Update in Pediatric Hospital Medicine 2014

Pediatric Grand Rounds
Bradley Monash, MD
Phuoc Le, MD, MPH
UCSF Division of Hospital Medicine

Conflicts of Interest

• None
Update in Pediatric Hospital Medicine

Updated literature since December, 2012

Process:
- Collaborative review of journals

Chose articles if they will:
- Change, modify, or confirm your practice.
- Breadth, not depth
- You will not hear these words:
  - Markov model, Kaplan-Meier, Student's t-test

You’re a hospitalist (for the next hour)
- Three cases (reviews/short takes)
- Multiple choice questions
Case Presentation 1

• You are called by the ED for a new admit
• 6yB (Max): “fast breathing” and hypoxia
• While the intern is looking up the most recent VS, he asks, “Could this be a PE?”

Case Continued

• The intern starts discussing Wells’ and Geneva scoring systems for pretest probability of PE
• You’re unclear as to whether these scoring systems translate to pediatrics

Diagnosing Pediatric Pulmonary Embolism

A. D-dimer is a specific test that can be used in the evaluation of pulmonary embolism
B. Clinical signs and symptoms are useless in the evaluation of pulmonary embolism
C. Adult PE risk scores do not translate to the pediatric population
D. Pediatric PE just means tiny little clots.
Diagnosing Pediatric Pulmonary Embolism

Question: Can we identify pediatric patients who require further testing for PE?

Design: Retrospective review > 1M visits, 105 pts with PE (25 met criteria), mean 15y (26-18y), applied Wells’ and PERC scores.

Wells Criteria

- DVT sx or symptoms: 3.0
- PE most likely diagnosis: 3.0
- HR > 100*: 1.5
- Immobilization: 1.5
- Prior DVT/PE: 1.5
- Hemoptysis: 1.0
- Malignancy: 1.0

PERC Rule

- Age < 50: No trauma/surgery
- HR < 100*: No hemoptysis
- SpO2 > 94%: No estrogen
- No hx DVT/PE: No sx sx DVT
Diagnosing Pediatric Pulmonary Embolism

<table>
<thead>
<tr>
<th>Patients</th>
<th>(Pre-Test Probability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wells’ score Low risk</td>
<td>48% (2-4%)</td>
</tr>
<tr>
<td>PERC screen negative</td>
<td>16% (&lt;2%)</td>
</tr>
</tbody>
</table>

Question: Can we identify pediatric patients who require further testing for PE?

Design: Retrospective review > 1M charts, 25/105 pts with PE, median 15y (26d-18y)

Conclusions: PE is rare in children; cannot apply adult rules to children; risk factors helpful

Comments: retrospective, Wells’, ICD-9, exclusion (hx PE, OSH dx/transfer), triage VS, 25 pts
Diagnosing Pediatric Pulmonary Embolism

A. D-dimer is a specific test that can be used in the evaluation of pulmonary embolism
B. Clinical signs and symptoms are useless in the evaluation of pulmonary embolism
C. Adult PE risk scores do not apply to the pediatric population
D. Pediatric PE just means tiny little clots.
But you happen to notice...

You head down to the ED.
Max is eating, using adult-sized dishware.
Concerned about the US obesity epidemic, you wonder whether size of the dishware matters.

Size can influence matters

Question: Does the size of the plate/bowl influence how much a child eats?

<table>
<thead>
<tr>
<th>Study Week</th>
<th>Classroom A</th>
<th>Classroom B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plate Size</td>
<td>Entrée Type</td>
</tr>
<tr>
<td>1</td>
<td>Adult</td>
<td>Unit</td>
</tr>
<tr>
<td>2</td>
<td>Adult</td>
<td>Amorphous</td>
</tr>
<tr>
<td>3</td>
<td>Child</td>
<td>Amorphous</td>
</tr>
<tr>
<td>4</td>
<td>Child</td>
<td>Unit</td>
</tr>
<tr>
<td>5</td>
<td>Child</td>
<td>Unit</td>
</tr>
<tr>
<td>6</td>
<td>Child</td>
<td>Amorphous</td>
</tr>
<tr>
<td>7</td>
<td>Adult</td>
<td>Amorphous</td>
</tr>
<tr>
<td>8</td>
<td>Adult</td>
<td>Unit</td>
</tr>
</tbody>
</table>

Bigger plates -> More food
More food -> More calories
Generalizability?
Case Continued

- T 38.2 BP 96/49 P 156 RR 60 SpO2 88% RA
- Max is "nontoxic appearing," w bronchial breath sounds involving the R mid lung zone.
- The RN enters the room and asks, "Would you like a CBC and blood cultures, doctor?"

Blood cultures for patients with CAP?

A. Blood cultures are recommended for all inpatients with PNA per 2011 IDSA guidelines
B. The incidence of bacteremia in pediatric patients with CAP is < 5%
C. MRSA has become the most common cause of CAP in children
D. Drawing blood cultures…. Is there an app for that??

CAP and blood cultures

Question: Can application of guidelines reduce unnecessary blood cultures?

Design: Guideline derivation, chart review with retrospective guideline application, 330 patients, 155 (47%) blood cultures [0-18y], 2010-2011
IDSA Guidelines 2011

"Blood cultures should be obtained in children requiring hospitalization for presumed bacterial CAP that is moderate to severe, particularly those with complicated pneumonia."

(strong recommendation; low-quality evidence)

Medical University of South Carolina Guidelines

- Febrile + <6 months or unimmunized
- Immunocompromised
- Chronic medical conditions -> PNA
- Hospitalization <14 days prior to PNA
- Toxic-appearing, requiring PICU
- Effusion, empyema, or abscess
- Indwelling CVL
Blood cultures **n = 155**

- “Unnecessary” 70 (45%)
- True Bacteremia 5 (~3%)
- Contaminants... 5 (~3%)

...More needle sticks, LOS, $$$, abx, parental anxiety...

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**Question:** Can application of guidelines reduce unnecessary blood cultures?

**Design:** Guideline derivation, retrospectively applied, 330 patients, 155 (47%) blood cultures [0-18y]

**Conclusions:** Following local guidelines can reduce unnecessary blood cultures

**Comments:** Retrospective, ICD-9, blood cultures not universal

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**When should you draw blood cultures for patients presenting with CAP?**

A. Blood cultures are recommended for all **inpatients** with PNA per 2011 IDSA guidelines
B. The incidence of bacteremia in pediatric patients with CAP is < 5%
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When should you draw blood cultures for patients presenting with CAP?

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C. MRSA has become the most common cause of CAP in children
D. Drawing blood cultures... Is there an app for that??

Case Continued

- You decide to hold off drawing blood cultures unless there is evidence of a complicated PNA
- You recommend a CXR, but the parents refuse...

Can we diagnose PNA without a CXR?

A. CXR is not routinely recommended for inpatients with PNA per IDSA guidelines 2011
B. PE findings have outstanding test characteristics in diagnosing PNA
C. U/S is highly specific for diagnosing PNA
D. Similar to diagnosing a UTI based on malodorous urine, you can dx PNA based on the scent of one’s breath
POC Ultrasound in Diagnosing PNA

Question: How reliable is U/S for diagnosing PNA in children and young adults?
Design: Prospective, obs cohort; 200 pts (0-21y); med age 3y [1-8y], 15 PED MDs; 1hr training.

<table>
<thead>
<tr>
<th>CXR+</th>
<th>36 (18%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U/S+</td>
<td>49 (25%)</td>
</tr>
<tr>
<td>U/S+ &gt; 1cm</td>
<td>36 (18%)</td>
</tr>
</tbody>
</table>

POC Ultrasound in Diagnosing PNA

Question: How reliable is POC U/S for diagnosing PNA in children and young adults?
Design: Prospective, observational cohort, 200 patients (0-21), 15 pediatric ED physicians.

<table>
<thead>
<tr>
<th>Variable</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Impression</td>
<td>1.4</td>
<td>0.41</td>
</tr>
<tr>
<td>POC U/S (&gt;1 cm)</td>
<td>28.2</td>
<td>0.14</td>
</tr>
<tr>
<td>Experienced Sonologist (&gt;25 exams)</td>
<td>51.7</td>
<td>0.08</td>
</tr>
</tbody>
</table>
POC Ultrasound in Diagnosing PNA

- 15 PNAs dx’d by U/S not CXR
- 5 PNAs dx’d by CXR not U/S
- U/S: 4 add’l pleural effusions

Question: How reliable is POC U/S for diagnosing PNA in children and young adults?
Design: Prospective, observational cohort, 200 patients (0-21), 15 pediatric ED physicians.
Conclusions: Clinicians may diagnose PNA using POC U/S with high specificity
Comments: Used CXR as reference standard; involved ED attendings with variable U/S experience; may miss central consolidation

Can we diagnose PNA without a CXR?
A. CXR is not routinely recommended for inpatients with PNA per IDSA guidelines 2011
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Case Continued

Max is started on amoxicillin and is discharged.

As a special treat, his mom takes him to Mickey D's for a 6-piece McNugget.

Chicken Little?

Randomly selected chicken nuggets from 2 national fast food chains were fixed in formalin, sectioned, and stained for microscopic analysis.
Chicken Little?

Randomly selected chicken nuggets from 2 national fast food chains were fixed in formalin, sectioned, and stained for microscopic analysis.

Striated muscle (chicken meat) was not the predominant component in either nugget.

Lots of fat (~56-58%) along with epithelium, bone, nerve, and connective tissue.


Summary

Start: Instituting local guidelines for evaluation and management of CAP

Stop: Applying adult PE scoring systems to the pediatric population

Consider: -- Using U/S to diagnose PNA
-- The importance of dishware size
-- Rethinking “tastes like chicken!”

Case 2

ER: 13yF (“Riley”) w/ c/o abdominal pain x 2 weeks. +Anorexia, +nausea, no vomiting, +constipation (2 BMs in 2 weeks), no fevers, no weight loss. ROS + stressors at home.

Exam AFVSS: abdominal exam S/ND, + diffuse TTP no rebound, nl bowel sounds, no HSM.
Case 2

Your intern states:

“Riley’s history and exam are benign. She’s probably uncomfortable from being constipated. No testing is warranted. Let’s give her some Miralax and send her home with PMD follow up.”

How do you respond?

A. Let’s check a KUB to confirm constipation
B. She’s nauseous and not eating, are you sure she’s not pregnant?
C. Did you do a rectal exam to confirm stool in the vault?
D. I agree, no work-up needed
E. A and C

Abdominal X-ray for Constipation

Question: Can KUBs ordered to diagnose constipation lead to serious misdiagnoses?

Design: Retrospective cohort study of ER visits (>3000) in a major children’s hospital with final dx of constipation.

Abdominal X-ray for Constipation

Results: 46% of all patients had KUB. Of those misdiagnosed, 75% had KUB. Major misdiagnoses (n=20): appendicitis, SBO, intussusception, CA. Minor misdiagnoses: PNA, UTI, AOM.

KUBs can lead to:  -- search satisficing  
              -- confirmation bias  
              -- ascertainment bias


Abdominal X-ray for Constipation

Question: Can KUBs ordered to diagnose constipation lead to serious misdiagnoses?

Design: Retrospective cohort study of ER visits (>3000) in a major children’s hospital with final dx of constipation.

Conclusion: Avoid KUBs for routine eval of constipation. Increases cost, radiation exposure, and can lead to serious misdiagnoses.


How do you respond?

A. Let’s check a KUB to confirm constipation  
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Short Take: New epidemic?

Question: Have inpatient pediatric admissions for chronic pain increased in the last 10 years?
Design: Admissions data from >40 children's hospitals in the US analyzed.

831% Increase!
**Short Take: New epidemic?**

**Question:** Have inpatient pediatric admissions for chronic pain increased in the last 10 years?

**Design:** Admissions data from >40 children’s hospitals in the US analyzed.

**Conclusion:** “The average child admitted with chronic pain is a teenaged female with a wide variety of comorbid conditions, many of which are GI and psychiatric in nature.”

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**Case 1 continues**

When you go to discharge Riley, her mother adamantly refuses.

“We need to get to the bottom of this pain! She’s so weak and dehydrated from not eating and drinking!”

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**Case 2 continues**

Intern: “No problem. I’ll start some maintenance fluids. Are you ok with D5 ½ NS w/ 20 of KCl?”
Hyponatremia and IVF

Question: Does giving hypotonic maintenance IVF to hospitalized children lead to hyponatremia?

Design: Retrospective cohort study of >1000 at a single tertiary care center.
**Hyponatremia and IVF**

**Table II. Multivariable model results for development of hyponatremia**

<table>
<thead>
<tr>
<th>OR</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotonic fluids: Hematology/oncology diagnosis</td>
<td>1.27</td>
<td>1.03-1.84</td>
</tr>
<tr>
<td>Hypotonic fluids: Cardiology diagnosis</td>
<td>2.37</td>
<td>1.74-3.25</td>
</tr>
<tr>
<td>Diabetic administration</td>
<td>2.68</td>
<td>1.34-3.20</td>
</tr>
<tr>
<td>Surgical admission</td>
<td>1.52</td>
<td>0.98-2.45</td>
</tr>
<tr>
<td>Age</td>
<td>1.44</td>
<td>1.09-1.91</td>
</tr>
<tr>
<td>Age</td>
<td>0.98</td>
<td>0.95-1.00</td>
</tr>
</tbody>
</table>

**Question: Does giving hypotonic maintenance IVF to hospitalized children lead to hyponatremia?**

**Design:** Retrospective cohort study of >1000 at a single tertiary care center.

**Conclusion:** Hyponatremia seen more often with hypotonic than with isotonic IVF.

**Comments:** Association only, other outcomes?

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**How should you respond?**

A. Sounds good, just make sure she pees before you give K.
B. Any reason we should use ½ NS over NS?
C. Sure but let's check her chemistries before we start fluids.
D. You’re a November intern, do you still need me to okay your fluid choice? Geesh!
**How should you respond?**

A. Sounds good, just make sure she pees before you give K.
B. Any reason we should use ½ NS over NS?
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D. You’re a November intern, do you still need me to okay your fluid choice? Geesh!

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**Short Take: Music, Clowns, and Pain**

When you mention the IV, Riley screams, “No, no I HATE needles!”

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**Short Take: Music, Clowns, and Pain**

Question: Can clowns or music lessen the pain of IV sticks?

2 Studies: Small single center RCTs. One used a clown as the distractor, while the other used music

Results: In clown study there were trends towards reduced pain. The music study showed reduced pain and distress.

Case 2 continues

Riley is now HD #7 and had completely negative workup so far including extensive lab studies, EGD/colonoscopy and MRE.

Your GI consultant says this is functional pain, and recommends discharge.

How should you respond?

A. Not so fast, we haven’t done a HIDA scan yet, can’t call it a million dollar work-up without that.
B. Okay, make sure she has an anti-emetic Rx before she goes.
C. Okay, but make sure she has close GI and PMD f/u.
D. Okay, but why don’t we try an outpatient CBT referral?
Cognitive Behavioral Therapy in FAP

Question: Can CBT reduce symptoms in functional abdominal pain?

Design: Single center RCT (N=100) comparing 6 weeks of CBT to intensive outpatient medical therapy.

Conclusion: CBT equally effective for reducing pain.
How should you respond?

A. Not so fast, we haven’t done a HIDA scan yet, can’t call it a million dollar work-up without that.
B. Okay, make sure she has an anti-emetic Rx before she goes.
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How should you respond?

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B. Okay, make sure she has an anti-emetic Rx before she goes.
C. Okay, but make sure she has close GI and PMD f/u.
D. Okay, but why don’t we try an outpatient CBT referral?

Take-Home Points

Start: Individualizing maintenance IVF to reduce hyponatremia.

Stop: Using KUBs to confirm to rule out constipation in ER setting.

Consider: --Employing musical clowns in ERs and procedure rooms.
--CBT in treatment of functional abdominal pain.
Case 3

- Your team is called by the ED for a new admit
- 2½ m girl (Erma) with “choking” episode at home. Self-resolved in < 1 min.
- Not during feeding. No color change. No LOC.

Case Continued

Upon conclusion of a comprehensive H&P, the intern offers “So I think this is an ALTE. We should order a full set of labs, ECG, chest Xray and admit Erma for a 5-channel pneumogram.”

As you construct your response, you ask yourself, “Is this the year that we’re going to have an ALTE breakthrough?”

Characterizing ALTEs

Question:

1. What hx and PE features suggest heightened risk & need for testing or hospitalization?
2. What testing is indicated?

“None of the 37 studies satisfied a high level of evidence for diagnostic or prognostic investigations, and there was little consistency in study populations, outcomes, follow-up periods, and measurement.”

Dx/Rx of ALTE

Authors’ conclusion:
Risks: prematurity, multiple ALTEs, child abuse

A new definition is needed, and should distinguish:

(1) ALTE as a description of a symptom
(2) Patients with clear etiology
(3) Minor vs. severe symptoms

Case Continued

You receive a call that Erma has spiked a fever to 38.2. Exam unremarkable. You opt to pursue a CBC, viral PCR, blood culture, UA and Ucx.

You discuss with the family that they should plan on Erma being in house for a 48h r/o.

The family is in town for Dreamforce, and have other kids to look after, and wonder whether 48h is necessary.
Time to rule out SBI

Question: Is the old 48 hour rule-out necessary?
Design: Retrospective, '07-'11, 0-90d w +blood, urine, or CSF for r/o SBI in ED or inpt, 307+ cx

Exclusion Criteria
- Blood from CVL
- Urine from Foley
- CSF from VPS
- Urological surgery
- Complex PMH
- ICU/stepdown
- Repeat cx

<table>
<thead>
<tr>
<th></th>
<th>Mean TDD pathogen</th>
<th>Mean TDD contaminant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood cx</td>
<td>13.3 hours</td>
<td>24.9 hours</td>
</tr>
<tr>
<td>(n = 101*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urine cx</td>
<td>21 hours</td>
<td>26.7 hours</td>
</tr>
<tr>
<td>(n = 111*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF cx</td>
<td>28.9 hours</td>
<td>57.7 hours</td>
</tr>
<tr>
<td>(n = 7*)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Non-excluded

Time to rule out SBI \( \leq 36 \) hours

97%  | 95%  | 86%

![Graph showing percentage of positive results by culture type and duration](Hospital Pediatrics 2013;3:97)
**Time to rule out SBI**

Question: Is the old 48 hour rule-out necessary?
Design: Retrospective, '07-'11, 0-90d w +blood, urine, or CSF for r/o SBI in ED or inpt.
Conclusions: In selected circumstances, inpatient observations for SBI may be decreased to 36h
Comments: Retrospective, used treatment decision to define pathogen vs. contaminant, no report amount of cx fluid, no data re pre-rx abx, once daily urine and CSF read-outs

**Case Continued**

Erma’s CBC and UA are unremarkable. She continues to look well, feed well.

You discuss that, given how well Erma looks, you will consider discharging her at 36 hours, if reliable follow-up can be secured

At 35.5 hours, you get a call that her blood is growing Pseudomonas. Albeit suspicious of the veracity, the resident says we must “double cover”

**Double Coverage for GNR Bacteremia**

Question: Does definitive dual abx therapy improve mortality in pts with GNR bacteremia?
Design: Retrospective cohort, 879 patients (0-18y), GNR bacteremia, 2002-2011, β-lactam +/- aminoglycoside

<table>
<thead>
<tr>
<th></th>
<th>Adjusted, Weighted Odds Ratio (CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>0.98 (0.93-1.02)</td>
<td>.27</td>
</tr>
<tr>
<td>Nephrotoxicity</td>
<td>2.15 (2.09-2.21)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Double Coverage for GNR Bacteremia

Question: Does definitive dual abx therapy improve mortality in pts with GNR bacteremia?

Design: Retrospective cohort, 879 patients (0-18y), GNR bacteremia, 2002-2011, β-lactam +/- aminoglycoside

Conclusions: Combination therapy (β-lactam + aminoglycoside) did not improve survival.

Comments: confounding (propensity scoring), 3/4 CVL infxn (not deep-seated), Cr x 72h, duration ill-defined

Double the coverage not necessarily double the fun!

Case Continued

• Prior to prescribing abx, you call the lab, confirming that there was a specimen mix-up

• Erma remains perfectly well, afebrile, occasional spit ups, no further episodes.

• You decided to chalk it all up to GERD. Erma’s parents are interested in medication...

GERD Label and Parental Desires

Question: Does dx of GERD influence parents’ perceived need to medicate?
Design: Randomized, 175 surveys, gen peds

<table>
<thead>
<tr>
<th>GERD Dx</th>
<th>No GERD Dx</th>
</tr>
</thead>
<tbody>
<tr>
<td>No information re: med effectiveness</td>
<td>(-) GERD Dx</td>
</tr>
<tr>
<td>(-) Info re: med effectiveness</td>
<td>(-) Info re: med effectiveness</td>
</tr>
<tr>
<td>Meds are ineffective</td>
<td>(-) GERD Dx</td>
</tr>
<tr>
<td>(-) Meds ineffective</td>
<td>(-) GERD Dx</td>
</tr>
<tr>
<td>(+) GERD Dx</td>
<td>(+) GERD Dx</td>
</tr>
<tr>
<td>(+) Meds ineffective</td>
<td>(+) Meds ineffective</td>
</tr>
</tbody>
</table>

Conclusions: Giving GERD dx and sharing med effectiveness data influence parental perceptions re need for medication

Comments: Restricted demographics, physiological mechanism described, hypothetical scenarios.
Case Continued

You collectively decide to withhold PPI,
Possibly sparing Erma from:
--- PNA
--- Interstitial nephritis
--- B12, Mg deficiency
--- And of course...

C diff

Summary

Start: Recognizing that labeling a pt with a “disease” may perpetuate parental desire for medication.

Stop: Accepting ALTE as a diagnosis, and clarify what the actual event(s) entailed.

Consider: -- Using monotherapy with β-lactam to definitively treat of GNR bacteremia
          -- Discharging well-appearing, stable “rule-outs” if cx remain negative at 36h.

Acknowledgments

- Brad Sharpe, MD
- Michelle Mourad, MD
- Mark Shen, MD
- UCSF Division of Pediatric Hospital Medicine
Appendix 1: Likelihood Ratios

Likelihood Ratios

\[ +LR = \frac{T+D+}{T+D-} \]

\[ -LR = \frac{T-D+}{T-D-} \]