Enhanced Recovery Pathways: 23 hour laparoscopic colectomy

Conor P. Delaney  MD  MCh  PhD
Chairman, Digestive Disease Institute
Professor of Surgery
Cleveland Clinic, Cleveland, Ohio

Operational Efficiency in Colon Surgery

Disclosure Slide
Conor Delaney MD PhD
Ethicon  Licensed patent - 2013
Socrates Analytics  Founder / Ownership / IP
Simbionix  Royalty – 2014
Covidien  Consultant – 2014
Surgisense  Consultant - 2014

Editorial Boards:
Dis Colon Rectum; World J Surg
Colorectal Disease; Polish J Surgery
World J Gastroenterol; Amer J Surgery
Operational Efficiency in Colon Surgery

Healthcare issues

• Reduced resources
  • fewer hospital beds
  • decreased staffing

• Financial
  • reduced reimbursement
  • increasing costs
  • modified reimbursement codes

• Training concerns

Cleveland Clinic
Clinical and Financial Significance

- HCFA data (Medicare): 1999-2000
  - 161,000 major intestinal / CR resections
  - mean post-op stay = 11.3 days
  - 1.8 million hospital bed-days
  - $1.75 billion per annum
Operational Efficiency in Colon Surgery

**Improvement & Reliability**

- Shift the mean
- Reduce variation

---

**International Hospital Stay**

<table>
<thead>
<tr>
<th></th>
<th>Mean stay in days</th>
</tr>
</thead>
<tbody>
<tr>
<td>In hospital</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>21</td>
</tr>
<tr>
<td>US</td>
<td>7.8</td>
</tr>
<tr>
<td>UK</td>
<td>12.8</td>
</tr>
<tr>
<td>France</td>
<td>16.5</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td></td>
</tr>
<tr>
<td>Post surgery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td>10.7</td>
</tr>
<tr>
<td></td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>13.2</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td></td>
</tr>
</tbody>
</table>


Figure 6. Mean length of hospital stay.

What causes variability?

- Practice profile / case mix
- Patient factors
- National culture
- Operating facility
- Equipment availability
- Team-work: residents, nurses, ancillary staff
- Perioperative care plan
- Surgical quality & technique

MOST CONTROL
Operational Efficiency in Colon Surgery

Hospital Discharge Associated With Recovery of GI Function

GI-2 = Recovery of bowel movement and toleration of solid food.


Readmission and Prolongation of Hospital Stay

POI = Postoperative ileus; SAE = Serious adverse event; EPSBO = Early postoperative small bowel obstruction.

**Operational Efficiency in Colon Surgery**

**Clinical pathway for planned 48hr stay**

- 60 patients
- colonic (not rectal) resection
- multimodal pathway:
  - transverse and oblique incisions
  - epidural
  - cathartic
  - prokinetic
- median stay 2 days (mean = 4.1)
- 9 readmissions (15%)

*Basse et al, Ann Surg 2000*

---

**Operational Efficiency in Colon Surgery**

‘Fast track’ postoperative management protocol for patients with high co-morbidity undergoing complex abdominal and pelvic colorectal surgery

Department of Colorectal Surgery/A-111, Cleveland Clinic Foundation, 9500 Euclid Avenue, Cleveland, Ohio 44195, USA

*Correspondence to Dr C. P. Delaney (e-mail: delaney@ccf.org)*

**Background:** A combination of factors has emphasized the need to reduce postoperative stay after surgery. Multimodal care plans may shorten hospital stay, but have been associated with high readmission rates and are generally reserved for straightforward, non-complicated colonic (not rectal) resections. This study evaluated a ‘fast track’ protocol in patients undergoing major colon and rectal...

*Delaney CP, Br J Surg, 2001*
Cleveland Clinic

**CREAD protocol**

- 44.4 ± 13.5 years; 46 male
- IBD = 28; CRCA = 13;
- ECF = 4; Other = 3

- 35 pelvic surgery
- previous major laparotomies in 34

- Mean hospital stay 4.3 ± 1.6 days
- Readmission 7%
- Complications 21%

*Delaney et al, Br J Surg, 2001*

---

**Colon resection**

<table>
<thead>
<tr>
<th>Post-operative pathway</th>
<th>n</th>
<th>LOS (d)</th>
<th>Reduction of stay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional care</td>
<td>273</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>Fast track care</td>
<td>106</td>
<td>4.7 †</td>
<td>39%</td>
</tr>
</tbody>
</table>

† *p*<0.001; *p*<0.0001

*Delaney, Senagore et al, Br J Surg, 2001*
### RCT: Fast track vs. Traditional care

<table>
<thead>
<tr>
<th></th>
<th>Fast track (n=32)</th>
<th>Traditional (n=33)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS under 70’s</td>
<td>4.7</td>
<td>5.8</td>
<td>0.01</td>
</tr>
<tr>
<td>LOS ‘Fast track’ surgeons</td>
<td>3.8</td>
<td>5.0</td>
<td>0.001</td>
</tr>
<tr>
<td>Pain score on D/C</td>
<td>3.1</td>
<td>3.1</td>
<td>0.79</td>
</tr>
<tr>
<td>Satisfaction with stay</td>
<td>8.1</td>
<td>8.2</td>
<td>0.81</td>
</tr>
<tr>
<td>Readmissions</td>
<td>3</td>
<td>6</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Delaney, et al, DCR 2003

**LOS = length of stay**

### CREAD Epidural vs PCA

<table>
<thead>
<tr>
<th></th>
<th>PCA</th>
<th>Epidural</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS</td>
<td>5.0 (4.0-8.5)</td>
<td>5.0 (4.0-7.0)</td>
<td>0.94</td>
</tr>
<tr>
<td>Age</td>
<td>47</td>
<td>44</td>
<td>0.52</td>
</tr>
<tr>
<td>Pain score at 48h</td>
<td>3.3</td>
<td>2.5</td>
<td>0.01</td>
</tr>
<tr>
<td>Pain score on D/C</td>
<td>3.1 ± 2.0</td>
<td>3.1 ± 2.4</td>
<td>0.79</td>
</tr>
<tr>
<td>Pain score (all others)</td>
<td>identical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs ($)</td>
<td>4586</td>
<td>3808</td>
<td>0.14</td>
</tr>
</tbody>
</table>


**LOS = length of stay in days**
Post-operative care pathways

Fast-track for ileal pouches

<table>
<thead>
<tr>
<th></th>
<th>CREAD (n=97)</th>
<th>Trad (n=97)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median stay</td>
<td>4</td>
<td>5</td>
<td>0.01</td>
</tr>
<tr>
<td>Mean stay</td>
<td>5.0</td>
<td>5.9</td>
<td>0.01</td>
</tr>
<tr>
<td>Readmission</td>
<td>24</td>
<td>20</td>
<td>0.49</td>
</tr>
<tr>
<td>Reoperation</td>
<td>9</td>
<td>10</td>
<td>0.80</td>
</tr>
<tr>
<td>Mean direct cost ($)</td>
<td>5690</td>
<td>6670</td>
<td>0.001</td>
</tr>
<tr>
<td>Complications</td>
<td>similar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Kariv, Delaney et al, DCR 2007

Operational Efficiency in Colon Surgery

Accelerated rehabilitation vs conventional care for segmental colectomy

<table>
<thead>
<tr>
<th></th>
<th>Hospital 1</th>
<th>Hospital 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Care path</td>
<td>Conventional</td>
<td>Multimodal</td>
</tr>
<tr>
<td>• Consecutive pts</td>
<td>130</td>
<td>130</td>
</tr>
<tr>
<td>• Accrual period</td>
<td>3 yr</td>
<td>3yr (approx)</td>
</tr>
<tr>
<td>• Defecation (d)</td>
<td>4.5</td>
<td>2 *</td>
</tr>
<tr>
<td>• Median LOS (d)</td>
<td>8</td>
<td>2 *</td>
</tr>
<tr>
<td>• Mean LOS (d)</td>
<td>10.0</td>
<td>3.3 *</td>
</tr>
<tr>
<td>• Complications</td>
<td>45%</td>
<td>25% *</td>
</tr>
<tr>
<td>• Anastomotic leak</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>• Readmission (%)</td>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

* P <0.05
Basse et al, DCR 2004
Unplanned readmission (UR)

- 553 resections in 6 months; 56 UR (10%)
- UR had more periop. steroids (32 vs 17%, p=0.03)
- No other association (complications, WBC, Hb, antibiotics, co-morbidity, fever, urgency, stoma, length of stay)
- Readmitted cases had a longer primary LOS (6 vs 5 days, p=0.04)
- No adverse event related to delayed diagnosis

Conclusion: UR is unpredictable, not related to LOS, doesn’t affect overall outcome

Kiran, Delaney, Senagore et al, JACS 2004

Meta-analysis of Readmissions

Eskicioglu et al, J GI Surg, 2009
Operational Efficiency in Colon Surgery

Enhanced recovery pathways optimize health outcomes and resource utilization: A meta-analysis of randomized controlled trials in colorectal surgery

Michel Adaminia, MD, PD, MSc,† Henrik Kehlet, MD, PhD,† George A. Tomlinson,§ Anthony J. Senagore, MD, MS, MBA,* and Conor P. Delaney, MD, MCh, PhD,* Cleveland, Oh, St. Gallen, Switzerland, Copenhagen, Denmark, Toronto, Ontario, Canada, and Grand Rapids, Mich

Operational Efficiency in Colon Surgery

Adherence to Surgical Care Improvement Project Measures and the Association With Postoperative Infections

The Surgical Care Improvement Project (SCIP) aims to reduce serious complications through measurement and reporting of 6 in prevention process-of-care measures. However, an association between SCIP adherence and clinical outcomes has not been demonstrated.

Context: The SCIP aims to reduce serious complications through measurement and reporting of 6 process-of-care measures. However, an association between SCIP adherence and clinical outcomes has not been demonstrated.

Objective: To examine the relationship between SCP infection-prevention of-care measures and postoperative infection rates.

Design, Setting, Participants: A retrospective cohort study, using Pren Perspective Database for discharges between July 1, 2006 and March 31, 2007, 405,720 patients (69% white and 11% black; 46% Medicare patients; 46% surgical cases from 382 hospitals in the United States for whom SCIP...
Operational Efficiency in Colon Surgery

Fast-track protocol – PRE-op

General:

- Pre-operative optimization
- Pre-operative information
- Frailty assessment
- Assessment of home support
- Pre-operative ostomy teaching and support

Operational Efficiency in Colon Surgery

Pre-operative information

Cleveland Clinic; Feb 2000
Operational Efficiency in Colon Surgery

**Modified Frailty Score**

- 852 colon resections
- 2009-12

- Strong correlation between MFI and hospital stay
  - MFI of 0 – correlated with 0-3 day stay
  - MFI of 2 – correlated with >3 day stay

Keller et al, DCR 2014

---

**Alvimopan: Hospital Resource Use (Phase III Pooled Data)**

<table>
<thead>
<tr>
<th></th>
<th>Placebo</th>
<th>Alvimopan 6 mg</th>
<th>Alvimopan 12 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prolonged hospital stay</td>
<td>13.7</td>
<td>8.6</td>
<td>7.0</td>
</tr>
<tr>
<td>Readmission</td>
<td>11.7</td>
<td>7.3</td>
<td>7.7</td>
</tr>
<tr>
<td>DCO written ≥7 days</td>
<td>38.1</td>
<td>24.4</td>
<td>19.9</td>
</tr>
</tbody>
</table>

*P=0.024; †P<0.001; ‡P=0.040; ¶P=0.059.

Alvimopan and Laparoscopic Colectomy

- 3525 ITT exact matched Premier patients
- Morbidity reduced (pulmonary, GI, IUC, thromboembolic, infectious, mortality) p<0.003
- Hospital stay reduced by 0.8 days
- Cost reduced by $1380


- 100 case matched with optimized ERP
- 3.6 vs 3.7 days hospital stay
- 2% vs 3% readmission rate

Obokhare et al, DCR, 2011

Standardized operative technique

- Vascular division
- Splenic flexure
- Mesorectal dissection
- Perineal dissection
- Rectal transection
- Anastomosis

Delaney, Neary, Heriot, Senagore 2005
Lindsetmo, J GI Surg 2009
Intra-operative ERP

- avoidance of epidurals
  - (except opioid dependent patients)
- oro-gastric tubes
- PONV and analgesia pre-treatment
- laparoscopy and counter-incision
- fluid restriction or GDFT??
- nerve blocks
- minimize drain use

Post-operative ERP

- oral tylenol
- PCA overnight
- oral analgesia day 1
- liquids *ad lib* in PACU / floor
- diet next day, chewing gum
- ambulation, sitting out
- reduce iv fluids
- standardized discharge orders
Operational Efficiency in Colon Surgery

Colon resection

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>LOS (d)</th>
<th>Reduction LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional care</td>
<td>273</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>Fast track care</td>
<td>106</td>
<td>4.7 †</td>
<td>39%</td>
</tr>
<tr>
<td>Laparoscopic care</td>
<td>42</td>
<td>2.9 *</td>
<td>60%</td>
</tr>
</tbody>
</table>

Post-operative pathway:

† p<0.001; * p<0.0001


Operational Efficiency in Colon Surgery

Laparoscopic rectal resection with a postoperative care pathway

- 37 patients: 21 for neoplasia; 16 inflammatory
- Two conversions (5% - males, narrow pelvis)
- Op time 184 (120 – 410)
- CRM all negative
- TME 92% intact
- Mean lymph nodes = 18
- Mean LOS 3.0 days
- Mortality 0%; leak rate 0%

Operational Efficiency in Colon Surgery

Comparison of 1000 Lx colon series

<table>
<thead>
<tr>
<th></th>
<th>1999-2005‡</th>
<th>2005-2011 §</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>28.3</td>
<td>29.5</td>
</tr>
<tr>
<td>Cancer</td>
<td>28</td>
<td>41</td>
</tr>
<tr>
<td>Proctectomies</td>
<td>&lt;10</td>
<td>18.9</td>
</tr>
<tr>
<td>Total and IPAA</td>
<td>7.5</td>
<td>10.7</td>
</tr>
<tr>
<td>OR time</td>
<td>121</td>
<td>151</td>
</tr>
<tr>
<td>Conversion</td>
<td>11</td>
<td>5.8</td>
</tr>
<tr>
<td>Mean hospital stay</td>
<td>3.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Readmission</td>
<td>9.1</td>
<td>6.0</td>
</tr>
</tbody>
</table>

§ Senagore and Delaney, Am J Surg 2006

SILS vs Laparoscopic colectomy

• 150 Laparoscopic, 150 SILS
• Case matched
• Four experienced centers
• Operative times: 135 vs 133 minutes
• Hospital stay: 4.3 vs 4.6 days
• Conversion to Lx: 11%
• Complications and other endpoints similar

Lx Colectomy: RCT epidural vs. PCA

- 21 patients per group
- Thoracic epidural vs PCA
- Identical carepath

- Hospital stay 2.3 vs 2.4 days
- Nausea / vomiting 28% both groups
- No NG tubes required

Senagore, Delaney et al, BJS 2003

---

2006 - Next day colectomy discharge?

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Day 1-2</th>
<th>Day 3</th>
<th>Day 4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Op time</td>
<td>142 +/- 58</td>
<td>134 ± 53*</td>
<td>138 ± 58</td>
<td>161 ± 55</td>
</tr>
<tr>
<td>Mean LOS</td>
<td>3.7 +/- 3.7</td>
<td>1.8 ± 0.4 †</td>
<td>3.0 ± 0</td>
<td>7.2 ± 5.2</td>
</tr>
<tr>
<td>Median LOS</td>
<td>3.0</td>
<td>2.0</td>
<td>3.0</td>
<td>5.0</td>
</tr>
<tr>
<td>SNF</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Home care</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

* p=0.04 vs D4+ only
† p<0.001 vs D3; D4+; and All

Delaney, Dis Colon Rectum, 2008
### 2006 - Next day colectomy discharge?

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Day 1-2</th>
<th>Day 3</th>
<th>Day 4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any complns</td>
<td>20</td>
<td>7 §</td>
<td>15</td>
<td>44</td>
</tr>
<tr>
<td>Ileus / SBO</td>
<td>11</td>
<td>4 ¶</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Serious compls</td>
<td>2.5</td>
<td>0 ‡</td>
<td>0</td>
<td>8.3</td>
</tr>
<tr>
<td>Readmissions</td>
<td>8.5</td>
<td>5.4</td>
<td>7.7</td>
<td>13.9</td>
</tr>
</tbody>
</table>

§ p<0.0001 vs D4+; 0.028 vs All
¶ p=0.001 vs D4+
‡ p=0.06 vs D4+

Delaney, Dis Colon Rectum, 2008

### Marcaine and Laparoscopic colectomy

- Case-matched cohort analysis
- No local = 66
- Wound marcaine = 67
- Wound and IP = 44
- Same pain scores: PACU, 3, 6, 9 and 12 hours
- Same analgesic use: POD 0 and POD 1
- Same PACU time, and hospital stay

Stuldreher et al, Surg Endosc 2011
**Acetaminophen and TAP Block Optimize ERP for Laparoscopy**

<table>
<thead>
<tr>
<th></th>
<th>ERP</th>
<th>ATAP + ERP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hospital stay</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- mean</td>
<td>3.2</td>
<td>2.1</td>
</tr>
<tr>
<td>- median</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Day #1 discharge</strong></td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td><strong>Day #2 discharge</strong></td>
<td>19</td>
<td>33</td>
</tr>
<tr>
<td><strong>Day #3 discharge</strong></td>
<td>41</td>
<td>26</td>
</tr>
</tbody>
</table>

*Favuzza et al, DCR 2013*

*Favuzza et al, Surg Endosc 2013*

*p=0.0003*
Randomized controlled trial: TAP vs no TAP

<table>
<thead>
<tr>
<th></th>
<th>TAP</th>
<th>No TAP</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>41</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>PACU pain score</td>
<td>2.1</td>
<td>3.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PACU opioid use</td>
<td>1.8</td>
<td>0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total stay pain score</td>
<td>2.6</td>
<td>3.5</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Total stay opioid use</td>
<td>1.8</td>
<td>2.0</td>
<td>0.7</td>
</tr>
<tr>
<td>LOS</td>
<td>2.9</td>
<td>3.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Readmission</td>
<td>5%</td>
<td>7%</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Keller et al, DCR 2014

Safe Early Discharge at 24-48 hours after Colorectal Resection

- 2736 consecutive cases
- 5 surgeons
- 360 cases (13.2%) discharged by POD #2
- Mortality 0.3%

<table>
<thead>
<tr>
<th></th>
<th>POD&lt;=2</th>
<th>POD&gt;=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 day readmission %</td>
<td>3.3</td>
<td>9.4</td>
</tr>
<tr>
<td>30 day complications %</td>
<td>4.4</td>
<td>25.9</td>
</tr>
</tbody>
</table>

Keller et al, JACS 2013
Efficient collection of data:
HARM score
(Hospital stAy, Readmission, Mortality)

- 81,000 cases
- Premier
- Pearson coefficient
  0.45
  (p<0.001)

Areas for study

- Post-operative QOL and function
- Prehabilitation and rehabilitation
- Regional blocks and long-acting agents
- Rescue therapy for POI
- Fluid optimization
- Tailored analgesia profile
Operational Efficiency in Colon Surgery

Keller et al, Surgery 2013

Areas for study

• Post-operative QOL

• Regional blocks and long-acting agents

• Rescue therapy for POI

• Fluid optimization / hypotension avoidance

• Tailored analgesia profile
Operational Efficiency in Colon Surgery

Tailored analgesia

Conclusions

- Enhanced recovery pathways are around for 15 years and are effective
- Opportunity depends on your baseline and how little you have used ERP before
- Monitor LOS and readmission rates
- Aspire to 50% discharge on POD#1 for non-ostomy colorectal surgery

Crawshaw et al, Am J Surg In press