Akron Children’s Hospital
Adolescent Idiopathic Scoliosis
Spinal Fusion Pathway

Todd Ritzman, MD
Director, Spine Institute
Akron Children's Hospital
AIS Pathway Overview

- Background
- Process
- Literature / evidence overview
- Pathway
- EMR order sets
- Compliance
- Outcomes
- Future
Historical ACH Scoliosis Care

- Heterogenous / inconsistent preoperative
- Heterogenous intraoperative
- Heterogenous analgesic regiment
- Mandatory PICU
- 24 hours bedrest – delayed mobilization
- Overnight NG tube – delayed PO initiation
- Heterogenous nursing unit
- PRN consultant utilization - reactive
Significant cooperation on behalf of all involved healthcare workers will be necessary to ensure that quality of care does not suffer while efforts for cost containment continue.
Pathway Development Process

• Multidisciplinary:
  – Surgeons, Anesthesia, Hospitalist, PT/OT, Case Management, OR staff, Pre-surg/PACU, Floor Nursing

• Evidence based / Best practice model
  – Subspecialty assigned literature review

• Group Consensus

• Pathway Review / Revisions

• Order Set build

• Education / roll out
Pediatric Intensive Care Unit Stay costly and unnecessary

- Shorter hospital stay, fewer blood tests, less analgesic / antianxiety meds, 16% reduction in cost
Pediatric Intensive Care Unit Stay costly and unnecessary

- RNF management safe in healthy AIS patients
- ICU should be considered in Neuromuscular Scoliosis patients & High Risk patients
Team Approach

- Core spine team = Quality & Safety

Reduced:
- SSI
- OR time
- Transfusion
- LOS
Heterogenous RNF / Nursing Care

2015 Average Daily Census by Patient Unit (Neuro, Ortho, Plastics)

Pathway = Standardization of care on one RNF (7100)
Feasibility of expedited postoperative pathway

- Pathway expedited d/c for AIS by 1/3
- No increase in complication rate
- Cost savings
Feasibility of expedited postoperative pathway

- Hospital stay 50% decreased with Accelerated Pathway
- Coordinated postoperative pathway
- No increase in post op complications
Benefit of PROACTIVE rather than REACTIVE consultation

- High rate of pre-op recommendations not recognized by orthopedic surgeon
  – (72% patients)
Hospitalist pre- and periop management of complex patients

Decreased LOS from 6.5 to 4.8 days

Benefit of PROACTIVE rather than REACTIVE consultation
Benefit of PROACTIVE rather than REACTIVE consultation

- Routine co-management all pediatric PSF patients
- LOS decreased 1 day
Adolescent Idiopathic Scoliosis Surgical Pathway

Pain Service Adolescent Idiopathic Scoliosis Perioperative Surgical Home

High Risk Neuromuscular Scoliosis Surgical Pathway
ORT IP Idiopathic Scoliosis Surgical Pre-op A

- **Case Request**
  - Location: A4N OR
  - Anesthesia Type: General

- **Pre-op Order Set**
  - Referral to Pediatric Hospital Medicine
  - Referral to Child Life
  - Physical Therapy: Specialty Services Required

- **Other Orders**
  - Verify informed consent
    - Routine, Ortho, IME, First occurrence today at 11:20, Pre-op, Sign & Hold

- **Pre-op**
  - Complain Blood Count
    - Expression: 1/19/2022, Routine, Lab, Collect, 2 mL, Minimum: 0.5 mL, Blood in a purple top (EDTA) tube.
  - Blood Metabolic Panel
    - Expression: 1/19/2022, Routine, Lab, Collect, 1 mL, Minimum: 1 mL, Blood in a green top (heparin) tube.
  - Prothrombin Time & Activated PT
    - Expression: 1/19/2022, Routine, Lab, Collect, 2 mL, Minimum: 1 mL, Blood in a black top (sodium citrate) tube.
  - Type & Screen
    - Expression: 1/19/2022, Routine, Lab, Collect, 2 mL, Minimum: 1 mL, Blood in a black top (sodium citrate) tube.

- **Medications**
  - Vancomycin is dosed intrasoperatively with bone graft substitute.

- **Additional Orders**
Epic

• AIS Post-op Order Set

**EPT IP Adolescent Idiopathic Scoliosis Surgical Pathway Post-OP Orders**

**PACU Orders**

- **Approach**
  - Open Approach
  - Minimally Invasive Approach
  - Tension-free Approach
  - Illesiive Approach

- **Nursing**
  - Initial Assessment
  - Pain Management
  - Wound Care
  - Oxygen Therapy
  - Vascular Access
  - IV Fluids
  - Diabetic Management
  - Nutrition
  - Medications
  - Catheter Care

- **Surgical**
  - Operating Room
  - Anesthesia
  - Ophthalmology
  - Ear, Nose, and Throat
  - Orthopedic Surgery
  - Gastroenterology
  - General Surgery
  - Plastic Surgery
  - Cardiothoracic Surgery
  - Vascular Surgery
  - Urology
  - Gynecology
  - Neurosurgery

- **Respiratory**
  - Respiratory Assessment
  - Respiratory Therapy

- **Pharmacy**
  - Medications
  - IV Fluids

**Laboratory**

- Blood Work
- Urinalysis
- Serum Calcium
- Serum Phosphorus
- Serum Magnesium
- Serum Sodium
- Serum Potassium

**Radiology**

- Chest X-ray
- Abdominal X-ray
- CT Scan
- MRI Scan
- Ultrasound

**Additional Orders**

- Pain Management
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### Day of Surgery

- **Pain**
  - Acetaminophen (ORIFMEV) IV 15 mg/kg/Dose, Intravenous EVERY 6 HOURS EXACT, Starting H-4 Hours, Alternate with ketorolac dosing schedule to be 4 hours apart.
  - Ketasol (TORADOL) IV 0.2 mg/kg/Dose, Intravenous, EVERY 8 HOURS for 4 doses, Alternate with acetaminophen dosing schedule to be every 4 hours apart.
  - Diazepam (VALUM) 5 mg/IV 0.2 mg/kg/Dose, Intravenous, EVERY 6 HOURS PRN
  - Gabapentin Order Panel

- **Nausea**
  -ondansetron (ZOFAN) injection 0.1 mg/kg/DOSE, EVERY 8 HOURS for 3 doses

- **Breakthrough Nausea**
  - Indicate the preferred administration sequence if multiple PRN medications are ordered for the same PRN reason.

- **Breakthrough Pruritus**
  - Diphenhydramine (Benadryl) injection 0.3 mg/kg/DOSE, Intravenous, EVERY 6 HOURS PRN, Third Line Nausea

- **Post-Op Days 1-4**

  1. **Pain**
     - Acetaminophen (TYLENOL) suspension 160 mg/kg/DOSE, Oral, EVERY 6 HOURS
     - Acetaminophen (TYLENOL) tablet 0.25 mg/kg/DOSE, Oral, EVERY 6 HOURS
     - Ibuprofen (ADVIL, MOTRIN) 100 mg/ML suspension Oral
     - Ibuprofen (MOTRIN) tablet Oral
     - Diazepam (VALUM) 1 mg/ML solution 0.07 mg/kg/Dose, Oral, EVERY 6 HOURS PRN
     - Diazepam (VALUM) tablet Oral, EVERY 6 HOURS PRN
     - oxycodone (immediate release) (ROXICODONE) solution Oral
     - oxycodone (immediate release) (ROXICODONE) tablet

  2. **Nausea**
     -ondansetron (ZOFAN) injection 0.1 mg/kg/DOSE, EVERY 8 HOURS PRN, First Line Nausea

  3. **Breakthrough Nausea**
     - Indicate the preferred administration sequence if multiple PRN medications are ordered for the same PRN reason.

### Breakthrough Pruritus
- Diphenhydramine (Benadryl) injection 0.3 mg/kg/DOSE, Intravenous, EVERY 6 HOURS PRN

### Clinical Decision Support

#### Pain Service Adolescent Idiopathic Scoliosis Perioperative Surgical Home Pathway

**Post-operative Phase:**

### Day of Surgery:

- **Breakthrough Pruritus**
  - Diphenhydramine (Benadryl) injection 0.3 mg/kg/DOSE, Intravenous, EVERY 6 HOURS PRN

- **Clinical Decision Support**
  - Pain Service Adolescent Idiopathic Scoliosis Perioperative Surgical Home Pathway

### Additional Orders

- **Breakthrough Pruritus**
  - Diphenhydramine (Benadryl) injection 0.3 mg/kg/DOSE, Intravenous, EVERY 6 HOURS PRN

- **Breakthrough Nausea**
  - Indicate the preferred administration sequence if multiple PRN medications are ordered for the same PRN reason.

- **Breakthrough Nausea**
  - Indicate the preferred administration sequence if multiple PRN medications are ordered for the same PRN reason.

- **Additional Orders**
  - Add all medications PRN and administration route PO
Taleo Nursing Education
PACU Nursing Education

AIS PACU Pathway Criteria and Education
11_17_2016

Beginning January 1, 2017 the AIS PACU to Floor Pathway Phase will begin. The objective is to ensure all AIS pathway patients meet criteria for transfer from PACU to FLOOR and the accepting HOSPITALIST SERVICE is up to date on patient condition through direct communication.

OR TO PACU:
OR nurse will notify PACU and HOSPITALIST team during skin closure to expect multidisciplinary sign-out in PACU within the next half hour.

Upon arrival to PACU a multidisciplinary operative phase sign-out will occur:
- Orthopedics (attending and resident)
- Anesthesiology (attending and CRNA)
- PACU nursing (bedside nurse)
- Hospitalist team (attending and/or NP)

PACU Care (3 hour total PACU stay under phase 1 nursing care):
The anesthesiology team will be responsible for managing the patient in PACU per routine. Any unexpected or unexplained clinical events should be discussed amongst the anesthesiologist and attending hospitalist.

If the attending anesthesiologist caring for spinal fusion patient is leaving they will give sign out to another attending that will assume pathway care.

AIS Pathway PACU Transfer Criteria:
2 hours post PACU arrival
PACU nursing assessment and criteria for floor transfer
Hemodynamically Stable
- HR 60-120
- SBP 90-140
- UOP >0.5cc/kg/hr
- NO PRESSOR REQUIREMENT

Respiratory Status Stable
- Follow PCA guidelines
- <3L nasal cannula or FiO2 <0.40

Neurologic Examination Stable
- CBC (prior to x-line discontinuation)
- Hgb >8

Anesthesiologist evaluation to confirm patient clinically appropriate for transfer
- Anesthesiologist EPIC PACU sign-out
- Hospitalist service notified by PACU for consult and evaluation prior to transfer
- Hospitalist attending and/or NP and anesthesiologist meet in PACU for transfer sign-out

3 hours post PACU arrival
7100 RNF transfer

Important Considerations:
- If transfer criteria and/or Hospitalist approval not met, mandatory discussion between ATTENDING SURGEON, ANESTHESIOLOGIST, AND HOSPITALIST should occur—probable PICU admission.

- If patient does not appear to be clinically appropriate, the anesthesiologist can initiate discussion for potential PICU admission at any point in the PACU stay. This should include attending hospitalist and surgeon. It will be surgical team responsibility to call PICU and arrange for bed/transfer and anesthesiologist responsibility to give medical report to PICU attending.

- If out of OR after 3pm ALL AIS PATIENTS WILL GO TO PICU.

- Please provide feedback directly to Dr. Meyer regarding your experiences.
Resident / Fellow Education

- Orientation material
- SharePoint site

<table>
<thead>
<tr>
<th>Tachycardia and/or Hypotension</th>
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</thead>
<tbody>
<tr>
<td>Differential diagnosis:</td>
</tr>
<tr>
<td>- Post-op acute blood loss anemia</td>
</tr>
<tr>
<td>- Post-op vasodilation related to intrathecal morphine</td>
</tr>
<tr>
<td>- Volume related hypovolemia</td>
</tr>
<tr>
<td><strong>Page on-call Orthopedic Resident</strong></td>
</tr>
<tr>
<td>- Anticipate IV fluid bolus order</td>
</tr>
<tr>
<td>- CBCs ordered in PACU POD 0 and AM POD 1</td>
</tr>
<tr>
<td>- PRBC transfusion rare but given when indicated at attending surgeon’s discretion</td>
</tr>
<tr>
<td>Isolated Tachycardia: assuming UOP satisfactory and Hg satisfactory</td>
</tr>
<tr>
<td>- Likely pain / anxiety induced</td>
</tr>
<tr>
<td><strong>Page Pain Service for all analgesia / anxiety concerns</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bradypnea and Hypoxia</th>
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</thead>
<tbody>
<tr>
<td>Differential diagnosis:</td>
</tr>
<tr>
<td>- Respiratory depression from opioids or anxiolytics</td>
</tr>
<tr>
<td><strong>Notify Acute Pain Svc as per PCA protocol</strong></td>
</tr>
<tr>
<td><strong>Page on-call Orthopedic Resident &amp; DRG Hospitalist Service</strong></td>
</tr>
<tr>
<td>- Nursing auscultation of breath sounds</td>
</tr>
<tr>
<td>- Notify resident &amp; hospitalist if diminished / absent</td>
</tr>
<tr>
<td>- Anticipate portable CXR order</td>
</tr>
<tr>
<td>- Apply Oxygen if Sat &lt;92% (&lt;96% if on PCA)</td>
</tr>
<tr>
<td>- Hold analgesia / PCA until Pain Service evaluation / recommendations</td>
</tr>
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<tr>
<th>Nausea / Vomiting</th>
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<tbody>
<tr>
<td>Differential diagnosis:</td>
</tr>
<tr>
<td>- Narcotic induced nausea</td>
</tr>
<tr>
<td>- Post-op ileus</td>
</tr>
<tr>
<td>- Narcotic induced constipation</td>
</tr>
<tr>
<td><strong>See Anesthesia Spinal Pain Pathway</strong></td>
</tr>
<tr>
<td>- Anti-emetic medications prn order on pain pathway order set</td>
</tr>
<tr>
<td>- Stool softener medications on AHS pathway order set</td>
</tr>
<tr>
<td>- Nursing abdominal auscultation and palpation: if hypoactive bowel sounds or tympanic / distended notify DRG hospitalist</td>
</tr>
<tr>
<td>- Anticipate portable KUB order to rule out ileus</td>
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</tbody>
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<tr>
<th>Fevers</th>
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<tr>
<td>Differential diagnosis:</td>
</tr>
<tr>
<td>- Atelectasis (most common cause)</td>
</tr>
<tr>
<td>- UTI (rare)</td>
</tr>
<tr>
<td>- Pneumonia (very rare)</td>
</tr>
<tr>
<td>- Wound Infection / Surgical Site Infection (very rare &lt;5 days post op)</td>
</tr>
<tr>
<td><strong>Document in EPIC Vitals; Ortho and DRG/Hospitalist will assess on am rounds</strong></td>
</tr>
<tr>
<td>- Encourage IS and mobilization</td>
</tr>
<tr>
<td>- Expeditious discontinuation of Foley Catheter</td>
</tr>
<tr>
<td>- POD1 if mobilizing to chair, POD 2 mandatory</td>
</tr>
<tr>
<td>- Tylenol IV or PO standard on pain pathway order set</td>
</tr>
<tr>
<td>- Notify on-call orthopedic resident if T&gt;38.5 after POD 3</td>
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<th>Neurologic change / abnormality</th>
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<td>Differential diagnosis:</td>
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<tr>
<td>- Post operative spinal cord injury / ischemia (exceedingly rare)</td>
</tr>
<tr>
<td>- Post operative epidural hematoma (exceedingly rare)</td>
</tr>
<tr>
<td><strong>Page on-call Orthopedic Resident</strong></td>
</tr>
<tr>
<td>- Nursing motor and sensory neuro exam all extremities as per protocol</td>
</tr>
<tr>
<td>- Establishes baseline familiarity</td>
</tr>
<tr>
<td>- Enables recognition of change</td>
</tr>
<tr>
<td>- Ortho resident must come to bedside; page Ortho attending on call if resident not immediately available</td>
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</table>
# 100% Epic Order Set Compliance

## Spinal Fusion Pathway Compliance Report

<table>
<thead>
<tr>
<th>CSN</th>
<th>Patient Name</th>
<th>Medical Rec</th>
<th>ADT Pat Class</th>
<th>Contact Type</th>
<th>Admit Date</th>
<th>Visit Smart Set Name</th>
<th>Visit Smart Set Id</th>
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<td>22989475</td>
<td>TUCKER, KAYLA MARIE</td>
<td>1367689</td>
<td>Inpatient</td>
<td>HospitalEncounter</td>
<td>1/3/17</td>
<td>ORTP ADOPTEENT IDOPATHIC SCILOISIS SURGICAL PATHWAY POST OP ORDERS</td>
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<td>23007902</td>
<td>MEHTA, JAZMIN</td>
<td>2336220</td>
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Outcome tracking

• NSQIP
  – Cheri Berry tracking ALL spines at ACH
    • Operative times, complications, EBL, etc
    • Unplanned 90 day reoperation
    • Postop 90 day SSI

• Pain Service
  – Shelley Sabastina
    • Pain scores, opioid consumption

• Custom Dashboard
  – Laurie Engler
    • Compliance, Pain scores, narcotic utilization, LOS, PICU transfers, ER or Floor readmission, hospitalization charges

• SRS 22
• Quarterly tracking of above
• 2 year retrospective comparison
Intraoperative Neurologic Monitoring

2017 – 60%

2019 – 100%
Intraoperative Adjuvant Antibiotics

2017 – 78%

2019 – 97%
Intraoperative Antifibrinolytics

2017 – 73%

2019 – 97%
Idiopathic Spinal ICU Utilization

2017 – 96%

2019 – 0%
# Scoliosis Care at Akron Children's Hospital

## Previous Care Plan

<table>
<thead>
<tr>
<th>Pre-op</th>
<th>No Uniformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination</td>
<td>PICU RNF POD#1 5 locations</td>
</tr>
<tr>
<td>Diet</td>
<td>NPO with NG until POD#1</td>
</tr>
<tr>
<td>Activity</td>
<td>Bedrest until POD#1</td>
</tr>
<tr>
<td>Pain Management</td>
<td>IV PCA</td>
</tr>
<tr>
<td>Anticipated LOS</td>
<td>6 days</td>
</tr>
<tr>
<td>PT</td>
<td>Daily POD#2</td>
</tr>
</tbody>
</table>

## 2017 Adolescent Idiopathic Scoliosis Pathway

<table>
<thead>
<tr>
<th>Pre-op</th>
<th>Uniformity Hospitalist / PSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination</td>
<td>RNF 7100 &amp; Hospitalist</td>
</tr>
<tr>
<td>Diet</td>
<td>Immediate CLD &amp; AAT Reg Diet</td>
</tr>
<tr>
<td>Activity</td>
<td>Up at bedside night of surgery</td>
</tr>
<tr>
<td>Pain Management</td>
<td>IT DuraMorph, IV Toradol, Tylenol, Gabapentin, IV PCA, PO ASAP</td>
</tr>
<tr>
<td>Anticipated LOS</td>
<td>3 days</td>
</tr>
<tr>
<td>PT</td>
<td>BID POD#1</td>
</tr>
</tbody>
</table>
Pathway Experience to Date

Hospitalist Co-Management

- **56% Patients identified additional needs**
  - Medication management, additional clearance, additional orders
- PACU signout
- Co-Management post-op
Average LOS for AIS Spinal Fusion Pathway Cases
January 2017 - July 2019

<table>
<thead>
<tr>
<th>Month</th>
<th>Avg. LOS</th>
<th>Median</th>
<th>Goal</th>
</tr>
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<tbody>
<tr>
<td>01/17</td>
<td>3.0</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>02/17</td>
<td>4.0</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td>03/17</td>
<td>3.0</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>04/17</td>
<td>4.0</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td>05/17</td>
<td>4.0</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td>06/17</td>
<td>3.0</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>07/17</td>
<td>3.0</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>08/17</td>
<td>3.0</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>09/17</td>
<td>3.0</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>10/17</td>
<td>3.0</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>11/17</td>
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<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>12/17</td>
<td>3.0</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>01/18</td>
<td>3.4</td>
<td>3.0</td>
<td>4</td>
</tr>
<tr>
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<td>3.0</td>
<td>4</td>
</tr>
<tr>
<td>03/18</td>
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<tr>
<td>04/18</td>
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<tr>
<td>05/18</td>
<td>3.1</td>
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<tr>
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<tr>
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</tr>
<tr>
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<tr>
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<tr>
<td>06/19</td>
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<tr>
<td>07/19</td>
<td>3.6</td>
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</tbody>
</table>

Length of Stay (Days) vs. Clinical Outcome vs. Month
## Outcomes

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2017-2018</th>
<th>Net Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong># of Spinal Fusions</strong></td>
<td>57</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td><strong>Length of Stay</strong></td>
<td>6.7 days</td>
<td>3.3 days</td>
<td>-3.4 days</td>
</tr>
<tr>
<td><strong>30 day readmission</strong></td>
<td>2</td>
<td>2</td>
<td>-1/yr</td>
</tr>
<tr>
<td><strong>Surgical site infection</strong></td>
<td>2</td>
<td>1</td>
<td>-1.5/yr</td>
</tr>
<tr>
<td><strong>Major complication</strong></td>
<td>2</td>
<td>1</td>
<td>-1/yr</td>
</tr>
<tr>
<td><strong>Unplanned ICU transfer</strong></td>
<td>0</td>
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<tr>
<td><strong>Patient Charges</strong></td>
<td>$182,500</td>
<td>$166,000</td>
<td>-$16,500</td>
</tr>
<tr>
<td><strong>Direct Cost /Patient</strong></td>
<td>$62,300</td>
<td>$52,000</td>
<td>-$10,300</td>
</tr>
<tr>
<td><strong>Net Income / Patient</strong></td>
<td>$30,700</td>
<td>$35,700</td>
<td>+$5,000</td>
</tr>
</tbody>
</table>

↓ Length of Stay 50%

No adverse impact on postoperative complications

Economic benefit to all involved parties
Conclusion

• Affirms Value:
  – Multidisciplinary team
  – Evidence Based / Best Practice Pathway
  – Collaboration with health care IT
    • Order sets
    • Pathway education
    • SharePoint
    • Compliance tracking
    • Outcome tracking

• Transformative change can have significant positive impact on both patient and institution