Community-Acquired Pneumonia Educational Module
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with contributions from the CAHO ASP Project Team

Antimicrobial Stewardship Program (ASP) in Intensive Care Units (ICU) ARTIC Project
Community-Acquired Pneumonia Educational Module
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“Getting patients the right antibiotics, when they need them”

SCENARIO

SK is a 56 year old female (no known allergies) from home brought to ED today via EMS following 2 days of worsening shortness of breath and right sided chest pain with productive cough and some alteration in level of consciousness this morning. On exam in ED she was febrile at 38.7°C with an oxygen saturation of 83% on room air. She was given IV fluids and a dose of antibiotics in the emergency room. She was taken to the ICU for mechanical ventilation. A set of blood cultures was taken prior to the antibiotics being administered. Her white blood cell count is 18.1 x 10⁹/L and neutrophils are 13.7 x 10⁹/L. Chest x-ray reveals a dense consolidation in the right lower lobe.

KEY MESSAGES

✧ Empiric antimicrobial treatment should include coverage for Streptococcus pneumoniae, Legionella species and Haemophilus influenzae. Other organisms should be covered on a case-by-case basis.

✧ Empiric treatment should be a 3rd generation cephalosporin plus a macrolide. Patients with severe allergic reactions should receive a respiratory fluoroquinolone alone.

✧ Treatment duration for uncomplicated CAP should not exceed 7 days.
BACKGROUND

Community-acquired pneumonia is a significant cause of morbidity, mortality and healthcare costs. In Canada, pneumonia and influenza are the eighth most common cause of death\(^1\). As many as 36% of patients with CAP require ICU admission and these patients have mortality ranging from 21-58%\(^2\). As well, patients with CAP in the ICU have longer durations of stay compared to those that are not in the ICU and this is associated with higher hospital costs\(^2\).

CLINICAL PRESENTATION

There are no set diagnostic criteria for CAP. The diagnosis is based on history, physical exam, and supported by radiological imaging of the lung.

Common symptoms include\(^3\):

- Fever
- Chills
- Pleuritic chest pain
- Cough producing mucopurulent sputum

Physical exam may reveal\(^3\):

- Fever
- Tachycardia
- Tachypnea
- Pleural rub
- Evidence of consolidation (dullness to percussion, crackles, bronchial breath sounds, egophony, increased fremitus)

For patients with CAP admitted to the ICU, blood cultures and urine for *Legionella* antigen should be obtained. Sputum cultures can be considered.
ETIOLOGY

Organisms

The most commonly identified bacteria responsible for CAP in a patient admitted to the ICU are:

- *Streptococcus pneumoniae*
- *Legionella* species
- *Haemophilus influenzae*

However, many other organisms can be implicated. Viruses, especially Influenza A and B and others causing influenza-like illness are notably common during influenza season. *Staphylococcus aureus* and Enterobacteriaceae are uncommon but are associated with high mortality. Although methicillin-resistant *Staphylococcus aureus* (MRSA) is an uncommon cause of CAP overall, in Western Canada and the United States in particular it has been found to be an important cause of severe CAP. MRSA may be suspected in a patient who is known to be colonized or previously infected with MRSA, although there may be other risk factors to consider.

Resistance

*Streptococcus pneumoniae* resistance from adult respiratory specimens from Ontario laboratories participating in the Canadian Bacterial Surveillance Network (CBSN)/Toronto Invasive Bacterial Diseases Network in 2010-2011 are shown below. Data are courtesy of Dr. Allison McGeer, Mount Sinai Hospital.

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Percent resistance in pneumococcal isolates</th>
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<tbody>
<tr>
<td>macrolides</td>
<td>28%</td>
</tr>
<tr>
<td>doxycycline</td>
<td>16%</td>
</tr>
<tr>
<td>cefuroxime</td>
<td>12%</td>
</tr>
<tr>
<td>amoxicillin</td>
<td>4.5%</td>
</tr>
<tr>
<td>levofloxacin</td>
<td>1.8%</td>
</tr>
<tr>
<td>penicillin IV (non-meningitis MIC)</td>
<td>0.4%</td>
</tr>
</tbody>
</table>
The following table shows the proportion of *H. influenzae* submitted to CBSN from Ontario laboratories in 2008-2009 which were resistant to ampicillin/amoxicillin. Data are courtesy of Dr. Donald Low, Mount Sinai Hospital.

<table>
<thead>
<tr>
<th></th>
<th>Percent of isolates resistant to ampicillin</th>
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<tbody>
<tr>
<td><em>H. influenzae</em> – outpatients</td>
<td>18%</td>
</tr>
<tr>
<td><em>H. influenzae</em> – in patients</td>
<td>22%</td>
</tr>
</tbody>
</table>

**PHARMACOTHERAPY**

**EMPIRIC**

To cover the most common organisms causing CAP in patients admitted to the ICU, and taking into account Ontario resistance patterns, first line empiric treatment should consist of a 3rd generation cephalosporin (ceftriaxone or cefotaxime) and a macrolide (azithromycin IV). The 3rd generation cephalosporin will cover two of the most common causes of CAP, *Streptococcus pneumoniae* and *Haemophilus influenzae*, as well as some Enterobacteriaceae (*E. coli*, *Klebsiella pneumoniae* and *Proteus mirabilis*). The macrolide is used for its coverage of *Legionella* species. If MRSA is suspected, then vancomycin should be added. If the patient has a severe allergy to beta-lactams, then a fluoroquinolone with reliable *Streptococcus pneumoniae* coverage should be used (levofloxacin or moxifloxacin). Levofloxacin and moxifloxacin also have good coverage for *Legionella* species, *Haemophilus influenzae* and Enterobacteriaceae. During influenza season, consider adding empiric antiviral therapy with oseltamivir for severe CAP, although there are no randomized trials that support or refute this approach.

It should be noted that for ICU treatment of CAP, the IDSA/ATS CAP guidelines recommend a beta-lactam (cefotaxime, ceftriaxone, or ampicillin-sulbactam) plus either azithromycin or a fluoroquinolone. From an antimicrobial stewardship perspective, the preference is for a beta-lactam plus azithromycin rather than a beta-lactam plus fluoroquinolone since fluoroquinolones:

- have unnecessarily broad gram-negative coverage for CAP
- are generally over-utilized
- are associated with the emergence of the NAP1 strain of *C. difficile*. 
TARGETED

If a pathogen is identified, therapy should be tailored to the most narrow spectrum antimicrobial that the organism is susceptible to and that the patient can tolerate. For example, if *Streptococcus pneumoniae* is cultured and is sensitive to penicillin, 3rd generation cephalosporins, respiratory fluoroquinolones and vancomycin, then treatment should be changed to penicillin IV 12-16 MU/day, as long as the patient does not have a penicillin allergy.

DURATION OF THERAPY

Treatment for CAP in the ICU should not exceed 7 days, as long as the patient is improving and has no complications such as empyema or extrapulmonary infection such as meningitis. For patients with bacteremic CAP consider 7 days of treatment, unless *Staphylococcus aureus* bacteremia is identified in which case treatment should be for a minimum of 14 days. If *Legionella* antigen is negative, azithromycin can be discontinued.

REFERENCES