Enhanced Recovery after Surgery

Considerations for Pathway Development and Implementation

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Introduction

Enhanced Recovery after Surgery (ERAS) refers to patient-centered, evidence-based, interdisciplinary team-developed pathways for a surgical specialty and facility culture to reduce the patient's surgical stress response, optimize their physiologic function, and facilitate recovery.[1-5] Originally developed for colorectal surgery in Denmark in the late 1990s, ERAS pathways have been successfully implemented in many other specialties, including pancreatic, gynecologic, cardiovascular, thoracic, pediatric, orthopedic, and urologic surgery.[1-4,6]

Terms such as fast-track, rapid, or accelerated recovery programs are similar but do not encompass the comprehensive culture of care represented by the pathway that engages the patient from their first visit to their surgeon's office through 30-90 days post-discharge. An ERAS pathway and program represent a fundamental shift away from each individual clinician's practice decisions to one that uses a procedure- and facility-specific pathway that limits variability yet can be modified to address each patient's unique needs. The interdisciplinary team reports and analyzes quality measures to continuously improve the pathway and patient outcomes.[7,8] While each facility has its own definition of what ERAS does, facilities can pull information from this document and tailor it to their needs.

Growing evidence suggests that ERAS contributes to improved patient outcomes,[7,8] reduces postoperative complications,[3,7,9] decreases the occurrence of wound infections,[3] accelerates recovery,[7,8] reduces the use of opioids,[10,11] and supports early discharge,[10,11] with savings from decreased length of stay,[12-15] complications, and readmission offsetting increased cost of care.[9,14] Though individual elements of an ERAS pathway are beneficial, implementation and compliance with patient-appropriate elements of a comprehensive pathway across the entire perioperative continuum have been shown to improve outcomes. Each patient must be evaluated for the value and appropriateness of the enhanced recovery pathway in their plan of care. The key elements of ERAS include patient/family education, patient optimization prior to

admission, minimal fasting that optimally includes a carbohydrate beverage and, at a minimum, clear fluids up until 2 hours before anesthesia, multimodal analgesia with appropriate use of opioids when indicated, returning to a normal diet and activities the day of surgery, and returning home.[5,6,11,14-17]

Purpose

These practice considerations are intended to support the anesthesia professional as a member of the interdisciplinary team that includes the patient and in implementing and continually improving ERAS pathways across the continuum of care from before admission to returning home. By collaboratively developing specialty- and facility-specific evidence-based ERAS pathways, the team limits individual provider variation in care to improve patient engagement, quality of recovery, safety, and outcomes. As members of the interdisciplinary team, anesthesia professionals are well-positioned to lead and collaborate to successfully implement ERAS pathways across the perioperative period.

Audience

These practice considerations are written for facilities that currently utilize or would like to implement an ERAS program into their perioperative period.

The Patient's Interdisciplinary Team

An interdisciplinary team refers to a group of healthcare professionals from diverse fields who work together in a cohesive and collaborative fashion with trust to share expertise, knowledge, and skills to engage and optimize the patient across the entire pathway.[7,17-20] The anesthesia professional integrates the core values of their profession and practice to optimize patient and team communication, patient safety, and evidence-based practice.[7,17-20] The interdisciplinary

team supports the patient, as an active member of the team, to contribute to the development of the plan of care and realistic goals for recovery.[18,21]

Most effective change begins with a small, engaged team that is interested in continued improvement. Team success is optimized when initial learning and ongoing education, training, and development are core to engagement and the continued improvement of the program.[21] The opportunity to develop and pilot a unique, evidence-based, and valuable initiative can be a powerful motivator. The first step after leadership buy-in is the development of an enhanced recovery pathway, which involves the identification of a surgical specialty (e.g., colorectal, gynecologic, oncology surgery) that has an interest in the creation and implementation of an ERAS pathway. Beginning with a small team (e.g., one pathway, one surgeon) and gradually refining the original pathway prior to a larger program rollout will keep the process on track and help identify any implementation gaps for improvement.

Culture and Leadership

Building a successful ERAS program goes far beyond simply creating a protocol or a pathway.[20] Translating change across the care continuum into practice takes considerable effort for patients, healthcare professionals and organizations. It requires committed and engaged leadership that creates and invests in a sustainable culture of trust, learning, communication, and effective teamwork.[20,21] Effective leaders are able to:[9,20-22,]

- Communicate to support the vision and culture necessary for the comprehensive, long-term program.
- Create a strategic plan or roadmap to guide the program.
- Encourage engagement and commitment to ownership, and continued excellence from all participants.

Enhanced Recovery after Surgery Pathway Development

Successful change management and implementation occur as a process that evolves from the creation of the climate for change to the engagement and empowerment of those involved through the development of the change initiative, the implementation or trial of the pathway, and sustained change with continued improvement.[23] Project and change management techniques and tools are not universally part of an entry-level healthcare education program curriculum. Partnering with professionals in your facility and accessing tools and literature will be helpful in managing the scope of this project.[24,25] Project management, safety, and team training resources are helpful considerations when embarking on a change initiative of this magnitude. The team's success in creating a specialty enhanced recovery pathway is also leveraged through learning from the experience of others by joining a collaborative network of colleagues by attending meetings or contributing to a related listserv, as well as the continued review of the literature and practice outcomes.

Begin with the Project Plan

Even before engaging the team in the idea of creating an ERAS pathway, it is necessary for the project leadership team to develop the project plan to assess the scope of the project. Elements of the project plan include readiness, pre-implementation, implementation and readiness, and evaluation.[26] During the assessment of readiness, the team reviews the related literature, existing protocols, case studies, the current program's data, and benchmark information from similar internal and external projects to provide the team with information to create a project charter and plan.[27] The project plan includes the identification of factors that may facilitate or impede the project.[28,29]

Project Vision and Strategy

Next, an assessment of staff readiness and capability to support the change is helpful during the development of the project strategy and vision. One approach to identifying related elements unique to your facility culture and people's biases related to their own practice and ERAS is to conduct focus sessions, surveys, and individual interviews with representative members of the practice. Consider the following questions:[30]

- Perception of the current state. What is working well and not working well with patient preparation, patient ambulation the day of surgery, pain management, and other areas of interest?
- Who should lead the change? Who is a trusted thought leader?
- What needs to be done and changed to implement the change?
- What resources (e.g., staff, equipment) do we have, and what will be required?
- Who or which specialty is prepared to trial the pathway?
- What is the timeline to develop and implement the change?
- What training and materials need to be developed for all staff and patients?

Pathway Development

The definition and development of facility- and culture-specific care pathway(s) is accomplished through a systematic review of outcome data, published ERAS guidelines, protocols, and trials. The review is based not only on the quality of the evidence, but also on an analysis of how the ERAS program may fit with the culture of the practice, its skills, and its resources.[24] The perioperative members of the ERAS team represent the patient and family, the surgeon's office, preanesthesia, nursing units, surgery, anesthesia, administration, patient education, and representatives of other core professions. This team reviews the evidence, assesses current practice and culture, and decides which pathway(s) should be implemented in the practice.

Additionally, facilities with an "ERAS Coordinator" have increased staff education and can solely focus on the implementation process.[31] It is always beneficial to partner with other specialties and facilities that have an ERAS program to learn from their experience and identify successes and barriers.[30]

Change Management

There are many models that offer a construct or framework to lead, develop, implement, and sustain successful change initiatives. Kotter's 8-Step Change Model offers a framework to generate and implement planned and sustainable change.[23] The model guides the team through the development and implementation of an ERAS pathway.[23]

In March 2017, the Agency for Healthcare Research and Quality (AHRQ) Safety Program for ERAS launched an initiative to increase the implementation of ERAS pathways in U.S. hospitals through the adoption of AHRQ's Comprehensive Unit-based Safety Program (CUSP).[32] The CUSP multifaceted approach facilitates front-line teams to more rapidly adopt evidence-based practices. AHRQ's Safety Program for Improving Surgical Care and Recovery uses the CUSP framework to promote the delivery of evidence-based perioperative care and prioritize quality improvement.[31] The CUSP Toolkit supports Kotter's 8-Step Change Model and is compatible with TeamSTEPPS® to support units in improving culture (See Table 5).[33]

Step 1. Create a Sense of Urgency

Tell a compelling story for individiuals and team to visualize the need and importance of their engagement in the change initiative.

- **Storytelling is key**: A short repeatable story is crucial to capture the project's vision and encourage participation
- **Urgency and Importance:** The story should create a sense of urgency, highlighting the importance of initiative
- **Diverse Teams:** Early engagement is vital because teams have different perspectives
- **Visuals Matter:** Combine spoken and visual elements (like infographics) for clear communication
- **Focus on Benefits:** The story should emphasize how the change improves patient outcomes and staff satisfaction
- **Variable Engagement:** Recognize that staff will engage at different paces and for different reasons

Step 2. Form a Powerful Guiding Coalition

Visible, coordinated support from top levels of leadership, key stakeholders and staff thought leaders who will lead the team to design and drive change.

- **ERAS Champions & Leaders:** ERAS success relies on a core team with representatives from various perioperative professions (surgeons, nursing, anesthesia professionals, pharmacists, etc.)
- **Champion Role:**
  - **Education & Communication:** Champtons facilitiate education and communication within their teams and accross professions to raise awareness and acceptance of the ERAS program
  - **Positive Attitue:** They bring a "can-do" attitude to encourage participation
  - **Key Qualities:** There's no perfect champion, but effective ones can clearly explain the program's value, provide direction and motiviation, build trust, foster collaboration accross professions, and communication effectively with colleagues

Steps 3 and 4. Create and Communicate the Vision for Change

Develop concise story that can be told in a less than 5 minutes, that is easily understood and remembered.

- **Share the Vision for Change:** Leaders need a clear vision of the desired future state for the program
- **Importance of Buy-In:** Getting everyone on board is crucial for effective change
- **Vision as a Tool:** A clear vision helps people see the benefit and actively contribute to developoing a patient-centered pathway
- **Early Involvement:** Including the team in decision-making from the start fosters ownershipand reduces resistance to change
- **Focus on Benefits**: Discussing both program goals and potential challenges allows for a more comprehensive plan

Step 5. Empower Broad-based Action

Identify persons, processes and other factors to address the barriers for the engaged team's success.

- **Empowering Action:** Removing barriers to change, both potential and existing, is crucial for broad-based participation
- **Leadership's Role:** Leaders play a central role in overcoming challenges and providing ongoing support to the team
- **Benefits of Empowerment:** Empowering the teams allows them to execute the vision and drive the change forward

Step 6. Generate Short-term Wins

Identify short-term targets to share quick, early victories for celebration of success and to create momentum.

- **Celebrating Success Matters:** Recognizing achievements motivates the team to continue following the ERAS pathway
- **Benefits of Celebration:**
  - **Encourages Compliance:** Celebrating success keeps the team engaged with the ERAS program
  - **Validation & Involvement:** Recognizing achievements validates everyone's contribution to the program's vision
  - **Confidence Building:** Celebrating successes builds confidence in the effectiveness of the ERAS program
  - **Attracts New Participants:** Recognition can draw others who haven't yet participated in the ERAS program

Step 7. Consolidate and Build on Change

Use momentum from quick wins to continue to build on what is going well and to identify improvement opportunities.

- **Beware of Premature Celebration:** Don't declare victory too soon. Celebrate progress, but continued improvement is essential
- **Maintain Focus on Change:** Kotter emphasizes that motivation and teamwork are crucial to solidify the new practices before full transformation is achieved
- **Learn from Wins:** Analyze short-term successess to identify what worked well and what needs improvement. This helsp refine the program for better outcomes

Step 8. Anchor Changes into Organization and Team Culture

The change becomes core to your culture through stories, recognition, orientation, and recruiting.

- **ERAS as a Journey:** Don't see ERAS as a one-time fix, but an ongoing process of improvement
- **Long-Term Sustainability:** To keep ERAS successful in the long run, several things are important:
  - **Continued Leadership:** Leaders need to stay involved and contribute to the program's ongoing development
  - **Team Education:** Provide ongoing education and training for the team to ensure everyone stays up-to-date
  - **Progress Updates:** Keep the team informed about the program's progress to maintain momentum
  - **Celebrating Wins:** Recognize short-term successes to keep the team motivated and enthusiastic
- **Ultimate Goal:** The goal is for ERAS to become a natural part of everyday practice

Enhanced Recovery after Surgery Pathway Trial Implementation

Following the development of the project plan and enhanced recovery pathway, the acquisition of necessary supplies and medications, the creation of patient education resources, the completion of trial team staff education, and many other elements, it is time to trial a case or several cases to identify successes and gaps in your preparation and execution. ERAS-related practice areas and roles vary across specialties, patients, facilities, and health systems.

Coordination of Care Support

Little takes the place of the value and effectiveness of face-to-face communication. Electronic health records (EHR) that are interfaced to support the coordination of care for patient safety and modification of the patient specific plan of care across the various practice settings and transitions of care. These transitions include prehospitalization through the patient's return home for recovery, therapy when necessary, and follow-up with surgeons, primary- and specialty-care providers. Integrating electronic health records and scheduling systems improves the safety, compliance, and efficiency of the ERAS program.[34] When EHR products do not interface or are not available, it is important to assess communication handoff pathways and tools to optimize safe care.

Patient Engagement

Patient education and expectation management in the Prehospital/Preadmission phase are critical to the success of the ERAS program. The patient learns about the ERAS program and establishes realistic goals for pain after surgery, nutrition, mobilization, and the expected hospital stay.[35] Education may also encourage the patient to engage in a physical activity or nutrition program to get in a better physical condition prior to the procedure to improve outcomes.[36,37]

Patient-related barriers to ERAS implementation include understanding why the perioperative processes they have come to expect have changed. Providing early education in the community and in the surgeon's office allows the patient to be a significant contributor to their care experience. Patient comorbidities, such as hypertension, hypercholesterolemia, chronic obstructive airway disease, and diabetes, can be optimized preoperatively with careful evaluation and assessment to participate in the ERAS pathway of care. If the patient is found to be a candidate for the pathway, additional planning to optimize their health through prehabilitation prior to surgery is important for a rapid return to health postoperatively.[37]

Multimodal pain management may also be a new concept for patients and their families. Education, success stories, and data are often helpful for the patient to develop a realistic understanding of the multimodal instead of one medication plan for analgesia.[38] Patients are also most successful when they are able to actively engage in lifestyle activities, such as exercise to lose weight or stopping smoking more than 2 weeks prior to surgery; ideally as a permanent cessation.[29]

Language, cultural and religious beliefs, and health literacy may also impact a patient's understanding of the enhanced recovery process. Please see the AANA document titled *Informed Consent for Anesthesia Care* for strategies to address communication, health literacy, and cultural competency.[39]

Engaging Staff

Staff attitudes, biases, and behaviors may also make ERAS implementation challenging.[40] Barriers may be due to resistance to personal practice change related to a limited understanding of ERAS value.[41,42] It is helpful to educate staff members to support the adoption of ERAS principles in their practice. Education includes the program itself, how their practice will change, and offering new education and skills opportunities that will position the staff

member as a successful contributor. Using many channels for effective communication across all ERAS team members contributes to the success of an ERAS program.[25] There is much to be done. Breaking down the project into small elements allows multiple teams and individuals to contribute to the success of the pathway from the beginning through implementation and continued improvement.

ERAS brings together a diverse team of healthcare professionals, each playing a vital role in empowering patients to actively manage their care. Risk managers, care navigators, pain management services, nutritionists, and social workers often go unnoticed, yet their contributions are essential for a holistic ERAS program.

Engaging the Team and Leadership

Obtaining buy-in from hospital administration and clinical leaders is essential to cultivating and leading improvement within the facility.[22] From the initiation stages to the implementation of an ERAS program., leadership roles that are strong supporters and visible champions will set the tone for the upcoming changes and display their commitment.[22] Practice-related barriers to ERAS implementation may include limited facility resources, low compliance with the program plan due to leadership, and administrative support.[29,41] Actively addressing these factors and other pathway barriers through the use of data and communication is critical prior to implementing the ERAS program.

Prehospital/Preadmission Phase

Surgeon's Office

The ERAS pathway begins when the patient visits their surgeon and the office team with a focus on patient education, patient expectations, engagement, and the development of a plan to

optimize their health before surgery and anesthesia for a rapid return to health post-procedure.[2] Identification of patients who will enter the pathway and early engagement of the interprofessional team may begin here. Patients, depending on their individual needs and the ERAS pathway they are entering, may meet only a few of the team members. As the complexity of the patient increases, they may not only meet the entire team preoperatively but also partner with the clinical team earlier for prehabilitation and longer post-procedure for successful rehabilitation.

Patient Optimization and Prehabilitation

Patients present for surgery and anesthesia with varying states of health. The goal of preprocedure prehabilitation is to identify patients with preexisting chronic and acute conditions in whom physiologic reserves can be improved or optimized prior to surgery.[2,43] Robust prehabilitation programs should be multimodal, aiming to improve cardiopulmonary capacity and metabolic flexibility through individualized exercise regimens, nutritional enhancements, and psychosocial support.[2] Creating a preoperative triage system of patient factors (e.g., advanced age,[44] frailty, cardiovascular deconditioning) and surgical complexity (e.g., major open vascular/abdominal, joint replacement, cardiac surgery on cardiopulmonary bypass)[19] improves patient screening, assessment, and ability to develop the prehabilitation plan when necessary.[45] Though several meta-analyses and randomized trials report the benefits of prehabilitation, further research is needed to measure patient outcomes through combined prehabilitation and ERAS techniques. Cost-effectiveness should also be further explored.[43]

Patient assessment and health history collection can occur through a patient portal, telephone interview, and, when appropriate, a preanesthesia assessment clinic to further assess and prepare complex patients for anesthesia and surgery.[35] Patient assessment and evaluation

focus on general health and the patient's functional capacity, and comorbidities to identify risk factors that may prolong recovery or lead to complications. A healthy patient has less to gain from preoperative medical optimization, though they may benefit from a health assessment and discussion of opportunities to maintain and improve their health.[46] Conditions associated with an increased risk of perioperative complications include cardiovascular disease, hypertension, chronic obstructive pulmonary disease (COPD), anemia, obesity, and diabetes mellitus.[47] The patient with comorbid conditions should begin assessment and optimization weeks prior to the procedure.

While certain health factors cannot be modified (e.g., age, extent of disease), there are modifiable elements (e.g., body mass index) that can be improved with exercise and diet modifications to enhance functional reserve.[48] Patients with low functional and physiologic reserves (e.g., elderly, frail, morbidly obese) may benefit from a plan for prehabilitation to improve physical fitness before surgery.[48] Addressing cigarette smoking with including cessation referrals, alcohol intake, and nutritional status to identify nutritionally depleted patients is also important to reduce intraoperative complications.[35] Some prehabilitation programs use assessment tools, such as cardiopulmonary exercise testing (CPET), to evaluate the patient's exercise capacity preoperatively.[49]

Patient/Family Education

The anesthesia professional plays a pivotal role in patient and family education by engaging the patient as an active participant in his or her care and the recovery process.[28] Anesthesia professionals continue to build on these activities throughout the Prehospital/Preadmission phase through patient assessment and evaluation to identify unique elements of the patient's health, pain, and anesthesia history that may require modification of the ERAS pathway to

coordinate the development of the plan of care with the patient and their primary care and specialty teams, as appropriate.[30]

Pain Management Plan

As part of the preanesthesia assessment, the anesthesia professional discusses with the patient their previous pain experiences and possible intensity of surgical discomfort to offer considerations for elements of a comprehensive perioperative plan to manage surgical pain. Collaboration with the patient's advanced pain management team and utilizing multi-modal pain management strategies can improve outcomes, especially for patients with difficult to control pain (e.g., chronic pain patients, substance use disorders).[50-52]

Preoperative Phase

Psychological Preparation of Surgery

Recent studies have found that patients with anxiety, depression, and catastrophizing attitudes may lead to postoperative complications, impaired recovery, and an increased rate of hospitalization.[53,54] These patients often experience a maladaptive response to surgical stress, which leads to hypermetabolic and hypercatabolic processes that affect the immune system, wound healing, and organ functionality.[54] Additionally, acknowledgment of the patient's pain psychology is an important aspect.[55] Patients who either experience these conditions or are at high risk for their development should be screened, counseled, and referred for treatment prior to undergoing surgery. Preoperative counseling may include setting clear expectations for pain management control and setting a plan for care during postoperative recovery. Please see the AANA document titled *A Holistic Approach to Pain Management: Integrated, Multimodal, and Interdisciplinary Treatment* for more on pain psychology.[55]

Preoperative Fasting

The most updated reports by the American Society of Anesthesiologists (ASA) Task Force on Preoperative Fasting and the ASA Committee on Standards and Practice Parameters recommend that patients can eat a light meal up to 6 hours preoperatively and a minimum fasting period of between 2 and 4 hours for clear fluids, such as water, fruit juices without pulp, carbonated beverages, carbohydrate-rich nutritional drinks, clear tea, and black coffee.[56,57] Though the preoperative fasting guidelines have been in place for some time, many anesthesia professionals, for varying reasons, require that the patient be NPO after midnight.

Current ERAS literature recommends that preoperative fasting time be kept to a minimum to reduce preoperative thirst, hunger, and anxiety, as well as the perception of pain.[8] In some ERAS pathways, it is recommended that the patient drink 400 – 800 mL of a 12.5 percent carbohydrate-containing clear liquid before midnight on the night before surgery and 400 mL of the same drink up to 2 hours prior to anesthesia.[17,56-58] Drinking a carbohydrate beverage 2 hours prior to the induction of anesthesia has been shown to reduce insulin resistance, minimize nitrogen and protein loss, and maintain muscle strength to accelerate recovery.[4,56,59,60] However, further research is required for diabetic patients, as the carbohydrate beverage must be considered as part of the glycemic management plan.[59] Due to this, it is recommended that water be used in lieu of a carbohydrate beverage for patients with diabetes mellitus.[59]

In addition to 12.5 percent carbohydrate-containing liquids, some patients may benefit from one of the several commercially available nutritionally balanced products on the market. In collaboration with dietary and nutrition services, considerations for selecting an optimal beverage include:[58,61]

- Avoidance of renal solute load.

- Low osmolality.
- A maltodextrin component for an optimal insulin secretion profile.
- Pleasant taste.
- Prepackaged in clinically relevant doses.
- Available and affordable to patients and hospitals.

Discharge Education and Planning

Discharge education and planning begin early in the surgeon's office, during the preoperative phase, and continue through discharge and return home. Early patient education (both written and verbal) and engagement increase understanding of the importance of their contribution and participation in their plan of care for the best outcomes, as well as the ability to monitor the compliance of the entire team in their care pathway.[17] The following activities may be included as part of discharge planning:

- An understanding of the timing of the elements and goals along the care continuum prepares the patient and their family to participate in the care they will receive.
- Transitions in the experience of pain and how pain can be managed with medications and non-pharmacologic modalities.
- Clear instructions about mobilization and diet with daily activity targets to achieve.
- Circumstances that may delay discharge and how they will be addressed.

Intraoperative Phase

Multimodal Analgesia

Multimodal analgesia describes the use of more than one modality or technique to achieve effective pain control from the preoperative period through initial recovery and return home.[7,8,17,60] A multimodal approach, instead of the traditional unimodal opioid approach,

involves the administration of several analgesics with separate mechanisms of action across the perioperative period and/or concurrent field block using local anesthetic, regional, or neuraxial analgesia (e.g., paravertebral block with non-opioid analgesia).[7,10,17] It is important to take into consideration the complexity of the surgical procedure, patient pain experience history and preferences, anticipated level of postoperative pain, and duration of action of analgesics and local anesthetics when deciding on pain management options for pathway development and for individual patients. Multimodal analgesia may eliminate or significantly reduce the use of opioids and adverse side effects such as respiratory depression, postoperative nausea and vomiting (PONV), and delayed return of gastrointestinal function.[7,10,17] However, low-dose opioids for a defined period of time should be made available when necessary, when other modalities are not effective to address the patient's discomfort. Opioids should be administered in a dose sufficient for adequate analgesia while limiting side effects (e.g., respiratory depression, sedation, nausea, and vomiting).[16]

Non-opioid medications include acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), systemic lidocaine infusion or ketamine infusion, long-acting local anesthetics, and gabapentinoids (gabapentin/pregabalin)*.[16,17,62-64] Other modalities using local anesthetics of varying durations of action include surgical site local anesthetic infiltration, field blocks (e.g., transversus abdominis plane (TAP) block), central neuraxial techniques (e.g., epidural and spinal analgesia), and regional blocks.[16,17,62-64] Non-pharmacological analgesia (e.g., acupuncture, music therapy) as well as cognitive-behavioral techniques (e.g., guided imagery, relaxation) may be used as an adjunct to pharmacological methods to support the patient in reducing postoperative pain, anxiety, and the use of pain medication.[10,64]

* Caution is suggested for patients over the age of 65 due to the increased risk of delirium, new antipsychotic use, and pneumonia.

Several factors to consider when developing a multimodal pain management plan of care with the patient include:[17,60,64]

- Patient preferences and previous experience with pain.
- Medical history, including comorbidities.
- Emotional and psychological status, including previous related experiences and concerns.
- Type of surgery and anticipated postsurgical pain experience.
- The risk-benefit of the various non-opioid multimodal strategies.

The following table offers a starting point to begin developing an ERAS multimodal analgesia pathway. Science is changing rapidly as teams review their outcome data. The facility formulary will provide a list of available medications to choose from or to identify medications to request additions to the formulary. In addition to reviewing existing pathways, a review of the literature will provide the team with peer-reviewed evidence to craft and improve their ERAS pathway.

Table 1. Considerations for Classes of Medications and Local Anesthetic Techniques* to Create Procedure Specific Enhanced Recovery Pathway[17]

	Class of Medication/Technique*	Medication	Considerations
Preop	Acetanilide derivative	• Acetaminophen	• Cost-effective (PO) • Contraindicated in severe liver impairment or disease
	Cyclooxygenase-2 inhibitor	• Celecoxib	• Selective NSAID subclass with fewer side effects • Less risk of perioperative bleeding
	Gabapentinoid	• Pregabalin • Gabapentin	• Glutamate inhibitor • Increased risk of sedation, confusion, ataxia, visual disturbances, and suicidal ideation[63] • Increased rate of postoperative adverse events in age > 65 years[63]
	Nonsteroidal anti-inflammatory drug (NSAID)	• Ibuprofen • Ketorolac	• Nonselective (inhibits both COX-1 and COX-2)[65] • Decreases inflammation[65] • Decreased platelet aggregation may result in increased risk of bleeding[65] • Renal elimination[65]
	Regional/neuraxial blockade*	• Spinal anesthesia • Epidural anesthesia/analgesia • Nerve blocks	See *Regional Anesthesia Techniques – An Element of Multimodal Pain Management*[66]
Intraop	Acetanilide derivative	• Acetaminophen	• Hepatic toxic metabolite, limit daily dose to 4 grams/day from combination drugs with acetaminophen[67] • IV maximum drug concentration, 70 percent greater than oral; overall drug exposure similar between IV and oral[67] • IV ketorolac and acetaminophen effective for moderate pain in children[67]
	Alpha 2 agonist	• Dexmedetomidine • Clonidine	• Anti-hypertensive effect • Sedative, anxiolytic, analgesic • Side effects: bradycardia, hypotension sedation[68]
	Beta-blocker	• Esmolol	• Avoid in sinus bradycardia, 1st degree heart block, and heart failure • May increased digoxin levels

	Class of Medication/Technique*	Medication	Considerations
	Electrolyte administration	• Magnesium sulfate	• Analgesic and anesthetic sparing effects • High therapeutic index • May prolong duration of nondepolarizing neuromuscular blockade
	• Infiltration of surgical site with local anesthesia as single dose or infusion	• Bupivacaine • Ropivacaine • Lidocaine • Liposomal Bupivacaine for prolonged release, single-dose administration	• Significant side effects are rare when intravascular injection is avoided • Chondrolysis for intra-articular injections and infusion should be considered • Ketorolac added to 0.5 percent Lidocaine for intravenous regional anesthesia (IVRA) provides effective anesthesia and analgesia
	Glucocorticoid steroid	• Dexamethasone	• When added to nonopioid analgesics, time to discharge is reduced
	Lidocaine infusion	• Lidocaine	• Treat neuropathic pain • Continued postop, may improve bowel function
	N-methyl-D-aspartate receptor antagonist	• Ketamine • Dextromethorphan	• Higher doses of Ketamine may have psychotropic effects
	Nonsteroidal anti-inflammatory drug (NSAID)	• Ketorolac	• Increased risk of gastrointestinal bleeding[69] • Concern for increased surgical site bleeding, limited evidence in the literature[65,69]
	Opioid	• Opiates • Semi-synthetic opioids • Synthetic opioids • Mixed agonist-antagonist opioids	• May cause nausea and vomiting, sedation[70] • Low to moderated dose(s) considered for anticipated moderate to severe pain
	Technology*	• Disposable local anesthetic infusion systems	• Cost • Patient education • Plan for removal post-discharge
Postop	Acetanilide derivative	• Acetaminophen	• IV or oral Acetaminophen
	Gabapentinoid	• Pregabalin • Gabapentin	• Increased risk of sedation, confusion, ataxia, visual disturbances, and suicidal ideation[63] • Increased rate of postoperative adverse events in age > 65 years[63]
	Ketamine infusion	• Ketamine	• Controls refractory pain • Reverses opioid tolerance and hyperalgesia related to chronic opioid use
	Lidocaine infusion	• Lidocaine	• Treat neuropathic pain • Continued postop, may improve bowel function

	Class of Medication/Technique*	Medication	Considerations
	Low to moderate dose IV or oral opioid for breakthrough pain	• Oxycodone • Morphine • Hydromorphone	• Useful for acute treatment of moderate-to-severe pain • Increased risk of PONV, decrease in bowel motility[70]
	Nonsteroidal anti-inflammatory drug (NSAID)	• Ibuprofen • Ketorolac	• In some procedures may increase bleeding[69] • Increased risk of nausea and vomiting
	Oral dextromethorphan	• Dextromethorphan	• Helpful for patients with chronic opioid use
	Technology*	• Transcutaneous electrical nerve stimulation (TENS)	• Patient education to manage post-discharge

Nausea/Vomiting Risk Assessment and Prophylaxis

Proactive management of PONV is core to the patient returning to preprocedure health and activity[4]. Several risk factors for PONV include a history of PONV or motion sickness, being female, being a nonsmoker, having a surgical procedure, a surgical procedure lasting more than 60 minutes, and the use of inhalation agents and/or opioids.[4]

PONV Risk Assessment

Several validated tools for the assessment of PONV are available. The Apfel Score assesses the patient for four PONV risk factors: female gender, nonsmoking status, postoperative use of opioids, and previous history of PONV, or motion sickness.[71,72] Each of the elements, if present, receives a score of 1 to predict the risk of PONV.

Table 2. Apfel Score to Predict Postoperative Nausea and Vomiting[71-74]

					Score*
Female					
Nonsmoker					
Post-operative use of opioids					
Previous history of PONV or motion sickness					
Risk Factor(s) Present	0	1	2	3	4
Percent Risk of PONV	10	21	39	61	79

*Score 1 is present, 0 is absent

Strategies to reduce the risk of PONV include:[71,74]

- Use regional anesthesia (rather than general anesthesia).
- Use of propofol for induction and maintenance of anesthesia.

- Avoid nitrous oxide.
- Avoid volatile anesthetics.
- Minimize opioids.
- Adequate hydration, while avoiding excessive fluid.

Goal Directed Fluid Therapy

Each element of the ERAS pathway is important to successful patient recovery. Euvolemia through goal-directed fluid therapy (GDFT) is maintained in the intraoperative phase through cardiac function monitoring to track the effects of small crystalloid or colloid boluses and vasopressors on cardiac parameters instead of administering large volumes of clear intravenous fluids without cardiac function monitoring. GDFT has been shown to reduce complications and length of stay using non-invasive or invasive monitoring of varying cardiac function parameters, depending on the monitoring platform, to maintain normovolemia, optimize cardiac function, and decrease fluid and salt excess.[75,76]

Evidence suggests that GDFT results in better patient outcomes compared to standard intra- and post-operative fluid management. The age-old formula that calculated volume deficit from fasting, insensible volume loss, hourly fluid rate, and crystalloid boluses to maintain blood pressure, heart rate, and urine output is a reference from our past that has been shown to place the patient at risk of complications and slow recovery.[77] A meta-analysis of 32 randomized controlled trials involving 5,056 patients showed a significant reduction in mortality in the high-risk (expected mortality > 20 percent) group.[78] Another study, which examined 29 randomized controlled trials involving 4,085 patients, also found a significant reduction in mortality and surgical complications for all patients.[79]

To decrease variability in fluid administration during surgery and to improve outcomes, it is important to tailor GDFT protocols to each patient's unique surgical and patient risk factors.[80] This can be achieved with an individualized patient and procedure fluid management plan.[81,82] GDFT maintains intraoperative normovolemia by monitoring stroke volume, cardiac output, and/or oxygen delivery to avoid hypovolemia and postoperative oxygen debt.[81,83] Monitoring technologies include esophageal doppler, arterial waveform analyzers, photoplethysmography-based devices, volume clamp-based devices, and bioreactance devices.[84]

Active Warming

Preoperative and intraoperative normothermia is another important element of the ERAS pathway to decrease oxygen demand from shivering post-operatively, as well as to improve healing and decrease the risk of surgical site infection.[4] Core temperature should be regularly monitored and maintained above 35.5-36°C in the intraoperative and immediate postoperative period.[4,85]

Glycemic Management

Perioperative hyperglycemia is associated with an increased risk of morbidity and mortality.[86,87] Surgical patients may develop hyperglycemia as a result of the hypermetabolic stress response, which is responsible for increased glucose production and insulin resistance.[88,89] Overtreatment and undertreatment of hyperglycemia present a significant risk to patients with and without diabetes.[90] Factors that may affect optimal blood glucose control include concern for overtreatment of hypoglycemia, clinical inertia to adopt policy, and medical management errors.[90]

Early studies showed a significant reduction in postoperative complications when patients received intensive insulin therapy to maintain glucose concentrations at 80-110 mg/dL or normoglycemia. This management is also known as "tight" glucose control.[90] While current recommendations for

optimal perioperative blood glucose levels in critically ill patients vary (see Table 1), national organizations agree that "tight" glucose control may not be beneficial. More recent studies found no benefit and, in fact, identified an increased risk of complications related to "tight" glucose control, including hypoglycemia.[86] In general, maintaining blood glucose concentrations of 180 mg/dL or less is recommended.[91,92]

Other recommendations include minimizing changes to antidiabetic drugs if possible, performing a hemoglobin A1C on all patients with diabetes or hyperglycemia if no A1C test result is available from the previous 3 months, and considering postponing surgery if the patient is showing complications of severe hyperglycemia (e.g., severe dehydration, diabetic ketoacidosis, hyperosmotic hyperglycemia, nonketotic state).[59,87,89]

Table 3. Recommendations for Optimal Preoperative Blood Glucose Range Levels

National Organization	Recommendations
American Diabetes Association (2024)[87] and American Association of Clinical Endocrinology (2022)[90]	Target blood glucose level of 140 and 180 mg/dL
American College of Physicians (2011)[93]	Target blood glucose level of 140 to 200 mg/dL
Society of Ambulatory Anesthesia (2024)[59]	Target blood glucose level <180 mg/dL
Society of Thoracic Surgeons (2009)[94]	Target blood glucose level ≤180 mg/dL

Tubes and Drains

Whenever possible, the routine use of postoperative nasogastric or orogastric tubes, urinary catheters, and abdominal and pelvic drains without clear indications should also be avoided.[95,96]

These strategies help promote postoperative feeding and mobilization, avoid dehydration, and promote patient comfort.[95]

Postoperative Phase

The facility delineates specific criteria for patient assessment, evaluation, monitoring, and documentation intervals during the recovery period. The patient is assessed and evaluated, noting the patient's recovery status and return to adequate function (e.g., level of consciousness, ability to ambulate, etc.). For additional guidance, review AANA *Postanesthesia Care Standards for the Certified Registered Nurse Anesthetist*.[97] Patients are encouraged to resume their normal diet and activities of daily living on the day of surgery.[98] These activities are supported by capping or removing the IV catheter, avoiding salt and water overload, preventing PONV, and administering non-opioid and, when necessary, opioid analgesia.[81]

Discharge Phase[30]

Patients can be discharged after they meet the facility's criteria for recovery.[30] Refer to the Aldrete score, or something similar, to determine the cognitive status of patients fit for discharge. These criteria may include:

- Acceptable respiratory status.
- Hemodynamically stable within 20 percent of admission vital signs or as determined by the facility.
- Ability to eat and drink without nausea or vomiting.
- Adequate pain control.
- Independently mobile; able to get out of bed and on/off the toilet or return to the level of preprocedure activity.

- No complications requiring extended hospital care.

Prior to discharge, the patient continues to receive comprehensive education that began in their surgeon's office related to anesthesia, surgical procedures, and pain management to address any questions and concerns. The patient, family, or caregiver also receives written information that includes instructions, symptoms to monitor for that need to be reported, who to report them to, emergency contact information, and strategies to aid recovery (e.g., how to control pain with medicine, how to care for the incisions).

Post-Discharge Phase

The patient's ERAS pathway and the participation of the interprofessional team continue when they return home. The patient is scheduled for follow-up appointments, as necessary, with the surgeon, proceduralist, primary care, and/or specialty care clinician.[30] When indicated, additional members of the team will be added to address specific patient needs.

Continued Quality Improvement Team Activities

Identification of desired ERAS pathway outcomes and facilities pre-ERAS pathway outcomes are helpful to identify opportunities for improvement and education for pathway compliance and outcomes. Several process and outcome measures, such as length of stay, readmission, pneumonia, venous thromboembolism, urinary tract infection, and surgical site infection, are being collected and reported by most facilities for several procedures. Considerations include:[30]

- What data is currently being collected?
- What additional data should be collected?
- How will data be entered, analyzed, and reported?
- How to use the collected data?

What Data to Collect

Developing a sustainable ERAS program requires tracking of outcomes and process measures.[34] While gathering data on every ERAS element may help improve patient outcomes, it may be unrealistic to expect compliance with every ERAS element on every patient for a number of clinical or process reasons.[34] It is important to consider a balanced approach to collecting information to identify trends from available resources that can be used for process improvement. Data related to an ERAS program may include:[30]

- Demographics and physical characteristics (e.g., age, physical status, body mass index, gender).
- Elements of patient health history (e.g., chronic pain, co-morbidities).
- Patient compliance with the elements (e.g., as a percentage or number of elements chosen).
- Providers must comply with pathway elements within their specialty.
- Patient outcome measures:
    - Length of stay
    - Readmission
    - Surgical site infection
    - Surgical complication
    - Dehydration requiring IV fluids
    - Mortality rate
- Benefits and costs per patient in the pathway.

Data Collection[30]

- Use existing systems (if available) to collect baseline data:
    - Electronic health record(s) (EHR)

- The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP)
- Others

- Adapt or develop ERAS checklists for preoperative and perioperative care.
- Consider learning from existing facility data collection practices to improve the data collection process.

Translating Data to Action[24]

Determine how best to analyze and communicate the ERAS pathway data to guide decision-making for pathway improvement and individual practice compliance to match their peers. Data may be posted and also shared at regular ERAS team meetings and through publications.

Addressing Implementation Challenges

Despite the well-established benefits of ERAS programs as effective and economically viable, challenges arise when introducing ERAS pathways into routine practice.[25,99] Barriers to implementation may be attributed to patient-related, staff-related, and practice-related factors.

Table 4. Possible Barriers and Solutions to ERAS Pathway Development, Implementation, and Compliance[29,41,100]

	Barriers	Solutions
• Patient-related	• Needs and expectations • Health literacy, understanding and engagement • Attitudes and behaviors • Health history	• Consistent communication and information • Agreed pathway • Ensure realistic expectations • Use of appropriate language

		and tools
• Staff-related	• Attitudes and behaviors • Engagement • Communication and collaboration • Skills and competencies	• Consistent communication and collaboration • Ongoing staff engagement, education and support
• Facility, Specialty-related	• Leadership and support • Initial and ongoing staff education • Optimizing staff privileges and competencies • Availability of medications, monitoring and resources • Applicable policies and procedures • Use of data for continued pathway improvement	• Regular reports documenting all aspects of ERAS process using data • Introducing an ERAS coordinator/specialist to focus on implementation and sustainability • Effective leadership • Data collection to observe what further improvements are needed and to highlight compliance and clinical outcomes

Conclusion

ERAS pathways contribute to positive patient outcomes,[7,8] reduced postoperative complications,[3,7,9] accelerated recovery,[7,8] and early discharge, [10,11] without increasing costs.[9,12-15] Successful ERAS implementation depends on many factors, including effective patient and staff education, strong leadership within the interdisciplinary team, and strategic practice management. Anesthesia professionals are well positioned as champion leaders and members of the patient-centered team for ERAS excellence.

Enhanced Recovery Resources

- American Society for Enhanced Recovery (ASER)
- ERAS Society Guidelines
- Peri-Operative Patient Simulation (POPS) – Intraoperative Goal Directed Fluid Therapy Protocols
- University of California, San Francisco - Clinical Resources: ERAS Pathway
- AANA ERAS Resources

604 **Table 5.** ERAS Pathway Development and Implementation Referencing Kotter, CUSP, and TeamSTEPPS®[23,24,30,33,41,101]

Phases	Kotter	CUSP	TeamSTEPPS®	Implementation Considerations

Creating a climate for change	• Establish a sense of urgency	• Understand the science of safety	• Create a change team	• Assess and analyze to identify themes of satisfaction, suggestions, and concerns in the current program
				• Patient satisfaction and other feedback sources
				• Benchmark U.S. and international sources for patient and community education communications and resources
				• Assess the scope of the project
				• Identify existing resources:
				  ○ Staff
				  ○ Equipment
				  ○ Drugs
				  ○ Clinical policies
				  ○ Education
				  ○ Documentation
				• Identify facilitators and barriers
				• Conduct an assessment of the readiness and capability
				• Represent an inclusive, “can-do” attitude

	• Create a guiding coalition	• Assemble the team • Engage senior executive	• Define the problem	• Identify “champions” (e.g., nurses, anesthesia professionals, surgeons) to lead and facilitate the ERAS program • Include patient advocate(s) on the leadership team
	• Communicat e the vision for change	• Understand the science of safety • Identify defects through sensemaking	• Define the intervention	• Clearly communicate and engage others in the vision • Obtain “buy-in” from all the members of the practice • Partner with community leaders to develop messaging through multiple channels to communicate understanding of patient and family responsibility, and engage service agencies in pre- and post-care support services to increase safety, satisfaction, and outcomes
Introducing New Practice	• Empower broad-based action, remove obstacles	• Assemble the team • Identify defects through sensemaking • Implement teamwork and communicatio	• Developing a plan for testing the effectiveness	• Develop and pilot the ERAS pathway in one surgical specialty • Begin with a small team • Develop initial learning, ongoing education, training, and continued team development • Conduct a systematic review of the literature and facility outcome data • Utilize patient feedback in developing the care pathways

Phases	Kotter	CUSP	TeamSTEPPS®	Implementation Considerations
		n		
Maintaining the Momentum	• Generate short-term wins	• Implement teamwork and communication	• Develop an implementation plan	• Utilize electronic health records (EHRs) to track progress • Celebrate initial and new successes • Recognize staff and patience excellence
	• Consolidate and build on change	• Identify defects through sensemaking	• Develop a plan for sustained improvement	• Develop outcome and process measures to track quality for continued improvement • Use outcome and process measures to track quality. Use data or audit feedback to make modifications • Audit all steps for compliance, review, and process • Audit documentation and patient compliance with care • Seek both positive feedback and opportunities to improve from patients and family • When possible, acquire patient and family assessments of care in real time to address less than satisfactory experiences
	• Anchor ERAS pathway changes into the organization and team culture	• Understanding the science of safety • Implement teamwork and communication	• Develop a communication plan	• View the ERAS program as a continuum and not as a final destination • Leadership presence, participation, and ongoing support • Initial and ongoing staff education and training • Frequent updates on the successes, challenges, and solutions being addressed by ERAS • Continue educating the patient and community on the significance and importance of ERAS • Celebration of short-term wins

ERAS Phase	Goal	Considerations
Preoperative Phase	• Engage the patient as a contributor and participant in their plan of care	• Provide detailed instructions prior to the procedure or surgery • Provide necessary resources and services for the Preoperative Phase • A light meal up to 6 hours preoperatively • Carbohydrate beverage up to 2 hours preoperatively • Initial multimodal medications and/or regional block placement • Seek the patient's expectations • Encourage the patient to ask questions and be an active participant in care decisions
	• Discharge planning begins before admission	• Discuss discharge planning, education, and a home medication plan with the patient and family/friends in the surgeon's office, and during preanesthesia assessment optimization and care planning • Encourage patients to ask questions and be active participants in care decisions • Provide the patient with written pamphlets, handouts, and/or web resources
Intraoperative phase		• Opioid sparing, multimodal analgesia • Normovolemia/goal-directed fluid therapy • Nausea/vomiting prophylaxis • Normothermia • Normoglycemia • Avoid tubes and drains
Postoperative Phase	• Encourage the patient to resume normal activities	• Multimodal analgesia Nausea/vomiting treatment • No or judicious IV fluid management • Ambulation on the day of surgery • Normal diet on the day of surgery
	• Discharge	• Anticipate needs for discharge • Provide patient or family education • Defined discharge criteria and patient/family education • Engage with the interprofessional team and family to understand how to return to health and symptoms to be aware of in order to seek appropriate help
Post-Discharge Phase	• Continue to support the patient to monitor for symptoms or changes in health and seek assistance • Patient follow up with surgeon, proceduralist, primary care, and/or specialty care • Continue therapy and other interprofessional activities as planned	
Continued Quality Improvement Team Activities	• Determine how best to analyze and communicate the ERAS pathway data to guide decision-making for pathway improvement and individual practice compliance • Analyze and share quality measures, patient surveys, and staff input to celebrate successes and identify opportunities for improvement • Utilize patient feedback to improve the ERAS program	

Adopted by AANA Board of Directors July 2017
Revised by AANA Board of Directors TBD

Appendix A. Sample Enhanced Recovery after Surgery Pathway Continuum to Develop Pathway and Team Engagement

MPerioperative Phase	Responsibility					
	Surgeon	Nurse	Anesthesia	Patient	Physical Therapist	Others as Needed
Prehospital/Preadmission Phase						
• For patient/family education						
• Pain management plan	Include patient's advanced pain management team as needed					
• Patient optimization	Include primary and specialty medicine as needed					
• Prehabilitation of select patients (e.g., diabetic, hypertensive)						
Preoperative Phase						
• Limited fasting (light meal up to 6 hours preop)						
• Carbohydrate beverage (up to 2 hours preop)						
• Initial multimodal medications and/or regional block placement						

• Discharge planning, education and home medication plan						
Intraoperative Phase						
• Opioid-free or opioid sparing multimodal analgesia						
• Normovolemia						
• Nausea/vomiting prophylaxis						
• Normothermia						
• Normoglycemia						
• Avoid tubes and drains						
Postoperative Phase						
• Early nutrition						
• Early mobilization					As needed	
• Multimodal analgesia emphasizing non-opioid techniques						
• Nausea/vomiting management						
• No or judicious IV fluid management						
• Patient/family education						
Post-Discharge Phase						
• Monitor for symptoms or changes in health to seek assistance						
• Follow-up with surgeon, proceduralist, primary care and/or specialty care						
• Continue therapy and other activities for recovery as planned						
Continued Quality Improvement Team Activities						
• Use data to celebrate successes and identify opportunities for improvement						

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