Common Children’s Hospital Admissions

Jeremy L. Gibson M.D.
Pediatric Hospitalist
Vice Chair of Pediatric Education
McLane Children’s Hospital
Baylor Scott & White Healthcare
McLane Children’s Hospitalist

254-935-KIDS (5437)
Our Practice Philosophy

How to be an expert

- **Expert, always in flow**
- **Kicking Ass Threshold**
  - "I'll keep pushing myself. There's always some way to do it better..."
- **Suck Threshold**
  - "Now that I can do it, I'll just keep doing it the same way."
  - "I suck at this. I give up."
- **Struggling, frustrating**

**Time**
- First time
- Years or decades

**Ability**
- Drop-out
Top 10 Reasons for Hospitalization -2009*

1. Respiratory system, including **pneumonia, asthma, and acute bronchiolitis** – 510,000.
2. Digestive system – 266,000
3. Nervous System – 172,000
4. Adolescent pregnancy – 155,000
5. Mental disorders, including mood disorders – 144,000
6. Endocrine, nutritional and **metabolic** – 139,000
7. Ear, nose, mouth and throat – 138,000
8. Musculoskeletal system – 128,000
9. Skin and subcutaneous tissue – 93,000
10. **Infectious and parasitic diseases** – 89,000

*Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project*
Review Topics for Today

- Neonatal Fever
- Viral Bronchiolitis
- Asthma
- Pediatric Maintenance Fluids
- Inpatient Antibiotics
Neonatal Fever
NNF

- Neonate
- Infant <3mo
- HSV
- RSV
- Procalcitonin
- US Guided Lumbar Puncture
Neonate

- High risk population for serious bacterial infection (SBI)
  - Big 3 – Group B Strep, E. coli, Listeria
  - Also other gram negatives, Community acquired infrequently
  - Consider HSV (more on this later)
- Fever may be only marker
- Absence of fever does not rule out sepsis
  - Hypothermia
  - Apnea/ALTE
  - Poor feeding
  - Lethargy
  - Seizure
Neonate

- Ampicillin + Gentamicin or Cefotaxime
- Acyclovir based on risk
HSV - when to test and treat?

- Risk factor based approach
- Maternal Risk – HSV, or STD history, ask about recent cold sore outbreak
- Sicker the baby lower threshold to test and treat
- Worrisome mucocutaneous lesions
- Abnormal CSF studies
- Elevated AST/ALT
Infant 29-90 days

- SBI still at risk but some wiggle room
- Scoring systems – Rochester, Philadelphia, Boston
- RSV
  - Febrile infants who are ≤60 days of age and have RSV infections are at significantly lower risk of SBI than febrile infants without RSV infection.
  - The rate of SBIs, particularly as a result of UTI, remains appreciable in febrile RSV-positive infants.
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Philadelphia Criteria</th>
<th>Rochester Criteria</th>
<th>Boston Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>29-60 d</td>
<td>≤60 d</td>
<td>28-89 d</td>
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<tr>
<td>Temperature</td>
<td>≥38.2°C</td>
<td>≥38.0°C</td>
<td>≥38.0°C</td>
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<tr>
<td>History</td>
<td>Not specified</td>
<td>Term infant</td>
<td>No immunizations within preceding 48 h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No perinatal antibiotics</td>
<td>No antimicrobial within 48 h</td>
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<tr>
<td></td>
<td></td>
<td>No underlying disease</td>
<td>Not dehydrated</td>
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<tr>
<td></td>
<td></td>
<td>Not hospitalized longer than the mother</td>
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<tr>
<td>Physical examination</td>
<td>Well-appearing</td>
<td>Well-appearing</td>
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<td>Unremarkable examination</td>
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<tr>
<td>Laboratory parameters (defines lower risk patients)</td>
<td>WBC &lt;15 000/mm³</td>
<td>WBC &gt;5000 and &lt;15 000/mm³</td>
<td>WBC &lt;20 000/mm³</td>
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<tr>
<td></td>
<td>Band-neutrophil ratio &lt;0.2</td>
<td>Absolute band count &lt;1500/mm³</td>
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<tr>
<td></td>
<td>UA &lt;10 WBC/hpf</td>
<td>UA ≤10 WBC/hpf</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urine Gram stain negative</td>
<td>CSF Gram stain negative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CSF &lt;8 WBC/mm³</td>
<td>CSF &lt;8 WBC/mm³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CSF Gram stain negative</td>
<td>CSF Gram stain negative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chest radiograph: no infiltrate</td>
<td>Chest radiograph: no infiltrate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stool: no blood, few or no WBCs on smear</td>
<td>Stool: no blood, few or no WBCs on smear</td>
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<tr>
<td>Higher risk patients</td>
<td>Hospitalize + empiric antibiotics</td>
<td>Hospitalize + empiric antibiotics</td>
<td>Hospitalize + empiric antibiotics</td>
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<tr>
<td>Lower risk patients</td>
<td>Home</td>
<td>Home</td>
<td>Home</td>
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<tr>
<td></td>
<td>No antibiotics</td>
<td>No antibiotics</td>
<td>Empiric antibiotics</td>
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<tr>
<td></td>
<td>Follow-up required</td>
<td>Follow-up required</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Sensitivity— not available</td>
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<tr>
<td></td>
<td>Sensitivity 98% (92-100)</td>
<td>Sensitivity 92% (83-97%)</td>
<td>Sensitivity—not available</td>
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<tr>
<td></td>
<td>Specificity 42% (38-46%)</td>
<td>Specificity 50% (47-53%)</td>
<td>Specificity—not available</td>
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<tr>
<td></td>
<td>Positive predictive value 14% (11-17%)</td>
<td>Positive predictive value 12.3% (10-16%)</td>
<td>Positive predictive value—not available</td>
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<tr>
<td></td>
<td>NPV 99.7% (98-100%)</td>
<td>NPV 98.9% (97-100%)</td>
<td>NPV—not available</td>
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</table>

* If obtained.
NNF and Procalcitonin

- Multiple inflammatory markers have been tested – CRP, HS-CRP, Procalcitonin, and TNF
- Procalcitonin (PCT) - may be superior to CRP in the detection of early sepsis (CRP rise 14-48 after onset of infection)
- Role yet to be fully determined
NNF and Procalcitonin (PCT)

- Precursor of calcitonin and is an 116 amino acids protein.
- Half life 25-30 hrs (In contrast to calcitonin that has a short half-life of 10 min)
- Barely detectable in healthy persons
- Exact sites of production in sepsis have not been identified, monocytes and hepatic cells are believed to be potential sources.
- Bacterial lipopolysaccharide (LPS) has been shown to be a potent inducer of PCT release into the systemic circulation.
- Starts to rise from 3-4 hr after an endotoxin challenge, peak about 6 hr, and remain increased for over 24 hr.
NNF and Procalcitonin

- Levels
  - <0.05 ug/L – healthy individuals
  - <0.5 – sepsis unlikely
  - 0.5 - <2 ug/L – sepsis possible
  - >2 – 10 – sepsis is likely
  - >10 – Definite systemic inflammatory response high likelihood of sepsis or septic shock
NNF and Procalcitonin

- Increased PCT levels may not always be related to systemic bacterial infection.
  - neonates < 48 hours of life (curves available)
  - the first days after a major trauma, major surgical intervention, severe burns, treatment with OKT3 antibodies and other drugs stimulating the release of pro-inflammatory cytokines
  - patients with invasive fungal infections, acute attacks of plasmodium falciparum malaria
  - patients with prolonged or severe cardiogenic shock, prolonged severe organ perfusion anomalies

- Low PCT levels not always indicate absence of bacterial infection.
  - early course of infections
  - localized infections
  - subacute infectious endocarditis.
NNF and US Guided LP

- literature demonstrates efficacy of ultrasound guidance for introduction of a spinal needle in neonates
- preferred method of "rescue" in cases of failed landmark-guided lumbar punctures
- McLane Children’s has developed a protocol for failed LP with our Pediatric Radiologist

Viral Bronchiolitis

In bronchiolitis, the airway becomes obstructed from swelling of the bronchiole walls.
Viral Bronchiolitis

- RSV and Other viruses
- Poly-virus
- Pertussis
- Standard diagnostics
- Standard therapies
- Bronchodilators
- Hypertonic Saline
- Steroids
- High Flow Nasal Cannula
RSV

- Very predictable time line
  - 0-2 days – Mild URI symptoms, +/- fever
    - Neonate may be admitted due to fever
    - Premie – due to apnea
    - CLD or CHD patient may decompensate early
  - 3-5 days – Peak lower respiratory symptoms and dehydration
  - 7-10 days – secondary bacterial infections
  - 2-4 weeks – recovery phase
Other Viruses

- Generally undifferentiated from RSV
- Rhinovirus – definitely a rhino
- Influenza – only potentially treatable form of viral bronchiolitis
- Adenovirus, parainfluenza, human metapneumovirus
Polyvirus

- Very common
- May destroy time line
- More common in household with other children and daycare attendance
Pertussis

- Always out there
- Can be a challenge to differentiate from viral bronchiolitis
- Look for risk factors
  - Unimmunized populations
  - Sick contacts
  - Late presentation for classical viral bronchiolitis
Standard diagnostics

- AAP guidelines does not recommend any routine diagnostic testing
- If test done should be very targeted to concern

*Pediatrics* 2006;118;1774
Subcommittee on Diagnosis and Management of Bronchiolitis
Diagnosis and Management of Bronchiolitis. DOI: 10.1542/peds.2006-2223
Standard Therapies

- Supportive care
- Ribivarin – very limited utility
- Synagis – start if not already begun for high risk population
Bronchodilators

- Never definitively been shown to be helpful
- Worth a trial
- Epi versus Albuterol
- Consider asthma
  - Old for bad bronchiolitis >15 mo
  - Strong family of atopy (asthma, allergies, eczema)
  - Noted response to bronchodilators
Hypertonic Saline

- Seems to be similar to bronchodilators – worth a trial but no miracle drug
- Nebulized
- 3-5%
- With or without bronchodilator of choice
Steroids

- Not proven role in treatment in viral bronchiolitis
- May add when strong suspicion for asthma
- 2009 study that looked at combo of nebulized epi and dexamethasone in ER reportedly reduced hospitalizations
High flow nasal cannula

- Newest supportive measure
- Does seem beneficial during peak of respiratory distress to reduce work of breathing
- Mechanism not completely clear, humidification and flow, ?CPAP equivalent
**Intervention (a)**

- Select an appropriate nasal cannula size (b)
- Initiate flow @ 6 LPM and FiO₂ 1.0
- Recheck bronchiolitis score 30 minutes after initiation (a)

**Bronchiolitis score still 6 or greater?**

- Bronchiolitis score still 6 or greater?
  - NO
    - Observe patient closely.
    - Check blood gas p.r.n.
    - Wean FiO₂ by 5-10% p.r.n. toward FiO₂ 0.4 as long as SpO₂ is 88% or greater and air entry is sufficient
  - FiO₂ 0.4 or less?
    - NO
      - HFNC 2 LPM or less?
        - Once HFNC is at 2 LPM, consider standard NC @ 2 LPM
    - YES
      - Notify MD/LIP
      - Check blood gas
      - Consider CXR
      - Additional lung inflation pressure may be needed - consider CPAP/intubation

- YES
  - Increase flow immediately by 1 LPM toward max flow provided by cannula (see b)
  - Check blood gas p.r.n.

**Bronchiolitis score still 6 or greater?**

- NO
  - Observe patient closely.
  - Check blood gas p.r.n.
  - Wean FiO₂ by 5-10% p.r.n. toward FiO₂ 0.4 as long as SpO₂ is 88% or greater and air entry is sufficient

### ALGORITHM NOTES:

**Criteria**

<table>
<thead>
<tr>
<th>Respiratory Rate</th>
<th>Value</th>
<th>Points</th>
<th>Score</th>
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<tbody>
<tr>
<td>Age less than 1 year</td>
<td>40 or less</td>
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<tr>
<td></td>
<td>41-54</td>
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<td>55-65</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Over 65</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Age 1 year or greater</td>
<td>30 or less</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>31 to 38</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>39 to 45</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Over 45</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Wheeze**

- None: 0
- Expiration: 1
- Inspiration and expiration: 2
- Diminished breath sounds: 3

**Reactions**

- None: 0
- 1 location: 1
- 2 locations: 2
- 3 or more locations: 3

**Intervention (b)**

- Selecting an appropriate NC size:
  - Choose a cannula that occupies 50-75% of nares opening:
<table>
<thead>
<tr>
<th>Size</th>
<th>Min-max flow*</th>
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<tbody>
<tr>
<td>Infant</td>
<td>2-7 LPM</td>
</tr>
<tr>
<td>Infant (intermediate)</td>
<td>2-7 LPM</td>
</tr>
<tr>
<td>Pediatric</td>
<td>2-8 LPM</td>
</tr>
</tbody>
</table>

*Exceeding maximum flow may cause significant airway moisture losses and airway cooling, which may thicken secretions and worsen bronchospasm

**Higher-risk patients may include those with:**

- Pertussis, croup, tracheitis, epiglottitis, or retropharyngeal abscess
- Pneumothorax
- Bronchopulmonary dysplasia or pre-existing chronic lung disease
- Neuromuscular disease with acute infection
- Unstable cardiac conditions
Asthma

- Inflammatory factors
  - Respiratory infections
  - Temperature change
  - Allergens

- Irritants
  - Exercise
  - Strong odors
  - Cold air

- Others
  - Work
  - Medication
  - Stress and emotions
  - Food additives

- TRIGGERS
  - Exercise
  - Cold air
  - Strong odors
  - Stress and emotions
  - Food additives
  - Allergens
  - Respiratory infections
  - Temperature change
Asthma

- (ABC’s)²
- “Asthmonia”
- Dexamethasone
- Saliva and Tobacco Smoke Exposure
ABC’s²

- ABC’s – Airway, Breathing, Circulation
- ABC’s of Asthma
  - Albuterol +/- Atrovent (Bronchodilators and lots of them)
  - Bolus – fluid hydration
- Corticosteriods
  - Prednisone, Prednisolone, Methylprednisone
  - Dexamethasone
Asthmonia

- Unofficial term used by pediatric hospitalist
- Describes patient in status asthmaticus admitted for pneumonia
- Most common triggers of asthma exacerbations in children
  - Viral Respiratory Infection
  - Allergen
  - Environmental Irritants
  - Atypicals such as mycoplasma or chlamydia
- The co-incidence of asthma and pneumococcal pneumonia is exceedingly small
  - Streptococcus pneumoniae, Haemophilus influenzae and Moraxella catarrhalis seem to have no major role in asthma (Expert Rev Anti Infect Ther. 2009 Sep;7(7):869-77. doi: 10.1586/eri.09.58)
Asthmonia

- Why the confusion?
  - Fever – common with viruses
  - Elevated WBC – stress, steroids
  - Opacity(ies) on CXR – atelectasis
- Bacterial Pneumonia is not typically in the differential for a diffuse pulmonary process
  - Hypoxia and respiratory distress unusual in pneumonia
    - Hypoxia results from V/Q mismatch – need a large amount of lung involvement
    - Wheeze – TRUE musical sounds – suggestive of NOT classic bacterial etiology
  - CXR NOT helpful in differentiating bacterial vs viral
    - CXR known to ‘lag’ behind clinical sx
    - CXR of asthma can look like pneumonia
  - CXR not recommended for routine assessment of asthma - NHLBI guidelines
- If concerned enough to treat, consider azithromycin which covers mycoplasma and has some anti-inflammatory properties
- Main point is don’t undertreat the asthma because you are distracted by the “pneumonia”
Dexamethasone

- ER literature supports single or 2-dose regimens of dexamethasone as a viable alternative to a 5-day course of prednisone/prednisolone. *Pediatrics* 2014;133:493–499
- No studies have assessed role for inpatient severe asthma
- No new asthma care guidelines since 2007
- A few children’s hospitals have begun using the 2-dose regimen with anecdotal success
Saliva and Tobacco Exposure

- Detectable serum and salivary cotinine levels were common among children admitted for asthma and were associated with readmission, whereas caregiver report of tobacco exposure was not. *Pediatrics* 2014;133:e355–e362
Pediatric Maintenance Fluids
Pediatric Maintenance Fluids

- Holliday Segar
- Hospital Acquired Hyponatremia
- Intravenous Fluid Prescription
- NPO Guidelines
- Recombinant Human Hyaluronidase - Hylenex
Pediatric Maintenance Fluids

- Based on studies conducted in healthy children more than 50 years back by Holliday and Segar
  - "The maintenance need for water in parenteral fluid therapy", *Pediatrics* 1957
- Primary basis for this recommendation
  - body needs 1ml of water/1 Cal spent
  - Na and K requirement of 3 and 2 meq/100 Cals/day respectively reflects the electrolyte composition of breast and cow milk.
- Important to remember that these recommendations are appropriate for a healthy child whose kidneys can handle significant variations in volume and composition of the fluid ingested.
- Studies have established the association between hypotonic fluids administration and hospital-acquired hyponatremia in children.
Fig. 1. The upper and lower lines were plotted from data of Talbot.2 Weights at the 50th percentile level were selected for converting calories at various ages to calories related to weight. The computed line was derived from the following equations:

1. 0-10 kg—100 cal/kg.
2. 10-20 kg—1000 cal + 50 cal/kg for each kg over 10 kg.
3. 20 kg and up—1500 cal + 20 cal/kg for each kg over 20 kg.
Hospital acquired hyponatremia

- Generally, two factors are required for Hyponatremia to develop.
  - Excess electrolyte free water (EFW)
  - Non-volumetric, non-osmotic release of Anti diuretic hormone (ADH) to prevent the excretion of that water.
- Non-osmotic release of ADH (SIADH) is stimulated by many abnormal physiological states commonly encountered during acute illnesses
  - Pain
  - Anxiety
  - Nausea
  - Fever,
  - Illnesses affecting the lungs and brain
  - Peri-operative states
Hospital acquire hyponatremia

- Syndrome of inappropriate ADH secretion (SIADH) thus occurs in most sick children
- This phenomena of SIADH has clear physiological advantages in sickness.
  - increased ADH release, hyponatremia does not develop because as PNa falls, thirst is suppressed and there is no longer any large intake of water.
- The nature failed to anticipate an intravenous route of forceful fluid administration.
- In contrast, in the hospital the physician rather than the patient determines the water intake.
ADH
Thirst
Access to water

Water  Sodium

ADH

Osmotic  Non-Osmotic
Intravenous Fluid Prescription

- So what is the prescription?
  - Universal fluid choice? NS?
  - \( \frac{1}{2} \) NS?
- Role for fluid restriction?
Intravenous Fluid Prescription

- Our Prescription for our Resident Team
  - Oral rehydration for mild to moderate dehydration
  - More NG hydration
  - Remember: IVFs are not a benign intervention
  -Prescribe IVFs that are appropriate to clinical scenario (M/D/OGL) – No Universal
  - Holliday-Segar formula remains useful
  - Remember stimuli for ADH
  - NS and ½ NS with glucose are safe and likely safer for sick infants and children
  - Know current NPO recommendations to avoid unnecessary NPO with IVF
  - If using hypotonic fluids
    - Consider re-check serum sodium if on IVF more than 24 hrs, and modify fluid accordingly
  - Frequently reassess patient’s fluid requirements
  - Once a child is rehydrated and has low risk of ongoing losses consider Saline-Lock, and give prn Normal Saline "drinks" boluses
### Pediatric NPO Guidelines

<table>
<thead>
<tr>
<th>Type of food or liquid</th>
<th>Fasting time before surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatty or fried food</td>
<td>8 hours</td>
</tr>
<tr>
<td>Light meal, milk</td>
<td>6 hours</td>
</tr>
<tr>
<td>Breast milk (infants)</td>
<td>4 hours</td>
</tr>
<tr>
<td>Clear liquids</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

Anesthesiology 2011; 114:495–511
Recombinant Human Hyaluronidase - Hylenex

  - safe and effective for young children with mild/moderate dehydration
  - subcutaneous access is achieved easily, and the procedure is well accepted by clinicians and parents.
  - Used occasionally for patient with failed ORT and refusal or NGR or multiple IV attempts
Inpatient Antibiotics
Inpatient Antibiotics

- Judicious antibiotic use
- Antibiotic Stewardship
- Parental choices for common inpatient infections
- Complicated Pneumonia
- Oral versus IV
Judicious Use of Antimicrobial

- Similar to Outpatient care (URI, AOM, OME, Pharyngitis) judicious antibiotic use is essential
  - High and growing rates of resistance
- Drives to prescribe are often the same:
  - diagnostic uncertainty
  - time pressure on physicians
  - patient demand
Antimicrobial Stewardship

- primary goal of antimicrobial stewardship is to optimize antimicrobial use, with the aim of decreasing inappropriate use that leads to unwarranted toxicity and to selection and spread of resistant organisms
- McLane’s has a stewardship committee including pediatric pharmacy and pediatric infectious disease to guide and monitor appropriate antibiotic use

The careful and responsible management of something entrusted in one’s care.
Parenteral Antibiotics for Common Infections

- Age
- Location
- Common pathogens to location
- Local versus systemic
- Local resistance patterns
- Culture directed therapy
- Most common resources (Besides Dr. James Brien)
  - Pediatric Redbook
  - Nelson’s Pediatric Antimicrobial Therapy
Meningitis

- Neonate
  - GBS, E. coli, Listeria, HSV
  - Ampicillin + Cefotaxime +/- Acyclovir
- Infant and Child
  - Strep pneumo, Meningococcus
  - Vanc + Ceftriaxone
Peri orbital/Orbital Cellulitis

- Peri orbital (Preseptal)
  - Staph, Strep
  - Clinda or Vanc +/- Ceftriaxone

- Orbital
  - Sinopulmonary, Staph
  - Vanc + Ceftriaxone
  - ENT and Opht
Sinusitis

- Pan-sinusitis
  - Sinopulmonary organisms
  - Unasyn
- Pott’s puffy tumor
  - Frontal Sinusitis with frontal bone osteo and intracranial extension with epidural abscess
  - Vanc + Ceftriaxone +/- Flagyl
  - ID consult
Neck

- Peritonsillar Abscess
  - Strep, anaerobic
  - Unasyn, OR Clindamycin and Ceftriaxone
  - ENT
- Retropharyngeal Abscess
  - Strep, anaerobic, occasional staph
  - Clinda or Van + Ceftriaxone
  - ENT
- Neck (lymph node, infected cyst)
  - Staph, Strep, Anaerobes
  - Clinda or Vanc +/- Ceftriaxone
  - ENT
- Bacterial Tracheitis
  - Tracheostomies colonized with everything
  - Sinopulmonary, Staph, Pseudomonas
  - Vanc + Zosyn
UTI/Pyelonephritis

- Get correct specimen given so much rides on this diagnosis—cath if still in diapers
- E coli and other gram negatives
- 3rd gen cephalasporin or Gent
- Double gram negative coverage if:
  - Septic
  - Abnormal anatomy
  - History of resistance or unusual organisms
  - Immune compromised
- Appropriate Renal/Urologic Workup based on age
Soft tissues, bone and joint

- Staph and strep predominate, Kingella osteo reported in toddlers
- Soft tissue – Clinda IV, may add 3rd gen ceph or Gent for diaper areas
- Bone and Joint – Clinda and Ceftriaxone, Vanc if severe or septic
Pneumonia

- Community Acquired
- "Asthmonia"
- Complicated
### Table 1. CAP: Age Specific Etiologies

<table>
<thead>
<tr>
<th>Age</th>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 month</td>
<td>Group B Streptococcus, <em>E. Coli</em>, <em>L. monocytogenes</em>, CMV, HSV</td>
</tr>
<tr>
<td>1-3 months</td>
<td>Virus, <em>S. pneumoniae</em>, afebrile pneumonitis pathogens, <em>S. aureus</em></td>
</tr>
<tr>
<td>3 months-5 years</td>
<td>Virus, <em>S. pneumoniae</em>, <em>S. aureus</em></td>
</tr>
<tr>
<td>School Age</td>
<td>Virus, <em>M. pneumoniae</em>, <em>S. pneumoniae</em>, <em>C. pneumoniae</em></td>
</tr>
</tbody>
</table>
CAP

- Narrow-spectrum penicillin such as ampicillin.
- High rates of intermediate or resistant pneumococcus may require higher dosing of ampicillin to surmount the altered penicillin-binding protein that is the cause of resistant pneumococcus.
- In areas where resistance is very high (>25% of strains being nonsusceptible), a third-generation cephalosporin.
- Older children, in addition, may receive a macrolide to cover for atypical infections.
Asthmonia

- As discussed CAP not a common trigger for asthma, except for mycoplasma
- Consider macrolide ABX if “true pneumonia is of concern.
Complicated pneumonia

- <3 mo of age
- Immune deficient
- Septic
- Aspiration (oral aerobes and anaerobes)
  Clinda +/- Ceftriaxone
- Parapneumonic effusion
- Vancomycin (particularly in areas where penicillin-resistant pneumococci and methicillin-resistant S aureus [MRSA] are prevalent) along with a second- or third-generation cephalosporin
Figure 2. Algorithm for Management of Empyema in Children

Admit Diagnosis: Pneumonia Suggestive of Parapneumonic Effusion by Exam

Chest X Ray

Moderate to Large Pleural Effusion

Confirm on Chest Ultrasound

Suggestive of Infection

Loculated

Medical Management

IV Antibiotics

Clindamycin and 3rd Generation Cephalosporin

Add Vancomycin if critically ill or young infant

Interventional Management

Pleural Fluid Analysis/Culture

Fibrinolytic

VATS

by Emily A. Thorell, MD and Mary Anne Jackson, MD, Infectious Diseases Division, Children’s Mercy Hospital, Kansas City, MO
Oral versus IV Antibiotics

- “The bacteria don’t know how the antibiotics got there”
  - PO vs IV for UTI, Osteo, CAP, cellulitis
  - Dependent on illness severity, bacterial coverage, and bioavailability
  - ID Consult, PICC Line placements, and home infusion therapy
Thanks for your attention!
Any questions?