WHAT'S NEW in this update?

Updated antibiotic recommendations:

- Use the Drug Resistance in Pneumonia (DRIP) score to identify inpatients at risk for MRSA, *pseudomonas*, and other bacteria resistant to usual CAP therapy. (See page 4.)

- For most outpatients, prescribe doxycycline alone or azithromycin plus amoxicillin (needed to address macrolide resistance) (See page 3).

GOALS

- Prompt and correct diagnosis, including a chest x-ray whenever possible

- Consistent use of objective, severity-of-illness criteria (CURB-65) to guide site-of-care decisions

- Prompt administration of appropriate antibiotics (varies by site of care and risk for resistant bacteria [DRIP])

- Influenza and pneumococcal vaccines for all appropriate inpatients and outpatients

- Venous thromboembolism (VTE) prophylaxis and early ambulation for all inpatients

MEASURES

- Compliance with antibiotic recommendations

- 30-day, all-cause mortality

- Length of hospital stay

- Appropriate site of care decisions

- Readmission rate
Community-Acquired Pneumonia (CAP)

(a) Symptoms suggestive of pneumonia:
- Fatigue 91%
- Chills 73%
- Cough 86%
- Dyspnea 72%
- Fever 74%
- Anorexia 71%
- Sweats 69%
- Pleuritic chest pain 46%
- Hemoptysis 16%
- Headache 58%
- Vomiting 25%
- Myalgia 51%
- Abdominal pain 16%

Note: In older patients, confusion is more common; fever, chills, sweats, headache, and myalgia are less common.

(b) Fever. During influenza season, fever alone may not require chest x-ray if no other signs or symptoms of pneumonia are present.

(c) Chest x-ray (CXR). Whenever possible, a chest x-ray should be used to confirm diagnosis of pneumonia. Either a positive CXR or CT scan is required to make the diagnosis per international guidelines. Keep in mind, however, that not everyone with a new radiographic shadow, cough, fever, and leukocytosis has CAP. Conversely, a negative x-ray is rarely followed by a subsequent positive film. If you suspect pneumonia despite a negative x-ray, begin treatment and repeat the x-ray in about 2 days.

(d) Alternate diagnoses. Influenza is probable if the patient is febrile, has severe myalgia, no rhinorrhea, and influenza is present in the community. Consider oseltamavir therapy. Other diagnoses to consider include:
- Acute bronchitis
- Acute exacerbation of chronic bronchitis
- Aspiration pneumonitis
- Hypersensitivity pneumonitis
- Lung cancer
- Pertussis
- Pulmonary embolism (with infarction)
- Pneumocystis, tuberculosis
- Hantavirus
- Sepsis with acute lung injury
- Travel-related infection

(e) CURB-65. About 75% of patients with pneumonia can be treated safely at home. Home treatment is significantly less costly than hospital treatment, and less-ill patients get better faster and have lower mortality rates at home. The simple, 5-point, CURB-65 severity risk scoring system shown here can quickly and accurately predict mortality risk and triage the patient into the appropriate management group.
**ALGORITHM: TREATMENT**

### Outpatient treatment

**Previously healthy AND no antimicrobial use within the last 3 months**
- **Mild pneumonia**
  - **Antibiotics (f):**
    - **Doxycycline**, 100 mg orally twice daily for 7 days (doxycycline monohydrate preferred)
    - OR
    - **Azithromycin**, 500 mg orally daily for 3 days PLUS amoxicillin, 1,000 mg 3 times daily for 7 days (if pregnant or allergic to doxycycline, use azithromycin.)
  - **Vaccinations:** Screen for influenza and pneumococcal vaccines, and give if appropriate (g)

**Moderate pneumonia**
- **Antibiotics (f):**
  - **Doxycycline**, 100 mg orally twice daily for 7 days (doxycycline monohydrate preferred)
  - OR
  - **Azithromycin**, 500 mg orally daily for 3 days (If pregnant, or allergic to doxycycline, use azithromycin.)
  - **Ceftriaxone**, 1 g IV daily until stable, then amoxicillin, 1,000 mg orally twice daily for 7 days
  - PLUS
  - Ceftriaxone, 1 g IV or IM daily until stable, then amoxicillin, 1,000 mg orally 3 times daily for 7 days

**Other outpatient best practices**
- **Patient education.** Use Intermountain’s *Pneumonia: Prevention and Care at Home* fact sheet, available from i-printstore.com.
- **Follow-up visit or phone call in** 48 to 72 hours.
- **Follow up in 6 weeks:**
  - Repeat CXR in 6 weeks if smoker > 35 years or for anyone age > 60.
  - 6-week follow-up visit: Give influenza and pneumococcal vaccines if not already given (g).
- **Provide smoking cessation advice/counseling (if applicable).** Use Intermountain’s *Quitting Tobacco: your journey to freedom* booklet available from i-printstore.com.

### Hospital treatment

**Non-ICU care**
- If not already done, consider blood cultures **BEFORE starting antibiotic.** Do not wait for culture results before giving antibiotics.
  - Non-ICU care
  - **Antibiotics (f):**
    - **Ceftriaxone**, 1 g IV every 12 hours until stable, then amoxicillin, 1,000 mg 3 times daily for total course of 7 days
    - OR
    - **Azithromycin**, 500 mg IV daily for 3 days
  - PLUS
  - **Ceftriaxone**, 1 g IV or IM daily until stable, then amoxicillin, 1,000 mg orally twice daily for 7 days

**ICU care**
- If not already done, draw 2 sets of blood cultures **BEFORE starting antibiotic.** Do not wait for culture results before giving antibiotics.
  - **Antibiotics (f):**
    - **Ceftriaxone**, 1 g IV every 12 hours until stable, then amoxicillin, 1,000 mg 3 times daily for total course of 7 days
    - OR
    - **Azithromycin**, 500 mg IV daily for 3 days
  - For antibiotic alternatives, refer to the PNEUMONIA ICU ORDER SET. (See page 4 for access directions.)

**Other inpatient best practices**
- **Patient education.** Use Intermountain’s *Pneumonia: Guide to Hospital Care* fact sheet available from i-printstore.com.
- **Early ambulation.** Have patient sit in chair and/or ambulate for at least 20 minutes during the first 24 hours of hospitalization.
- **VTE prophylaxis.**
- **Provide smoking cessation advice/counseling (if applicable).** See left for patient education information.
- **Influenza and pneumococcal vaccines before discharge.** (g)

### Dosing notes

- **doxycycline** (doxycycline monohydrate preferred)
  - INSTRUCT patients to take with full glass of water and remain upright for 1 hour.
  - Has phototoxic side effect.
  - Contraindicated for children under 8 years old.
  - Category D in pregnancy. Use azithromycin for pregnant women.
- **Doxycycline monohydrate** is lower cost than other compounds and has lower GI toxicity.

- **azithromycin**
  - Z-Pak dosing is obsolete. Newer dosing is 500 mg daily for 3 days.

- **ceftriaxone**
  - When stable (afebrile for 12 hours, WBC improving or normal, and patient feeling better), switch to amoxicillin to complete 7-day course.

- **amoxicillin**
  - If beta-lactam allergic: Monotherapy with levofloxacin (Levaquin) 750 mg orally once daily for 5 days. Do not combine levofloxacin with doxycycline or azithromycin.

- **cefepime**
  - Requires renal adjustment for subsequent dosing.

- **vancomycin**
  - Requires renal adjustment for subsequent dosing.

### Vaccinations

- All patients should be screened for need for an influenza or pneumococcal vaccine at outpatient clinic visits or before discharge (if hospitalized).
- **Influenza:** All patients ≥ 6 months should have an annual influenza vaccination to ensure appropriate protection against new antigenic types.
- **Pneumococcal vaccines:**
  - At age > 65 years, give PCV13 (Prevnar)
  - At least 1 year later, give PPSV23 polysaccharide vaccine (Pneumovax)
  - Then, no further pneumococcal vaccines after age 65

If vaccine status is unknown, vaccination is recommended. Both vaccines can be given simultaneously, but each should be given at a separate site. Moderate-to-severe acute illness with or without a fever is a precaution for all vaccines, but the following are not considered precautions or contraindications (i.e., vaccines can be given): fever, mild disease with or without fever, convalescence phase of an illness.
DRUG RESISTANCE IN PNEUMONIA (DRIP) SCORING

DRIP scoring identifies patients at risk for infection with MRSA, Pseudomonas, and other bacteria resistant to usual CAP therapy. (DRIP replaces the HCAP criteria, which do not accurately identify at-risk patients or improve mortality.)

To calculate the DRIP score for a patient, sum the points for applicable risk factors shown in the table below. A score ≥4 indicates an increased risk of drug-resistant pneumonia. In such cases, consider using an antipseudomonal beta lactam (cefepime or piperacillin-tazobactam) plus a macrolide (azithromycin), and an anti-MRSA agent (vancomycin or linezolid).

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotic use &lt; 60 days</td>
<td>2</td>
</tr>
<tr>
<td>Long-term care resident</td>
<td>2</td>
</tr>
<tr>
<td>Tube feeding</td>
<td>2</td>
</tr>
<tr>
<td>Prior drug-resistant pneumonia (DRP) (1 year)</td>
<td>2</td>
</tr>
<tr>
<td>Hospitalization &lt; 60 days</td>
<td>1</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>1</td>
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<tr>
<td>Poor functional status</td>
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<tr>
<td>Gastric acid suppression</td>
<td>1</td>
</tr>
<tr>
<td>Wound care</td>
<td>1</td>
</tr>
<tr>
<td>MRSA colonization (1 year)</td>
<td>1</td>
</tr>
</tbody>
</table>

To calculate the DRIP score for a patient, sum the points for applicable risk factors shown in the table below. A score ≥4 indicates an increased risk of drug-resistant pneumonia. In such cases, consider using an antipseudomonal beta lactam (cefepime or piperacillin-tazobactam) plus a macrolide (azithromycin), and an anti-MRSA agent (vancomycin or linezolid).

Use Intermountain’s e-tool for calculating DRIP. Click here or from Intermountain.net, type “DRIP” into the address bar.

ANTIBIOTICS DISCUSSION

- Increased macrolide resistance appeared in 2013 and 2014. Macrolide resistance (azithromycin, erythromycin, and clarithromycin) among Streptococcus pneumoniae isolates has increased at all Utah Intermountain hospital microbiology labs. Resistance has increased among respiratory pneumococcal isolates to 60% in northern Utah and 32% in St. George. Among blood isolates from adults, resistance is now 15% to 35% in northern Utah and 21% in St. George.

- Why has resistance increased? Increased resistance results from Z-Pak (azithromycin) prescribing for chest colds and sinus infections and perhaps under-vaccination with PCV13 (Prevnar) in children. Children vaccinated with PCV13 have greatly reduced carriage of most multi-drug-resistant pneumococcal strains. Pneumococcus remains the most common and deadly bacteria that causes pneumonia.

- What antibiotics provide coverage? Pneumococcal activity remains very high for ceftriaxone and amoxicillin. (Clavulanate in Augmentin contributes nothing against streptococci.) Azithromycin remains effective for treatment of other pathogens that cause pneumonia, such as Mycoplasma, Chlamydia, Haemophilus influenzae, and Moraxella.

- Generic, first-line antibiotics should be used whenever possible. All recommended first-line antibiotics are available in generic form. They are as effective as brand-name antibiotics.

- Quinolones SHOULD NOT be used as first-line therapy due to documented immune-modulating effects of macrolides and lower mortality with combined therapy versus quinolone monotherapy in sicker patients. Overuse of quinolones has led to increased resistance. If a quinolone is used, the recommended dose of levofloxacin (Levaquin) remains at 750 mg for 5 days; adjust subsequent doses if creatinine clearance less than 30. Longer courses increase cost, drive resistance, and increase the likelihood of secondary C. difficile.

RESOURCES

The following Intermountain resources are available on the Pneumonia topic page at intermountainphysician.org/clinicalprograms or intermountain.net/clinicalprograms:

- Care process models. CPMs are available for related diagnoses such as Bronchitis, Asthma, and COPD. A Pediatric Community-Acquired Pneumonia CPM is also available.

- Flash cards. Adult and Pediatric CAP flash cards summarize key decision points from the CPMs.

- Patient education. Patient fact sheets are available for Pneumonia (at Home and in the Hospital), Colds and Coughs (Adult and Children/Adolescents), and other topics. A smoking cessation booklet is also available. All patient education can be accessed and ordered at i-printstore.com.

- Order sets. Both ICU and NON-ICU ORDER SETS are available on the Pneumonia topic page of intermountainphysician.org/clinicalprograms as well as in the Clinical Forms library. The materials will also appear in the iCentra EMR as suggested patient education items.

REFERENCES

Citations are available on the Pneumonia topic page of intermountainphysician.org/clinicalprograms.

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This CPM is based on best evidence at the time of publication. It is not meant to be a prescription for every patient. Clinical judgment based on each patient’s unique situation remains vital. We welcome your feedback. Contact Nathan Dean, MD, at 801-507-4696 or Nathan.Dean@imail.org.