Pediatric Perioperative Pathways
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Disclosures

• Research Funding
  - American Society of Anesthesiologists
  - Society for Pediatric Anesthesia
  - NIH/NIMHD (R21 – Pending)

• No financial conflicts of interest
Learning Objectives

- Quality of care
- Pathways – Need and Examples
- Example of NPO pathway
- Example of tonsillectomy pathway

Quality of Care in U.S. Adults

- **Acute**: 53%
- **Chronic**: 56%
- **Preventive**: 55%

Average: 55%

### Quality of Care in U.S. Children

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>47%</td>
</tr>
<tr>
<td>Acute</td>
<td>68%</td>
</tr>
<tr>
<td>Chronic</td>
<td>53%</td>
</tr>
<tr>
<td>Preventive</td>
<td>41%</td>
</tr>
</tbody>
</table>


### Start of Pathways

- Healthcare system pressures
- Tightly constrained resources
- Global Economic Crisis 2007-2008
- Great Recession 2008-2012
- Improvement in clinical quality
- Good value
  - Cost effective
  - Clinical effective

Grocott et al. 2015
Grocott et al. Perioperative Medicine. 2017
What is a Pathway?

• Structured plans of care
• Each pathway details care in a protocol, algorithm, or other inventory of actions

• Multidisciplinary clinical care teams
• Covers 80% of the intended population
  - Limits practice variation
  - Does NOT affect patient related variation

Benefits of Having A Pathway

Foundation for quality improvement efforts
Monitor effectiveness-efficiency of patient care
Close Gaps between evidence and real-time decision making
Shortened hospital stay
  - Reduced complications
  - Reduced variance in Adverse Outcomes
  - Earlier return to baseline activities

Gan et al. Anesthesia & Analgesia 2018;126:1870-1873
Examples of Pathways

Pathways

- Enhanced Recovery After Surgery (ERAS)
- Perioperative Surgical Home (PSH)

Safe Care
Reduced Adverse Events
Applicable to most patients


Pathways in Children (vs. Adults)

- Underdeveloped
- Challenges (compared to adults)
- Heterogeneity in the age and development
- Burden of morbidity
- Adverse Events
- Interpretation of Surgical Outcomes - Variable
Pediatric Pathways (vs. Adults)

- Approximately 24 interventions in adults
- Mean number of interventions in pediatrics – 5.6
- Thromboembolism prophylaxis – less important
- Exciting and uncharted research territory
- Pathways mostly on abdominal surgeries
- Patient specific sleep apnea pathway is limited


Research Challenges

“it takes 17 years, on average, ...
...for 14 % of research ...
...to translate into practice”

Slide Courtesy: Dr. E. Alessandrini MD, Cincinnati Children’s Hospital Medical Center, Ohio
## Interventions for children with OSA

<table>
<thead>
<tr>
<th>Preoperative</th>
<th>Intraoperative</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Education</td>
<td>• Multimodal Pain Rx</td>
<td>• Multimodal Pain Rx</td>
</tr>
<tr>
<td>• Avoidance of prolonged fasting</td>
<td>• Fluids</td>
<td>• Avoidance of Foley</td>
</tr>
<tr>
<td>• Carbohydrate Loading</td>
<td>• Antiemetics</td>
<td>• Avoid NG catheters</td>
</tr>
<tr>
<td>• Antibiotics</td>
<td>• Temperature</td>
<td>• Nutrition</td>
</tr>
<tr>
<td>• Pain Adjuncts</td>
<td></td>
<td>• Early mobilization</td>
</tr>
</tbody>
</table>

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**Pathway to reduce prolonged fasting – Quality Improvement Project at Children’s Hospital of Philadelphia**
Why Fast?

- Current American Society of Anesthesiologists (ASA) Guidelines:
  - NPO Clears 2 hours prior to induction of Anesthesia
  - Prevent pulmonary aspiration of gastric contents

- New data shows safety of shorter clear fluid fasting times

Preoperative fasting and OSA

- Dehydration

- Increased difficulty in IV placement

- Hypotension

- Increased postoperative dehydration risk

- Increased PONV risk

- Increased readmissions?
**Key Drivers for NPO times**

| OR delays            | • Knowing about delays  
|                      | • Deciding if appropriate for patient to drink in pre-op |
| Preop Instructions   | • No active language or wording to encourage drink  
|                      | • Format – many disparate locations for preop instructions |
| Family/ Parent Themes| • Kid Factors – Won’t drink  
|                      | • Parent Factors – feel ‘longer is better’  
| Clinician Themes     | • Unwilling to offer clears (case might move)  
|                      | • GA Policy for clears was 2 hours prior to induction |
| System Issues/ Patient Flow | • First cases – longer NPO times due to early morning arrival  
|                      | • Board runner (not in-charge anesthesiologist) often called to request clears  
|                      | • OR unaware of NPO time - too late to offer drink |

**Project SMART Aim**

To decrease clear liquid NPO time prior to induction of anesthesia to ≤ 4 hours for 60% of day procedure patients by July 2018.

*S = Specific*  
– Children having anesthesia

*M = Measurable*  
– 60% of day procedures

*A = Attainable*  
– ≤ 4 hours

*R = Relevant*  
– Preliminary data and published literature

*T = Time-Bound*  
– by July 2018
The Children’s Hospital of Philadelphia

% Patients with NPO Time ≤ 4 Hours

Baseline: 15%
Goal: 60% by July 2018

25% of children received a drink after reaching the hospital

Updated NPO Policy: 1 Hour Clears to Induction 5/10/17

PDSA #1
PDSA #2
PDSA #3


Main Hospital OR – Control Chart

How do we know we are not making things worse?

Balancing Measures
Goal: see no increase in these measures from baseline

<table>
<thead>
<tr>
<th></th>
<th>Case Cancellations for NPO Violations</th>
<th>Case Delays for NPO Violations</th>
<th>Emesis Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Main: 0.21% ASCs: 0.31%</td>
<td>Main: 0.37% ASCs: 0.15%</td>
<td></td>
</tr>
<tr>
<td>Current State</td>
<td>Main: 0.24% ASCs: 0.19%</td>
<td>Main: 0.29% ASCs: 0.16%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any Anesthetic event: &lt; 0.08%</td>
<td></td>
<td>All cases are being reviewed monthly. No increase in events post-changes</td>
</tr>
</tbody>
</table>
• Opioid related claims
  - 16% of death claims
  - 4% injury claims
  - Highest monetary awards

• Monetary awards
  - Death claims $1,625,892
  - Injury claims $3,484,278

Fatal Injuries = 98
Non fatal Injuries = 144

• OSA was the most common comorbidity
  - 17.4% of fatal claims
  - 10.4% of nonfatal claims


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• N = 37,325
• PSG n=1,125

Practice guidelines for the perioperative management of patients with obstructive sleep apnea. Anesthesiology Feb 2014


McClung H, Jablonka D, Subramanyam R. Screening for Pediatric Obstructive Sleep Apnea. SASM Newsletter
Challenges of pediatric preoperative screening

Mean Age 8.5 years; BMI 22 kg/m²; AHI 7.7

<table>
<thead>
<tr>
<th></th>
<th>No OSA</th>
<th>Mild OSA</th>
<th>Moderate</th>
<th>Severe</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSA on ASA Screening Questionnaire Yes/No</td>
<td>65/111</td>
<td>207/247</td>
<td>87/88</td>
<td>102/96</td>
<td>461/542</td>
<td>0.026</td>
</tr>
<tr>
<td>OSA on Pediatric Sleep Questionnaire Yes/No</td>
<td>96/1</td>
<td>284/15</td>
<td>105/3</td>
<td>103/5</td>
<td>588/24</td>
<td>0.33</td>
</tr>
</tbody>
</table>

AHI continuous vs. ASA Guidelines: 0.0059
AHI continuous vs. PSQ: 0.567

(Unpublished Data from Cincinnati Children's Hospital, Ohio)

ASA screening questionnaire vs. PSG

Questionnaires on ASA Guidelines p-value (AHI categorical) p-value (AHI continuous)

1. PREDISPOSING PHYSICAL CHARACTERISTICS ONE OR MORE
   Adolescent BMI 0.0687 0.02
   95th percentile for age and sex 0.0008 <0.0001
   Craniofacial abnormalities affecting the airway <0.0001 <0.0001
   Anatomical nasal obstruction 0.0032 0.0003
   Tonsils nearly touching or touching in the midline <0.0001 <0.0001

2. HISTORY OF APPARENT OBSTRUCTION DURING SLEEP TWO OR MORE
   Loud snoring <0.0001 <0.0001
   Frequent snoring 0.0002 <0.0001
   Observed pauses in breathing during sleep <0.001 <0.0001
   Awakens from sleep with choking sensation <0.001 <0.0001
   Frequent arousals from sleep 0.1168 0.0068
   Intermittent vocalization during sleep 0.0667 0.0107
   Parental report of restless sleep, difficulty breathing <0.0001 0.0001
   Child with night terrors 0.1009 0.2009
   Child sleeps in unusual position 0.002 0.0001
   New onset enuresis 0.0038 0.0098

3. SOMNOLENCE ONE OR MORE
   Frequent daytime somnolence 0.2178 0.2713
   Falls asleep easily in a non-stimulating environment 0.5414 0.1355
   Parents/teacher - child appears sleepy during the day 0.0918 0.0383
   Child often difficult to arouse 0.2166 0.0024

OSA PRESENT IF = 1+2, 1+3, 2+3 OR 1+2+3
T & A Pathway Creation at CHOP

• Marked variation for children who undergo adenotonsillectomy (T & A)
  - Location - Ambulatory care center (ASC) vs. hospital
  - Hospital discharge criteria:
    ~To home
    ~Hospital ward
    ~Pediatric intensive care unit (PICU)

• Discrepancy exists in published guidelines:
  - American Academy of Otolaryngology - Head and Neck Surgery (AAO-HNS)
  - American Academy of Pediatrics (AAP)

American Academy of Otolaryngology-Head and Neck Surgery

• Clinical practice guidelines in 2011 (2-18 years)

• Post-operative admission
  - Children < 3 years of age
  - Any age with severe OSAS
    ~AHI > 10 apnea or hypopnea events/hour
    ~SpO₂ nadir < 80% on preoperative PSG

• Comorbid conditions (mentioned in fine print)

• Published similar clinical practice guidelines in 2012

• Hospital admission for high-risk children
  - Age < 3 years
  - Obese or had serious comorbidities
  - Severe OSAS
    - AHI ≥ 24/hour
    - Peak PCO2 ≥ 60 mmHg
    - SPO2 nadir < 80%

## T&A at CHOP – Surgery Location

<table>
<thead>
<tr>
<th></th>
<th>Ambulatory Surgery Center (ASC)</th>
<th>Day Surgery</th>
<th>Inpatient</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>&gt;= 3.5 years</td>
<td>&gt; 3 years</td>
<td>&lt; 3 years</td>
</tr>
<tr>
<td><strong>Comorbid conditions</strong></td>
<td>No comorbid conditions</td>
<td>No comorbid conditions</td>
<td>Any age with comorbid condition</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>BMI &lt; 99% BMI 10-34</td>
<td>BMI &gt; 99% and approved by physicians</td>
<td>BMI &gt; 99% BMI &lt; 10 and &gt; 35</td>
</tr>
<tr>
<td><strong>PSG</strong></td>
<td>AHI 0-23 Peak CO2 &lt;=55 O2 nadir &gt;= 90</td>
<td>AHI 0-23 Peak CO2 &lt;=60 O2 nadir &gt;= 85</td>
<td>AHI 0-23 Peak CO2 &gt;=60 O2 nadir &lt;= 85</td>
</tr>
<tr>
<td><strong>Bed Request</strong></td>
<td>None</td>
<td>None</td>
<td>PICU or inpatient unit</td>
</tr>
</tbody>
</table>

## T&A at CHOP – Post Op Disposition

**Ambulatory Surgery Center (ASC)**

- **Admit to Inpatient Surgical Unit**
  - FiO\textsubscript{2} < 40% by mask
  - Length of time to get to Phase II Recovery

**Direct Admit to PICU**

- Age: < 1 y/o or < 2 y/o and history of < 36 weeks premature
- Severe obesity (BMI > 99 percentile)
- Comorbid conditions:
  - Cardiac – pulmonary hypertension or requires cardiac anesthesia
  - Respiratory – post-operative intubation, or acute mechanical ventilation via trach, baseline home ventilator, BiPAP/CPAP dependence or oxygen requirement, difficult/critical airway, active wheezing
• PICU admissions decreased by 40% in 3 years
  -255 to 154

• PICU admissions
  -Scheduled patients decreased from 181 to 99
  -Unscheduled patients decreased from 74 to 55
Barriers to Pathway Compliance

• Lack of education
  - Patients
  - Family members
  - Medical staff

• Lack of available resources
  - Nurses
  - Financial support

• Inadequate buy-in & Resistance to change
  - Rigid guidelines not evidence based
  - Poor communication
  - Lack of collaboration between team members.


Future Areas for Pathway Development

• Complete pathway for OSA patient presenting for various operating room and NORA procedures
• Account for absence of pre-procedure polysomnography (majority of patients)
• Monitor pathway compliance over time
• Assess for potential gains
  - Reduced cost
  - Reduced length of stay
  - Reduced readmissions
  - Improved resource utilization
  - Improved patient outcomes and family satisfaction
“Between the health care that we have and health care that we could have lies not just a gap, but a chasm.”

Institute of Medicine, Crossing the Quality Chasm, 2001