidelines and protocols for certain specialties and collaborates with experts in these specialties to develop and update ERAS guidelines and protocols based on the latest research and best practices.[1]

1.2 **Implement an ERAS program.** *[Recommendation]*

A comprehensive ERAS program considers every step of the patient's experience, starting from the moment they are referred for a surgical procedure until their ultimate discharge. While each individual care element may not yield substantial benefits when examined independently, their integration with other components of the treatment process is believed to create a powerful synergistic effect.[2-33]

High-quality evidence supports that the implementation of an ERAS program benefits the patient. Some of the benefits found in the literature include

- reducing the incidence of patient complications (eg, surgical site infection [SSI]),[34-54]
- promoting a faster recovery,[37,47]
- promoting a shorter length of hospital stay,[30,32,34 36,38,39,41-46,48-51,53,55-89]
- improving patient satisfaction,[47]
- reducing morbidity rates in certain procedures,[55,63]
- reducing readmission rates,[30,34,40,46,50,54,60,75]
- improving functional recovery,[35,42,49,53,58,61,68,76,80,85,90]
- decreasing opioid consumption,[56,69,80,87-89]
- reducing pain,[35,40,61,66,68,69,71,80,87,88,91]
- decreasing intraoperative blood loss,[80,85]
- reducing the incidence of postoperative nausea and vomiting (PONV),[38,71,80]
- decreasing patient depression and anxiety,[91,92] and
- decreasing costs.[34,43,44,46,56,59,66,67,76,77,80,81,83,86,93]

In addition to these benefits to the patient, there is evidence of benefits to nursing staff who provide care to patients admitted to the intensive care unit (ICU) after surgery. A quasi-experimental study examined the workload of nurses caring for 100 surgical patients in a cardiac ICU, with 50 patients enrolled in an ERAS protocol and 50 patients not receiving the protocol. The Nursing Activities Score was used to assess nurses' workload in terms of demand for nursing care in the ICU. The study found that nurses' workload was significantly lower with the ERAS group patients compared to the non-ERAS group patients.[94]

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1.2.1 **The ERAS program should be developed and overseen by an interdisciplinary team that includes**

- **ERAS coordinator(s) designated by the organization who have the expertise and authority needed to lead the program,**
- **anesthesia professionals,**
- **surgeons,**
- **perioperative RNs,**
- **perianesthesia RNs (representing both preoperative and postoperative phases of care),**
- **RNs representing surgeons' clinics,**
- **pharmacists,**
- **nutritionists**
- **physiotherapists**
- **nurse informaticists,**
- **quality assurance professionals, and**
- **others identified by the organization (eg, a designated pain specialist, other specialists, educators, leaders).**

[Recommendation]

Each member of the team plays a specific role in implementing the various components of the ERAS program. Collaboration is essential because it allows for a coordinated and seamless delivery of care throughout the perioperative period. By working together, health care professionals can expect that all aspects of the program are implemented effectively and that the patient receives comprehensive and individualized care. Collaboration also enables the team to identify and address any potential barriers to recovery and allows for continuous quality improvement and the sharing of best practices among team members. Perioperative RNs hold the essential role of care coordinators in the perioperative setting and can best facilitate this collaboration.

Although the literature review for this guideline did not find studies specific to the contributions of all ERAS team member roles, there was research specific to the pharmacist's role to optimize medication management before, during, and after surgery.[95] Pharmacists contribute to developing and implementing evidence-based protocols and guidelines to enhance patient outcomes, improve medication safety, and promote efficient medication use. They may participate in research activities and quality improvement initiatives to evaluate and optimize medication management practices in the ERAS program.[95] Additionally, pharmacists may participate in the selection of preoperative antibiotics to reduce the incidence of SSIs.

Pharmacists address barriers to optimal pain management by educating the perioperative team and patients about evidence-based guidelines for effective care. They provide education to surgical and other patients on the safe use, storage, and proper disposal of opioids. Additionally, pharmacists instruct caregivers on the appropriate use of naloxone. As the field of public health care continues to evolve, patients and health care teams greatly benefit from the expertise and involvement of pharmacists.[96]

Including a nutritionist in the core interdisciplinary team supports incorporating nutrition risk screening into ERAS programs to gather vital information about patients who may be at nutritional risk. This screening helps to identify the need for nutrition resources and care, as well as provides insight into how nutrition risk can affect adherence and outcomes within ERAS programs. Patients who screen positive for nutrition risk can be promptly referred to a registered dietitian or nutritionist for a thorough nutrition assessment. This assessment aims to determine the severity of malnutrition or other nutrition-related concerns, considering factors like underlying causes and the presence of symptoms.[97]

Additional interdisciplinary team members needed for specific phases of care and patient populations are listed in other sections of this guideline.

1.2.2 **During the development process for the ERAS program, the interdisciplinary team should consult with executive leadership at the organization.** ***[Recommendation]***

Organizational executive leaders can provide support for the ERAS program by bolstering organizational buy-in and including the program and its needed resources in the financial and strategic plan.

1.3 **Create a standardized clinical care pathway as part of the ERAS program.** ***[Recommendation]***

Implementing a standardized clinical care pathway allows the entire perioperative team to systematically manage the patient's care, reducing variability and optimizing predictable outcomes.[98]

1.3.1 **The standardized clinical care pathway should include considerations foundational to ERAS, such as**[99,100]

- **preoperative counseling,**
- **perioperative glucose control (ie, avoid hyperglycemia and minimize insulin resistance),**[101]
- **preoperative smoking and alcohol cessation,**[101]
- **surgical optimization to include nutrition and exercise,**[101]
- **antimicrobial prophylaxis and skin preparation,**[101]

- **multimodal analgesia,**[101]
- **opioid minimization,**
- **regional anesthesia,**
- **preoperative fasting and carbohydrate loading,**[101]
- **maintenance of euvolemia,**[101]
- **PONV prophylaxis,**[101]
- **venous thromboembolism (VTE) prophylaxis,**[101]
- **patient temperature management,**
- **minimization of drains and catheters,**
- **use of recovery scores and readiness for discharge scales,**
- **early postoperative feeding and mobilization,**[101] **and**
- **postoperative analgesia.**

[Recommendation]

A systematic review explored the perioperative care protocols associated with successful ambulatory breast reconstruction procedures. The researchers focused on studies that described perioperative care protocols for postmastectomy breast reconstruction in ambulatory settings (with discharge within 24 hours). There were 12 studies involving 1,484 patients that investigated 16 ERAS items. Preoperative counseling was mentioned in 11 of 12 studies, preoperative and intraoperative multimodal analgesia was part of the protocol in 11 of 12 studies, and postoperative analgesia was mentioned in 10 of 12 studies. The researchers recommended implementing thorough ERAS protocols, which is crucial for maintaining consistent discharge procedures and reducing the risk of higher readmission rates and postoperative complications.[102]

In a systematic review, researchers reviewed 21 currently published ERAS surgery protocols to determine if consensus was reached across ERAS core items. A consensus was reached regarding 21 core components of the current ERAS guidelines, particularly those concerning pharmacology and pharmacotherapy selection, including specifics about dosage schedules and administration timing. However, there is still a need for additional research and standardization on unique elements associated with specific surgical procedures. This will aid in enhancing guidelines, bolstering uniformity, and improving patient results.[101]

1.3.2 **The standardized clinical care pathway should be structured to allow for individualization using procedure-specific protocols.** *[Recommendation]*

The structure of the standardized clinical care pathway provides the foundation on which individualization according to the procedure type and the nuances associated with each are built.

2. ERAS Program Implementation

2.1 **Implement an ERAS program under the direction of the interdisciplinary team** (see Recommendation 1.2.1)**.**[18,31,103-117] *[Recommendation]*

Successful implementation of an ERAS program and ERAS principles necessitates collaboration and careful organization among all perioperative team members. Institutions can use established strategic frameworks for implementation or tailor a strategy to address the unique requirements of their facility and take into account any obstacles to change within the local context.[18,114,117]

Effective change often starts with a small, engaged team committed to continuous improvement. The team's success is enhanced when there is a focus on initial learning and ongoing education, training, and development as central components of engagement. By continuously improving the program, starting with a small team (eg, perioperative decision makers, champions, administrators, ancillary department leaders) and then gradually scaling up, organizations can stay on track and identify any gaps in implementation that need to be addressed.[31]

2.2.1 **Implementation strategies may include actions listed in Table 1.**[31,32,96,106,107,111-113,115,116,118-128] *[Conditional Recommendation]*

Reducing the surgical stress response, minimizing variability in care to prevent errors, and ultimately enhancing patient outcomes are crucial concepts to instill in developing an ERAS culture. Providing education and training that emphasizes the benefits to the patient can orient team members toward this common goal and rally institutional support behind the initiative.[18,31,105,108,115,118,120,122,124,128]

Implementation challenges are best addressed by collaborative practice. Clinical pharmacists involved in program development may help to overcome barriers by planning for therapeutic options, building the electronic medical record for ERAS medications, and helping to develop **ERAS pathways**.[95]

A common obstacle to implementation is the variation in care driven by physicians' strong personal preferences. Some programs have successfully navigated this challenge by involving physician leaders and representatives from various disciplines to develop and advocate for key elements of protocols. By basing these protocols on the best available evidence, organizations can maintain a sense of impartial objectivity, shifting the focus of discussions toward the patient's well-being and away from historical provider preferences.[108,118] Additionally the use of a structured electronic health record order set can help to reduce variability and guide clinical practice.[129]

Table 1. Actions that May Be Used as Successful ERAS Program Implementation Strategies

Phase	Action	Method	For Example
Deciding to Implement Changes to Practice	Identifying the need for change[31,118,127]	Conducting a gap analysis to identify variances in non-standardized delivery of care[105,110,115,118,125]	• Gaps in existing protocols • Unstructured or non-standardized approaches to patient education • Gaps in knowledge of team members
	Communicating a sense of urgency[31,118,127]	Using communication channels to disseminate the message	• Team huddles • Scheduled meetings for existing committees with oversight of perioperative services
Planning the Change	Structuring the plan	Using a structured framework and a stepwise approach when planning, designing, implementing, and evaluating an ERAS program[30,105,106,110-112,114,119-124,127]	• Change theory • Human factors model • Quality improvement process
	Identifying the interdisciplinary team	Including all disciplines whose expertise is needed and work is affected	**See Recommendation 1.2.1**
	Identifying program leaders and champions	Selecting leaders who have the knowledge and authority to lead the clinical practice changes for ERAS[30,104-106,110-112,114,119-124]	• Surgeons • Anesthesiologists • RNs
	Identifying a dedicated ERAS nurse coordinator	**See Recommendation 2.3**	Creating a position for an ERAS nurse coordinator
	Engaging frontline team members	Using effective communication about the implementation process, education of team members, and new hire education[31,95,110,114,115,124]	Tailoring the message and feedback mechanisms according to team roles
Implementing the Change	Piloting the ERAS program/pathway/principles and adjusting as needed before an organization-wide implementation[117]	Starting with a select segment of the organization's service lines	Beginning with the segment physicians and anesthesia professionals who demonstrate optimism about the program
	Making the changes part of the perioperative team's culture and workflow	Integrating the changes into the team's existing workflows and standard communication methods	Adding ERAS components to the organization's surgical safety checklist[126]
	Identifying and addressing barriers to implementation	Conducting ongoing monitoring of the program and making adjustments where barriers are identified	Regularly and intentionally soliciting feedback from surgeons, anesthesia professionals, and other members of the perioperative team

In a study aimed at integrating ERAS guidelines with the World Health Organization's Surgical Safety Checklist, a diverse group of international ERAS users from various clinical specialties participated in a three-round modified Delphi model. The study evaluated 27 recommendations for colorectal and gynecological oncology surgeries to determine their appropriateness for inclusion in an ERAS surgical safety checklist. The researchers concluded that the Surgical Safety Checklist could be adapted to align with ERAS recommendations for patients undergoing major surgery. Decision makers and experts collaborated to create an ERAS surgical safety checklist that could be implemented directly or used to modify existing institutional checklists for easier adoption.[126]

2.2 Include ongoing evaluation of patient outcomes and audits of ERAS program intervention compliance in ERAS program implementation.[5,18,30,103-108,110,112,114,115,117,119-124,130,131] *[Recommendation]*

See Section 8: Quality for more information about program evaluation, monitoring, and performance improvement.

2.1.1 The interdisciplinary team (see Recommendation 1.2.1) should determine the outcomes on which the ERAS program will focus (ie, informed by a review of the current status and identification of gaps in care). The team will determine the targets or metrics related to those outcomes and the processes or clinical interventions to meet those metrics.[118] *[Recommendation]*

Utilizing local information and technology resources in conjunction with the clinical expertise of the ERAS team can facilitate the development of dashboards for regular review. By integrating

patient-reported outcomes into these dashboards and leveraging existing data management infrastructure used for other purposes, organizations can effectively monitor program compliance and track progress.[108,118,130]

2.3 **The ERAS program should include a dedicated ERAS nurse coordinator.**[18,34,109,113,118,120,132] *[Recommendation]*

The ERAS nurse coordinator serves as a pivotal figure within the interdisciplinary team, taking on responsibilities such as planning meetings, working directly with ERAS champions, collecting data, communicating with organizational leaders, and actively advocating for ERAS principles among perioperative teams. The primary objective of the ERAS nurse coordinator is to enhance compliance in daily clinical practice and serve as the patient liaison. Acting as a liaison within ERAS programs, as well as within the department and the health care facility, the nurse coordinator provides valuable feedback used to refine protocols and is essential for the successful implementation and continuous evaluation of the ERAS protocols.[109]

2.4 **Perioperative RNs should be included in each phase of ERAS program implementation.** *[Recommendation]*

Perioperative RNs play a crucial role in coordinating care in the perioperative care setting, and this care coordination is imperative for successful ERAS programs.[133] In addition, basic nursing interventions are fundamental to ERAS success. These include creating guidelines for patient education; designing and implementing plans of care throughout the perioperative care continuum;[134] preoperative counseling and education;[135] discharge preparation; in-hospital care; postoperative monitoring;[136] and post-discharge follow-up through phone calls, text messages, or visits.[133,137] Perioperative RNs liaise with primary care and outpatient surgery teams to coordinate prehospital and post-discharge ERAS care. These actions directly influence the quality of health care delivered to patients, leading to positive patient outcomes.[120,138] Nurses provide health care assessments, educate patients, coordinate and evaluate care, and conduct research in ERAS programs.[139]

3.1.1 **The organization may identify ERAS nurse navigators as a means to promote patient education and to encourage patient adherence to ERAS protocols and interventions.** *[Conditional Recommendation]*

A study of 100 patients undergoing colon surgery compared patients who did and did not have an ERAS nurse navigator. Nurse navigators educated patients and supported adherence to ERAS protocols. The researchers found that nurse navigators can influence patient adherence to ERAS protocols and demonstrated a reduction in the use of opioids at discharge for participants in this study.[140]

2.5 **Implement ERAS principles and pathways in both inpatient and ambulatory surgical settings.** *[Recommendation]*

Research on ERAS in ambulatory surgery settings is limited. However, the principles of ERAS that have proven effective in inpatient settings can also be applied to patients undergoing ambulatory and short-stay surgeries. As ambulatory surgery facilities increasingly take on more complex procedures, the development of ERAS pathways becomes crucial for ensuring successful outcomes and expansion. While a shorter length of stay is a key indicator of success in inpatient ERAS programs, this may not hold the same importance in the ambulatory setting. Instead, the focus of ERAS programs in ambulatory surgery should be reducing variance in other patient outcomes to enhance overall quality of care.[98] Patient outcomes for ambulatory surgery ERAS programs may include reduced pain, minimization of opioid use, reduced incidence of PONV and post-discharge PONV, early ambulation, improved quality of recovery, and improved patient satisfaction.[98]

Many specialties have specific ERAS guidelines that have been developed based on systematic evaluation of best evidence, and these are a good resource for ambulatory surgical settings.

3. Prehabilitation Phase/ Surgical Optimization

3.1 **An interdisciplinary team that includes those responsible for the ERAS program (see Recommendation 1.2.1) and members of other disciplines with the needed expertise for surgical optimization (see Recommendation 3.1.1) should make decisions on individual patient surgical optimization interventions, taking into consideration individual patient comorbidities and the type of surgery.**[16,17,19,31,122,141-189] *[Recommendation]*

Surgical optimization refers to the process of optimizing a patient's physical and mental health before surgery. In the literature, the terms *prehabilitation* and *surgical optimization* are used interchangeably. The goal of surgical optimization is to identify medical complexities and risk stratification and enhance a patient's ability to withstand the stress of surgery, minimize complications, and improve patient recovery. Surgical optimization offers a chance for personalized patient care and serves as a strategy to promote patients' engagement in their own health care. ERAS

emphasizes the importance of individualized care and empowering patients to take an active role in their recovery process.[145,183]

3.1.1 **In addition to the ERAS interdisciplinary team described in Recommendation 1.2.1, professionals from other disciplines who may provide needed surgical optimization expertise include**

- **physiotherapists,**
- **occupational therapists,**
- **internists,**
- **cardiologists,**
- **nutritionists,**
- **wound ostomy nurses,**
- **smoking cessation facilitators, and**
- **mental health professionals (eg, psychologists, psychiatrists, therapists, social workers).**

[Conditional Recommendation]

3.2 **Begin ERAS surgical optimization with an individualized patient assessment (eg, frailty screening, cardiopulmonary exercise testing, anemia identification, nutritional assessment, assessment of unhealthy lifestyle behaviors such as smoking, cognitive and psychological assessments) and optimize modifiable comorbidities in the preoperative process.**[9,31,142,157,159,183,187,190,191] ***[Recommendation]***

ERAS surgical optimization generally begins weeks to months before the scheduled procedure. Individualized patient assessment is essential in determining each patient's functional status, identifying those at high risk for intraoperative complications, and identifying barriers to optimal recovery after surgery. Preoperative testing is focused on individual patient risk factors and symptoms that may affect patient care.[17,21,22,143,174,176,192]

For most patients, minimal testing is necessary, and no testing is usually needed for healthy patients undergoing low-risk procedures. Focused risk-based assessments found in the literature include

- electrocardiogram[143];
- stress testing[143];
- B-natriuretic peptide[143];
- hemoglobin and hematocrit[17,21,22,143,174,176,192];
- platelets[143];
- creatinine[143];
- electrolytes[143];
- fasting glucose and hemoglobin A1c[17,21,143,174,176];
- liver enzymes[143];
- coagulation studies[143];
- albumin, pre-albumin, and transferrin[143,174];
- pregnancy testing[143];
- urinalysis[143];
- methicillin-resistant *Staphylococcus aureus* screening[143];
- chest x-ray[143];
- pulmonary function test[143]; and
- sleep study.[143]

3.2.1 **Use preoperative risk assessment tools that are validated or demonstrated as reliable for surgical patients to evaluate risk for all patients.** ***[Recommendation]***

Validated preoperative risk assessment tools include

- cardiac risk calculators (eg, Revised Cardiac Risk Index/Lee Criteria [RCRI], Gupta MICA, ACS NSQIP, AUB-HAS2, DASI),[8,9,19,21,22,143,185,193]
  - measuring biomarkers troponin, BNP (B-type natriuretic peptide), NT-proBNP (N-terminal pro B-type natriuretic peptide)
- pulmonary risk calculators (eg, Gupta Respiratory Failure, Gupta Postoperative Pneumonia, ARISCAT, ACS NSQIP, STOP-BANG, sleep apnea clinical score),[143,193]
- VTE risk calculators (eg, Caprini, ACCP, ACS NSQIP),[143,194] and
- PONV risk calculators (eg, Apfel Score, Koivuranta Score).[9,10,13,29,31,143,193]

The RCRI is a commonly used screening tool to estimate the likelihood of cardiac events in patients undergoing noncardiac surgery. However, the accuracy of this tool is not always reliable; therefore, a 2021 Cochrane review investigated whether adding information such as biomarkers to the RCRI would improve the prediction of cardiac-related events in patients undergoing noncardiac surgery. The study identified 69 different predictors that were added to the RCRI tool. The accuracy of the RCRI seemed to improve with the addition of some biomarkers derived from blood, which included troponin, BNP, and NT-proBNP. The authors concluded that Troponin, BNP or NT-proBNP may improve the ability of the RCRI to predict heart-related complications.[195]

A prospective cohort study conducted in 16 hospitals across nine countries involved 10,400 patients ages 45 years or older undergoing inpatient noncardiac surgery. The study aimed to assess whether preoperative NT-proBNP levels provided additional predictive value compared to a clinical risk score for the combined outcome of vascular death and myocardial injury within 30 days post-surgery. All patients had their NT-proBNP levels measured before surgery and daily for up to 3 days after the procedure. The study findings indicated that preoperative NT-proBNP levels were strongly linked to vascular death and myocardial injury within 30 days following noncardiac surgery. Additionally, incorporating

NT-proBNP levels improved the prediction of cardiac risk in conjunction with the clinical risk score. This suggests that NT-proBNP could serve as a valuable marker for identifying patients at higher risk of adverse cardiovascular events after noncardiac surgery.[196]

Using validated preoperative risk assessment tools can enhance clinical decision-making. A systematic review and meta-analysis examined the efficacy and accuracy of BNP, cardiac troponin, high-sensitivity C-reactive protein (hsCRP), and C-reactive protein (CRP) in predicting major adverse cardiovascular events in patients undergoing noncardiac surgery. The review included 26 studies with a total of 7,877 patients. The findings revealed a significant association between BNP/NT-proBNP, cardiac troponin, and hsCRP levels with major adverse cardiovascular events in patients undergoing noncardiac surgery. The analysis indicated that all five biomarkers increased the risk of major adverse cardiovascular events. Specifically, elevated levels of BNP, cardiac troponin, and hsCRP either preoperatively or immediately after surgery were predictive of a substantially higher risk of postoperative major adverse cardiovascular events in patients undergoing noncardiac surgery.[197]

None of the other predictive models demonstrated superior performance in predicting major adverse cardiac events (MACE) compared to the RCRI. Additionally, the predictive accuracy of the RCRI for MACE improves when incorporating NT-proBNP or BNP, as well as troponin or their combinations. These biomarkers could potentially serve as valuable tools for identifying individuals at increased risk for adverse cardiovascular outcomes following noncardiac surgery.[197]

The 2022 European Society of Cardiology Guidelines on Cardiovascular Assessment and Management of Patients Undergoing Non-Cardiac Surgery provides evidence-based guidance for the screening and management of patients undergoing noncardiac surgery and offers a stepwise evaluation of the patient that integrates clinical risk factors and test results with recommended strategies based on that patient assessment.[198]

3.2.2 **Additional patient assessment tools that may be used on an individualized basis include**

- **geriatric risk calculators (eg, Risk Analysis Index, Frailty Score, Modified Frailty Index, Mini-Cog, The Katz Index, Intensive Care Delirium Screening Checklist),**[7,8,12,21,22,143,163,177,178,183,194]
- **frailty models (Phenotype Model, Cumulative Deficit Model),**[163]
- **hepatic risk calculators (eg, MELD, Child-Pugh),**[143]
- **nutritional risk calculators (eg, Nutritional Risk Screening Score, Subjective Global Assessment, Patient-Generated Subjective Global Assessment, Malnutrition Universal Screening Tool, Preoperative Nutrition Screen, Canadian Nutrition Screening Tool, Malnutrition Universal Screening Tool),**[5,11,13,14,16,17,19,21,22,97,167,177,178,183-185,193,199-205]
- **cardiopulmonary exercise testing (CPET) 2- and 6-minute walk test,**[176]
- **other risk calculators (eg, CAGE, AUDIT-C, Duke Activity Status Index),**[143]
- **surgical risk assessments to determine surgical urgency (urgent or emergent surgery has been shown to increase the risk of complications),**[143] **and**
- **pain assessment for patients with complex pain problems to include assessment of pain and current consumption of pain medications including opioids.**[31,206]

[Conditional Recommendation]

3.3 **ERAS programs may include the implementation of exercise programs for surgical optimization including targeted aerobic, strength, balance, and flexibility training.** *[Conditional Recommendation]*

Targeted training can enhance a patient's response to surgery by strengthening muscles, improving cardiovascular health, enhancing immune function, promoting weight loss, improving measures of frailty, increasing range of motion, and reducing anxiety and stress.[8,11,14,17,18,21,22,142,144-153,155,157,159,161,163,164,166,168,174,176,178,179,181,183,186,187,193,207-211]

3.3.1 **When included in ERAS surgical optimization, exercise programs may**

- **prioritize convenience and minimize burdens by being easily accessible at home or within a centralized facility where other medical appointments can also be attended**[171]**;**
- **be structured to direct patients to follow a FITT (frequency, intensity, time, and type) exercise program**[142]**;**
- **be personalized to meet individual goals, providing incentives and motivation to patients**[171]**; and**
- **be tailored to gradually increase in intensity based on the patient's cardiovascular capacity.**[171]

[Conditional Recommendation]

3.4 **ERAS surgical optimization may include implementation of nutritional therapy, as indicated by a patient assessment of nutritional key indicators and known comorbidities (eg, cancer).** *[Conditional Recommendation]*

Determination of nutritional interventions depends on the etiology of malnutrition or other nutrition-related problems.[2,5,11-13,16,17,21,22,33,97,142,145-147,150,151,153,155,157,162-164,166,168,173,174,176-179,183,189,192,193,199,200,202-205,207,209,212,213] In the perioperative period, it is essential to enhance nutrient reserves and ensure sufficient nourishment to counteract the body's catabolic reaction after surgery. Following a diagnosis of malnutrition or other nutrition issues, an individualized nutrition intervention plan can be implemented without delay. This plan is tailored to the patient's preferences and designed to support their specific condition, ultimately aiding in their recovery process.[97]

3.4.1 **Nutritional therapy interventions may include**

- **nutritional counseling,**[12,14,17,177,200,213]
- **oral essential amino acid supplementation,**[21,162,177,186,193]
- **maintaining protein intake at 1.0 g/kg to 1.2 g/kg body weight per day,**[164,209]
- **high-quality carbohydrate and protein intake 7 to 10 days prior to surgery,**[162]
- **nutritional supplements as indicated,**[2,16,174,177] **and**
- **referral to a registered dietitian.**[177]

[Conditional Recommendation]

3.5 **Include screening for and management of anemia in ERAS surgical optimization.** *[Recommendation]*

Patients with anemia are at increased risk of experiencing postoperative complications such as infections, longer hospital stays, increased morbidity, and prolonged recovery. Anemia is an independent risk factor for mortality complications during surgery.[2,7,9,10,12-14,17,21,22,29,176,183,184,186,192,193,213,214]

3.6 **Include alcohol and tobacco cessation resources and programs in ERAS surgical optimization.** *[Recommendation]*

Patients who engage in daily smoking or alcohol use face a heightened risk of experiencing complications after surgery. Patients who ingest an equivalent of three standard drinks per day have an increased risk of perioperative bleeding and wound infection.[9] Reducing or eliminating smoking and managing alcohol use has been shown to have a significant potential for reducing the occurrence of postoperative complications.[2,7-9,13,14,17,21,22,25,29,31,144,164,174,178,184-186,189,192,193,203,210,214]

3.6.1 **Smoking and alcohol cessation should be completed at least 4 weeks before planned elective surgical procedures.**[7,8,13,16,19,21,22,29,185,186,193,210,213] *[Recommendation]*

3.7 **Include individualized patient education and counseling with clear expectations (eg, pain control) in ERAS surgical optimization.** *[Recommendation]*

There is a notable dearth of studies examining the impact of patient education on outcomes. However, it is imperative that patient education be integrated into the multimodal surgical optimization process. Patient education has been shown to have a beneficial effect on patients without causing any harm. It serves as a foundation for effective communication and empowers patients to actively participate in their own care.[2,3,5,8,10-14,16,17,19,21,22,25,29,31,33,97,118,122,145,174,184-186,190,192,193,199,202,209,210,213-217]

Educating patients in the surgical optimization stage by providing comprehensive information on different analgesic options and establishing practical postoperative pain expectations can potentially reduce patients' pain and reliance on opioids.[31,206,218-222]

3.8 **ERAS surgical optimization may include psychological interventions (eg, cognitive behavioral therapy).** *[Conditional Recommendation]*

Implementing psychological interventions (eg, deep breathing exercises, progressive muscle relaxation, meditation, guided imagery, acupuncture, Reiki, inhaled essential oils) or cognitive behavioral therapy (eg, problem-solving techniques and coping strategies) can play a crucial role in alleviating distress; enhancing quality of life; and reducing anxiety, depression, pain severity, and fatigue.[17,21,142,145,146,151,157,163,166,170,174,176,178]

4. Preoperative Phase

4.1 **Oral carbohydrate-containing clear liquids may be administered in healthy patients until 2 hours before elective procedures.**[2,5,8-12,16-19,21,22,25,31,33,177,186,187,189,190,193,200,202,208,209,216,217,223-236] *[Conditional Recommendation]*

Oral carbohydrate consumption has been linked to the potential alleviation of the catabolic state during the perioperative period, less nausea and vomiting,[209] less postoperative muscle wasting,[209] a decrease in insulin resistance, and a reduction in protein breakdown.[2,224,233,237] However, there is a lack of evidence supporting this, and more research needs to be conducted on the benefits of carbohydrate-containing clear liquid administration before elective procedures.

A systematic review revealed that consuming oral carbohydrates before surgery is a beneficial and practical approach for individuals with diabetes mellitus. By consuming carbohydrates 2 to 3 hours prior to the procedure, the risk of experiencing hypoglycemic reactions caused by fasting during the perioperative

period can be avoided. This approach also helps to alleviate thirst and hunger before surgery while reducing excessive gastric juice secretion, delayed gastric emptying, and the occurrence of aspiration pneumonia and other unfavorable events. Although oral carbohydrate intake before surgery may temporarily increase blood sugar levels, there is no significant evidence in this systematic review indicating a demonstrable risk of hyperglycemia or adverse effects on the surgical process for patients with diabetes mellitus.[238]

The Society for Ambulatory Anesthesia recommends that adult patients with diabetes mellitus who are undergoing ambulatory surgery may receive water in lieu of carbohydrate loading.[239] The Endocrine Society recommends that adults with diabetes undergoing elective surgical procedures not receive carbohydrate-containing oral fluids preoperatively.[240]

4.2 **Reduce prolonged fasting before surgery according to the American Society of Anesthesiologists (ASA) fasting guidelines.**[223,241] *[Recommendation]*

Studies have found that reducing prolonged preoperative fasting (eg, allowing clear liquids until 2 hours before the procedure) did not increase the risk of aspiration or related complications and led to significantly lower gastric volumes.[2,5,8-12,16-19,21,22,25,29,31,33,167,184,185,187,190,192,193,199,200,202,208,214,217,225,226,233,235,237,241-247]

4.2.1 **Provide patients with the following guidelines regarding oral consumption before surgery**[2,3,8,9,11,12,16-19,21,22,25,29,31,33,184,185,189,190,193,199,200,203,209,210,216,225,226,233,234,242-246]**:**

- **for children, adults, and older adults, clear liquids up to 2 hours, a light meal up to 6 hours before the scheduled procedure**
- **for infants, breast milk up to 4 hours, infant formula up to 6 hours, nonhuman milk up to 6 hours before the scheduled procedure**

[Recommendation] P

Some researchers suggest that patients should be encouraged to eat a light meal (eg, toast and clear liquids).[18] Clear and consistent patient education and instructions on fasting can avoid misinterpretation and day-of-surgery cancellations or delays.

4.3 **Collaborate with surgeons, pharmacists, and anesthesia professionals for preoperative antimicrobial prophylaxis administration.** *[Recommendation]*

High-quality evidence supports administering antimicrobial prophylaxis to effectively prevent SSIs in some patient populations, with an intravenous bolus dose being administered zero to 60 minutes before a skin incision is made and optimal timing ranging from 15 to 30 minutes.[3,5,7,10,13,16-18,21,22,25,29,33,184,189,192-194,199,202,213,217,233]

The type of antibiotic will vary based on the intended procedure, patient history, and allergies.

The American Society of Health-System Pharmacists, the Infectious Diseases Society of America, the Surgical Infection Society, and the Society for Healthcare Epidemiology of America developed clinical practice guidelines for antimicrobial prophylaxis in surgery that can be used to standardize the approach to the safe and effective use of antimicrobial agents for the prevention of SSIs. Guidance is given for patient- and procedure-specific considerations as well as institution-specific factors that practitioners should consider before instituting these guidelines.[248]

4.4 **Assess patients for risk of VTE and bleeding, and implement VTE prophylaxis measures, including pharmacologic and mechanical interventions.** *[Recommendation]*

High-quality evidence supports the use of compression stockings and low molecular weight heparin in all cases when the individual risk of thrombosis exceeds the risk of bleeding.[2,3,7,8,10,13,16,18,19,21,22,25,29,33,184,185,192,194,199,213,217,234,249] Researchers evaluating VTE best practices in ERAS protocols have concluded that the intervention should commence 12 hours before the surgery and continue for up to 28 days after the surgery, depending on a patient's risk profile.[17]

The American Society of Hematology provides guidance for the management of VTE in surgical hospitalized patients for general surgery, orthopedic surgery, major general surgery, major neurovascular procedures, urological surgery, cardiac surgery, major vascular surgery, major trauma surgery, and major gynecological surgery; see this guide[250] and the AORN Guideline for Prevention of Venous Thromboembolism for more information.[251]

4.5 **Implement a structured SSI prevention bundle.** *[Recommendation]*

Surgical site infection prevention bundle elements as part of ERAS protocols have included:

- having patients shower or bathe with chlorhexidine gluconate or soap the night before surgery[7,13,18,193];
- performing nasal decolonization if indicated (eg, the patient is colonized with methicillin-resistant *S aureus* or methicillin-susceptible *S aureus*)[7,8];
- avoiding hair removal if it is not essential for surgical site access, and if it is indicated, using a hair clipper instead of a razor to remove hair[2,8,13,18]; and
- performing preoperative surgical site skin preparation with an alcohol-based antiseptic unless contraindicated.[2,8,16,18,33,184,193,194]

See the AORN Guideline for Preoperative Patient Skin Antisepsis for detailed information about implementation of SSI prevention bundles.[252]

4.6 **Start patient warming in the preoperative period.**[9,10,13,16-19,21,22,25,29,33,184,185,193,194,199,213,214,233] *[Recommendation]*

Maintaining a normothermic state throughout the perioperative patient experience reduces the risk of postoperative complications. See the AORN Guideline for Patient Temperature Management for more information.[253]

4.7 **Assess risk for PONV, beginning in the preoperative period, and use multimodal prophylaxis based on the assessment.**[2,9-11,13,16-19,21,22,25,29,31,33,184,186,192-194,199,202,209,210,213,214,217,233,236,254-256] *[Recommendation]* P

Effective PONV prophylaxis is based on a multimodal intervention using pharmacologic therapy, avoiding fluid overload, limiting preoperative fasting, implementing early mobilization, and avoiding opioid use.[17] In patients with one to two risk factors, a combination of two drugs is often recommended, and in patients with higher risk, three drugs can be used in combination. If rescue treatment is needed despite prophylaxis, drugs from classes not yet used should be employed.[29]

The American Society of Enhanced Recovery and the Society for Ambulatory Anesthesia have published a comprehensive, evidence-based set of guidelines for preventing and treating PONV in both adults and pediatric patients. The guidelines provide recommendations on identifying high-risk patients, managing baseline PONV risks, choices for prophylaxis, and rescue treatment for PONV as well as recommendations for the institutional implementation of a PONV protocol. The guidelines focus on the evidence for newer drugs (eg, second-generation 5-hydroxytryptamine 3 [5-HT3] receptor antagonists, neurokinin 1 [NK1] receptor antagonists, dopamine antagonists), use of general multimodal PONV prophylaxis, and PONV management as part of enhanced recovery pathways.[256]

In a systematic review with meta-analysis of 14 randomized controlled trials (RCTs) that included 1,653 patients, transcutaneous electrical acupoint stimulation for preventing PONV showed obvious superiority in lowering the incidence of PONV, lowering the number of patients needing antiemetic rescue, and lowering incidence of dizziness and itching compared to controls. The researchers recommended adding this modality to a multimodal management approach for the prevention of PONV.[254] See Recommendation 3.2.1 for information about validated PONV risk assessment tools and see the AORN Guideline for Complementary Care for more on alternative approaches to preventing PONV that were not addressed in the ERAS literature.[257]

4.8 **Collaborate with anesthesia professionals to reduce the use of sedatives in the preoperative period.**[2,13,16-19,21,22,29,193,217] **and use low-dose short-acting medications if needed.**[11,19] *[Recommendation]*

Administering sedatives before a surgical procedure can have a negative impact on a patient's postoperative recovery. Instead of relying solely on medication, it can be beneficial to focus on effective communication techniques, such as having conversations with the patient, providing preoperative educational sessions, and providing psychological support.[13,17] This approach has shown better results in patient outcomes and improves the patient's perioperative experience.[13,17]

4.9 **Begin collaborative planning for implementation of a multimodal pain management plan that includes regional anesthesia (eg, nerve blocks) in the preoperative phase of care.** *[Recommendation]*

See Recommendation 5.4 for additional information. See the AORN Guideline for Complementary Care for more on alternative approaches for pain management that were not addressed in the ERAS literature.[257]

4.10 **Implement measures to maintain preoperative glucose levels under 180 mg/dL in both diabetic and non-diabetic patients.**[7,18,19,21,22,31,184,187,194,235,236,255] *[Recommendation]*

5. Intraoperative Phase

5.1 **Implement measures to maintain intraoperative normothermia.** *[Recommendation]*

Maintaining a normal body temperature throughout the surgical process is important to help prevent adverse patient outcomes.[9,10,13,31,33,185,190,192,199,202,210,214,217,233,235,236,255]

See the AORN Guideline for Patient Temperature Management for detailed information about interventions to maintain patient normothermia.[253]

5.1.1 **Measure and monitor the patient's temperature (eg, nasopharyngeal, zero heat flux, core thermometry) during all phases of perioperative care.**[16,17,19,21,22,25,29,184,193,194] *[Recommendation]*

See the AORN Guideline for Patient Temperature Management for more information.[253]

5.2 **Collaborate with anesthesia professionals to implement interventions that maintain intraoperative patient euvolemia.** *[Recommendation]*

Anesthesia professionals often devise a plan of goal-directed fluid therapy (GDFT) tailored to each patient for fluid management and monitoring, considering individual comorbidities and the level of surgical risk involved.[3,7-11,13,16-19,21,22,25,29,33,184-186,189,190,192-194,199,202,209,210,213,214,217,233,235,236,255,258-262]

Intraoperative fluid management serves to preserve intravascular fluid volume and avoid unnecessary salt and water intake from using crystalloid solutions. A euvolemic state is achieved by balancing maintenance fluid and volume replacement therapy.[7,258-260] Maintaining optimum blood volume is crucial during the entire perioperative phase to ensure sufficient blood flow to the tissues. Both hypovolemia and hypervolemia have been linked to adverse outcomes after surgery.

A systematic review and meta-analysis of RCTs evaluated the effect of GDFT compared to conventional fluid therapy on postoperative recovery in adult patients undergoing abdominal surgery. A total of 45 RCTs with 6,344 patients were included in the analysis. The researchers found that patients who received GDFT had improved survival rates, reduced overall complication rates, and faster gastrointestinal function recovery.[262]

A systematic review with meta-analysis of RCTs compared GDFT and conventional therapy on patient outcomes in colorectal surgery. A total of 1,281 patients were included: 624 in the GDFT group and 657 in the control (ie, conventional therapy) group. No significant differences were found between groups in 30-day mortality, length of stay, and ICU admission. The GDFT group had a lower complication rate and improvement in gastrointestinal function.[263]

A systematic review that included two systematic reviews with meta-analyses and four RCTs involving 2,018 patients that compared GDFT and conventional therapy in colorectal surgery had similar conclusions. The authors also concluded that when GDFT was implemented within ERAS programs, there was a significant reduction in hospital length of stay. When GDFT was used in a non-ERAS patient care setting, there was a significant reduction in overall morbidity rate and faster time to first flatus.[264]

5.2.1 **Technology-based hemodynamic monitoring may be implemented to optimize GDFT.** *[Conditional Recommendation]* P

Assessment of hemodynamic status[265,266] includes measurements of

- central venous pressure (CVP),
- mean arterial pressure (MAP),
- stroke volume (SV)/stroke volume index,
- cardiac output (CO),
- pulse pressure variation (PPV),
- stroke volume variation (SVV),
- Pleth Variability Index (PVi), and
- aortic blood flow peak velocity variation (ΔV peak).

Technology-based hemodynamic monitoring[266] methods includes either invasive and noninvasive methods, such as

- arterial pulse contour analysis,
- arterial pulse power analysis,
- thoracic bioimpedance and bioreactance,
- plethysmograph waveform analysis,
- thermodilution, and
- ultrasound.

Various technology-based monitoring systems use distinct physiological principles and present a range of advantages and disadvantages. Additionally, these systems rely on diverse algorithms and techniques to compute dynamic parameters, resulting in varying values for the same parameter on different monitors. Therefore, it is crucial for clinicians to take into account the specific type of surgery being performed and the existing evidence supporting the use of GDFT guided by that monitoring system and dynamic parameter. It is essential for clinicians to possess a comprehensive understanding of how dynamic parameters are computed and derived from the monitoring system.[259]

Bioimpedance is a noninvasive technology that uses circulating fluid volume in the thoracic cavity to derive cardiac output. Bioreactance uses the same principle but was developed to improve signal-to-noise ratio and usability of bioimpedance.[258,261] It is also a noninvasive way to monitor hemodynamic parameters during the entire surgical process; it can be used preoperatively, intraoperatively, and postoperatively to assess intravascular volume loss and fluid responsiveness. By establishing a baseline fluid status before the administration of anesthesia, anesthesia providers can effectively manage fluid levels throughout surgery and recovery. Bioreactance can utilize changes in stroke volume to help guide fluid decisions.

The proactive treatment of predicted intraoperative hypotension can yield beneficial outcomes for patients. The hypotension prediction index (HPI), an advancement in the arterial wave form analysis, was created using a machine learning algorithm. This algorithm examines physiological changes in the radial artery's arterial form as early indicators of impending hypotension. The HPI can forecast hypotension up to 15 minutes before it occurs with up to 88% sensitivity and 87% specificity. This allows anesthesia providers to act in advance to stabilize blood pressure, thus avoiding an actual hypotensive episode. These technologies can be applied both perioperatively and in intensive care medicine, but they are not yet approved for pediatric use.

In a retrospective analysis of 100 adult patients undergoing moderate- or high-risk noncardiac surgery with invasive arterial pressure monitoring, either the HPI guidance or arterial waveform analysis was used based on the availability of the device at the time the procedure was performed. A personalized treatment protocol was implemented in both groups. The primary objective was to assess the occurrence and length of hypotensive events, defined as a mean arterial pressure below 65 mmHg, evaluated by a time-weighted average of hypotension. The findings of this study revealed that the implementation of the HPI in conjunction with a personalized treatment protocol led to a reduction in both the frequency and duration of hypotension compared to using arterial waveform analysis alone. This research contributes to the growing body of evidence supporting the shift from predicting to actively preventing hypotension through the use of HPI.[267]

In the FEDORA Trial, a multicenter randomized controlled trial involving adults undergoing major elective surgery, the objective was to evaluate the impact of goal-directed hemodynamic therapy on postoperative complications in low- to moderate-risk surgical patients. The study compared the use of esophageal Doppler monitors (EDMs) to guide fluid therapy in one group, known as the GDFT group, to the traditional method of fluid administration in the control group. Results showed a substantial reduction in complications in the GDFT group compared to the traditional group, with rates of 6% and 16.6%, respectively.[268]

A prospective study was conducted to assess the clinical efficacy of a continuous noninvasive cardiac output monitoring (NICOM) device in adult patients' post cardiac surgery. The study focused on 110 consecutive patients who required a pulmonary artery catheter for cardiac output monitoring. Cardiac output measurements obtained from the NICOM were compared to those from the thermodilution method, recorded simultaneously minute by minute. The study aimed to evaluate the accuracy, precision, responsiveness, and reliability of the NICOM device in detecting cardiac output changes. The findings indicated that the NICOM device demonstrated acceptable accuracy, precision, and responsiveness in various circulatory conditions, highlighting its effectiveness as a noninvasive monitoring tool.[269]

A quasi-experimental study compared a NICOM and an EDM for guiding GDFT in 100 colorectal surgery patients. The intervention group had GDFT guided by the NICOM, while the control group had GDVT guided by the EDM. The study aimed to determine if there were significant differences between the two monitoring devices. The results revealed that the NICOM performed comparably to the EDM in guiding GDFT, with no clinically significant variations in outcomes. Furthermore, the NICOM was noted for its ease of use and fewer missing data points, making it a viable noninvasive alternative for monitoring and guiding GDFT, as opposed to the invasive EDM.[270]

5.3 **Collaborate with anesthesia professionals in efforts to structure and implement a standardized anesthesia protocol.** *[Recommendation]*

A standardized anesthesia protocol plays a vital role in ERAS programs. The anesthesia regimen should be carefully tailored to ensure rapid patient recovery. Various methods, such as general anesthesia, regional anesthesia, and local anesthesia with sedation, have all proven to be successful in surgical procedures. However, there is no conclusive evidence favoring one technique over the others when multiple options are available. The choice of anesthetic should be based on the patient's unique characteristics, the nature of the specific surgical procedure, and institutional considerations.[9,13,18,21,22,25,33,184,192,193,199,210,214,233,235,236,255]

Standardized anesthesia techniques often include

- use of short-acting volatile or IV anesthetics or their combination,[3,5,13,25,29,192,193,213,217,271]
- quantitative over qualitative monitoring of neuromuscular block depth along with complete reversal,[9,13,18,272]
- a lung protective ventilatory strategy with tidal volumes 6 mL/kg to 8 mL/kg and positive end expiratory pressure 6 cmH2O to 8 cmH2O if feasible,[18,22,189,193,210,255] and
- use of regional anesthesia.[21,22,33,192,193,211,214,233]

See Recommendations 4.9 and 5.4 for more information about multimodal pain management, which includes regional anesthesia.

5.4 **Collaborate with patients, surgeons, anesthesia professionals, perianesthesia RNs, and pharmacists to implement a multimodal pain management protocol.**[3,5,7,9-11,13,17-19,21,22,29,31,33,96,184,186,189,192-194,202,206,209,211,213,214,217,233-236,249,255,273-286] *[Recommendation]*

The pressing demand for action against the opioid crisis in the United States highlights the criticality of this issue. To address the problem of postoperative prescription opioid usage, it is imperative to implement interventions that are not only highly effective but also free from unintended adverse effects. These interventions are most effective when based on evidence and fostered through collaborative endeavors

involving pharmacists, nurses, surgeons, anesthesiologists, and most importantly, patients.[96,278]

ERAS protocols rely heavily on multimodal medication regimens to effectively manage patients' pain. By strategically targeting various physiological pathways, multimodal analgesia aims to optimize pain control while minimizing the adverse effects associated with narcotic pain medications. This approach can be employed throughout the entire perioperative care process, starting in the preoperative period and extending into the intraoperative period. Close collaboration with anesthesia providers ensures a seamless transition and that benefits of multimodal medication continue into the postoperative period. The primary objective of this approach is to mitigate the inflammatory response triggered by surgical pain, thereby reducing its downstream impact.[18,211,271,273,278] Multimodal analgesia within an ERAS program has resulted in decreased opioid use, less PONV, decreased length of stay, and reduced health care costs.[274]

A systematic review with meta-analysis included 26 RCTs with 1,934 patients undergoing laparoscopic gynecological surgery, upper gastrointestinal surgery, or breast surgery who did not receive any opioids preoperatively, during anesthesia induction, before skin closure, or before emergence from anesthesia. The authors concluded that there is firm evidence that opioid-free anesthesia significantly reduced adverse postoperative events, mainly driven by decreased nausea and vomiting.[287]

Multimodal pain management techniques often include strategies for proactive, scheduled administration of non-opiate pain medications for a period of time after the procedure, to avoid pain crises and rebound overdosing. Medications and techniques that are often used in multimodal pain management techniques include

- nonsteroidal anti-inflammatory drugs[18,96,137,211,219,220,236,271,274,276,288-296];
- acetaminophen[18,137,211,219,220,274,276,288-295];
- gabapentinoids[137,211,219,276,288-291,293-295,297-299];
- regional block techniques,[9,13,16,18,21,22,29,184,187,192,194,217,236,249,255] such as
  - transverse abdominal plane [TAP],[219,220,276,290,291,300,301]
  - paravertebral block [PAB],[275,276,302]
  - peripheral nerve block,[211,219,293,295,297,303]
  - thoracic epidural analgesia [TEA],[276,297,304]
  - paracervical blocks,[289]
  - thoracic paravertebral block [TPV],
  - intercostal field block,[289,305]
  - pectoralis nerve block [PECS],[291,306]
  - erector spinae plane [ESP],[86,292] and
  - quadratus lumborum [QL] blocks[292];
- local infiltration analgesia[211,219,220,271,276,286,288,290-293,295,305];
- liposomal bupivacaine (LB)[137,276,288,291,295,301,305,307-310];
- spinal or epidural analgesia[219,276,288-292,294,295,297];
- N-methyl-D-aspartate receptor antagonists (ketamine, dextromethorphan, magnesium)[219,220,236,255,271,276,288,290,292-295,297];
- systemic lidocaine[276,288,290,293,295,297];
- A2-agonists (clonidine, dexmedetomidine)[271,276,290,292, 293,295];
- glucocorticoids[137,220,276,289-295];
- muscle relaxants[291];
- topical anesthetics[291];
- nonpharmacologic techniques (eg, acupuncture, aromatherapy, music therapy, transcutaneous electrical nerve stimulation, hypnosis, biofeedback, external cooling devices, heat)[96,220,276,288,291]; and
- cryoneurolysis.[311-318]

There is conflicting evidence regarding the use of perioperative gabapentinoids.[319,320] A systematic review of 14 RCTs comparing gabapentinoids and placebo found a benefit from using gabapentinoids and a low incidence of adverse events. The authors concluded that gabapentinoids have a role in decreasing postoperative pain intensity and decreasing supplemental opioid use; however, the optimal dose and dosing regimen are not yet well understood.[320] A systematic review and meta-analysis for perioperative administration of gabapentin to alleviate postoperative acute pain involved a total of 281 RCTs, encompassing 24,682 participants. The main outcome was the severity of postoperative acute pain; secondary outcomes included subacute pain, incidence of chronic pain post-surgery, opioid consumption, persistent opioid use, length of hospital stay, and adverse events. Ultimately, the findings suggested that there was no significant clinical benefit to using gabapentin for postoperative pain relief, nor was there evidence to support its efficacy in preventing chronic pain after surgery. In fact, the analysis indicated a heightened risk of adverse events associated with its use. Based on these results, the researchers concluded that it is not recommended to routinely utilize pregabalin or gabapentin for managing postoperative pain in adult patients.[319]

In an RCT of 55 patients undergoing colorectal surgery, half received IV meloxicam and half received a placebo to compare the safety and efficacy of meloxicam. Use of IV meloxicam was associated with 35% lower opioid consumption and significant reductions for pain intensity; length of stay; and time to first bowel sounds, first flatus, and first bowel movement versus placebo.[296]

An RCT of 100 patients undergoing total knee arthroplasty compared 54 patients who received LB admixed with bupivacaine and 46 patients who received ropivacaine in an adductor canal block. Primary outcomes were pain, milligrams morphine equivalent, and length of stay. Secondary outcomes were joint pain and stiffness and measures of

patient-reported function. No significant between-group differences were observed for any outcomes. The authors concluded that LB provided increased pain relief following total knee arthroplasty compared to the control medication.[321]

A systematic review with meta-analysis compared LB and TAP blocks on reduced opioid use and length of stay in 2,512 patients undergoing colorectal surgery in 12 trials. A TAP block with LB was most likely to reduce morphine requirements, followed by wound infiltration with LB. Compared to standard analgesia, LB-based wound infiltration reduced morphine usage and length of stay. On meta-regression, the findings held for minimally invasive surgery only. The study concluded that although LB-based interventions were associated with reduced postoperative morphine requirements and length of stay in this network meta-analysis, the confidence in these estimates was graded as very low. Further, well-executed trials should be conducted before LB can be recommended as a first-line agent.[322]

A systematic review with meta-analysis compared LB with traditional, non-LB agents after total shoulder arthroplasty or rotator cuff repair surgery. The outcomes of note were visual analog scale pain scores at 24 and 48 hours after surgery, opioid consumption 24 and 48 hours after surgery, hospital stay duration, and complications within 48 hours after surgery. Eleven trials and 846 patients were included in the analysis. The study concluded that LB was similar to non-LB agents in terms of overall pain relief and opioid requirements. The duration of hospital stay and complication rates were also similar in the two groups. The authors concluded that adequately powered RCTs should be conducted before LB is recommended in these types of surgeries.[323]

In an RCT of patients undergoing shoulder surgery that compared placebo (n = 71) and a single injection, ultrasound-guided brachial plexus block with LB (n = 69), the researchers concluded that the brachial plexus block with LB resulted in significant pain reduction through 72 hours and less opioid consumption compared to placebo, and the patient was nine times more likely to be opioid-free at zero to 48 hours.[308]

In a retrospective study of patients undergoing total knee arthroplasty, 29 received cryoneurolysis and 28 matched controls did not. Although not statistically significant, patients who received cryoneurolysis had a shorter length of stay and, overall, less inpatient and outpatient opioid use. Patients who received cryoneurolysis had significantly improved 6-week range of motion and improved patient reported outcomes.[311]

A systematic review of postoperative outcomes following single-site or peripheral nerve blocks included 28 studies of 6,703 patients. The study found substantial improvement in postoperative pain levels, postoperative opioid consumption, and patient satisfaction in patients receiving peripheral nerve blocks compared with patients who did not receive them.[303]

See the AORN Guideline for Complementary Care[257] for more information about nonpharmacologic interventions.

5.1.1 **Multimodal pain management teams should include patients and their family members or caregivers, the perioperative team, and pharmacists.**[95,96] *[Recommendation]*

5.5 **Implement collaborative measures to minimize the use of drains and catheters.**[3,11,17-19,21,29,33,184,186,189,194,199,209,213,234,249] *[Recommendation]*

Minimizing the use of drains and catheters helps to reduce the risk of infections, promotes faster recovery, improves patient comfort, decreases complications, and helps to achieve cost-effective patient care.

5.6 **Implement measures to support surgeons who perform minimally invasive surgical techniques.**[11,13,16-19,33,185-187,189,194,209] *[Recommendation]*

The field of surgery has experienced a remarkable revolution thanks to minimally invasive techniques. This has led to numerous advantages for patients, including reduced intraoperative complications, decreased blood loss, improved postoperative pain management, shorter hospital stays, better cosmetic outcomes, and faster recovery to normal functioning. Therefore, it is increasingly recommended to opt for minimally invasive approaches, such as conventional laparoscopy, arthroscopic procedures, and robotic-assisted procedures using low pressure insufflation over traditional (ie, open) surgical approaches.

6. Postoperative Phase

6.1 **Collaborate with the surgeon and anesthesia professional to remove indwelling urinary catheters as early as possible after surgery.**[3,11,17-19,21,184,199,209,213,234,249] *[Recommendation]*

6.2 **Implement measures to support early patient mobilization.**[2,5,9-11,13,17,19,21,22,25,29,33,184,185,189,194,199,202,209,213,217,288,324-326] *[Recommendation]*

Early mobilization helps to combat the well-known harmful physiological effects linked with extended bed rest. Such effects include heightened insulin resistance, muscle wasting, diminished lung function, hindered tissue oxygenation, increased risk of SSIs, and an increased likelihood of thromboembolism.

A quasi-experimental study of patients undergoing major open abdominal surgery compared a group of patients (n = 21) who were ambulated in the ICU on the day of surgery to a control group (n = 21) who were not ambulated. The patients who were ambulated early had a longer mobilization time (128 minutes vs 34 minutes), quicker time to flatus passage, decreased length of stay in the ICU, and higher sleep quality and patient satisfaction scores.[327]

See the AORN Guideline for Prevention of Venous Thromboembolism for information about how early ambulation supports prevention of VTE.[251]

6.3 **Implement measures to support postoperative exercise (eg, targeted aerobic, strength, balance, and flexibility training) and physiotherapy.**[328] *[Recommendation]*

Aerobic training and physiotherapy following surgery are safe and effective at improving health-related outcomes. Exercise has a significant effect on a patient's psychological well-being and quality of life.[328]

A systematic review with meta-analysis of patients older than 18 years who underwent cancer surgery with curative intent and participated in an exercise program that included aerobic exercise starting at any point in the postoperative period up to 12 weeks identified 11 studies: two inpatient, one mixed inpatient/outpatient, and eight outpatient studies. The authors found that postoperative exercise benefits patients in this population by improving aerobic function postoperatively and can be safely delivered in various formats, including home-based or group classes.[328]

6.4 **Collaborate with surgeons and anesthesia professionals to establish protocols for early oral feeding.**[11,13,16-19,21,22,25,29,33,184-187,189,194,202,209,213,217,249] *[Recommendation]*

Patients should be encouraged to reestablish oral nutrition as early as possible. Early feeding involves the reintroduction of oral or enteral nutrition within hours after surgery. This approach aims to accelerate the recovery process, shorten hospital stay, and reduce postoperative complications. Some patients may require a more gradual reintroduction of food, while others may be able to tolerate a regular diet sooner.

7. Patient-Specific Considerations

7.1 **The interdisciplinary team (see Recommendation 1.2.1) and the patient's primary care practitioner should determine the organization's implementation strategy of ERAS for older adults**[141,159,165,175,247,329-336] **and should work with older adult patients and their families to identify ERAS components for individualized implementation.** *[Recommendation]*

Older adult patients benefit significantly from the principles of ERAS, which include preoperative optimization, reduction of surgical stress, and early rehabilitation. Older adult patients are a diverse group with unique challenges, and reducing postoperative complications through proper patient selection, counseling, risk assessment, and optimization is crucial in managing these individuals.[159,165,329,330]

A systematic review with meta-analysis analyzed the safety and effectiveness of ERAS protocols for older adults undergoing orthopedic surgeries. The review included 15 studies and a sample of 2,591 orthopedic surgical patients whose mean age was 74.51 ± 6.83 years. The authors concluded that implementing an ERAS program for older patients undergoing orthopedic surgeries is safe and effective. However, there is still a lack of standardization of protocols for older patients across institutions and centers for orthopedic surgery. Identifying ERAS components that are beneficial to older patients and developing ERAS protocols suitable for all adults may lead to improved outcomes.[331]

7.1.1 **Determine methods for identifying patients who are at increased risk for cardiac complications by**

- **preoperatively evaluating cardiac risk among older adults and others with known vascular disease, and**
- **defining methods to identify cardiac complications postoperatively among these patients.**

[Recommendation]

Each year, more than 10 million adults worldwide have a major cardiac complication in the first 30 days after noncardiac surgery. Two-thirds of postoperative ischemic cardiac events are asymptomatic and are associated with an increase in the risk of death within 30 days. Being older than 75 years, being male, and having multiple comorbidities as well as recent acute conditions, such as an acute aneurysm rupture, recent high-risk coronary artery disease, recent placement of coronary artery stents, recent stroke, or acute trauma such as a hip fracture or urgent or emergent surgery, are all risk factors for cardiac complications that are frequently present in the older adult population.[337]

Precise preoperative assessment of cardiac risk in older adult patients plays a crucial role in preoperative care. It provides reliable predictions of the possible risks and advantages associated with surgery, aiding practitioners in making well-informed decisions regarding

the suitability of the procedure. Additionally, accurate estimation of cardiac risk can help in determining the most appropriate management approach, such as deciding between minimally invasive or open surgical techniques. It also assists in decisions regarding postoperative monitoring, such as the use of troponin levels for assessing cardiac health after surgery. It is important that preoperative cardiac risk assessments are conducted by a physician or surgeon who possesses extensive expertise in this field and is skilled in conducting thorough cardiac clinical evaluations.[337,338]

A prospective cohort study of 2,018 patients who underwent noncardiac surgery at a single center was conducted to determine the association between perioperative high-sensitivity troponin levels (hsTnT) and 30-day mortality and potential diagnostic criteria for myocardial injury due to ischemia associated with 30-day mortality. hsTnT levels were measured in the first 3 days after surgery. Myocardial injury was defined as an hsTnT level above the 99th percentile upper reference limit. The primary outcome of the study was a composite of myocardial injury and 30-day mortality. The researchers also looked at secondary outcomes, including individual components of the primary outcome, such as cardiovascular events and acute kidney injury. Multivariable analyses were conducted to assess the association between postoperative hsTnT levels and outcomes, adjusting for potential confounding factors such as age, sex, and comorbidities. The researchers found that elevated levels of hsTnT after noncardiac surgery were associated with an increased risk of myocardial injury and 30-day mortality, and elevated postoperative hsTnT levels without an ischemic feature were also associated with 30-day mortality.[339]

A systematic review of 195 studies examined myocardial injury after noncardiac surgery (MINS) a common complication with adverse cardiovascular outcomes. Among 169 unique studies reporting on 530,867 surgeries, the incidence of MINS was found to be 17.9%. Patients with MINS were typically older men with more cardiovascular risk factors and known coronary artery disease. Postoperative mortality rates were higher in patients with MINS compared to those without, both in the hospital and at 1 year after surgery. Studies also highlighted the mechanisms and medical treatment options for MINS, indicating that it occurs frequently in patients with cardiovascular disease and its risk factors, leading to increased short- and long-term mortality. Although more research is needed to develop strategies for prevention and treatment of MINS, it is clear that this complication is a significant issue in clinical practice.[340]

The Canadian Cardiovascular Society Guidelines on Perioperative Cardiac Risk Assessment and Management for Patients Who Undergo Noncardiac Surgery gives guidance for perioperative cardiac risk assessment and management.[338]

Additionally, the scientific statement from the American Heart Association on diagnosing and managing patients with myocardial injury after noncardiac surgery offers diagnostic criteria; reviews the epidemiology, pathophysiology, and prognosis of such injuries; and outlines surveillance strategies and treatment approaches.[341]

7.1.2

The interdisciplinary team may also include geriatricians, cardiologists, nurse navigators, pharmacists, nutritionists, social workers, physical therapists, occupational therapists, and speech therapists.[247,342] *[Conditional Recommendation]*

The implementation strategy for ERAS in the care of older adults in the surgical optimization and preoperative phases are based on the American College of Surgeons National Surgical Quality Improvement Program and the American Geriatric Society combined best practice guidelines for the perioperative care of older adults.[247] These guidelines focus on practices that are particularly relevant to preoperative care and include

- using a cognitive screening test and communicating results to the patient's primary care provider and anesthesia provider;
- screening for depression, communicating results to the patient's primary care provider, and considering delaying surgery to optimize treatment before surgery if the patient has severe symptoms;
- identifying postoperative delirium risk factors using a standardized tool and addressing modifiable risk factors;
- screening for alcohol and other substance abuse or dependence and potentially delaying surgery for treatment if needed;
- performing a preoperative cardiac evaluation to estimate functional capacity;
- performing a cardiac risk assessment and communicating the perioperative cardiac risk to the patient;[338]
- identifying patient risk factors for postoperative pulmonary complications such as aspiration, atelectasis, and others;
- assessing functional status and falls history;

- measuring frailty and alerting the anesthesia provider;
- assessing nutritional status and providing interventions for at-risk patients;
- identifying high-risk medications and polypharmacy and considering referral to a pharmacist;
- determining the patient's treatment goals and expectations and participating in thoughtful discussion (eg, the 4Ms framework: What Matters, Medication, Mentation, and Mobility);
- determining the patient's family and social support systems and considering social referrals if support systems are lacking; and
- conducting preoperative screening for hemoglobin, renal function, albumin, and other testing as needed.[247]

Surgical optimization programs can play a crucial role in reducing postoperative complications, as well as decreasing the degree of frailty in patients and improving psychological and social factors that can affect recovery.[159,247]

The 4Ms framework was developed by the Institute for Healthcare Improvement as part of the Age-Friendly Health Systems initiative, in collaboration with the John A. Hartford Foundation and the American Hospital Association. The framework aims to improve care for older adults by focusing on key principles that are essential for addressing the unique needs of this population. The 4Ms were designed to shift the focus of care from a disease-centered approach to a more holistic and person-centered approach. By addressing the mind, mobility, medications, and what matters most to the individual, health care providers can better support the overall health and well-being of older adults. The framework emphasizes the importance of considering the individual's preferences, values, and goals when providing care, as well as the need to assess and address cognitive and physical function, medication management, and mental health. By incorporating the 4Ms into care practices, health care providers can help older adults maintain their independence, improve their quality of life, and reduce the risk of adverse health outcomes.[343]

7.1.3

Intraoperative ERAS interventions specific to care of the older adult may include

- **avoiding benzodiazepines[342];**
- **keeping patient's glasses, hearing aids, and dentures available in the OR[342];**
- **neuromonitoring[342,344]; and**
- **GDFT.[344]**

[Conditional Recommendation]

The induction and maintenance of anesthesia, the surgical procedure, and the early postoperative phase all play crucial roles in determining the postoperative course for the older adult patient.[345] Designing a protocol that enhances the patient's well-being and sense of orientation in the operating room is a medically indicated measure for preventing postoperative delirium.[342] The vulnerability of older adult patients to the depressant effects of anesthetic drugs underscores the importance of recognizing and preventing hypotension, as it can lead to organ hypoperfusion and ischemia, resulting in adverse outcomes.[344]

Failure to effectively assess older adult patients and develop a surgical plan that balances benefits and risks can lead to negative outcomes and potential harm. It is crucial for the interdisciplinary team to thoroughly evaluate the patient's physiological reserves, cardiovascular and pulmonary health, cognitive function, and common geriatric conditions to tailor the surgical plan accordingly. The anesthetic plan must also be carefully selected to minimize risks for older adult patients, as general anesthesia has been linked to complications such as respiratory failure, longer hospital stays, and higher mortality rates, particularly in cases of hip fractures. While some studies suggest that spinal anesthesia may be a safer option for older adult patients, additional research is needed. The incidence of postoperative cognitive dysfunction is on the rise, making early detection and thorough assessment of cognitive changes essential. Collaboration between physicians and nurses is key in monitoring cognitive function, and institutional guidelines should be established to ensure all perioperative staff are equipped to improve neurological outcomes for elderly patients.[345]

A study of patients 60 years and older with ASA physical status classification of I, II, or III undergoing surgery under general anesthesia (N = 88) aimed to evaluate the effectiveness of preoperative inferior vena cava (IVC) sonography in predicting postanesthetic hypotension and its association with volume status in elderly patients. The patients were randomized into two groups: those who did not receive IV fluid before induction of anesthesia and those who did receive an IV infusion before anesthesia. The study measured various parameters including maximum (dIVCmax) and minimum (dIVCmin) inferior vena cava diameters, inferior vena cava collapse index (IVC-CI), and basal postinduction mean arterial pressure. Results indicated that of 88 patients, 39 developed hypotension after anesthesia induction, with a higher incidence

observed in those who did not undergo preoperative fluid assessment. Inferior vena cava ultrasonography showed promise in predicting preoperative hypovolemia in elderly patients, with high IVC-CI and low dIVCmax values correlating with a lower incidence of hypotension in patients receiving pre-anesthetic fluid infusions.[344]

7.1.4 **Postoperative ERAS interventions specific to care of the older adult may include**

- **delirium screening continuing up to the fifth postoperative day[342];**
- **nonpharmacological measures for delirium including orientation, communication and stimulation, mobilization, regulating the sleep-wake pattern, and involving relatives or other support persons that the patient trusts[342]; and**
- **measuring troponin levels for patients who are identified to be at increased risk for cardiac events.[338]**

[Conditional Recommendation]

Recognizing early changes in a patient's awareness is crucial for identifying delirium. Perioperative nurses should be knowledgeable about the risk factors for postoperative delirium and trained in implementing preventive measures.[342]

7.2 **For pediatric patients, the interdisciplinary team (see Recommendation 1.2.1) and the patient's pediatrician should determine the organization's implementation strategy for ERAS and should work with pediatric patients' caregivers[346] to identify ERAS components for individualized implementation.** *[Recommendation]* P

The evidence for the application of ERAS in pediatric patients is limited. Although initial data on early pediatric ERAS outcomes show promise, further research is essential to ascertain whether pediatric patients can derive similar benefits from ERAS protocols to those seen in adults.[347]

A recent systematic review has resulted in the creation of a detailed and evidence-based ERAS guideline specifically tailored for neonates undergoing intestinal resection surgery. This guideline serves as a solid framework for the development of future ERAS guidelines, with the potential to enhance perioperative care in various pediatric surgical fields.[346] The Pediatric ERAS Society Committee is embarking on the task of addressing recommendations and principles that are universally applicable in the realm of pediatric surgical care. This initiative has the potential to facilitate the implementation of ERAS protocols and enhance surgical care for children worldwide.[324]

In a quasi-experimental study that compared pediatric patients who had an ERAS protocol (n = 13) to a control group (n = 32), pediatric patients who had an ERAS protocol had improved outcomes such as decreased length of stay and decreased complications.[348]

A systematic review with meta-analysis of 10 studies and 1,298 pediatric patients undergoing colorectal surgery with an ERAS protocol found that the ERAS patients had significantly less intraoperative fluids; less postoperative opioid use; shorter time to bowel function, enteral nutrition, and oral intake; lower readmission rates; shorter length of stay; and decreased hospital costs.[349]

7.2.1 **Elements of an ERAS program in pediatrics may include**

- **preoperative medical management and counseling to include a pain management plan[350];**
- **anti-anxiety measures[350];**
- **shorter fasting guidelines[350,351];**
- **carbohydrate loading[351];**
- **antibiotic prophylaxis[346,351];**
- **PONV prophylaxis[351];**
- **a standardized anesthesia plan[350];**
- **maintaining euvolemia[346,351];**
- **maintaining normothermia[346,350,351];**
- **minimizing opioids[351];**
- **multimodal pain management[346,351] (eg, acetaminophen, regional anesthesia, lingual sucrose/dextrose);**
- **early ambulation[351];**
- **early feeding[346]; and**
- **perioperative team communication that is structured, interdisciplinary, and uses existing checklists.[346]**

[Conditional Recommendation] P

The ASA Practice Guidelines for Preoperative Fasting recommend that pediatric patients at low risk for aspiration be allowed clear liquids as close as possible to 2 hours before surgical procedures. For a shorter clear liquid fasting duration, clinical judgment is recommended.[223]

7.3 **Implement ERAS programs among all patients as a means to reduce health disparities that can occur among marginalized patient populations as a result of conscious and unconscious bias.[88,352-357]** *[Recommendation]*

Health disparities stem from a variety of factors, including differences in access to and quality of care at the patient, provider, and health care system levels. To address and reduce surgical disparities, potential interventions may include enhancing patient-clinician communication with a focus on patient-centered care, engaging with communities through outreach efforts, improving health care facilities that serve predominantly minority populations,

offering rehabilitation support, and evaluating the long-term effects of acute interventions.[357] An effective intervention to eliminate surgical disparities would ideally be comprehensive in its reach and impact on patients, providers, and the health care system. Within this framework, ERAS protocols may meet many of these requirements.[357]

Adopting an ERAS protocol provides standardization in patient care, aiming to eliminate any unconscious biases or implicit factors that could lead to unfair outcomes. Implementing ERAS protocols can be a step toward addressing health care disparities and promoting more equitable outcomes. However, it is crucial to also actively combat overt racism and unconscious biases that contribute to perpetuating health inequalities.[352]

A systematic review of 32 studies investigated race, sex, and socioeconomic status differences in postoperative pain and management of pain. In most studies, Black patients experienced more severe postoperative pain than White patients, and White patients were more likely to be prescribed opioids for pain management. Individuals of lower socioeconomic status and females reported more postoperative pain. One study found that there were no racial or ethnic group differences in pain levels and opioid use after the implementation of an ERAS protocol. The authors concluded that standardization of care may help to reduce disparities in postoperative pain management.[353]

Eighty-one studies with, collectively, 8,064,239 vascular surgery patients were included in a systematic review and meta-analysis of RCTs and observational studies reporting race or ethnicity and presentation of severity or postoperative outcomes for adult patients who had undergone major vascular surgery procedures. The study reported significant racial differences in presentation severity and postoperative outcomes.[354]

A systematic review and meta-analysis of disparities in outcomes among patients in different racial groups undergoing surgery for degenerative spine diseases included 3,501,830 patients in 30 studies. Black patients had a 55% higher risk of dying after spine surgery compared to White patients, had a longer length of stay, and had higher risk of non-home discharge and 30-day readmission. The authors concluded that Black patients generally experience worse long-term clinical outcomes and have lower satisfaction scores. Standardization of care and shared decision-making are ways to target these disparities.[355]

A quasi-experimental study researched pre-ERAS (n = 100), and post-ERAS (n = 100) protocols to determine the effectiveness of an ERAS protocol in reducing racial or ethnic disparities in post-cesarean pain management. The primary outcome was total opioid use in the first 24 hours post-surgery, and a secondary analysis compared opioid use and pain scores by racial group. The researchers reported that the implementation of an ERAS protocol was associated with significantly decreased racial and ethnic differences in postoperative pain scores with movement, but not at rest, after cesarean delivery.[352]

In a retrospective cohort study of minority patients undergoing total knee arthroplasty, patients received (n = 182) or did not receive (n = 144) an ERAS protocol. Outcomes included length of stay, patient-controlled analgesia, blood transfusion, postoperative hemoglobin, complications, and disposition at discharge. The patients were Hispanic, Black, Asian, and White. Those patients receiving an ERAS protocol had a shorter length of stay, less patient-controlled analgesia use, more frequent discharge to home, fewer transfusions, and higher postoperative hemoglobin with no difference in total incidence of complications. The researchers concluded that an ERAS protocol was safe and effective in improving outcomes in minority patient populations.[356]

A quasi-experimental study of patients undergoing gynecological surgery who had inadequate insurance, comorbid conditions, and barriers to care such as lack of transportation, access to outpatient care, and financial resources for medical care compared patients who underwent an ERAS protocol (n = 271) to those in a non-ERAS protocol group (n = 318). Outcomes were length of stay, pain, opioid use, and readmission rates. The patients in the ERAS group had a shorter length of stay, less pain, and less opioid use. Readmission rates were the same. The researchers concluded that ERAS protocols are safe and can be effective in vulnerable populations.[88]

8. Quality

8.1 **Establish and implement a quality assurance/performance improvement process for the ERAS program.** *[Recommendation]*

The successful implementation of an ERAS program with high compliance hinges on process measures that are linked to enhanced patient outcomes. These process measures should encompass four key phases of surgical care: the preadmission, preoperative, intraoperative, and postoperative stages. Process measures include all ERAS components.[5,123,358,359]

8.1.1 **Quality metrics related to an ERAS program may include**

- **patient adherence to the ERAS protocol[5];**
- **health care practitioner compliance with program elements specific to the ERAS protocols adopted by the organization;**
- **patient outcome measures such as**
  - **length of stay,[5,360]**

- **readmission,**[5,360]
- **SSI,**[5,360]
- **dehydration requiring fluids,**[5,360]
- **mortality rate,**[5,360]
- **postoperative myocardial ischemic events,**
- **incidence of VTE,**[360]
- **reduced opioid use**[360] **and**
- **morbidity**[119]**; and**

- **costs per patient in the pathway.**[5,34,43,59,77,93,349,361,362]

[Conditional Recommendation]

Monitoring both outcome and process measures is crucial for establishing a sustainable ERAS program. Although collecting data on every element of ERAS can potentially enhance patient outcomes, expecting full compliance with every element for every patient may be unrealistic due to various clinical factors. It is important to take a balanced approach in gathering information to identify and optimize available resources for process improvement.[5]

ERAS programs impact cost by reducing patient length of stay, minimizing resource use, lowering readmission rates, eliminating the use of high-cost interventions such as ICU stays and prolonged opioid use, and encouraging patients to adhere to their postoperative care instructions, leading to reduced complications.

A recent literature review and analysis of national statistical data explored the cost-effectiveness framework for patients undergoing hepatectomy within ERAS programs. Cost-benefit and cost-minimization analyses were conducted to compare ERAS with conventional treatment from the perspectives of patients, hospitals, and society. The capital flow diagram was utilized to assess the economic impact, revealing a significant reduction in the economic burden of disease on patients, with ERAS costing $8,935.02 compared to $10,470.02 for conventional treatment. The findings indicated that ERAS provided incremental benefits, with a benefit-cost ratio of 1.09. The total social cost was reduced to $5,958.67 for ERAS compared to $6,725.80 for conventional treatment. The flow diagram analysis showed a decrease in the average cost per capita in the ERAS group, dropping from $669.51 to $589.98. These benefits were attributed to the reduction in hospital stay and productivity loss. The study concluded that ERAS operates by reducing the average length of hospital stay, thereby alleviating the economic burden and productivity loss experienced by patients. It also highlighted the positive impact on hospital bed turnover rates. The recommendation was made for ERAS programs to focus on expediting the rehabilitation process and for hospitals to receive increased economic support to effectively implement ERAS protocols.[361]

A high-volume hospital's pancreatic surgery service evaluated their ERAS program after 2 years of implementation. There was a notable cost reduction for patients who had surgery after implementation of ERAS protocols compared to patients who had surgery before implementation. The analysis revealed an 18% decrease in direct supply costs.[34]

8.2 **Health care institutions should consistently collect and act upon patient-reported outcomes as a quality measure for ERAS programs.** *[Recommendation]*

Using patient-reported outcomes offers a valuable opportunity to enhance clinical care and evaluate quality standards. Additional research focused on the consistent integration of patient-reported outcome measures in ERAS is needed to support clinical decision-making, improve recovery outcomes, and establish quality benchmarks on a broader scale.[358,363,364]

8.2.1 **Determine a structured method for and gather patient-reported outcomes at baseline (ie, before surgical optimization interventions), during the hospital stay, and after discharge.**[363] *[Recommendation]*

Selecting and adopting patient reported outcome measure (PROM) and patient experience measure (PREM) tools that have been validated for use among surgical patients can be an effective way to implement structured method of gathering patient-reported outcomes. Bull et al[365] provided a guide for selecting and implementing patient reported outcome and experience measures to assess health system performance.[365] The quality of recovery-15 score is suggested for immediate postoperative assessment, with additional assessments using the World Health Organization Disability Assessment Scale 2.0 or the Patient Reported Outcomes Measurement Information System at 30- and 90-days post-surgery when possible.[363] Other PROMs that researchers have used to measure patient-reported outcomes related to enhanced recovery programs include

- quality of recovery score (QoR) - QoR-9, QoR-15, QoR-40;
- the Patient Reported Outcomes Measurement Information System (PROMIS);
- EuroQol 5 dimension questionnaire (EQ-5D);
- the Short Form – 36 Health Survey (SF-36);
- the Short Form 12 (SF-12) and Short Form 1 Health Survey (SF-1);

- the European Organization for Research and Treatment of Cancer QoL C30 (EORTC QLQ0C30);
- the Postoperative Recovery Index (PORI); and
- the Gastrointestinal Quality of Life Index (GIQLI).[363]

8.2.2 **Patient-reported outcomes may include**
- **symptoms reported by the patient,**
- **functional status after surgery, and**
- **overall global perception of health.**[364]

[Conditional Recommendation]

The American Society for Enhanced Recovery and the Perioperative Quality Initiative have identified no validated patient-reported outcomes measurement tool for the universal assessment of recovery after surgery in all of the recommended domains including physical, mental, and social.[363]

8.3 **Use a quality improvement framework to improve process measures compliance.** *[Recommendation]*

Employing a quality improvement framework that offers a standardized methodology for planning, executing, assessing, and documenting improvement initiatives can assist in conducting a thorough improvement effort to achieve an optimal state. The implementation of the ACS Quality Improvement Framework prototype could empower hospitals and health care providers to enhance their improvement endeavors and attain significant improvements in process measure compliance.[123] Another framework that appears in the literature for ERAS quality assurance and performance improvement is the Institute for Healthcare Improvement methods including the Plan, Do, Study, Act (PDSA) methodology.[350]

8.4 **The interdisciplinary team (see Recommendation 1.2.1) should identify outcomes measures and ERAS program compliance measures that will be used in quality assurance and performance improvement efforts for ERAS programs.** *[Recommendation]*

Monitoring compliance with ERAS elements (eg, with auditing) and evaluating outcomes measures that are specific to the ERAS program is essential for quality assurance and performance improvement.[93]

8.4.1 **Determine methods for data collection and systematic evaluation of the ERAS program using the identified outcomes and compliance measures.** *[Recommendation]*

8.4.2 **Existing systems (eg, the reporting functions in the electronic health record, ACS NSQIP reports) may be used to collect data.**[5] *[Conditional Recommendation]*

9. Education

9.1 **Provide education to and verify the competency of perioperative team members about their role in the organization's ERAS program.** *[Recommendation]*

Initial and ongoing education of perioperative personnel facilitates the development of knowledge, skills, and attitudes that affect safe patient care. The health care organization is responsible for providing initial and ongoing education and verifying the competency of its personnel; however, the primary responsibility for maintaining ongoing competency remains with the individual.

One research study that explored nurses' knowledge and attitudes toward a cardiac surgery ERAS program found that an increase in knowledge about evidence-based practices related to cardiac surgery led to a more positive attitude among nurses participating in a cardiac surgery ERAS program. To promote positive change, strategies such as assessing readiness, identifying barriers and facilitators, conducting audits, providing feedback, offering clinical supervision, and promoting adaptability can be implemented. Additionally, tactics like tailoring strategies, identifying and training champions and early adopters, recruiting and training leaders, organizing educational meetings, fostering a collaborative learning environment, forming new clinical teams, updating professional guidelines, involving patients and consumers in care decisions, incentivizing adherence to clinical innovations, creating disincentives for noncompliance, and implementing system changes and mandates can help drive positive outcomes in the health care setting.[366]

Glossary

ERAS coordinator: The person responsible for implementing and coordinating ERAS protocols and practices within a health care facility or ambulatory surgical center. Their role involves working with a multidisciplinary team to develop and customize ERAS protocols based on best practices and evidence-based guidelines. The ERAS coordinator also educates and trains health care providers, staff, and patients on the principles of ERAS and the importance of adherence to the protocols. The ERAS coordinator is responsible for overseeing the implementation of ERAS protocols before, during, and after surgery to optimize patient outcomes, improve recovery times, reduce complications, and enhance patient satisfaction. They monitor and track outcomes, collect data, and conduct quality improvement initiatives to continuously evaluate and improve the ERAS program. Additionally, the ERAS coordinator serves as a liaison between health care providers, patients, and families to ensure effective communication and coordination of care

throughout the perioperative period. The ERAS coordinator also collaborates with stakeholders to address any barriers or challenges to the successful implementation of ERAS protocols and work toward achieving sustainable improvements in surgical care.

ERAS nurse navigator: A registered nurse who plays a key role in coordinating and guiding patients through the perioperative care pathway designed to optimize recovery following surgery. The nurse navigator typically has expertise in perioperative care, patient education, and care coordination. The ERAS nurse navigator acts as a central point of contact for patients undergoing surgery, providing them with information, support, and guidance throughout the entire surgical journey, from preoperative preparation to postoperative recovery. They work closely with the interdisciplinary team, including surgeons, anesthesiologists, and other health care professionals, to ensure that the ERAS protocols are effectively implemented and that the patient's individual needs and preferences are addressed. The nurse navigator may be responsible for educating patients about the ERAS program, coordinating preoperative assessments and preparations, monitoring the patient's progress during the perioperative period, and facilitating communication between the patient and the health care team. By serving as an advocate and resource for patients, the ERAS nurse navigator helps to optimize patient outcomes, improve satisfaction, and enhance the overall surgical experience.

ERAS pathway: A structured, interdisciplinary perioperative care plan designed to optimize patient outcomes and enhance recovery following surgery. It typically includes a set of evidence-based protocols and interventions that are implemented before, during, and after surgery to minimize stress on the body, reduce complications, and accelerate the recovery process. Key components of an ERAS pathway may include preoperative patient education, nutritional optimization, standardized anesthesia and pain management protocols, early mobilization, enhanced fluid management, and early feeding post-surgery. By following an ERAS pathway, health care providers aim to improve patient comfort, facilitate quicker recovery, and reduce hospital length of stay.

ERAS principles: A set of evidence-based guidelines and strategies aimed at optimizing patient outcomes and improving recovery following surgery. These principles are based on the concept of applying an interdisciplinary, multimodal approach to perioperative care, with the goal of reducing surgical stress, minimizing complications, and accelerating the patient's return to normal function. Key principles of ERAS include preoperative patient education, preoperative optimization (such as nutrition and physical conditioning), standardized anesthesia and pain management protocols, early mobilization, early feeding, and minimizing the use of drains and tubes. By adhering to these principles, health care providers can enhance the overall surgical experience for patients, improve outcomes, and reduce the length of hospital stays.

ERAS program: A multimodal, evidence-based approach to perioperative care that aims to optimize the patient's recovery following surgery. It involves a coordinated, interdisciplinary team effort to implement a set of perioperative protocols and interventions that have been shown to improve patient outcomes, reduce complications, and shorten hospital stays. Key components of an ERAS program may include preoperative patient education, optimized pain management strategies, early mobilization, and standardized postoperative care pathways.

Exercise program: A structured plan or regimen that outlines specific physical activities, routines, and workouts designed to improve fitness, strength, flexibility, or overall health. Exercise programs are typically developed based on individual goals, fitness levels, and specific needs, and may include a combination of cardiovascular exercises, strength training, flexibility exercises, and other forms of physical activity. Exercise programs can be designed for various purposes, such as weight management, muscle building, improving cardiovascular health, enhancing athletic performance, or rehabilitation from injury. They are often created by fitness professionals, such as personal trainers, physical therapists, or exercise physiologists, and may be tailored to suit the preferences and abilities of the individual participating in the program. Consistency and adherence to an exercise program are key factors in achieving desired outcomes and maintaining long-term health benefits.

Functional status: An evaluation of a person's ability to perform activities of daily living and fulfill personal roles through assessment of elements of the person's being. Functional status includes the level of achievable exercise or metabolic demand measured in metabolic equivalents (eg, walking or running) This assessment includes elements of the person's social support, living environment, mental and emotional state, physical health, economic situation, and use of assistive services.

Nutritional therapy: A treatment approach that involves using food and nutrients to manage and prevent health conditions. It is a specialized form of health care that focuses on the role of nutrition in promoting overall health and well-being, as well as in preventing and treating various diseases. Nutritional therapy is typically provided by registered dietitians or nutritionists who work closely with patients to assess their dietary intake, identify any nutritional deficiencies or imbalances, and develop personalized nutrition plans tailored to their specific health needs. These plans may include recommendations for specific foods, dietary supplements, and lifestyle modifications to help individuals achieve their health goals and improve their overall quality of life.

Patient-reported outcomes: Any report of the status of a patient's health condition that comes directly from the patient, without interpretation by a health care provider or anyone else. Patient-reported outcomes can include a wide range of information, such as symptoms, quality of life, functional status, and overall well-being, as reported by the patients themselves. Patient-reported outcomes are important in health care as they provide valuable information

about the patient's perspective on their health and the impact of their condition or treatment on their daily life. These outcomes can help health care providers better understand the patient's experience, tailor treatment plans to meet individual needs, and assess the effectiveness of interventions from the patient's point of view. Patient-reported outcomes are often collected through surveys, questionnaires, interviews, or electronic health records to capture the patient's subjective experience and outcomes.

Surgical optimization: The process of preparing a patient for surgery by addressing and optimizing various aspects of their health and well-being to improve surgical outcomes and reduce the risk of complications. This may involve a multidisciplinary approach that includes medical evaluation, preoperative testing, medication management, nutritional support, physical conditioning, and addressing any underlying medical conditions that could impact the surgical procedure. The goal of surgical optimization is to ensure that the patient is in the best possible condition before undergoing surgery, which can help minimize the risk of complications, reduce the length of hospital stay, and improve overall recovery. By optimizing a patient's health and addressing any potential risks or challenges prior to surgery, health care providers can help improve the success and safety of the surgical procedure. Synonym: Prehabilitation

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