ERAS

Presented by
Timothy L. Beard MD, FACS, CPI
Bend Memorial Clinic
Outline

• Definition
• Justification
• Ileus
• Pain
Outline

• Specifics
• Data
• BMC Data
• Worldwide Data
• Implementation
What is ERAS?

• AKA Fast-track or ERP
• Developed by Kehlet in Denmark in colonic surgery
• Gradually has gained world-wide acceptance
• Originally described in Open Surgery but same advantages seem to apply for Laparoscopy
• Gustafsson/Scott
Goal of ERAS

**Implement** a standardized, patient centered protocol.

**Integrate** the pre-operative, intra-operative, post-operative and post-discharges phases of care to reduce LOS.

**Improve** patient experience and satisfaction and decrease variability.
Getting Popular
Why Me?
Studies as PI

A Multicenter, Randomized, Double-Blind, Placebo-Controlled Study to Evaluate the Efficacy and Safety of IV Ulimorelin Administered Post-Operatively to Accelerate GI Motility in Subjects Who Have Undergone a Partial Bowel Resection. 2010
Studies as PI

Phase IIA Multicenter, Randomized, Double-Blind, Placebo-Controlled, Parallel-Group study of Intravenous Methylnaltrexone (MOA-728) for the Treatment of Post-Operative Ileus after Bowel Resections and Ventral Hernia Repairs  2007
Studies as PI

Studies as PI

A Phase 4, Multicenter, Double-Blind, Placebo-Controlled, Parallel Study of Alvimopan for the Management of Postoperative Ileus in Subjects Undergoing a Radical Cystectomy 2010
Radical Cystectomy

- Complex abdominopelvic procedure for invasive bladder cancer\(^1\)
  - Complete removal of bladder, nearby lymph nodes, part of the urethra, distal ureters, seminal vesicles, and prostate in men
  - Complete removal of bladder, nearby lymph nodes, urethra, distal ureters, uterus, and part of the vagina for women
  - Pelvic lymphadenectomy in men and women
- Morbidity rate 25% to 45%\(^2\)
- Most common postoperative complications are gastrointestinal (29% of patients), including postoperative ileus (22.7% of patients)\(^3,4\)
- Delayed gastrointestinal recovery results in prolonged length of hospital stay\(^3\)
- Gastrointestinal recovery is a critical clinical milestone and primary driver for important patient management decisions after complex surgeries, including bowel resections and radical cystectomy

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## Comparison of Radical Cystectomy and Bowel Resection

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Bowel Resection</th>
<th>Radical Cystectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most common reason for surgery</td>
<td>Intestinal cancer (32%–44%)(^1,2)</td>
<td>Bladder cancer (100%)(^3)</td>
</tr>
<tr>
<td>Procedures per year</td>
<td>~500,000(^3)</td>
<td>~10,000(^3)</td>
</tr>
<tr>
<td>Age</td>
<td>64 years(^1)</td>
<td>68 years(^4,5)</td>
</tr>
<tr>
<td>Surgical approach</td>
<td>≤60% open(^1,2)</td>
<td>Vast majority open(^6)</td>
</tr>
<tr>
<td>Most commonly resected bowel segment</td>
<td>Left large bowel(^1)</td>
<td>Distal small bowel(^3)</td>
</tr>
<tr>
<td>Mean length of procedure</td>
<td>2 hours(^7)</td>
<td>5 hours(^4)</td>
</tr>
<tr>
<td>Type of postoperative pain management</td>
<td>70% opioid-based IV-PCA; 16% use thoracic epidural(^6)</td>
<td>Majority opioid-based IV-PCA(^3)</td>
</tr>
<tr>
<td>Postoperative LOS</td>
<td>5 days (laparoscopic) 8 days (open)(^2)</td>
<td>11 days(^9)</td>
</tr>
</tbody>
</table>

LOS=length of stay; IV-PCA=intravenous patient-controlled analgesics.
Postoperative Ileus (POI) and Radical Cystectomy

- Reported rates of POI associated with radical cystectomy range from 10% to 22.7%\textsuperscript{1-4}

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Patients (N)</th>
<th>POI rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chang et al\textsuperscript{1}</td>
<td>2002</td>
<td>304</td>
<td>22.7%</td>
</tr>
<tr>
<td>Lee et al\textsuperscript{2}</td>
<td>2004</td>
<td>262</td>
<td>15%</td>
</tr>
<tr>
<td>Hollenbeck et al\textsuperscript{3}</td>
<td>2005</td>
<td>2538</td>
<td>9.7%</td>
</tr>
<tr>
<td>Svatek et al\textsuperscript{4}</td>
<td>2010</td>
<td>283</td>
<td>15.2%</td>
</tr>
</tbody>
</table>

- POI rates ranged from 1.6% to 23.5% (average, 9.9%) in a systematic review of 77 studies including 13,793 radical cystectomy patients\textsuperscript{5}

- POI is the most common factor contributing to increased length of stay\textsuperscript{1}

- Additional cost per patient for increased length of stay associated with POI is approximately $10,000\textsuperscript{6}

Design of the ENTEREG® (alvimopan) Phase 4 Radical Cystectomy Study

Please see Important Safety Information on prior slides and full prescribing information.

*CV=cardiovascular; BID=twice daily; POD=postoperative day; AE=adverse event; SAE=serious adverse event; MI=myocardial infarction; CVA=cerebrovascular accident; TIA=transient ischemic attack.

*CV disease=previous MI, coronary revascularization, CVA/TIA, and or peripheral arterial disease; *Defined in 24-hour intervals based on the calendar day.

Standardized Accelerated Multimodal Postoperative Care Pathway in the ENTEREG® (alvimopan) Phase 4 Radical Cystectomy Study

- Used in placebo and ENTEREG study arms
- Intended to manage GI recovery unless not warranted by patient’s condition

Please see Important Safety Information on prior slides and full prescribing information.

GI=gastrointestinal; NGT=nasogastric tube; POD=postoperative day.

ENTEREG® (alvimopan) Reduced POI-Related Morbidity in the Phase 4 Radical Cystectomy Study

Please see Important Safety Information on prior slides and full prescribing information.

POI=postoperative ileus; NGT=nasogastric tube; LOS=length of stay.

Note: *P values derived from Fisher exact tests comparing proportions.

ENTEREGR® (alvimopan) Reduced Postoperative LOS in the Phase 4 Radical Cystectomy Study

\[ P=0.0051 \]
(Wilcoxon rank-sum test)

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean postoperative LOS, days</th>
<th>Median postoperative LOS, days</th>
<th>Postoperative LOS ≥ 7 days, patients %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo (n=134)</td>
<td>10.07</td>
<td>8.0</td>
<td>51.5</td>
</tr>
<tr>
<td>ENTEREGR 12 mg (n=143)</td>
<td>7.44</td>
<td>7.0</td>
<td>32.9 (18.6%)</td>
</tr>
</tbody>
</table>

-2.63 days

-1.0 days

Please see Important Safety Information on prior slides and full prescribing information.

LOS=length of stay.

Alvimopan, a Peripherally Acting \(\mu\)-Opioid Receptor Antagonist, is Associated with Reduced Costs after Radical Cystectomy: Economic Analysis of a Phase 4 Randomized, Controlled Trial

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From Cubist Pharmaceuticals (TLK, LT, JMI), Lexington, Massachusetts, University of Texas Health Science Center at San Antonio (RSS), San Antonio and Baylor University, Baylor College of Medicine (GA) and University of Texas M.D. Anderson Cancer Center (AMK), Houston, Texas, Bend Memorial Clinic (TLB), Bend, Oregon, Vanderbilt University Medical Center (SSC), Nashville, Tennessee, Cleveland Clinic Foundation (AF, JOI), Cleveland, Ohio, Mayo Clinic (RIK), Rochester and Optum (CM), Eden Prairie, Minnesota, Indiana University Medical Center (MK), Indianapolis, Indiana, University of Michigan (ICTL), Ann Arbor, Michigan, L. Lee Moffitt Cancer Center and Research Institute (NVIS), Tampa, Florida, University of Oklahoma College of Medicine (UIW), Oklahoma City, Oklahoma, University of Chicago Medical Center (GDS), Chicago, Illinois, and University of Colorado Health Science Center (SSW), Aurora, Colorado

**Purpose:** We evaluated the effect of alvimopan treatment vs placebo on health care utilization and costs related to gastrointestinal recovery in patients treated with radical cystectomy in a randomized, phase 4 clinical trial.

**Materials and Methods:** Resource utilization data were prospectively collected and evaluated by cost consequence analysis. Hospital costs were estimated from 2012 Medicare reimbursement rates and medication wholesale acquisition costs. Differences in base-case mean costs between the study cohorts for total, post-

**Abbreviation and Acronyms**
- DRG = diagnostic related group
- ECG = electrocardiogram
- GI = gastrointestinal
- LOS = length of stay
Postoperative Ileus (POI)

Definition, characteristics, risk factors, role of opioids, and key considerations

and

Enhanced Recovery Pathways
Delayed GI Recovery Is Expected After Bowel Resection

- POI is the period of cessation of coordinated bowel motility that occurs after bowel resection surgery\(^1\)

- The Postoperative Ileus Management Council—a multidisciplinary group of experts from the fields of general surgery, colorectal surgery, anesthesiology, and radiology—defined POI as transient cessation of coordinated bowel motility after surgical intervention, which prevents effective transit of intestinal contents or tolerance of oral intake\(^1\)

- Characteristics\(^2,3\):
  - Abdominal distension and bloating
  - Abdominal pain
  - Nausea and vomiting
  - Accumulation of gas and fluids in the bowel
  - Delayed passage of flatus and defecation

POI=postoperative ileus, GI=gastrointestinal.
Opioids Affect Both the CNS and the GI Tract\(^1-3\)

**Opioids and the CNS**
Opioids bind to \(\mu\)-opioid receptors in the CNS for pain control\(^1,3\).

**Opioids and the GI tract**
Opioids also bind to peripheral \(\mu\)-opioid receptors in the GI tract, impairing motility\(^1,3\).

CNS=central nervous system; GI=gastrointestinal.

The Opioid Component of Delayed Gastrointestinal Recovery After Bowel Resection

Timothy L. Beard · John B. Leslie · Jeffrey Nemeth

Received: 22 December 2010 / Accepted: 23 March 2011 / Published online: 15 April 2011
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Abstract
Introduction Patients undergoing bowel resection or other major abdominal surgery experience a gastrointestinal recovery associated with increased postoperative morbidity and longer hospital length of stay. Contributing factors include nausea, vomiting, abdominal distension, bloating, pain, intolerance to solid or liquid food, and intolerance to gas. The exact cause of delayed gastrointestinal recovery remains unknown.
Potential Risk Factors Influencing the Severity and Duration of Delayed GI Recovery

- Extent of bowel manipulation
- Operation time
- Patient health
- Systemic infections
- Amount of opioids
- Patient age, gender, race
- Surgical site

Duration and severity of POI cannot be reliably predicted before bowel resection surgery

GI=gastrointestinal.

Bowel Resection Surgeries in the United States

Premier Perspective® database

1. Data on file. Premier Perspective® Database. Cubist Pharmaceuticals; Lexington, MA.
Increased LOS and Hospitalization Costs Associated With POI\(^a\) in Colectomy Patients\(^1\)

Retrospective cohort analysis of patients in a large US multihospital database (2004)

- All-cause readmission rates were significantly higher in patients with POI than in those without POI (0.9% vs 0.3%; \(P<.0001\))

\(\text{LOS}=\text{length of stay}; \ POI=\text{postoperative ileus}; \ ICD-9-CM=\text{International Classification of Diseases, Ninth Revision, Clinical Modification.}\)

\(^a\)Defined as the presence of a diagnostic code for POI (ICD-9-CM 580.1 [paralytic ileus] and/or 997.4 [digestive system complications not elsewhere classified]) during the inpatient stay.

Increased LOS and Hospital Costs Associated With POI\textsuperscript{a} Following Abdominal Surgery\textsuperscript{1}

Retrospective analysis of patients in a large US multihospital database (2002)

- Estimated total annual costs attributed to the management of POI in the United States were $1.46 billion\textsuperscript{b}

\textit{LOS}=length of stay; \textit{POI}=postoperative ileus; ICD-9=International Classification of Diseases, Ninth Revision.
\textsuperscript{a}Defined as the presence of ICD-9 diagnostic codes 560.1 (paralytic ileus) and/or 997.4 (digestive complication, not elsewhere classified);
\textsuperscript{b}Costs adjusted to 2006.

Key Considerations After Bowel Resection Surgery

- GI recovery is an important step in patient management following BR surgery\(^1\)
  - Key determinant of discharge readiness

- Delayed GI recovery is expected to some extent in all patients after BR surgery\(^1,2\)

- Associations between POI severity and types of surgery, preexisting comorbidity, and pharmacological therapy have been reported\(^3\)
  - A fully developed risk equation has not been evaluated in clinical studies

\(\text{GI=gastrointestinal; BR=bowel resection; POI=postoperative ileus.}\)
Enhanced Recovery Pathways Can Help Optimize Care

- Enhanced recovery pathways that include pre-, intra-, and postoperative components can contribute to quicker GI recovery after bowel resection surgery\(^1,2\)

- Broad implementation of enhanced recovery pathways remains a challenge
  - A survey of 407 surgeons (207 general surgeons and 200 colorectal surgeons) revealed that only 30% work in hospitals where there are perioperative care protocols that include improving GI recovery components for elective bowel resections (January 2009–February 2009)\(^3\)

GI=gastrointestinal; LOS=length of stay.
The Midwest Surgical Association

Association of surgical care practices with length of stay and use of clinical protocols after elective bowel resection: results of a national survey

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KEYWORDS:
Postoperative ileus; Clinical pathway; Enhanced recovery pathway; Bowel resection; Perioperative care

Abstract

BACKGROUND: Although management techniques have been proposed to accelerate gastrointestinal recovery after elective bowel resection (BR), most data are derived from single-institution experience. This study assessed the current state of perioperative care for elective BRs and the effect of pathway components on length of stay.

METHODS: A web-based survey was conducted among surgeons regarding their last elective BR.

RESULTS: Among 207 general and 200 colorectal surgeons, 30% practice in hospitals with a perioperative surgical care pathway intended to accelerate gastrointestinal recovery. Pathway components included early toleration of oral nutrition, early ambulation, tube resection avoidance, and opioid-sparing pain

Pain
Acute Perioperative Pain

- Perioperative pain
  - Approximately 46 million inpatient procedures and 35 million outpatient surgeries were performed in the US in 2006\(^1,2\)
  - Despite new treatment standards, guidelines, and educational efforts, acute postoperative pain continues to be undertreated, with up to 75% of patients in the US still failing to receive adequate postoperative pain relief\(^3,4\)
  - With the advent of Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) surveys, patients are now able to make decisions on hospitals based on quality of care, including quality of pain management

The Historical Acute Pain Paradigm

- Severe Pain
  - +++
  - Opioids

- Moderate Pain
  - ++
  - Opioids

- Mild Pain
  - +
  - Opioids

Aubrun et al., 2003

The Joint Commission Sentinel Event Alert

- Joint Commission Sentinel Event Alert Entitled “Safe use of opioids in hospitals”
  - Focuses on the need for assessing and managing pain to help avoid accidental opioid overdose among hospital inpatients
  - Provides a number of actions that can be taken to avoid the unintended consequences
- Recommendations include advising clinicians who prescribe pain medications to use both non-pharmacologic and pharmacologic alternatives
  - Non-pharmacologic therapies: physical therapy, acupuncture, manipulation or massage, ice, etc.
  - Pharmacologic treatment: non-opioid analgesics, such as acetaminophen, NSAIDs, antidepressants, anticonvulsants, and muscle relaxants, can be used before prescribing an opioid
  - When used in combination with opioids, these non-opioid pharmacologic treatments may reduce the dose of opioids required to effectively manage pain

Multimodal Techniques for Perioperative Pain Management

- Multimodal analgesia combines two or more analgesic agents or techniques that act by different mechanisms to provide analgesia\(^1\)
- ASA, WHO, ASPMN, and The Joint Commission recommend use of a multimodal approach\(^1-4\)
- Opioid dose-sparing effects can be achieved via the use of non-opioid agents and regional blocks\(^1\)
- ASA Task Force recommendations:
  - Unless contraindicated, all patients should receive an around-the-clock regimen of a non-opioid agent
    - Non-steroidal anti-inflammatory drugs (NSAIDs)
    - Cyclooxygenase-2 specific drugs (COXIBs)
    - Acetaminophen
  - Consider supplemental regional anesthesia techniques

Multimodal Approach to Analgesia

Multimodal Approach to Acute Pain Management

Severe Pain

STEP 3
STEP 2 and
Higher doses of opioids

Moderate Pain

STEP 2
STEP 1 and
Low doses of opioids

Mild Pain

STEP 1
Acetaminophen, NSAIDs, or COXIBs and
Local/regional anesthesia

Focus of HCAHPS on Pain and Patient Satisfaction

- Pain
  - Establishing and maintaining an institutional pain performance improvement plan is a Joint Commission requirement\(^1\)

- Patient satisfaction
  - Local, regional, or national patient satisfaction data are now being reported via Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS, also known as CAHPS\(^\circledast\) hospital survey)\(^2\)
  - As part of the Affordable Care Act 2010, the Centers for Medicare and Medicaid (CMS) have established hospital reimbursement based on HCAHPS scores\(^3\)
    - Effective beginning October 1, 2012

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Elements of ERAS

- Pre-OP
- Intra-OP
- Post-OP
Develop Clinical Specifics and Standardization of Care

Clinic
Prep
Inpatient and ICU unit
PACU (pain control and mobilization)
Post-op pain control plan
Factors Influencing Patient Recovery

Accelerated recovery:
- Preop information
- Optimised organ function
- No nutritional defects
- No alcohol preop
- Stop smoking preop
- Neuraxial blockade
- Minimal invasive op’n
- Normothermia
- Nausea prevention
- Ileus prevention
- Early feeding
- Good oxygenation
- Good sleep
- Opioid-sparing
- EB post-op care

Delayed recovery:
- Anxiety, fear
- Preop organ dysfunction
- Surgical stress response
- Hypothermia
- Nausea, vomiting
- Ileus
- Semi-starvation
- Hypoxaemia
- Poor sleep
- Drains, tubes
- Catheters
Benefits

- Fitter patients (sooner)
- Reduced LOS
- Shorter pathways/reduced waits
- Rehabilitation & return to work
- Increased capacity for trust
- Ongoing care interventions reduced / quicker
- Operational & quality standards met
- Improved Pt experience
- Improved clinical outcome
- Cost efficiency savings
Example of Enhanced Recovery Elements

Referral from Primary Care
- Optimised health / medical condition
- Informed decision making
- Pre operative health & risk assessment
- PT information and expectation managed
- DX planning (EDD)
- Pre-operative therapy instruction as appropriate

Pre-Operative
- Minimally invasive surgery
- Use of transverse incisions (abdominal)
- No NG tube (bowel surgery)
- Use of regional / LA with sedation
- Epidural management (inc thoracic)
- Optimised fluid management Individualised goal directed fluid therapy

Admission on day
- Admission on day
- Optimised Fluid Hydration
- CHO Loading
- Reduced starvation
- No / reduced oral bowel preparation (bowel surgery)

Intra-Operative
- Planned mobilisation
- Rapid hydration & nourishment
- Appropriate IV therapy
- No wound drains
- No NG (bowel surgery)
- Catheters removed early
- Regular oral analgesia
- Paracetamol and NSAIDS
- Avoidance of systemic opiate-based analgesia where possible or administered topically

Post-Operative
- DX when criteria met
- Therapy support (stoma, physio)
- 24hr telephone follow up

Follow Up
- Optimising pre operative haemoglobin levels
- Managing pre existing co morbidities e.g. diabetes
- Optimising pre operative haemoglobin levels
- Managing pre existing co morbidities e.g. diabetes
Guidelines for Perioperative Care in Elective Colonic Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations

U. O. Gustafsson · M. J. Scott · W. Schwenk · N. Demartines · D. Roulin · N. Francis · C. E. McNaught · J. MacFie · A. S. Liberman · M. Soop · A. Hill · R. H. Kennedy · D. N. Lobo · K. Fearon · O. Ljungqvist

© Enhanced Recovery After Surgery, The European Society for Clinical Nutrition and Metabolism, and International Association for Surgical Metabolism and Nutrition 2012

Abstract

Background This review aims to present a consensus for optimal perioperative care in colonic surgery and to provide graded recommendations for items for an evidence-based enhanced perioperative protocol.

Methods Studies were selected with particular attention paid to meta-analyses, randomised controlled trials and large prospective cohorts. For each item of the perioperative treatment pathway, available English-language literature was examined, reviewed and graded. A consensus recommendation was reached after critical appraisal of the literature by the group.

Results For most of the protocol items, recommendations are based on good-quality trials or meta-analyses of good-quality trials (quality of evidence and recommendations according to the GRADE system).

Conclusions Based on the evidence available for each item of the multimodal perioperative care pathway, the Enhanced Recovery After Surgery (ERAS®) Society, International Association for Surgical Metabolism and Nutrition (IASMEN) and European Society for Clinical Nutrition and Metabolism (ESPEN) present a comprehensive evidence-based consensus review of perioperative care for colonic surgery.

Introduction

The delay until full recovery after major abdominal surgery has been greatly improved by the introduction of a series of...
Pre-Op

• Preadmission counseling
• Fluid and Carbohydrate Loading
• No Prolonged Fasting
• No/Selective Bowel Prep
Pre-Op

• Antibiotic Prophylaxis
• Thromboprophylaxis
• No Pre-Meds
Intra-Op

- Short-acting anesthetic agents
- Epidural or other regional block
- PONV prophylaxis
- Limit Fluids
Intra-Op

- No NGT
- No Drains
- Lap Approach if Possible
- Normothermia
Post-Op

• Early Removal of Foley
• Early Feeding
• Early Ambulation
• Limit IVF
Post-Op

- Multi-Modal pain management
- Epidural
- Non-Opioids
Complete Guidelines
## ERAS Results

<table>
<thead>
<tr>
<th>Type of Operation</th>
<th>Duration of stay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid endarterectomy</td>
<td>1-2 days</td>
</tr>
<tr>
<td>Lung lobectomy</td>
<td>1-2 days</td>
</tr>
<tr>
<td>Prostatectomy</td>
<td>1-2 days</td>
</tr>
<tr>
<td>Colectomy</td>
<td>1-3 days</td>
</tr>
<tr>
<td>Aortic Aneurysm</td>
<td>3-4 days</td>
</tr>
</tbody>
</table>
Incorporation of Alvimopan (Enter
erg®) as Part of Perioperative Management of Patients Undergoing Colectomy:
1 Surgeon’s Experience

Timothy L. Beard, MD; Bob Cutter, PharmD;
Emily Meeks; Karla Lichter, RN, CCRC
Bend Memorial Clinic, Bend, Oregon
Study Design

Independent study of patients undergoing open colectomy
• All patient data from same surgeon

Conducted at Bend Memorial Clinic
• Multispecialty medical clinic with 85 physicians and 600 staff members

Patients in 2 of 3 arms received a standardized accelerated postoperative care pathway (post-pathway or alvimopan + pathway)
Based on alvimopan phase III clinical trials\(^1-4\)
• Removal of NGT at the end of surgery or morning before first postoperative dose of alvimopan
• Early ambulation (initiated POD 1)
• Early diet advancement (liquids offered POD 1, solids offered POD 2)

Abbreviations: NGT, nasogastric tube; POD, postoperative day.
## Study Design

<table>
<thead>
<tr>
<th>Treatment arms</th>
<th>Type of analysis</th>
<th>Enrollment dates</th>
<th>Patients (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-pathway</td>
<td>Retrospective</td>
<td>10/04 - 10/05</td>
<td>19</td>
</tr>
<tr>
<td>Post-pathway</td>
<td>Retrospective</td>
<td>3/07 - 9/08</td>
<td>26</td>
</tr>
<tr>
<td>Alvimopan + pathway</td>
<td>Prospective</td>
<td>7/08 - 5/09</td>
<td>25</td>
</tr>
</tbody>
</table>
## Baseline Demographics and Surgery Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Pre-pathway (n = 19)</th>
<th>Post-pathway (n = 26)</th>
<th>Alvimopan + pathway (n = 25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male, n (%)</td>
<td>NA</td>
<td>14 (53.8)</td>
<td>10 (40.0)</td>
</tr>
<tr>
<td>Mean age, years</td>
<td>NA</td>
<td>67.1</td>
<td>73.9</td>
</tr>
<tr>
<td>Type of BR surgery, a %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low anterior resection</td>
<td>36.8</td>
<td>19.2</td>
<td>24.0</td>
</tr>
<tr>
<td>Right colectomy</td>
<td>42.1</td>
<td>46.2</td>
<td>48.0</td>
</tr>
<tr>
<td>Transverse colectomy</td>
<td>0</td>
<td>15.4</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>21.1</td>
<td>19.2</td>
<td>28.0</td>
</tr>
<tr>
<td>Mean length of surgery, min</td>
<td>NA</td>
<td>81.0</td>
<td>65.7</td>
</tr>
</tbody>
</table>

Abbreviations: BR, bowel resection; NA, not available.

aAll BRs performed via laparotomy.
Alvimopan Reduced Length of Stay (LOS)

- LOS > 5 days was observed in 84%, 77%, and 32% of patients in the pre-pathway, post-pathway, and alvimopan + pathway groups, respectively.

Unpaired 2-tailed $P$ values were calculated using a $t$-test.
Alvimopan Reduced Time to First Postoperative Bowel Movement

Note: Time to first bowel movement (BM) was not collected for patients in the pre-pathway group. Unpaired 2-tailed $P$ values were calculated using a $t$-test.
Alvimopan Reduced the Need for Nasogastric Tube (NGT) Reinsertion and Readmission

- Patients requiring NGT insertion was 19.2% in the post-pathway group and 0% in the Alvimopan + pathway group.
- Patients requiring readmission was 7.7% in the post-pathway group and 0% in the Alvimopan + pathway group.

*There was 1 death in the alvimopan + pathway group; this was attributed to sepsis.
Proportion of patients requiring NGT insertion or readmission was not collected for patients in the pre-pathway group.
Alvimopan Appeared to Reduce Total Adjusted Hospital Costs

- Mean total adjusted hospital costs, US $:
  - Post-pathway: $29,860
  - Alvimopan + pathway: $25,725

*a* Cost data corrected for a specific fee increase that occurred 1/09; changes in billing practices occurred between the post-pathway and pathway + alvimopan groups.

Total adjusted hospital costs were not calculated for patients in the pre-pathway group.
Alvimopan Use in Laparoscopic Bowel Resections

Byron Holloway MS 4
WesternU/COMP
Timothy L. Beard MD, FACS
Bend Memorial Clinic
Bend Memorial Clinic Study

Retrospective Review
BMC is a multi-specialty clinic with over 80 providers and 5 general surgeons
Data collected from 2009 - early 2012
Extensive chart review
Data

37 pts in Entereg group
44 pts in control group
No hand assisted cases
All done by board certified surgeons
Mix of right and left colon resections
Alvimopan Group

N=37
Average age 61.5 range 33-93
Ave length of stay 4.24 days range 3-6
Ave time to first BM 2.62 days range 1-5
No SAEs in this group
Control Group

N=44
Ave. age 64.02    range 33-85
Ave. length of stay 4.84 days    range 3-8
Ave. time to first BM 3.57 days   range 2 to 6
No SAEs in this group
One pt. excluded from this group.
Length of Stay

Length of stay decreased 4.81 to 4.25
P value is 0.0075
Statistically significant difference
BMC Outcomes with Laparoscopic Colon Resections
Length of hospital stay (days)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>ERAS Mean</th>
<th>ERAS SD</th>
<th>Total</th>
<th>TC Mean</th>
<th>TC SD</th>
<th>Total</th>
<th>Weight</th>
<th>Mean Difference IV, Random, 95% CI</th>
<th>Mean Difference IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson 2003</td>
<td>4</td>
<td>1.8</td>
<td>14</td>
<td>7</td>
<td>2.1</td>
<td>11</td>
<td>19.3%</td>
<td>-3.00 [-4.56, -1.44]</td>
<td></td>
</tr>
<tr>
<td>Delaney 2003</td>
<td>5.2</td>
<td>2.5</td>
<td>31</td>
<td>5.8</td>
<td>3</td>
<td>33</td>
<td>21.7%</td>
<td>-0.60 [-1.95, 0.75]</td>
<td></td>
</tr>
<tr>
<td>Gatt 2005</td>
<td>6.6</td>
<td>4.4</td>
<td>19</td>
<td>9</td>
<td>4.6</td>
<td>20</td>
<td>9.6%</td>
<td>-2.40 [-5.22, 0.42]</td>
<td></td>
</tr>
<tr>
<td>Khoo 2007</td>
<td>5</td>
<td>8.5</td>
<td>35</td>
<td>7</td>
<td>14.75</td>
<td>35</td>
<td>3.1%</td>
<td>-2.00 [-7.64, 3.64]</td>
<td></td>
</tr>
<tr>
<td>Muller 2009</td>
<td>6.7</td>
<td>4.84</td>
<td>76</td>
<td>10.3</td>
<td>4.97</td>
<td>75</td>
<td>19.2%</td>
<td>-3.60 [-5.17, -2.03]</td>
<td></td>
</tr>
<tr>
<td>Serclaova 2009</td>
<td>7.4</td>
<td>1.3</td>
<td>51</td>
<td>10.4</td>
<td>3.1</td>
<td>52</td>
<td>27.1%</td>
<td>-3.00 [-3.92, -2.08]</td>
<td></td>
</tr>
</tbody>
</table>

Total (95% CI) 226 226 100.0% -2.51 [-3.54, -1.47]

Heterogeneity: Tau² = 0.80; Chi² = 11.04, df = 5 (P = 0.05); I² = 55%
Test for overall effect: Z = 4.76 (P < 0.000001)

Experimental group= Enhanced Recovery After Surgery (ERAS)
Control = Traditional Care (TC)
## Complications

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>ERAS</th>
<th>TC</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson 2003&lt;sup&gt;19&lt;/sup&gt;</td>
<td>4</td>
<td>14</td>
<td>0.63 [0.22, 1.80]</td>
<td></td>
</tr>
<tr>
<td>Delaney 2003&lt;sup&gt;20&lt;/sup&gt;</td>
<td>7</td>
<td>31</td>
<td>0.75 [0.32, 1.71]</td>
<td></td>
</tr>
<tr>
<td>Gatt 2005&lt;sup&gt;21&lt;/sup&gt;</td>
<td>9</td>
<td>19</td>
<td>0.63 [0.37, 1.08]</td>
<td></td>
</tr>
<tr>
<td>Khoo 2007&lt;sup&gt;22&lt;/sup&gt;</td>
<td>9</td>
<td>35</td>
<td>0.56 [0.29, 1.10]</td>
<td></td>
</tr>
<tr>
<td>Muller 2009&lt;sup&gt;3&lt;/sup&gt;</td>
<td>16</td>
<td>76</td>
<td>0.43 [0.26, 0.70]</td>
<td></td>
</tr>
<tr>
<td>Serclova 2009&lt;sup&gt;4&lt;/sup&gt;</td>
<td>11</td>
<td>51</td>
<td>0.45 [0.25, 0.81]</td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>226</strong></td>
<td><strong>226</strong></td>
<td><strong>0.53 [0.41, 0.69]</strong></td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>56</td>
<td>108</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.00; \text{Chi}^2 = 2.26, df = 5 (P = 0.81); I^2 = 0%$

Test for overall effect: $Z = 4.81 (P < 0.00001)$

**Experimental group= Enhanced Recovery After Surgery (ERAS)**

**Control = Traditional Care (TC)**
Readmissions (days)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>ERAS Events</th>
<th>Total Events</th>
<th>TC Events</th>
<th>Total Events</th>
<th>Weight</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson 2003&lt;sup&gt;19&lt;/sup&gt;</td>
<td>0</td>
<td>14</td>
<td>0</td>
<td>11</td>
<td>41.9%</td>
<td>Not estimable</td>
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</tr>
<tr>
<td>Delaney 2003&lt;sup&gt;20&lt;/sup&gt;</td>
<td>3</td>
<td>31</td>
<td>6</td>
<td>33</td>
<td>0.53</td>
<td>[0.15, 1.95]</td>
<td></td>
</tr>
<tr>
<td>Gatt 2005&lt;sup&gt;21&lt;/sup&gt;</td>
<td>1</td>
<td>19</td>
<td>4</td>
<td>20</td>
<td>0.26</td>
<td>[0.03, 2.15]</td>
<td></td>
</tr>
<tr>
<td>Khoo 2007&lt;sup&gt;22&lt;/sup&gt;</td>
<td>3</td>
<td>35</td>
<td>1</td>
<td>35</td>
<td>3.00</td>
<td>[0.33, 27.46]</td>
<td></td>
</tr>
<tr>
<td>Muller 2009&lt;sup&gt;3&lt;/sup&gt;</td>
<td>3</td>
<td>76</td>
<td>2</td>
<td>75</td>
<td>1.48</td>
<td>[0.25, 8.61]</td>
<td></td>
</tr>
<tr>
<td>Serclova 2009&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0</td>
<td>51</td>
<td>0</td>
<td>52</td>
<td>Not estimable</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>226</strong></td>
<td><strong>226</strong></td>
<td><strong>100.0%</strong></td>
<td></td>
<td><strong>0.80</strong></td>
<td><strong>[0.32, 1.98]</strong></td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>10</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.08; Chi² = 3.29, df = 3 (P = 0.35); I² = 9%
Test for overall effect: Z = 0.49 (P = 0.62)

---

**Experimental group= Enhanced Recovery After Surgery (ERAS)**
**Control = Traditional Care (TC)**
Mortality

Experimental group = Enhanced Recovery After Surgery (ERAS)
Control = Traditional Care (TC)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>ERAS Events</th>
<th>ERAS Total</th>
<th>TC Events</th>
<th>TC Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson 2003</td>
<td>0</td>
<td>14</td>
<td>1</td>
<td>11</td>
<td>32.8%</td>
<td>0.27 [0.01, 5.97]</td>
<td>Not estimable</td>
</tr>
<tr>
<td>Delaney 2003</td>
<td>0</td>
<td>31</td>
<td>0</td>
<td>33</td>
<td></td>
<td>Not estimable</td>
<td></td>
</tr>
<tr>
<td>Gatt 2005</td>
<td>1</td>
<td>19</td>
<td>0</td>
<td>20</td>
<td>32.1%</td>
<td>3.15 [0.14, 72.88]</td>
<td></td>
</tr>
<tr>
<td>Khoo 2007</td>
<td>0</td>
<td>35</td>
<td>2</td>
<td>37</td>
<td>35.2%</td>
<td>0.20 [0.01, 4.02]</td>
<td></td>
</tr>
<tr>
<td>Muller 2009</td>
<td>0</td>
<td>76</td>
<td>0</td>
<td>75</td>
<td></td>
<td>Not estimable</td>
<td></td>
</tr>
<tr>
<td>Serclova 2009</td>
<td>0</td>
<td>51</td>
<td>0</td>
<td>52</td>
<td></td>
<td>Not estimable</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>226</td>
<td></td>
<td>226</td>
<td></td>
<td>100.0%</td>
<td>0.53 [0.09, 3.15]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>1</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Tau² = 0.00; Chi² = 1.83, df = 2 (P = 0.40); I² = 0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 0.69 (P = 0.49)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Results

### Table 5. Selected Results From Studies of ERAS Protocols

<table>
<thead>
<tr>
<th>Surgical Procedure</th>
<th>Patients, n</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorectal surgery*</td>
<td>452</td>
<td>Decreased hospital LOS (2.5 d less; 95% CI, −1.85 to −3.34)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decreased risk for complications (RR, 0.53; 95% CI, 0.44 to 0.64)</td>
</tr>
<tr>
<td>Colorectal resections*</td>
<td>376</td>
<td>Reduced total and primary hospital LOS (~3.64 and ~3.76 d, respectively; P&lt;0.001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decreased rates of morbidity and readmission</td>
</tr>
<tr>
<td>Colorectal surgery*</td>
<td>237</td>
<td>Decreased hospital LOS (median, −2.94 d; 95% CI, −3.69 to −2.10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced risk for complications (RR, 0.50; 95% CI, 0.35 to 0.71; P&lt;0.0001)</td>
</tr>
<tr>
<td>Colorectal surgery</td>
<td>142</td>
<td>Reduced hospital LOS (5 vs 7 d; P&lt;0.0001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fewer urinary tract infections (13% vs 24%; P=0.03)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower readmission rates (9.8% vs 20.2%; P=0.02)</td>
</tr>
<tr>
<td>Hip arthroplasty</td>
<td>1,476 (1,751 cases)</td>
<td>52% decrease in hospital LOS (P&lt;0.0001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced risk for admission (CR, 0.36; 95% CI, 0.14 to 0.93; P=0.04)</td>
</tr>
<tr>
<td>Knee arthroplasty</td>
<td>252</td>
<td>Hospital LOS reduced from 76.6 to 56.1 h (P&lt;0.001)</td>
</tr>
<tr>
<td>Laparoscopic sleeve</td>
<td>78</td>
<td>Decreased hospital LOS (1 vs 2 d; P&lt;0.001)</td>
</tr>
<tr>
<td>gastrectomy</td>
<td></td>
<td>Decreased cost (P=0.01)</td>
</tr>
<tr>
<td>Multilevel spine surgery*</td>
<td>41</td>
<td>Reduced opioid consumption, postoperative days 1 and 2 (P=0.024 and 0.048, respectively)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earlier mobilization and ambulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced nausea, sedation, and dizziness</td>
</tr>
</tbody>
</table>

* Systematic review and meta-analysis.
* Multimodal pain treatment, PONV protocol.

ERAS, enhanced recovery after surgery; LOS, length of stay; OR, odds ratio; PONV, postoperative nausea and vomiting; RR, relative risk

Adapted from references: 26 and 43-54.
Implementing an Enhanced Recovery Pathway

- Multidisciplinary team approach\textsuperscript{1-4}
  - Surgeons
  - Anesthesiologists
  - Nurses
  - Physical therapists
  - Dieticians
  - Patients

- Physician champions are needed to lead initiatives and provide education\textsuperscript{2}

- Evidence-based literature can support elements used in enhanced recovery pathways\textsuperscript{2}

- Consider developing enhanced recovery pathways that include preoperative, intraoperative, and postoperative components\textsuperscript{4,5}

Measuring the Impact of an Enhanced Recovery Pathway

- Measuring, evaluating, and disseminating results are important to the success of an enhanced recovery pathway\textsuperscript{1-3}

Example from an enhanced recovery pathway implemented in a healthcare system of 8 community hospitals:\textsuperscript{1}

- Enhanced recovery pathway performance metrics could include\textsuperscript{1}
  - Patient demographics
  - Severity of illness
  - Clinical outcomes
  - Length of stay

- Web-based dashboard with up-to-date data\textsuperscript{1}
  - Automated updates

Website
Can we do this at SCMC?

• Barriers
• Cost
• Physicians
• Admin
We Can Do IT

• ERAS website

• ERAS Society help

Well Rounded Team
Questions?