Ethan A. Mezoff, MD
Clinical Instructor
Division of Pediatric Gastroenterology, Hepatology, and Nutrition
Cincinnati Children’s Hospital Medical Center
Ethan.Mezoff@cchmc.org

Coauthors: Lin Fei, PhD; Misty Troutt, MS, MBA; Kim Klotz, RN, MSN, CRNI; Samuel A. Kocoshis, MD; and Conrad R. Cole, MD, MPH, MSc
The authors report

NO RELEVANT FINANCIAL RELATIONSHIPS
Intestinal Failure

- No single accepted definition
- A failure of the intestine to support the nutritional and hydration needs of the body
- Central access required for $\geq 30$ days to support fluid, electrolyte, and/or nutritional needs
Central Line-Associated Blood Stream Infection (CLABSI)

• Primary bloodstream infection in a patient who has a central line

• No other identified source with identical organism

• Measured in: Events per 1,000 catheter days
• CLABSI rates for inpatient pediatric units
  – 0.5-1.9 per 1,000 catheter days

• CLABSI rates among pediatric IF
  – 8.0-10.2 per 1,000 catheter days
  – Proposed reasons
    • Relative immune-deficient state
    • Poor intestinal motility
    • Reduced barrier function
    • Frequency of line access/Line colonization

Locking Solutions

- Antimicrobial locking solutions
  - Expensive
  - Encourage resistant organisms

- Ethanol
  - Cheap
  - Antimicrobial
    - Kills bacteria, fungi, and viruses
  - Penetrates biofilms
• ELT in pediatric IF
  – Effective?
    • Several studies examined small groups using ELT
      – up to 23 patients per study
    • Meta-analysis: CLABSI reduction of 7.7 per 1,000 catheter days
    • Problems: low number of patients, diverse practices with ELT
  – Safe?
    • No studies, only anecdotes of occlusion and breakage

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### Table: Study Results

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<tr>
<th>Study or Subgroup</th>
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<th>SE</th>
<th>Weight</th>
<th>Mean Difference IV, Fixed, 95% CI</th>
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<tr>
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- Heterogeneity: $\chi^2 = 1.26$, df = 3 ($P = .74$); $I^2 = 0$
- Test for overall effect: $Z = 8.36$ ($P < .00001$)
AIM of our study

• ELT in pediatric IF
  – Effective?
    • Several studies examined small groups using ELT
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Test for overall effect: \( Z = 8.36 \) (\( P < .00001 \))

**AIM:** Describe **SAFETY** and **EFFECTIVENESS** of ELT in our population

Dannenberg *Clin Infect Dis* 2011; Opilla *JPEN* 2007; Oliveira *Pediatrics* 2012
Intestinal Rehabilitation Registry

• >200 registered patients

• >6 years of data
  – Demographics
  – Lab values
  – CLABSI events
  – Admissions

• Maintained by database specialist

• Purpose:
  – Retrospective clinical studies (Data collected prospectively)
  – Quality improvement
    • 4 current projects

• Current Outcomes
  – CLABSI rate: **1.3 per 1,000 catheter days**
  – % of population with total bilirubin level <0.2: **100%**
### Inclusion/Exclusion Criteria

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<td>Greater than two line infections in a one year period with gram negative enteric organisms</td>
<td>Allergy to ethanol</td>
</tr>
<tr>
<td>One previous instance of a fungal positive blood culture from a central line</td>
<td>Hypercoagulable state</td>
</tr>
<tr>
<td>Continuation of home or outside hospital-initiated therapy</td>
<td>Loss of two or more catheters to occlusion</td>
</tr>
<tr>
<td>More than three line infections with any organism in a one year period</td>
<td>A psychosocial situation that prevents the use of ethanol</td>
</tr>
<tr>
<td>Removal of a second vascular catheter due to infection</td>
<td>Parent(s) or guardian(s) objecting to the use of ethanol</td>
</tr>
<tr>
<td>Lines not known to be compatible with ethanol locks</td>
<td></td>
</tr>
</tbody>
</table>
CCHMC ELT Method

- Determine ELT priming volume
- Educate caregiver
- Schedule dwell time
  - >2hrs up to length of window (12hrs)

1. Flush w/ NS
2. Instill priming volume of **70% Ethanol**
3. Dwell (no access to CVC)
4. Withdrawal with small flash of blood
5. Flush line with >5 mL NS
6. Resume use

<table>
<thead>
<tr>
<th>Bard</th>
<th>Priming Volume</th>
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</thead>
<tbody>
<tr>
<td>2.7 Fr</td>
<td>0.15 mL</td>
</tr>
<tr>
<td>4.2 Fr</td>
<td>0.3 mL</td>
</tr>
<tr>
<td>6.6 Fr</td>
<td>0.7 mL</td>
</tr>
<tr>
<td>7.0 Fr DL Red</td>
<td>0.8 mL</td>
</tr>
<tr>
<td>7.0 Fr DL White</td>
<td>0.6 mL</td>
</tr>
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<table>
<thead>
<tr>
<th>Cook</th>
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</tr>
</thead>
<tbody>
<tr>
<td>3 Fr</td>
<td>0.3 mL</td>
</tr>
<tr>
<td>5 Fr</td>
<td>0.3 mL</td>
</tr>
<tr>
<td>4 Fr DL White</td>
<td>0.2 mL</td>
</tr>
<tr>
<td>4 Fr DL Blue</td>
<td>0.1 mL</td>
</tr>
<tr>
<td>5 Fr DL White</td>
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## Demographics of Study Participants

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<td>Number of Patients</td>
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</tr>
<tr>
<td>Median Patient Age (Range)</td>
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<td>Pseudoobstruction</td>
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<td>Congenital Enteropathy</td>
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<tr>
<td>Metabolic</td>
<td>3</td>
</tr>
<tr>
<td>Post-multivisceral transplant</td>
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</table>
Primary Diagnosis

- Multivisceral transplant support (28%)
- Pseudoobstruction (21%)
- Metabolic/Mitochondrial myopathy (10%)
- Necrotizing enterocolitis (10%)
- Gastrochisis (10%)
- Jejunal atresia (7%)
- Ileal atresia (7%)
- Primary enteropathy (4%)
- Resection following severe abdominal trauma (3%)
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**Total Line Days**
- Off ELT 8,865 days (median 210)
- On ELT 14,337 days (median 296)

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<tr>
<td>Tunneled Central Venous Catheter</td>
<td>87</td>
</tr>
<tr>
<td>Peripherally Inserted Central Catheter</td>
<td>61</td>
</tr>
<tr>
<td>Port</td>
<td>8</td>
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**Total Line Days** 23,202
Blood Stream Infections

Events per 1,000 line days

*Difference significant (p<0.013) by Poisson regression modelling
Infecting Organisms Recovered by Blood Culture

Events per 1,000 line days

- **Gram Positive**: Off ELT 2.48, On ELT 1.39
- **Gram Negative**: Off ELT 1.35, On ELT 0.84
- **Fungal**: Off ELT 0.07
- **Polymicrobial**: Off ELT 1.13, On ELT 0.84
Central Line Complications

Events per 1,000 line days

Perforation/Breakage: 1.8 (Off ELT), 1.53 (On ELT)
Extravasation: 0.14 (Off ELT), 0.28 (On ELT)
Occlusion: 0.56 (Off ELT), 0.28 (On ELT)

*Difference significant (p<0.006) by zero-inflated Poisson regression modelling
Conclusions

ELT is a **SAFE** and **EFFECTIVE** method for reducing CLABSIIs in the pediatric IF population.

- CLABSI rates are *reduced* with ELT ($p<0.013$)
- Central line perforations or breaks are *reduced* with ELT ($p=0.006$)
- Central line occlusion rates trended *downward* with ELT ($p=0.056$)
- Low rates *are possible* with fastidious line care

**Future Directions:**
- Be able to distinguish translocation from line infections
- Determine how antibiotic exposure changes the ability to grow
- **Create a collaborative improvement network**
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Thank you for your support!!!

This work was supported in part by:
NIH grant P30 DK078392 of the Digestive Disease Research Core Center in Cincinnati
NIH grant T32 DK007727 (EAM)
NIH grant R21 DK88027  (CRC)

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ELT Administration Workflow

Ethanol Lock Administration

1. Gather all equipment. Perform HAND HYGIENE
2. Place equipment on clean surface.
3. Place barrier under catheter hub.
4. Apply non-sterile gloves.
5a. If passive disinfection device not in place or compromised, scrub the needleless connector using alcohol prep pad for 30 seconds. Allow to dry for 15 seconds.
6. Access cap with normal saline syringe.
7. Pull back on plunger until blood flashback visualized.
     - 7a. Reposition patient, have patient take deep breath, and access cap with empty 1 or 3 ml sterile syringe, reattempt to aspirate blood.
     - 7b. If flashback obtained, flush CVC.
     - 7c. If flashback not obtained, set up for hub entry.
9. Instill ordered Ethanol volume
10. Cover cap with sticker “ETHANOL LOCK”

If flashback not obtained, continue with steps:

8. Flush with normal saline as ordered
7d. Complete cap change and heparinize line per policy
7e. Notify MD and consider Alteplase