ERAS
Enhanced Recovery After Surgery

Meghan Shimp, RN
Edward Kofsky, MD
Goals and Learning Objectives

• History of Enhanced Recovery After Surgery
• Components of ERAS
• Effects of healthcare on National Opioid Crisis
• Multimodal Analgesia
• Patient Outcomes
• Winchester Medical Center’s path for ERAS implementation
What is ERAS?

**ERAS: Enhanced Recovery After Surgery**

Multi-disciplinary, peri-operative care pathway that affords clinicians tools to help optimize a patient's recovery.
History of ERAS

• 1990s- Henrick Kehlet, a Danish colorectal surgeon, started research to improve surgical patient outcomes and reduce surgical stress.

• 1990s- Laparoscopic surgical techniques emerge.

• 1999- H. Kehlet publishes *Acute Pain Control and Accelerated Postoperative Surgical Recovery*.

• 2001- A group of European surgeons starts the ERAS Study Group.

• 2001-2010- ERAS Study Group continues to publish research and data about ERAS protocols.

• 2010- ERAS Society is officially registered as a non-profit.

• 2010-2019- ERAS Society continues to publish recommendations for ERAS protocols for multiple disciplines.
Not Just for Colorectal Surgery

- Thoracic
- Urology
- Gynecology
- Orthopedic
- Vascular
- Pancreatic
- Gastric
- Esophageal
- Bariatric
- ?Cardiac
Goals of ERAS

• The goal of ERAS is to improve patient overall experience and outcomes with a fast track clinical pathway.

• Benefits include:
  - Reduction of LOS
  - Reduction of post-op complications
  - Reduction of readmissions
  - Reduction of cost
  - Reduction in opioid use
ERAS Phases of Care

ERAS interventions are implemented in the phases of care:

− Preoperative
− Intraoperative
− Postoperative
Preoperative Interventions

- Preadmission counseling
- Managing expectations around pain
- Strong for Surgery tenets
  - Nutrition
  - Glycemic Control
  - Medication Reconciliation
  - Smoking Cessation
- Limit Fasting
- Clear liquids up to 2 hours prior to induction
- Carbohydrate drink completed 2 hours prior to induction (Gatorade, Ensure Pre-Surgery)
- Initial multimodal analgesia
Carbohydrate Loading

SOME OF US JUST LOVE THE SMELL OF CARBS
Carbohydrate Loading

- 1960s concern over aspiration during anesthesia led to the “golden rule” NPO after midnight
- Current ASA recommendations are to drink clear liquids up to 2 hours prior to surgery
- Prolonged fasting increases insulin resistance postop
- Research shows carbohydrate loading 2 hours before surgery can reduce insulin resistance
- Insulin resistance can slow the healing process
- It reduces hunger, thirst, malaise, anxiety, and nausea postoperatively which improves the patient’s overall wellbeing
Intraoperative Interventions

- Judicious use of IV fluids
- Regional anesthesia
- Nausea/Vomiting prophylaxis
- Maintain Normothermia
- Maintain Normovolemia
- Maintain Normoglycemia
- Avoidance of tube/drains as appropriate
Postoperative Interventions

• Early Ambulation (day of surgery)
• Multimodal analgesia
• Scheduled non-narcotic pain control
• Early advancement of diet
• Early removal of catheters and drains
• Antiemetic management
• Judicious use of IV fluids
• Patient education
Opioid Crisis

Around 46 people die every day from overdoses involving prescription opioids.
Impact of Opioid Crisis

- 1990s, the number of opioid prescriptions starts to increase
- 218,000 people have died from prescription opioids from 1999-2017 in the US
- On average 130 people die every day from an opioid overdose in the US
- 48.5 million Americans have used illicit drugs or misused prescription drugs
- 47,000 people died from overdose in 2017, 36% of those involved prescription medication
- The most common prescription medications involved in opioid deaths: Methadone, Oxycodone, Hydrocodone

http://www.cdc.gov
ERAS and the Opioid Crisis

- A study found that in patients who were opioid naïve prior to surgical procedure, both major and minor, 5.9 to 6.5% were persistent opioid users 90 days postop.
Multimodal Analgesia

• What is multimodal analgesia?
  2 or more drug classes that target different pain pathways

• Multimodal analgesia medications:
  – Celebrex (COX-2 Inhibitor)
  – Toradol (NSAID)
  – Ibuprofen (NSAID)
  – Tylenol (Oral/IV)
  – Gabapentin
  – IV Lidocaine
ERAS by the Numbers - Colorectal

• Reduction in LOS from 5.6 to 2.5 days
• Increase in patient satisfaction scores
• Reduction in cost of $3,000 per patient
• Readmission rate reduced to 4.6%
• Reduction in use of opioids (50% required 0-5mg morphine equivalents for surgery/postop care combined)

ERAS Worldwide

- Estimated 300 million major operations performed annually
- ERAS protocols used throughout Europe for years
- ERAS protocols implemented in over 20 countries in the past decade
- ERAS protocols vary across the world

ERAS in the US

So why the delay in the United States jumping onboard?
Barriers to ERAS

• Challenges deeply rooted perioperative practice
• Upfront cost of medications (IV Tylenol)
• Resources
• Staff Education
• Patient Education
• Communication
ERAS Programs

So what is necessary to make a program successful?
ERAS Programs

Imperative:
• Staff engagement
• Buy in from key stakeholders
• Physician champions from multiple specialties
• Nursing champions from involved units
• Dieticians
• Designated Coordinator
• Administrative support
• Patient engagement
Current/Future ERAS Services

• Current ERAS services
  - Colorectal
  - Bariatric
  - Thoracic Surgery

• Upcoming ERAS Services
  - Additional oncology procedures
  - Vascular Surgery
  - Urology
  - Cardiac
ERAS CARDIAC

FIRST WITH THE CONCEPTS, LATE TO THE PARTY
**ERAS Guidelines by specialty - 2017**

For these disciplines, guidelines serve as a resource for individual institutions to implement **high-quality, evidence-based perioperative care in standardized clinical pathways.**

Note representation by every major specialty EXCEPT CARDIAC SURGERY!!

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**Table 3. ERAS Society Guidelines**

<table>
<thead>
<tr>
<th>Procedure and Topic</th>
<th>Year of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colonic resection</td>
<td>2012</td>
</tr>
<tr>
<td>Rectal resection</td>
<td>2012</td>
</tr>
<tr>
<td>Pancreaticoduodenectomy</td>
<td>2012</td>
</tr>
<tr>
<td>Cystectomy</td>
<td>2013</td>
</tr>
<tr>
<td>Gastric resection</td>
<td>2014</td>
</tr>
<tr>
<td>Anesthesia protocols</td>
<td>2015</td>
</tr>
<tr>
<td>Anesthesia pathophysiology</td>
<td>2015</td>
</tr>
<tr>
<td>Major gynaecology (parts 1 and 2)</td>
<td>2015</td>
</tr>
<tr>
<td>Bariatric surgery</td>
<td>2016</td>
</tr>
<tr>
<td>Liver resection</td>
<td>2016</td>
</tr>
<tr>
<td>Head and neck cancer surgery</td>
<td>2016</td>
</tr>
<tr>
<td>Breast reconstruction</td>
<td>2017</td>
</tr>
<tr>
<td>Hip and knee replacement</td>
<td>Under production</td>
</tr>
<tr>
<td>Thoracic noncardiac surgery</td>
<td>Under production</td>
</tr>
<tr>
<td>Esophageal resection</td>
<td>Under production</td>
</tr>
</tbody>
</table>


*For updates and free download, go to [http://www.erassociety.org](http://www.erassociety.org).*

From Ljungqvist et al

*JAMA Surgery* March 2017 Volume 152, Number 3
Overview

• Educational Objectives
• History of ERAS Cardiac – Fast Track CABG 1994, led the way to ERAS development with ultimate high global penetration
• ERAS Cardiac Society 2017 – emphasis on research, collaboration, sharing of best practices
• ERAS Cardiac Consensus Guidelines 2018 – focus on evidence
• Early ERAS Cardiac Outcomes
• Implementation of a successful ERAS Cardiac Program – Requirements and Barriers, Defining program objectives
• ERAS Cardiac at WMC and future opportunities for success
Learning Objectives

• Note the early contributions by Cardiac Surgeons to enhanced recovery, avoidance of complications and reducing cost per case by more efficient use of healthcare resources.

• Acknowledge the important ongoing transition to Value-Based Healthcare, and the growing interrelationship between high-quality outcomes, patient experience and reimbursement.

• Recognize the unique interventions in each phase of care that might have a positive impact on the outcomes and experience of Cardiac Surgery patients.

• Appreciate the challenges of creating programs in ERAS Cardiac incorporating new or controversial concepts with often suboptimal supporting data in an environment with strong opinions favoring status quo.

• Note the importance of using evidence-based interventions whenever possible, and leveraging institutional and unit strengths into program development.

• Understand the critical role of program champions and coordinator in driving the successful ERAS program forward and providing energy and education.

• Gain an understanding of the importance of how a series of incremental improvements can synergize to lend a substantial effect on outcome improvement and experience enhancement.
If it’s front cover-worthy for this journal, it must be a big deal!
**ERAS Fundamentals:**
Modification of Surgical Stress to Accelerate Return of Functional Capacity

**Approaches to reduce surgical stress and improving outcomes**

- Minimally Invasive Surgery
- Pharmacologic Interventions: non-opioid, multimodal analgesia, anti-emetics, glucocorticoids, systemic local anesthetics, insulin, β-blockers, α2-agonists, anabolic agents
- Surgical stress:
  - pain, catabolism, fluid/salt retention, immune dysfunction, nausea/vomiting, ileus, impaired pulmonary function, increased cardiac demands, hypercoagulability, sleep disturbances, fatigue
- Other interventions:
  - fluid balance
  - normothermia
  - preoperative carbohydrate exercise
- Afferent neural blockade:
  - thoracic epidural
  - local infiltration anesthesia
  - peripheral nerve blocks

**Enhanced recovery after surgery**

- Surgery
- Multi-modal ER intervention
- Traditional care

Kehlet and Wilmore, Ann Surg 2008 (revised)

ValleyHealth
Healthier, together.
Everything Old is New Again!

Groundbreaking early ERAS work from 1994

Fast-Track Recovery of the Coronary Bypass Patient

Richard M. Engelman, MD, John A. Rousou, MD, Joseph E. Flack III, MD,
David W. Deaton, MD, Chester B. Humphrey, MD, Lee H. Ellison, MD,
Philip D. Allmendinger, MD, Susannah G. Owen, AB, and Penelope S. Pekow, PhD

Departments of Surgery, Baystate Medical Center, Springfield, Massachusetts, Hartford Hospital, Hartford, Connecticut, and the University of Connecticut School of Medicine, Farmington, Connecticut, and the School of Public Health, University of Massachusetts, Amherst, Massachusetts

A new approach termed “fast-track recovery” was undertaken at both the Baystate Medical Center and Hartford Hospital. The fast-track protocol involves the following principles: (1) preoperative education; (2) early extubation; (3) methylprednisolone sodium succinate before bypass followed by dexamethasone for 24 hours postoperatively; (4) prophylactic digitalization, metoclopramide HCl, docusate sodium, and ranitidine HCl; (5) accelerated rehabilitation; (6) early discharge; (7) a dedicated fast-track coordinator to perform both daily telephone contact and a 1-week postoperative examination; and (8) a routine 1-month postoperative visit with a PA or MD. To evaluate the effects of this approach on patient care, a retrospective 1-year analysis was undertaken in both institutions with all coronary artery bypass grafting patients compared in a consecutive manner before the origin of the fast-track protocol and subsequent to its beginning. There were 280 patients in the fast-track and 282 in the non–fast-track group. The two groups were not significantly different except inexplicably there was a lower ejection fraction in the fast-track group and a longer cross-clamp time. Postoperatively, the mean time to extubation decreased from 22.1 to 15.4 hours, and peak weight gain decreased from 2.8 to 1.6 kg from the non–fast-track to the fast-track group (p < 0.01). This was accompanied by significant (p < 0.001) decreases in intensive care unit duration from 2.4 to 1.9 days and in postoperative length of stay from 8.3 to 6.8 days from the non–fast-track to the fast-track group. There was no increase in morbidity or mortality associated with the fast-track protocol either early or late. Thirty-day hospital readmission was not significantly different between the two groups. Fast-track methodology is effective, and we routinely employ this approach for all patients undergoing cardiopulmonary bypass.

“Fast Track” Cardiac Surgery

• Compared two well-matched groups of CABG pts at two hospitals, looked at 562 consecutive patients, ~280 in each group, included all comers including emergencies.

• Pre-fast track group was treated with conventional high-dose narcotic anesthetic and received standard post-op care for the era. Fast-track group received isoflurane-based inhalational anesthetic, high dose periop steroids, and followed “fast-track protocol”, with intense education, expectation management, and given limited IV fluids, digoxin, reglan, dulcolox and zantac, with early extubation and mobilization as part of protocol, with strict discharge criteria followed and daily phone calls post-dc by FT coordinator and early f/u at one week, repeat f/u at 3 weeks (unheard of at the time). Emphasis on not just achieving early discharge, but having patients feel they were truly ready to leave the hospital sooner.
"Fast Track" Study Groups Comparable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Fast-Track (n = 282)</th>
<th>Fast-Track (n = 280)</th>
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<tbody>
<tr>
<td>Age (y)</td>
<td>65.5 ± 0.56</td>
<td>64.7 ± 0.59</td>
</tr>
<tr>
<td>Male (%)</td>
<td>72.7</td>
<td>77.4</td>
</tr>
<tr>
<td>LVEF</td>
<td>0.50 ± 0.09*</td>
<td>0.47 ± 0.09</td>
</tr>
<tr>
<td>Diabetic (%)</td>
<td>21.3</td>
<td>25.0</td>
</tr>
<tr>
<td>Hx CHF (%)</td>
<td>12.8</td>
<td>17.1</td>
</tr>
<tr>
<td>Hx MI (%)</td>
<td>53.2</td>
<td>52.9</td>
</tr>
<tr>
<td>Hx unstable angina (%)</td>
<td>80.1</td>
<td>72.5</td>
</tr>
<tr>
<td>Emergent/urgent operation (%)</td>
<td>44.6</td>
<td>52.9</td>
</tr>
<tr>
<td>Preop IABP (%)</td>
<td>6.4</td>
<td>6.8</td>
</tr>
</tbody>
</table>

* p < 0.05 versus fast-track group.

CHF = congestive heart failure; Hx = history of; IABP = intraaortic balloon pump; LVEF = left ventricular ejection fraction; MI = myocardial infarction.
“Fast Track” Cardiac Surgery Results

Table 3. Kaplan-Meier Survival Tests

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Fast-Track (n = 282)</th>
<th>Fast-Track (n = 280)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extubation time (hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25% Quartile</td>
<td>13.5</td>
<td>9.0</td>
</tr>
<tr>
<td>50% Quartile</td>
<td>17.0</td>
<td>11.5</td>
</tr>
<tr>
<td>75% Quartile</td>
<td>22.2</td>
<td>15.1</td>
</tr>
<tr>
<td>ICU LOS (days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25% Quartile</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>50% Quartile</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>75% Quartile</td>
<td>3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Postop LOS (days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25% Quartile</td>
<td>5.0</td>
<td>4.0</td>
</tr>
<tr>
<td>50% Quartile</td>
<td>7.0</td>
<td>6.0</td>
</tr>
<tr>
<td>75% Quartile</td>
<td>9.0</td>
<td>7.0</td>
</tr>
</tbody>
</table>

* p < 0.0001 versus non-fast-track strata.

ICU = intensive care unit; LOS = length of stay.

Table 4. Late Postoperative Patient Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Fast-Track (n = 282)</th>
<th>Fast-Track (n = 280)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU duration (days)</td>
<td>2.4 ± 0.1*</td>
<td>1.9 ± 0.1</td>
</tr>
<tr>
<td>Postoperative LOS (days)</td>
<td>8.3 ± 0.3*</td>
<td>6.8 ± 0.3</td>
</tr>
<tr>
<td>Discharge within 3 to 5 days of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>operation (%)</td>
<td>25.6*</td>
<td>47.5</td>
</tr>
<tr>
<td>Incidence of atrial operation (%)</td>
<td>27.3</td>
<td>22.9</td>
</tr>
<tr>
<td>Mediastinal or sternal infection (%)</td>
<td>2.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Leg wound infection (%)</td>
<td>4.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Operative mortality (%)</td>
<td>4.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Late (1 to 24 mo) mortality (%)</td>
<td>3.6</td>
<td>2.0</td>
</tr>
<tr>
<td>30-Day hospital readmission (%)</td>
<td>7.1</td>
<td>8.3</td>
</tr>
</tbody>
</table>

* p < 0.001 versus fast-track group.

ICU = intensive care unit; LOS = length of stay.
"Fast Track" Data:
Also demonstrated cost savings

INVITED COMMENTARY

This is a timely and important contribution by Dr Engelman and colleagues, which shows that 48% of coronary artery bypass graft patients can be discharged home safely 3 to 5 days after operation. This "fast track" protocol resulted in a cost savings of $3,989.00 per patient.

We have developed a similar protocol at Duke, referred to as our "CABG care map," which specifies exactly which tests, procedures, medications, or educational activities are to occur on the preoperative day and postoperative days 1 through 5. This CABG care map was instituted in February 1994, and to date, 567 consecutive patients have been enrolled. Sixty-two percent were discharged on or before postoperative day 6. As of June 1994, 54% of our patients have been discharged on or before postoperative day 5. The average cost savings per patient is $5,091.00. To date, we have encountered no adverse medical events attributable to this protocol.

Engelman and associates found that 77% of patients felt comfortable with early discharge, in contrast to only 54% of their families. This important observation underscores the importance of not only patient education but family education and postoperative daily telephone follow-up. In addition, we strongly believe that outside referring physicians need to understand the purpose and details of a fast-track protocol, and they must receive all important medical information on the day of or the day after discharge, because on occasion they will be administering postoperative care formerly provided during hospitalization.

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“Fast Track” Cardiac Surgery Summary

• By eliminating long acting anesthetic, modifying pt/family understanding and expectations, and making key interventions to optimize early mobility, return of bowel fxn and avoidance of cardiac complications and fluid overload, substantial reductions in vent times, ICU and Post-Op LOS were accomplished. 30d readmissions same in both groups at 7-8%, improved patient satisfaction in FT group, but family satisfaction unchanged.

• The vital role of the Fast Track Coordinator was recognized and emphasized as mission critical to program success.

• Cost analysis at Baystate MC for DRG106 (CABG without Cath) showed hospital costs for FT were $3900 less that non-FT per case, translating to a savings of $2.8M/yr for their volume of 700 CABG

• Due to a spike in wound complications noted in a post-hoc study, IV steroid administration was eliminated, despite many salutary anti-inflammatory effects, from their protocol soon after the publication. This may have dampened the enthusiasm for this otherwise remarkable set of findings.
ERAS Evolution

- As outlined earlier, ERAS emerged in late 1990’s, in part, based on the groundbreaking work in “Fast Track“ cardiac surgery.
- Most robust data from colorectal surgery, but ERAS has expanded in breadth to include virtually all surgical specialties, with very high penetration in Europe, where much of the early research has been performed.
- While each specialty will have unique components and interventions that specifically address the procedures and patient challenges faced by those practitioners, there are some common themes that run true throughout the ERAS continuum and can be thought of as the global value-proposition of enhanced recovery efforts:

1- Preop, Intraop and Postop phase of care interventions, each aimed to accomplish specified ERAS goals
2- Focus on multi-modal Pain Management with goal of overall reduction in opioid utilization
3- Reduction in Perioperative Complications and associated costs.
4- Aim to improve overall care experience and accelerate the return to normal organ function
5- Promote efficiencies to drive costs down. Some up front investment might be necessary for success.
6- Constant monitoring for compliance, deviations, outcomes and opportunities for improvement
7- Intense pre-op patient education, including handbooks, videos and checklists set the tone and are invaluable
ERAS: The Essence of High Value Health Care

- Patient-focused, data-driven, evidence-based.
- Fewer complications, shorter LOS = Huge cost savings
- Value = Quality/Cost
- All Stakeholders, including patients, are fully engaged in process
- ERAS Fulfills the tenets of Triple AIM
**ERAS and the IHI Triple Aim**

*Triple Aim* is a framework for healthcare improvement put forth by the Institute for Healthcare Improvement that describes an approach for optimizing health system performance. New programs should be developed that simultaneously pursue the three dimensions of the Triple Aim:
- Improving the patient experience of care, including quality and satisfaction
- Improving the health of populations
- Reducing the per capita cost of Health Care

Very soon, hospitals and physicians will be rewarded for applying these principals successfully!

*ERAS goes a long way toward fulfilling the Triple Aim*
Basic components of any ERAS protocol

Enhanced Recovery After Surgery
Key Components

<table>
<thead>
<tr>
<th>Active Patient Involvement</th>
<th>Intra-operative</th>
<th>Post-operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-operative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-admission counselling</td>
<td>Active warming</td>
<td>Early oral nutrition</td>
</tr>
<tr>
<td>Early discharge planning</td>
<td>Use of multi-modal pain management</td>
<td>Early ambulation</td>
</tr>
<tr>
<td>Reduced fasting duration</td>
<td>Surgical techniques</td>
<td>Early catheter removal</td>
</tr>
<tr>
<td>Carbohydrate loading</td>
<td>Avoidance of prophylactic NG tubes &amp; drains</td>
<td>Use of chewing gum</td>
</tr>
<tr>
<td>No/selective bowel prep</td>
<td></td>
<td>Defined discharge criteria</td>
</tr>
<tr>
<td>Venous thromboembolism prophylaxis</td>
<td>Use of multi-modal anti-emetic prophylaxis</td>
<td></td>
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<tr>
<td>Antibiotic prophylaxis</td>
<td></td>
<td></td>
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<tr>
<td>Pre-warming</td>
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</tbody>
</table>

Audit of compliance & outcomes

Whole Team Involvement

THE IMPORTANCE OF OPTIMAL FLUID MANAGEMENT-
Finding the “Sweet Spot” in fluid administration.
Aggregation of Marginal Gains:
Early UK Pilot Study showing Cumulative Benefit of Small Changes across all phases of Cardiac Care
Application of ERAS Lessons Learned to Cardiac Surgery
The “Re-emergence” of ERAS Cardiac
Late to the Party, but Coming on Strong

• With improved outcomes demonstrated by other ERAS Programs, and with a clear shift toward Value-Based Medical Practice, ERAS Cardiac Society was formed as a subsidiary of ERAS International by a group of impassioned cardiovascular practitioners in 2017.

• Joined by an advisory board and a panel of subject matter experts, Consensus Guidelines for ERACS Cardiac were formulated and presented at AATS 2018. As previously noted, guideline recommendations were divided into the three phases of care, were heavily informed by cardiac-specific literature, not extrapolated from other specialties.

• Each recommendation was assigned a Class rating and Level of Evidence critique based on standard guideline-writing practices.
ERAS CARDIAC GUIDELINE GENERATION:
The ”Quality of Evidence” Pyramid
How are ERACS Guidelines Rated?

Accepted Standards for Weighting Recommendations

For each Guideline, we should ask:
- How good is the evidence?
- Was evidence based on RCTs?
- Were there meta-analyses?

Recommendation Class has some element of subjectivity.
The relative safety or danger of the intervention will impact the strength of the recommendation.
ERAS Cardiac Guidelines

• These evidence-based interventions are meant to supplement other basic care strategies in each of the three perioperative phases.

• We will review more comprehensive ERAS Cardiac Care Paths that have been successfully adopted at other institutions later.

• Many of these components to be described are very new ideas and occasionally fly in the face of our established conventional wisdom, while others will seem very familiar to us and indicate that we have been on the right track and at “the tip of the spear“, in many circumstances, in providing optimum value-based care for our patients. A green check mark denotes a WMC cardiac practice.
ERAS Cardiac : Preop Phase

*Preoperative assessment of Hgb A1C is reasonable to be performed ✓*

- Class IIa, Level of Evidence C – Limited Data
- Low pre-operative serum hemoglobin A1c (HbA1c) < 6.5% is associated with decreased complications, including sternal wound infection and myocardial ischemia.
- Additional studies will identify if delaying non-urgent procedures in patients with stable cardiac disease to improve glycemic control will lead to improved outcomes.
- May not be practical to delay OHS to effect reduction in A1C.
ERAS Cardiac: Preop Phase

Correction of Nutrition Deficiency, and Assessment of serum Albumin, when feasible, can be beneficial.

• Class IIa, Level of Evidence C-Limited Data

• Low preoperative serum albumin levels in patients undergoing cardiac surgery are associated with acute kidney injury, increased infection rates, prolonged mechanical ventilation and length of stay, and decreased long-term survival.

• Intensive nutrition supplementation for 5-7 days prior to surgery may improve outcomes in patients with a pre-operative serum albumin <3.0 g/dL.
ERAS Cardiac : Preop Phase

*Screening and treatment for excessive alcohol and cigarette smoking should be performed preoperatively when feasible.* ✓

- Class I, Level of Evidence C-Limited Data
- Tobacco smoking and excessive alcohol consumption have been identified as lifestyle risk factors.
- Smoking or excessive alcohol intake can lead to lung, wound, bleeding, metabolic and infectious complications.
- Stopping smoking and consuming alcohol before surgery can reduce these complications.
ERAS Cardiac: Preop Phase

A clear liquid diet is reasonable to be continued up until 4 hours before general anesthesia. Carbohydrate loading may be considered before surgery.

- Class IIb (weak), Level of Evidence C-Limited Data
- Prolonged preoperative fasting may contribute to postoperative insulin resistance. This may promote deleterious post-op hyperglycemia.
- Maintenance of a clear liquid diet up until 2-4 hours before surgery is an important component in non-cardiac ERAS protocols.
- Provision of a carbohydrate drink has been shown to reduce insulin resistance and tissue glycosylation, thereby improving postoperative glucose control, enhancing return of gut function, and reducing length of stay (following non-cardiac surgery).
- A small study in cardiac surgery patients found that near-complete gastric emptying occurred 2-hours following an oral carbohydrate drink.
- The risk-benefit profile of oral carbohydrate load has not been sufficiently studied in cardiac surgical patients to warrant more than a weak recommendation at this time.
ERAS Cardiac: Preop Phase

Patient engagement through online or application-based systems to promote education, compliance, and patient reported outcomes can be useful.

- Class IIa, Level of Evidence C-Limited Data
- Numerous e-health innovations have emerged aimed at increasing patient engagement and improving surgical care.
- These innovations engage, educate, activate, and allow for patient reported outcomes (PROs) to be captured.
- Patient activation denotes a willingness to obtain preventive care or engage in regular physical exercise.
- Less activated patients are three times as likely to have unmet medical needs and twice as likely to delay medical care.
- ERAS pilots in cardiac surgery have demonstrated effectiveness of an e-health platform in increasing patient activation.
- SeamlessMD and HealthLoop are two competing platforms that offer a variety of patient engagement tools throughout the continuum of care. Clearly requires some level of technology savviness.
Patient Engagement and “Activation” works!

By Judith H. Hibbard and Jessica Greene

What The Evidence Shows About Patient Activation: Better Health Outcomes And Care Experiences; Fewer Data On Costs

ABSTRACT Patient engagement is an increasingly important component of strategies to reform health care. In this article we review the available evidence of the contribution that patient activation—the skills and confidence that equip patients to become actively engaged in their health care—makes to health outcomes, costs, and patient experience. There is a growing body of evidence showing that patients who are more activated have better health outcomes and care experiences, but there is limited evidence to date about the impact on costs. Emerging evidence indicates that interventions that tailor support to the individual’s level of activation, and that build skills and confidence, are effective in increasing patient activation. Furthermore, patients who start at the lowest activation levels tend to increase the most. We conclude that policies and interventions aimed at strengthening patients’ role in managing their health care can contribute to improved outcomes and that patient activation can—and should—be measured as an intermediate outcome of care that is linked to improved outcomes.

2013, Health Affairs
Potential Impact of Interactive software platforms

CASE STUDY
Optimizing An Enhanced Recovery After Cardiac Surgery (ERACS) Program

Prairie Heart Institute established a Cardiac ERAS program in 2017. In an effort to further reduce LOS, Readmissions, and Skilled Nursing Facility (SNF) use, Prairie Heart Institute partnered with SeamlessMD to help measure and improve ERAS patient compliance, deliver real-time education for patients to better self-manage, and to remotely monitor patients post-discharge to ensure safe recovery at-home and/or to track patients admitted to a SNF.

Solutions Used:
- Patient-Reported Outcomes Collection
- Patient Education & Self-Management
- Remote Patient Monitoring
- ERAS Compliance Tracking & Reports

<table>
<thead>
<tr>
<th>Sample size</th>
<th>Traditional care</th>
<th>Traditional care + SeamlessMD</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>11%</td>
<td>7.6</td>
<td>6.8</td>
<td>1.6%</td>
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<tr>
<td>53%</td>
<td>35%</td>
<td>28%</td>
<td>7%</td>
</tr>
<tr>
<td>11%</td>
<td>5%</td>
<td>4%</td>
<td>1%</td>
</tr>
</tbody>
</table>

"The feedback we have received from our team, our patients and their families has been overwhelmingly positive. SeamlessMD is instrumental in achieving our goals of promoting a positive surgery experience for patients and their families, reducing complications, and coordinating post-discharge care."

What Prairie Heart Patients Love About SeamlessMD:
- "The ease of being in contact with doctor and nurse whenever I needed to talk about things I was concerned about."
- "Felt connected to the surgery team after I went home and helped answer questions I would of needed to call about. Put me at ease that my recovery program was normal."

Info@seamlessmd.com | www.seamlessmd.com
ERAS Cardiac : Preop Phase

“Pre-habilitation” is beneficial for patients undergoing elective cardiac surgery with multiple comorbidities or significant deconditioning.

• Class Iia (moderate), Level of Evidence B-Non-Randomized
• Exercise is one component of an intervention that increases functional capacity, improves the health status, decreases sympathetic over-reactivity, improves insulin sensitivity, and increases lean body mass to body fat ratio.
• For cardiac surgery patients, “pre-habilitation” may improve physical and psychological readiness for surgery.
• A cardiac prehab program should include nutrition optimization (N), exercise training (E), and anxiety (W for worry) reduction (also referred to as the ‘NEW’ approach).
• Prehab opportunities are limited by the urgency of surgery.
• More studies demonstrating a direct effect of improving functional capacity on operative outcomes are needed.
Three Goals of Successful Cardiac Prehab

Figure 1. The components of "NEW" prehabilitation in cardiac surgery patients.

Prehab in Cardiac Surgery Patients

- Worry: Allieving preoperative anxiety and stress
- Nutrition: Dietary modification to counter protein-energy malnutrition
- Exercise: Individually-tailored exercise intervention to improve baseline functional capacity
ERAS CARDIAC: INTRAOP PHASE

Tranexamic acid (TXA) or epsilon aminocaproic acid (Amicar) should be administered for on-pump cardiac surgical procedures to reduce blood loss.

- Class I (strong), Level of Evidence A Exceptional strength of evidence seldom seen in CS literature
- Tranexamic acid (TXA) or epsilon aminocaproic acid (EAA) reduces bleeding by inhibiting the lysis of polymerized fibrin by reversibly blocking the lysine binding site of plasminogen.
- Most of the cardiac surgical data on antifibrinolytic therapy is for TXA.
- Evidence from large randomized controlled trials has shown a reduction in blood product transfusion in patients given intra-operative TXA.
- Higher doses of TXA have been associated with an increased risk of post-operative seizure. It is recommended to avoid TXA doses in excess of 4-6g, or 100mg/kg, particularly in patients > 50 years of age.
ERAS CARDIAC: INTRAOP PHASE

Rigid sternal fixation can be useful to reduce mediastinal wound complications ✅

• Class IIa (moderate), Level of evidence B (randomized)
• Most surgical disciplines managing fractures/osteotomies adhere to the principles of approximation, compression, and stabilization of the bone using rigid fixation.
• The majority of cardiac surgeons continue to use wire cerclage for sternotomy closure because of the perceived low rate of sternal wound complications and the low cost of wires.
• Concern of inadequate bone healing lead to most cardiac surgery patients recovering under “sternal precautions”, which limits their ability to mobilize.
• In a randomized multicenter trial, sternotomy closure with rigid plate fixation vs. wire cerclage resulted in significantly better sternal healing, fewer sternal complications, improved patient reported outcomes, and no additional cost at 6 months after surgery.
• Rigid sternal fixation should be considered in high-risk individuals such as those with a high BMI, previous chest wall radiation, severe COPD, or steroid use.
RCT shows better results with RSF over traditional WC
ERAS CARDIAC: INTRAOP PHASE

Hyperthermia (>37.9 C) while rewarming on CPB is potentially harmful and should be avoided. ✅

- Class III : Harm (strong), Level of Evidence B-Randomized
- Cerebral hyperthermia following cardiac surgery is associated with neurologic injury and dysfunction.
- Hyperthermia has also been associated with increased rates of mediastinitis and postoperative acute renal failure.
- Limiting the maximum target temperature during the rewarming following CPB can prevent cerebral hyperthermia without significant adverse events.
ERAS CARDIAC: INTRAOP PHASE

A *care bundle of evidence-based best practices should be performed to reduce surgical site infection.*

- **Class I (strong), Level of evidence B-Randomized**
- Sternal wound infection (SWI) and donor site infection (DSI) were diagnosed in 4.7% and 1.5% of patients during hospitalization, 6.8% and 4.6% at 30 days postoperatively, and 9.0% and 7.3% at 90 days postoperatively.
- Care bundles have reduced the incidence of infections in ICUs, providing an ideal framework for adoption in cardiac surgery. A care bundle is between 3-5 evidence-based interventions performed together, with better results than if performed individually in a non-structured fashion.
- Topical mupirocin or betadine pre-operatively can reduce surgical site infection by eradicating staphylococcal colonization in patients undergoing heart surgery.
- Cefazolin or cefuroxime should be administered 30-60 minutes before skin incision and continued for no longer than 48 hours after completion of surgery.
- Additional measures, such as showers with chlorhexidine, standardization of surgical field preparation, use of a wound protector, or daily washing of the incision with chlorhexidine require additional research to determine efficacy.
Persistent hypothermia after CPB should be avoided in the early postoperative period.

- Class I (strong), Level of evidence B-Non-randomized

- Unless active measures are undertaken to maintain patient normothermia during chest closure and transport, the patient’s temperature may dip below 35°C prior to arrival in the ICU.

- Even mild hypothermia is associated with multiple physiologic derangements including coagulopathy, increased incidence of wound infection, prolonged hospital stay and death.

- Large registry observational studies suggest that if hypothermia is treated, outcomes can be improved.

- Hypothermia can be reduced by using forced-air warming blankets, and by warming irrigation and IV fluids.
ERAS CARDIAC: POST-OP PHASE

Biomarkers can be beneficial in identifying patients at risk for acute kidney injury.

• Class IIa (moderate), Level of evidence B-Randomized

• Two novel urinary renal biomarkers, insulin-like growth factor-binding protein 7 (IGFBP7) and tissue inhibitor of metalloproteinases-2 (TIMP-2) can identify renal stress as early as one hour after starting cardiopulmonary bypass.

• Serum biomarkers may eventually allow us to accurately identify patients with normal glomerular filtration rates at risk of postoperative AKI.

• Studies have shown that earlier intervention based on biomarkers may decrease the incidence of postoperative acute kidney injury and decrease costs.

• Interventions include avoidance of nephrotoxic agents, discontinuation of ACE inhibitors and angiotensin II receptor blockers, avoidance of hyperglycemia, and close hemodynamic monitoring.
• 15-30% of cardiac patients develop postop AKI
• Urinary biomarkers NGAL, IL6, midkine and TP were measured in 200 patients preop, 6h and 24 h, with renal fxn assessed preop, 90d and 5y postop
• Independent of renal fxn, urinary biomarker + patients had worse outcomes, with NGAL+ patients without conventional evidence of renal dysfunction demonstrating a 10-fold increase in in-hospital mortality.
• Urinary biomarkers are a new paradigm for measuring subclinical AKI, or KIDNEY STRESS
• By using biomarker guidance to drive goal-directed therapy (GDT) with Renal Care Bundles, the incidence of post-cardiac surgery AKI was reduced by 30%
Routine stripping of chest tubes is not recommended.

- Class III-No Benefit (moderate), Level of evidence A (meta-analysis)
- Milking or stripping tubes has been shown to be time consuming, ineffective, and potentially harmful.
- Harm concerns derive from studies that show negative pressures >400 mmHg generated by tube stripping
ERAS CARDIAC: POST-OP PHASE

Active maintenance of chest tube patency is effective at preventing retained blood.

- Class I (strong), Level of evidence B-Randomized
- Chest tubes used to evacuate shed mediastinal blood are prone to clogging with clot.
- Large volumes of retained mediastinal blood can lead to mechanical compression of the heart or lungs, resulting in the need for re-interventions.
- Smaller volumes of retained mediastinal blood promotes an inflammatory process that can contribute to the development of pleural and pericardial effusions or the triggering of atrial fibrillation.
- Retained blood is associated with increases in transfusion, AKI, time of mechanical ventilation, length of stay and mortality.
- Active tube clearance (ATC) has been shown to prevent chest tube occlusion and reduce the incidence of the retained blood in cardiac surgery patients.
- Studies have additionally shown ATC can be helpful in reducing rates of reoperation for bleeding and atrial fibrillation
Active clearance of chest drainage catheters reduces retained blood and reduces complications

Active clearance of chest drainage catheters reduces retained blood

Joachim Sirch, MD,1 Miroslaw Ledwon, MD,1 Tamas Piski, MD,1 Ed M. Boyle, MD,1 Steffen Pfeiffer, MD,1 and Theodor Fischlein, MD1

ABSTRACT

Objective: Chest tubes are used to clear blood from around the heart and lungs after heart surgery, but they can be obstructed by a blood clot, leading to retained blood syndrome (RBS). We sought to examine the frequency of RBS and associated morbidity, and to determine the influence of a preventative active chest tube clearance (ATC) protocol on these outcomes.

Methods: A multidisciplinary team developed a simple protocol to institute ATC to preventively clear chest tubes of clot during the first 24 hours after heart surgery. An extensive educational in-service was performed before universal implementation (phase 1). We retrospectively compared data collected prospectively from 1849 patients before universal implementation (phase 0) with data from 256 patients collected prospectively after universal implementation (phase 2), and then used propensity matching for outcomes assessment.

Results: In propensity-matched patients, 19.9% of patients had interventions for RBS (phase 0). After the implementation of ATC (phase 2), the percent of patients with interventions for RBS was reduced to 11.5%, representing a 43% reduction in RBS (P = .0087). These patients had a 33% reduced incidence of postoperative atrial fibrillation from 30% (78 out of 256) in phase 0 to 20% (52 out of 256) in phase 2 (P = .013).

Conclusions: ATC is associated with a reduced need for interventions for RBS and postoperative atrial fibrillation. Our findings underscore the importance of maintaining chest tube patency in the early hours after cardiac surgery. (J Thorac Cardiovasc Surg 2016;151:832-38).

2016, JTCVS
Post-operative systematic delirium screening is recommended at least once per nursing shift. ✅

- Class I (strong), Level of evidence B-Non-randomized
- Current contemporary reports suggest up to 20% of cardiac surgery patients have postoperative delirium (nearly twice the rate observed in other elective non-cardiac procedures).
- Delirium in critically ill patients is recognized as a major public health problem occurring in up to 50% of postoperative cardiac surgery patients, and costing billions annually in the United States alone.
- The occurrence of delirium after cardiac surgery has been associated with a reduced in-hospital and long-term survival, freedom from hospital readmission, and reduced cognitive and functional recovery.
- An optimal balance of analgesia, sedation, anxiety, and delirium management in the ICU, may result in reduced pain, decreased anxiety, managed delirium, enhanced quality of sleep, and improved recovery.
Post-Op Delirium has substantial negative impact on survival and long-term cognition

The Long-Term Cognitive and Functional Outcomes of Postoperative Delirium After Cardiac Surgery

Sandra Koster, MANP, Ab G. Hensens, MS, and Job van der Palen, MS, PhD

Departments of Thoracic Surgery and Epidemiology, Medisch Spectrum Twente, Enschede, the Netherlands

Background. Delirium or acute confusion is a temporary mental disorder, which occurs frequently among hospitalized elderly patients. Patients who undergo cardiac surgery have an increased risk of developing delirium. This is associated with many negative consequences such as prolonged hospital stay, nursing home placement, and reduced cognitive and functional recovery.

Methods. In this prospective follow-up study, a questionnaire was used 1 to 1.5 years after cardiac surgery in our earlier cohort of 112 patients who underwent elective cardiac surgery, of which 24 patients (21%) developed postoperative delirium as diagnosed by a single psychiatrist.

Results. Postoperative delirium after cardiac surgery may be associated with increased mortality (12.5% in patients with delirium versus 4.5% in patients without delirium; \( p = 0.16 \)), more readmissions to the hospital (47.6% vs 32.6%; \( p = 0.19 \)), dysfunction in memory (31.6% vs 22.6%; \( p = 0.39 \)), and concentration problems (36.8% vs 20.2%; \( p = 0.13 \)); and is associated with sleep disturbance (47.4% vs 23.8%; \( p = 0.03 \)).

Conclusions. Postoperative delirium after cardiac surgery may be associated with increased mortality and readmissions to the hospital, as well as poorer cognitive and functional outcomes. Therefore, prevention and (or) early recognition of delirium must be improved. In addition, patients and caregivers (family and general practitioner) must be better informed about the long-term consequences of delirium and what they can do about it.

(Am Thorac Surg 2009;87:1469–74)
© 2009 by The Society of Thoracic Surgeons

2009, Annals Thoracic Surg
Post-Op Delirium heavily impacts ICU & overall LOS and Hospital Costs, and is potentially preventable.
ERAS CARDIAC: POST-OP PHASE

*Early extubation strategies after cardiac surgery should be employed.* ✓

- Class IIa (moderate), Level of evidence B-Non-randomized
- Prolonged mechanical ventilation after cardiac surgery is associated with higher morbidity, mortality, and increased costs.
- Early extubation within 6 hours is safe and can be achieved with time directed protocols and low dose opioid anesthesia.
- Factors associated with prolonged mechanical ventilation include depressed level of consciousness due to anesthetic agents administered in the operating room and ICU.
- Programmatic transitioning to earlier extubation is cost-effective and associated with decreased ICU LOS.
Initial Ventilation <6hrs - WMC

90th VCSQI percentile

Great Job!
CC4 MONTHLY EXTUBATION SUCCESS IN LESS THAN 6 HOURS, NURSE COLLECTED DATA 10/13 TO 2/19. LAST 12 MONTHS AVERAGED 87% SUCCESS, LAST 2 YEARS OF DATA COLLECTED IS IN BEST PRACTICE RANGE.
Early Extubation by Hospital: Isolated CAB, 2016–2018

VCSQI 2018: 65.0%  
STS 2017: 54.8%

[Bar chart showing early extubation rates for different hospitals with data for 2016-17 and 2018.]
**ERAS CARDIAC: POST-OP PHASE**

_Perioperative glycemic control is recommended._

- Class I (strong), Level of evidence B-Randomized
- Strong support for avoidance of hypoglycemia, too tight glycemic control can be harmful.
- Perioperative hyperglycemia has been associated with poor clinical outcomes, likely mediated via direct glucose toxicity, increased oxidative stress, inflammation, and induction of a prothrombotic state.
- Perioperative glycemic control is recommended based on randomized data from studies not specific to cardiac surgery and on quality observational studies.
Insulin infusion is reasonable to be performed to treat hyperglycemia in all patients in the perioperative period. ✅

- Class IIa (moderate), Level of evidence B-Non-Randomized
- Insulin infusion is likely the most effective way to maintain glycemic control
- BS 110-150 good target range
ERAS CARDIAC: POST-OP PHASE

A multimodal, opioid-sparing, pain management plan is recommended postoperatively.

• Class I (strong), Level of evidence B – Non-randomized
• Optimizing postoperative pain control accelerates normalization of quality of life and functionality for patients.
• Inadequately treated acute pain can contribute to the development of chronic pain in 20% of patients.
• Opioids are associated with the undesirable side effects of sedation, respiratory depression, nausea, vomiting, and ileus.
• Multimodal analgesia has emerged as an essential component of all ERAS pathways due to the fact that concurrent use of primarily non-opioid analgesics can have additive, if not synergistic, analgesic effect.
Use of preoperative gabapentin significantly reduces postoperative opioid consumption: a meta-analysis

Objectives: Effective postoperative pain management is crucial in the care of surgical patients. Opioids, which are commonly used in managing postoperative pain, have a potential for tolerance and addiction, along with sedating side effects. Gabapentin’s use as a multimodal analgesic regimen to treat neuropathic pain has been documented as having favorable side effects. This meta-analysis examined the use of preoperative gabapentin and its impact on postoperative opioid consumption.

Materials and methods: A comprehensive literature search was conducted to identify randomized control trials that evaluated preoperative gabapentin on postoperative opioid consumption. The outcomes of interest were cumulative opioid consumption following the surgery and the incidence of vomiting, somnolence, and nausea.

Results: A total of 1,703 patients involved in 17 randomized control trials formed the final analysis for this study. Postoperative opioid consumption was reduced when using gabapentin within the initial 24 hours following surgery (standard mean difference: -1.35, 95% confidence interval: [-1.96 to -0.74], Z=0.001). There was a significant reduction in morphine, fentanyl, and tramadol consumption (P<0.05). While a significant increase in postoperative somnolence incidence was observed (relative risk 1.30, 95% CI: 1.10-1.54, P<0.05), there were no significant effects on postoperative vomiting and nausea.

Conclusion: The administration of preoperative gabapentin reduced the consumption of opioids during the initial 24 hours following surgery. The reduction in postoperative opioids with preoperative gabapentin increased postoperative somnolence, but no significant differences were observed in nausea and vomiting incidences. The results from this study demonstrate that gabapentin is more beneficial in mastectomy and spinal, abdominal, and thyroid surgeries. Gabapentin is an effective analgesic adjunct, and clinicians should consider its use in multimodal treatment plans among patients undergoing elective surgery.

Keywords: gabapentin, preemptive analgesia, opioid, postoperative pain
Alternative Analgesic Strategies by Phase of Care

Pre-op Gabapentin has been shown to reduce post-op narcotic requirements in other specialties. Intraoperative Ketamine and propofol have allowed lower narcotic use intraoperatively. Successful postop multimodal analgesic strategies have included gabapentin, scheduled IV or PO Tylenol, judicious use of parenteral NSAIDs, gabapentin, tramadol and low dose fentanyl or OxyContin for breakthrough pain. Some programs have added Lidoderm patches, and more unconventional strategies such as Reiki and other therapeutic touch modalities.
ERAS CARDIAC: POST-OP PHASE

Chemical thromboprophylaxis can be beneficial following cardiac surgery ✔

• Class IIa (moderate), Level of evidence C- Limited Data
• Vascular Thrombotic Events (VTE) include both deep venous thrombosis (DVT) and pulmonary embolism (PE) and are a major potentially preventable form of morbidity and mortality for patients recovering from surgery.
• Some studies have documented an incidence of DVT following cardiac surgery as high as 15-20%.
• A recent meta-analysis suggested that VTE prophylaxis could significantly reduce the risk of VTE without increasing the risk of bleeding and cardiac tamponade, however the strength of this recommendation was limited by the low quality of the studies included.
• In this context of sparse data, we suggest the use of pharmacological prophylaxis as soon as satisfactory hemostasis has been achieved, in addition to mechanical measures such as intermittent pneumatic compression devices.
**Early ERAS CARDIAC DATA:**
Very Scant reporting prior to formation of ERAS Cardiac in 2017

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Study Type</th>
<th>Population</th>
<th>Number of Patients</th>
<th>Interventions</th>
<th>Outcomes</th>
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</thead>
<tbody>
<tr>
<td>Sola et al.14</td>
<td>2016</td>
<td>Descriptive</td>
<td>Transcatheter aortic valve</td>
<td>N/A</td>
<td>ERCS bundle</td>
<td>None</td>
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<td>Fleming et al.</td>
<td>2016</td>
<td>Prospective, observational trial</td>
<td>Coronary artery bypass and valve surgery</td>
<td>105</td>
<td>ERCS bundle</td>
<td>Reduction in complications and pain scores</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No difference in length of stay</td>
</tr>
<tr>
<td>Zaouter et al.</td>
<td>2015</td>
<td>Observational, retrospective trial</td>
<td>Coronary artery bypass</td>
<td>71</td>
<td>ERCS bundle with robotic total endoscopic coronary artery bypass v fast-track anesthesia</td>
<td>Reduced transfusion and ICU and hospital length of stay in TECAB group</td>
</tr>
</tbody>
</table>

Abbreviations: ERCS, enhanced recovery in cardiac surgery; ICU, intensive care unit; TECAB, total endoscopic coronary artery bypass.
ERAS Cardiac: Early Outcomes in US: WakeMed/DukeHealth Experience

Two well-matched groups of ~450 pts, one observed prior to ERAS Cardiac program initiation, the other observed following program initiation
Both groups well‐matched for demographics, procedures and risk‐factors.
ERAS Cardiac: Early Outcomes in US: WakeMed/DukeHealth Experience
**Early Outcomes in US:**
WakeMed/DukeHealth
ERAS CARDIAC Protocol

<table>
<thead>
<tr>
<th>TABLE 1: First-year protocol for enhanced recovery after cardiac surgery</th>
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<tbody>
<tr>
<td><strong>Consulting phase</strong></td>
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<tr>
<td>Preoperative information, education, and counseling</td>
</tr>
<tr>
<td>Preoperative optimization</td>
</tr>
<tr>
<td>Smoking and alcohol cessation</td>
</tr>
<tr>
<td>Preoperative nutritional status</td>
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<tr>
<td><strong>Preoperative phase</strong></td>
</tr>
<tr>
<td>Preoperative fasting and carbohydrate treatment</td>
</tr>
<tr>
<td>Preoperative multimodal analgesia</td>
</tr>
<tr>
<td>Analgesic medications</td>
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<tr>
<td><strong>Intraoperative phase</strong></td>
</tr>
<tr>
<td>Intraoperative opioid administration</td>
</tr>
<tr>
<td>Hydromorphone 0.5-1 mg given near completion of surgery</td>
</tr>
<tr>
<td>Intraoperative multimodal analgesia</td>
</tr>
<tr>
<td>Postoperative sedation initiated</td>
</tr>
<tr>
<td><strong>Postoperative phase</strong></td>
</tr>
<tr>
<td>Early extubation</td>
</tr>
<tr>
<td>Pulmonary function optimization</td>
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<tr>
<td>Multimodal analgesia</td>
</tr>
<tr>
<td>Gabapentin 300 mg twice daily,* started after POD 5</td>
</tr>
<tr>
<td>Oxycodeine 5/10 mg every 4 h as needed (liqid given through orogastric tube while intubated, orally once extubated and tolerating clear fluids)</td>
</tr>
<tr>
<td>Fentanyl IV for breakthrough pain resistant to oral medication management</td>
</tr>
<tr>
<td>*Gabapentin 100 mg given as maintenance dose if patient is aged &gt;70 y with hold parameters for sedation</td>
</tr>
<tr>
<td>PONV prophylaxis</td>
</tr>
<tr>
<td>Promethazine 6.25-12.5 mg IV as needed for breakthrough nausea with avoidance if patient aged &gt;70 y</td>
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<tr>
<td>Bowel motility</td>
</tr>
<tr>
<td>Lactulose 20 g solution orally POD 2 if no bowel movement</td>
</tr>
<tr>
<td>Bisacodyl 10 mg suppository starting POD 1, held for loose stools</td>
</tr>
<tr>
<td>Glycemic control</td>
</tr>
<tr>
<td>Diet</td>
</tr>
<tr>
<td>Early mobilization</td>
</tr>
<tr>
<td>Lines and drain management</td>
</tr>
</tbody>
</table>

*NPO, Non per os; IV, intravenous; ICU, intensive care unit; POD, postoperative day; PONV, postoperative nausea and vomiting.
Implementation of ERAS Cardiac led to significant reductions in opioid use, ICU and hospital LOS and halved GI complications!
**ERAS Cardiac: Early Outcomes in US:**
WakeMed/DukeHealth Experience

Workplace domain scores for inpatient staff before and after implementation of ERAS Cardiac Program showed improvement in staff satisfaction and enthusiasm.
Starting a New ERAS Cardiac Program: Key Principals

As with any new program development efforts, success depends on achievement of several crucial early steps:

• Creation of a well-defined and fully-aligned team, with clinical leaders/champions ambitious and enthusiastic about accomplishing goal, with a recognition that collaboration is essential, and roles clearly established
• Designate an ERAS Cardiac coordinator. Consistently shown to be an indispensable element for success.
• Establish standardized protocols and goals, built on consensus, with little room for real-time deviation
• Commitment to data collection/outcome measurement, ongoing monitoring for deviations, and an emphasis on continuous quality improvement and open-mindedness toward updating protocols as evidence emerges.
• **Full buy-in from all key stakeholders,** including all surgeons, anesthesiologists, nursing, administration as well as key ancillary staff, such as pharmacy, RT,PT
• Patients should also be considered key-stakeholders and should be given a strong voice
• Recognition that ongoing education of all involved staff is an expected and necessary part of a successful rollout. Emphasis of new principals of **prophylaxis** against nausea/vomiting and pain important.
• Leverage EMR to facilitate standardized order set creation, compliance and trigger intervention
Starting a new ERAS Cardiac Program:
Defining Project Goals and Success Metrics

• Primary Outcomes  = Reducing Complications
  • Prolonged ventilation
  • Hospital-acquired infection
  • Reoperations
  • Stroke
  • Renal failure
  • Atrial Fibrillation
  • Ileus/other GI complications
  • Death

• Secondary Outcomes
  • Reduce Hospital Readmissions
  • Reduce ICU LOS
  • Reduce Hospital LOS
  • Reduce ”cost per case”
  • Improve patient satisfaction scores
  • Improve pain score
  • Reduce overall opioid use

Pathway should be designed by consensus with interventions that leverage the strengths of the institution, and that are likely to achieve the defined goals
Starting a new ERAS Cardiac Program: Defining Pre-work, Scope and Duration

• Logistics are considerable. Who owns what?
• Will the program look at all OHS patients, or CABG only? All patients or exclude some?
• How are ERAS pathway patients identified through continuum of care? Armbands? Color-coding charts? EMR flagging?
• Will the initial program be a pilot project or a permanent addition?
• Timeline from conception to launch should be 6-9 months. Deadlines are essential for key milestones to go-live.
• EPIC builds critical and most time-consuming component.
ERAS Cardiac Program Initiation: Team Composition

- Surgeon/Anesthesiologist/Nurse/APC Champions
- ERAS Cardiac Coordinator (dedicated)
- Data Manager
- Pharmacy lead
- Administrator liaison
ERAS Cardiac Coordinator: “The straw that stirs the drink”
ERAS Cardiac Program Initiation: Barriers to Success

• Suboptimal leadership by champions around objectives
• Insufficient staff and patient/family education by ERAS Team
• Non-alignment across the service line and with administration
• Inadequate monitoring and data acquisition
• Absence of Culture of Continuous Quality Improvement
• Pressure to achieve optimal STS performance reduces appetite for change. “Don’t rock the boat”
• Tension between “fast track” early discharge and maintaining low readmission rates
• Patient factors: short window between dx and surgery, complex patient co-morbidities, unrealistic patient expectations
ERAS Cardiac Program Initiation: Getting Started at WMC

• Is there a need? Early adopter data is very encouraging
• Understanding our culture, our strengths and opportunities
• Creating a **new culture** based on chosen interventions and defining a “new normal” for cardiac care through the continuum
• Sanguine analysis of strengths, barriers and potential challenges
• Making the quality, satisfaction and business case to key players, including administration
• Can we leverage EPIC, and what priority will this project be assigned?
• What have we learned from our other ERAS projects and with other program development successes at WMC?
ERAS Cardiac Program Initiation:
Why WMC is Poised to succeed in ERAS Cardiac

• Mission focus on Innovation
• Commitment to Triple Aim
• Exceptional nursing staff dedicated to provision of cutting edge care
• Already high penetration of evidence-based ERAS Cardiac guidelines and application of Cardiac CarePath
• Rapidly emerging data showing compelling patient, institutional and societal benefits.
Closing Thoughts/ Future Directions for ERAS Cardiac

• ERAS, across specialties, is really a multi-disciplinary, perioperative philosophy of care with enormous potential benefit.

• Without a fully-integrated, educated and committed team, success will be difficult.

• Research is exploding across ERAS, especially in Cardiac. Potential new avenues for intervention to reduce complications may include:
  - POC coagulation monitoring (ROTEM,TEG) to reduce blood product
  - Anti-arrhythmia prophylaxis in reducing Afib (amiodarone etc.)
  - Exploring the path toward narcotic-free cardiac surgery
Thank You

Questions?

For more information, visit ERAS CARDIAC.ORG
or contact me: ekofsky@valleyhealthlink.com
Purpose:
To achieve higher levels of performance