Community Acquired Pneumonia (CAP)

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What is a Clinical Pathway?

An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective, and consistent patient care.
Objectives of Pathway

- Decrease variation in antibiotic usage for CAP
- Decrease unnecessary use of broad spectrum antibiotics
  - Utilization of procalcitonin, MRSA nasal PCR
- Decrease unnecessary use of azithromycin
- Optimize ampicillin/amoxicillin dosing for local pneumococcal resistance
- Decrease antibiotic usage to shortest effective duration
- Increase appropriate use of Oseltamivir
**Background**

- **Infectious Disease Society of America published guidelines for CAP in 2011**
  - CXR required to support the diagnosis
  - Strongly encouraged testing if the result was likely to change individual antibiotic management
  - Blood cultures for those that were very ill
  - Modify antibiotic recommendations based on local susceptibility patterns
  - Treatment duration of a minimum of 5 days, afebrile 48-72 hours and no more than 1 clinical instability sign before discontinuing antibiotics

- **EPIC (Etiology of Pneumonia in the Community) Study: a prospective, multi-center, population-based, active surveillance study from Jan 1 2010-June 30, 2012**
  - 3 pediatric hospitals, 5 adult hospitals
  - Assessed the burden of pneumonia hospitalizations in children and adults in the U.S.
  - Identify viral and bacterial etiologies
  - Have conducted numerous studies on the burden of CAP
Background
EPIC Study - Publications

- Viral pneumonia was the most common cause of pneumonia among children hospitalized for CAP\(^2,3\)
- Increased rates of anti-MRSA treatment despite low prevalence of MRSA PNA\(^4\)
Updates for 2019:
What has changed in this Pathway?

• Removal of prematurity as an exclusion criteria
• Utilization of procalcitonin and its role in antibiotic usage
• Utilization of MRSA nasal swab and indications for Vancomycin use
• Azithromycin usage and second-sign restrictions
• Duration of antibiotics:
  o Mild/Moderate – 7 days
  o Severe - 14 days (but use procalcitonin to help determine duration)
• Clarified discharge antibiotics
Procalcitonin (PCT)
Background

- Precursor of calcitonin, and a cytokine mediator
- Elevated in bacterial infections (not viral)
- Studies have shown that PCT can be better at determining bacterial vs viral CAP than CRP, WBC, ESR
- Studies vary on cut-off values, but can agree that a cut-off value of 0.25 ng/mL can be used
- Data in adults, and more recently in pediatrics, show that PCT can decrease antibiotic start, decrease duration of antibiotics, and subsequently decrease number of antibiotic adverse effects
Procalcitonin (PCT) Utilization

- Now available with a quick turnaround time (TAT): STAT = 1 hour vs routine = 4 hours
- Sending STAT PCT at presentation if getting bloodwork
- Start antibiotics in patients with PCT >0.25 ng/ml
  - If PCT ≤0.25 ng/mL and concern for pneumonia developing, can repeat levels in 6-8 hours
- Consider stopping antibiotics if PCT ≤0.25 ng/mL
- For those staying inpatient for longer period of time:
  - Consider repeating PCT at day 4-5 of admission, and then every 2 days, and stop antibiotics when PCT ≤0.25 ng/mL
Respiratory BIOFIRE

• A note on respiratory BIOFIRE:
  o Tests are expensive
  o Often do not alter course of management
  o Recommend sending off influenza, RSV and STAT procalcitonin first as PCT can help determine between viral and bacterial causes (as BIOFIRE cannot)
  o BIOFIRE is only routinely recommended to test for pertussis
Azithromycin

• Several recent publications highlight the lack of efficacy of azithromycin in the use of pediatric CAP\textsuperscript{10}
• Definite lack of efficacy in children ≤5 years old
• Questionable efficacy in older patients
Connecticut Children’s Usage of Azithromycin

<table>
<thead>
<tr>
<th>Age</th>
<th>Pneumonia</th>
<th>Atypical Pneumonia</th>
<th>CAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5 years old</td>
<td>3</td>
<td>15</td>
<td>62</td>
</tr>
<tr>
<td>&gt;5 years old</td>
<td>5</td>
<td>17</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>32</td>
<td>143</td>
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</tbody>
</table>

- Large proportion of our azithromycin use for CAP is those under 5 (against pathway recommendations)
- Azithromycin usage is now RESTRICTED via Antimicrobial Stewardship Program (ASP)
MRSA in CAP

Background

- 2007 IDSA guidelines for CAP¹:
  o empiric tx for MRSA with shock, necrotizing/cavitary PNA, or risk factors for MRSA (drug use, prior flu, prior antibiotic use)
  o Early discontinuation of empiric MRSA tx if negative cultures (if S aureus doesn’t grow, likely not cause of infection)

- Problem: can only obtain a good respiratory culture 30-50% of the time
New evidence to support the use of MRSA nasal PCR to rule out MRSA pneumonia quickly\textsuperscript{11,12}

- 20\% of people are persistently colonized with S. Aureus (60\% are intermittent carriers)
- MRSA colonization usually precedes infection
- PCR testing:
  - Will remain positive regardless of organism viability and can be obtained up to 48 hours after MRSA treatment begun
  - ≥95\% negative predictive value in pneumonia
  - PCR test results within 1-5 hours
  - If negative: can reduce exposure and toxicity from vancomycin
  - If positive: possible that infection is caused by MRSA as patient is colonized and colonization often precedes infection; will support quicker time to goal concentration
MRSA Nasal PCR Utilization

- Add MRSA nasal PCR to patients who need vancomycin from pneumonia
- Stop vancomycin if MRSA nasal swab negative
This is the Community Acquired Pneumonia Clinical Pathway.

We will be reviewing each component in the following slides.
This pathway is meant for children 2 months and older with suspected CAP

Exclusion Criteria:
- Less than 2 mo of age
- Certain underlying conditions:
  - immunocompromise, congenital heart disease, bronchopulmonary dysplasia, sickle cell, neuromuscular disease
- Hospital acquired pneumonia
- Aspiration pneumonia
Management in the ED is focused on diagnosing CAP and initiating appropriate treatment based on presenting symptoms.

Not every patient with CAP requires admission.
Patients with Mild to Moderate CAP are generally safe for Med/Surg admission.

Severe CAP is defined as patients with cyanosis, impeding respiratory distress, sepsis.
- Provider concern can also be reason for PICU evaluation
Mild/Moderate CAP management:

Assess Immunization status and History:
- Up to date with Hib and Pneumococcus at 2, 4, & 6 months?
- Failed outpatient therapy?
- Empyema?
Mild/Moderate CAP management:

- Ampicillin every 6 hours will be the lone antibiotic of choice for most patients
  - Standard dosing: 200 mg/kg/day
  - Outpatient treatment failure dosing: 400 mg/kg/day
- High dose Amoxicillin may be used in well appearing patients

Outpatient treatment failure is considered when a patient does not improve on at least 48 hours of the correct antibiotic at the correct dose

- High dose Ampicillin or Ceftriaxone

Consider stopping antibiotics if procalcitonin ≤0.25 mg/mL.

- **Ampicillin** 200 mg/kg/day div q6hr (max 2 g/dose) OR
- **Amoxicillin** 90 mg/kg/day div 3 doses (max 1 g/dose)

If PCN allergy:

- **Ceftriaxone** 50 mg/kg/day (max 2 g/dose) OR
- **Clindamycin** 40 mg/kg/day div 3 or 4 doses (max 1800 mg/day)

If failed outpatient:

- **Ampicillin** 400 mg/kg/day div q6hr (max 2 g/dose) OR
- **Ceftriaxone** 75 mg/kg/day div 2 doses (max 2 g/dose)
Mild/Moderate CAP management:

If NOT fully vaccinated OR Empyema present – need to cover both resistant pneumococcus and H. flu
- Send Blood Culture if not already done
- **Ceftriaxone** is the antibiotic of choice
  - Levofloxacin may be used in the case of Cephalosporin allergy
- Consider surgery consult for moderate/large empyema
In either treatment arm:

Consider discontinuing antibiotics if procalcitonin is less than or equal to 0.25 ng/mL
Severe CAP management:

Patients with severe CAP will be more ill on presentation, and will typically require PICU admission.

On admission, work up labs should be completed if not done already.

IF starting on anti-MRSA antibiotic, please obtain MRSA PCR nasal swab.
Severe CAP management:

In patients with severe CAP, treatment starts with more broad spectrum antibiotics and MRSA coverage.

- Ceftriaxone AND Vancomycin
- If the patient has a cephalosporin allergy can use Levofloxacin AND Vancomycin

Antibiotics and Duration of treatment should be adjusted based on ongoing lab assessment.
Special Considerations: MRSA, Atypical, and Influenza

Certain patients will need additional treatment based on history, physical symptoms, and developing symptoms

- Suspect MRSA then ADD Vancomycin
- Suspect atypical IN PATIENT >5 YEARS OLD then CONSIDER addition Azithromycin (evidence lacking)
  - Unless already on Levofloxacin
- Suspected or known Influenza then ADD Oseltamavir

Suspect MRSA?
(worsening empyema/abscess despite adequate treatment, sepsis, recent proven influenza infection)
- Add Vancomycin
  - 15 mg/kg/dose q6hr (≥18 yr old: q8hr)
  - Max initial dose: 1 g/dose
  - Adjust dose based on trough to maintain 15-20 mg/l
- Send: MRSA nasal swab and consider stopping vancomycin if negative

Suspect Atypical?
(>5 yrs old AND one of following: sub-acute presentation, interstitial infiltrates, failed empiric tx for pneumococcus x48hrs, bullous myringitis OR 2-3 mo olds for chlamydia coverage OR any age for pertussis coverage)
- Add Azithromycin
  - ≥6 mo old: 10 mg/kg (max 500 mg/dose) x1-2 days, then 5 mg/kg (max 250 mg/dose) to complete 5 days
  - <6 mo old: 10 mg/kg x5 days
- Not needed if using levofloxacin.
New AAP guidelines for influenza:
• ALL hospitalized patients with positive flu PCR should receive oseltamivir treatment (regardless of duration of symptoms)
• If patients are immunocompromised or severely ill with influenza and not improving after 5 days of therapy:
  • Re-test for influenza to determine if any additional anti-influenza therapy is needed
Pathogen Identification:

Note that antimicrobial treatment should be adjusted at any point if a positive pathogen is identified.

• Including positive blood cultures
Discharge Planning:

Consider change from IV to PO antibiotics after 2-3 days of clinical improvement.

Can consider discharge once discharge criteria are met and when clinically appropriate.

- Δ IV to PO after 2-3 days clinical improvement and if clinically appropriate

Discharge Criteria:
- O₂ >90% on RA x 24 hr, decreased fever x 24 hr, increased activity/appetite, baseline mentation, compliance w treatment, f/u in place

Discharge Medications:
Total duration of treatment: 7 days for mild-moderate CAP; 14 days for severe CAP.

- PO Amoxicillin (if fully immunized; likely pneumococcus) OR PO Augmentin (if under-immunized) 90 mg/kg/day div 3 doses (max 1 gram/dose)
- If PCN allergy: Clindamycin PO 40 mg/kg/day div 3 or 4 doses (max 1800 mg/day) OR Cefdinir 14 mg/kg/day div 2 doses (max 600 mg/day)
- If MSSA concern: Augmentin (dosing as above)
- If documented resistant pneumococcus: Levofloxacin (dosing as above)
- If atypical PNA: Azithromycin (see dosing above) x 5 days total
- If influenza: Oseltamivir (see dosing above) x 5 days total
Transition to oral antibiotics:

- High dose Amoxicillin or Augmentin (90 mg/kg/day) for 7 days will be standard treatment for most patients
- Consider other medications based on the clinical circumstances.

**Discharge Criteria:**
- Δ IV to PO after 2-3 days clinical improvement and if clinically appropriate
- O₂ >90% on RA x24 hr, decreased fever x24 hr, increased activity/appetite, baseline mentation, compliance w treatment, f/u in place

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- If MSSA concern: Augmentin (dosing as above)
- If documented resistant pneumococcus: Levofloxacin (dosing as above)
- If atypical PNA: Azithromycin (see dosing above) x5 days total
- If influenza: Oseltamivir (see dosing above) x5 days total
Please note:

- Cefdinir is inferior to high dose amoxicillin or augmentin TID for the treatment of pneumococcal pneumonia
- Augmentin only provides additional H. flu and staph coverage (compared to amoxicillin)

\[ \Delta IV \text{ to PO after 2-3 days clinical improvement and if clinically appropriate} \]

**Discharge Criteria:**

- O2 >90% on RA x24 hr, decreased fever x24 hr, increased activity/appetite, baseline mentation, compliance w treatment, f/u in place
Review of Key Points

• Antibiotics:
  o Ampicillin is drug of choice in most cases!
    – Use high dose (400mg/kg/day) for failed outpatient treatment
  o Use Ceftriaxone if not fully immunized (Prevnar and Hib), if empyema present or if severely ill
  o If (+) blood culture, use sensitivities
Review of Key Points

• Procalcitonin is a useful biomarker to determine between bacterial vs viral CAP
• Procalcitonin can be utilized to determine antibiotic duration
• MRSA nasal PCR can be utilized to determine if vancomycin is necessary
• Azithromycin is not typically indicated for CAP and will be restricted in its usage

• Duration of antibiotics:
  o Mild/Moderate – 7 days
  o Severe - 14 days (but use procalcitonin to help determine duration)
Quality Metrics

- Percentage of eligible patients treated per pathway
- Percentage of patients with order set usage
- Percentage of patients with appropriate inpatient antibiotic selection
- Percentage of patients with correct inpatient discharge antibiotic selection
- Percentage of patients with correct inpatient discharge antibiotic dosage
- Average duration of antibiotic coverage (inpatient + outpatient prescription)
- Percentage patients who had a CBC, who also had procalcitonin drawn
- Percentage of patients with a procalcitonin level ≤0.25 who receive an antibiotic
- Percentage of patients who receive vancomycin or linezolid
- Percentage of patients with negative MRSA PCR, and vancomycin or linezolid discontinued
- Admit length of stay (days)
Pathway Contacts

• Jennifer Girotto, PharmD, BCPPS, BCIDP
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• Grace Hong, APRN
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  o Connecticut Children’s Pediatric Hospital Medicine
References


About Connecticut Children’s Clinical Pathways Program

Clinical pathways guide the management of patients to optimize consistent use of evidence-based practice. Clinical pathways have been shown to improve guideline adherence and quality outcomes, while decreasing length of stay and cost. Here at Connecticut Children’s, our Clinical Pathways Program aims to deliver evidence-based, high value care to the greatest number of children in a diversity of patient settings. These pathways serve as a guide for providers and do not replace clinical judgment.

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