CARILION CLINIC Antimicrobial Stewardship

Guideline for the Treatment of Outpatient and Inpatient Pneumonia in Adults

Last updated: 1/2021

Disclaimer: These guidelines are not intended to replace clinical judgment. Pneumonia order sets based on the following recommendations have been built in Epic for provider convenience. An Infectious Diseases consultation is always available for complex patients and should be strongly considered for severe infections and immunocompromised patients. Please refer to the Carilion Clinic: Antibiotic Dosing Optimization Recommendations for additional antibiotic dosing guidelines.

Major Updates from Previous Institutional Guidelines
Additional information on when to order urinary antigens and respiratory cultures
Removal of azithromycin monotherapy as a treatment option for outpatient CAP
Removal of HCAP and utilizing a more targeted approach to risk-stratify possibility of MRSA or *Pseudomonas*
Addition of MRSA swab guidance
Addition of HAP/VAP section

Community-Acquired Pneumonia (CAP)

1. Assessment of Severity

a. Outpatient vs. Inpatient

- A **CURB-65 Score**, in addition to consideration of comorbidities and other patient-specific factors, may be calculated to assist in treatment disposition decisions.
  - 1 point assigned for the presence of each of the following patient characteristics:
    - **C**onfusion
    - **U**rea (BUN > 20 mg/dL)
    - **R**espiratory rate ≥ 30 breaths/min
    - **B**lood pressure (systolic < 90 mmHg or diastolic ≤ 60 mmHg)
    - **65** years of age or older
  - Recommended site of care based on total CURB-65 score:

Score	30-day Mortality Risk	Treatment Disposition
0 –1	0.7 – 2.1%	Outpatient
2	9.2%	Outpatient or Inpatient
3	14.5%	Inpatient ± ICU
4 – 5	40 – 57%	ICU

- The **Pneumonia Severity Index (PSI)** is another risk stratification tool that may be considered, though is more difficult to use in practice
  - See appendix for full scoring reference
  - Final step: risk stratification based on total score

Score	Risk Class	Setting	Mortality risk
N/A	I	Outpatient	0.1 – 0.4%
≤ 70	II	Outpatient or inpatient	0.6 – 0.7%
71-90	III	Outpatient or inpatient	2.8%
91-130	IV	Inpatient ± ICU	8.2 – 8.5%
>130	V	ICU	29.2 – 31.1%

b. ICU vs. Non-ICU

Patients meeting the criteria for **Severe CAP** are at an increased risk of mortality and should be admitted to the ICU. Severe CAP is defined by the presence of either of the major criteria (i.e. need for mechanical ventilation or septic shock requiring vasopressors) or the presence of **three or more of the following minor criteria:**

- RR ≥ 30 breaths/min
- PaO2/FiO2 ≤ 250
- Multilobar infiltrates
- Confusion
- BUN ≥ 20
- WBC < 4
- Platelets < 100
- Hypothermia (< 36 °C)
- Hypotension requiring fluid resuscitation

2. Microbiology (CAP)

This chart is not intended to replace susceptibility data. For more information on expected susceptibilities, please refer to the CRMH Inpatient Antibiogram.

	Streptococcus spp. (particularly Streptococcus pneumoniae)	*H. influenzae, M. catarrhalis*	Atypicals (*M. pneumoniae, C. pneumoniae, Legionella spp.*)	Gram-negative bacilli	*Pseudomonas spp.*	MRSA	Oral anaerobes
Setting							
Outpatient	±	+++	++	-	-	-	-
Inpatient (non-ICU)	+	+++	++	-	-	-	±
Severe (ICU)	+++	+	+	+	±	+	±
Aspiration	±	±	±	±	-	±	+++
CAP w/ risk factors for MRSA or *Pseudomonas*	++	±	±	++	++	+++	-
Expected Coverage							
Azithromycin*				No enterics			Gram + only
Doxycycline							
Levofloxacin							Gram + only
Moxifloxacin							
Ampicillin/sulbactam							
Amoxicillin/clavulanate							
Piperacillin/tazobactam							
Cefpodoxime, Cefdinir							
Ceftriaxone							
Cefepime							
Aztreonam							
Vancomycin							Gram + only
Linezolid							Gram + only
Clindamycin							Weak Gram -
Metronidazole							

***Monotherapy is not an option due to increased risk of Drug-Resistant *Streptococcus pneumoniae* (DRSP) in our area.**

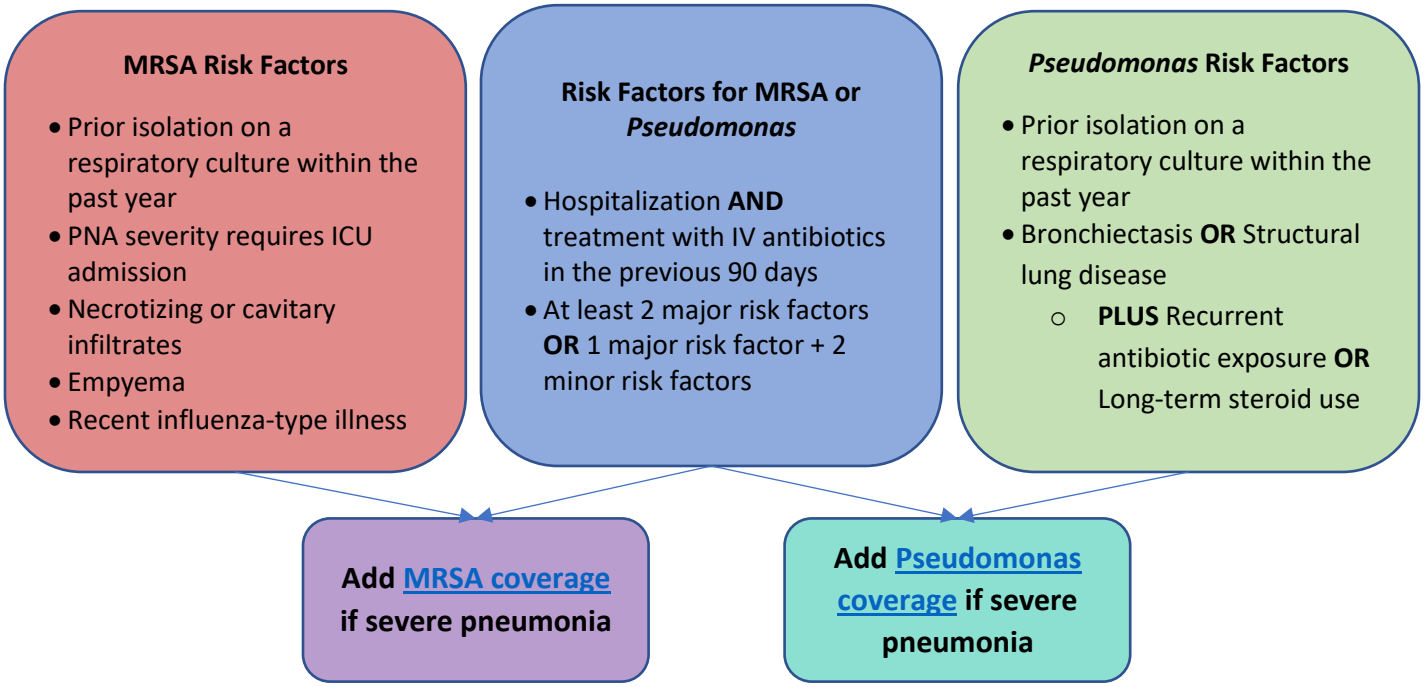
Note: Respiratory viruses may cause primary pneumonia and lead to secondary bacterial superinfection. Influenza testing should be considered.

3. Obtaining antigen testing/cultures

Antigen testing	**Pneumococcal urine antigen** • Patients with severe CAP	***Legionella* urine antigen** • Patients with severe CAP or • Possible exposure to a locality with a *Legionella* outbreak
Cultures	**Sputum cultures** • Patients classified as severe CAP • Patients receiving empiric treatment for MRSA or *P. aeruginosa* • Patients previously infected with MRSA or *P. aeruginosa* (particularly if those cultures were from respiratory tract) • Recent hospitalization with receipt of IV antibiotics in the previous 90 days	**Blood cultures** • Patients classified as severe CAP • Patients receiving empiric treatment for MRSA or *P. aeruginosa* • Patients previously infected with MRSA or *P. aeruginosa* (particularly if those cultures were from respiratory tract) • Recent hospitalization with receipt of IV antibiotics in the previous 90 days

4. Risk factors for MRSA or *Pseudomonas*

Major Risk Factors	Minor Risk Factors
• Antibiotic use (IV/PO) within previous 60 days • Skilled nursing facility (SNF) with limited mobility • Chronic tube feeds • Prior infection with MDRO in previous year	• Hospitalization within previous 60 days • Chronic pulmonary disease • Poor functional status • Gastric acid suppression • MRSA colonization in the previous year



5. Antibiotic Selection

Outpatient CAP		
Otherwise healthy (and no comorbidities)	• Doxycycline or Amoxicillin (dosing guidance) *Azithromycin monotherapy not currently recommended as an option due to macrolide resistance rates of ~40% in our area.	**Comorbidities associated with poor outcomes of *S. pneumoniae* infection** • Age ≥ 65 years • Alcoholism • Diabetes mellitus • Malignancy/immunosuppression • Chronic heart, lung, liver, or renal disease (e.g. asthma/COPD, cirrhosis, hemodialysis)
Comorbidities present	• Cefdinir, Cefpodoxime, Cefuroxime, OR Amoxicillin/clavulanate + Azithromycin or Doxycycline (dosing guidance) **OR** Moxifloxacin or Levofloxacin	

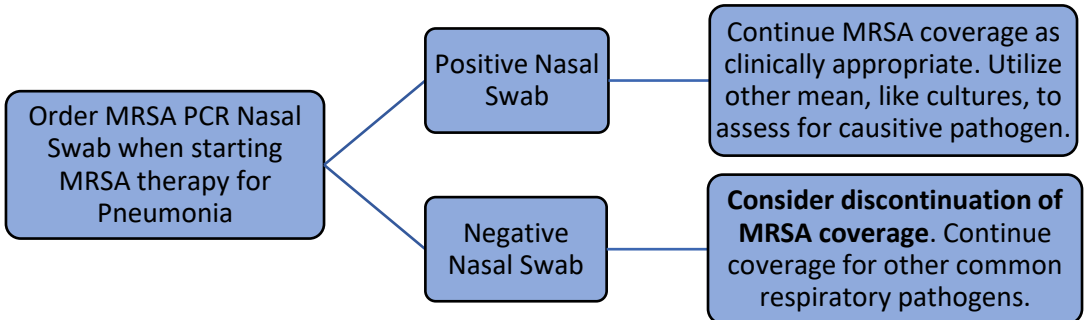
Inpatient CAP with NO risk factors for MRSA or *Pseudomonas*	
Non-ICU Admission (consider oral agent as soon as patient improving and taking PO) **OR** **Severe CAP and ICU Admission**	• **PREFERRED:** **Ceftriaxone OR ampicillin/sulbactam* +** **Azithromycin (or Doxycycline)** • **TRUE β-lactam allergy: Levofloxacin • **Stepdown:** **Cefdinir, cefpodoxime, cefuroxime, OR amoxicillin/clavulanate** (dosing guidance) ****+/- Doxycycline*** Alternative: Levofloxacin

*Consider ampicillin/sulbactam if patient has concurrent indications for this medication
**Consider penicillin allergy assessment
***Azithromycin has an extended half-life (~72 hours) and **does not need** to be continued in patients who received multiple doses as an inpatient. If doxycycline is utilized for atypical coverage, it should be continued in addition to a PO cephalosporin.

Inpatient CAP with risk factors for MRSA or *Pseudomonas*		
***Pseudomonas* or MRSA risk factors present with NON-SEVERE pneumonia**	• Withhold MRSA or Pseudomonas coverage and obtain cultures • If cultures are positive, initiate antibiotics	
***Pseudomonas* Risk Factors Present with SEVERE pneumonia** (narrow coverage at 48h if culture not c/w *Pseudomonas*)	• **PREFERRED:** **Cefepime** • *TRUE β-lactam allergy: Meropenem If high concern for MDR-Pseudomonas, consider adding tobramycin	**Risk Factors for MDR-*Pseudomonas*** • History of MDRO infection • Neutropenia • High local prevalence • Recent ICU admission • Hospitalization ≥ 5 days
High Risk for MRSA with SEVERE pneumonia (narrow coverage at 48h if culture ± screening not c/w MRSA)	• Add: Vancomycin or Linezolid* • Order MRSA PCR nasal swab *Consider switch from vancomycin to linezolid if patient is not clinically improving, has inadequate vancomycin levels, or if the vancomycin MIC is ≥ 2 mcg/mL in confirmed MRSA	
MRSA Nasal Swabs	MRSA PCR nasal swabs should be ordered when initiating MRSA coverage in CAP. Swab results are processed in ~ 2 hours and can rule out MRSA pneumonia allowing for quick discontinuation of unnecessary therapy. Positive MRSA swabs should never be used to initiate MRSA coverage. There is no correlation with a positive swab result and MRSA pneumonia. **See Flowchart**	

MRSA Swabs cannot be used to rule out Pneumonia when:

- Positive PCR or Culture in the last 7 days for MRSA
- Ventilated at collection time
- Decolonization in previous 30 days
- Hx of Bronchiectasis/cystic fibrosis



Aspiration Pneumonia		
Large Volume Aspiration (treatment indicated if concern for lung abscess or empyema)	• Add: Clindamycin or Metronidazole OR • Switch to: ampicillin-sulbactam (piperacillin-tazobactam if concerned for *Pseudomonas* – hospitalization for > 48 hours)	**Risk Factors for Aspiration PNA** • Gingival disease • Esophageal motility disorder Plus • Loss of consciousness (secondary to seizure, overdose, EtOH, etc.)

6. Duration of Therapy

Prolonged courses of antibiotics are not necessary for pneumonia. Cough and chest X-ray abnormalities may linger long after effective treatment (4 – 6 weeks) but antibiotics do not need to be continued if the patient is otherwise asymptomatic. **Repeat chest X-rays should not be obtained to assess for clinical resolution**.

Most patients will begin to show signs of clinical improvement within 48 – 72 hours of treatment initiation and can be treated for 5-7 days. Consider ID consultation for organism-specific duration concerns. **Non-responders should be evaluated for alternative sources of infection or noninfectious mimics of pneumonia.**

Treatment should ALWAYS be narrowed based on culture results. There is no documented benefit to prolonged use of double coverage for *Pseudomonas spp.*

Therapy can be stopped after the patient:

- Receives at least 5 days total of active therapy
- Is afebrile for >48 hours
- Meets IDSA criteria for clinical stability (no more than one of the following symptoms):
  - Heart rate >100 bpm
  - Respiratory rate >24 breaths/min
  - Systolic BP <90 mmHg
  - O_2 sat <90%
  - Altered mental status

Treatment duration:

5 days	7 days	10+ days (consider ID consultation)
• Mild-to-moderate pneumonia • Immunocompetent • No structural lung disease	• Moderately immunocompromised • Structural lung disease	• Poor/delayed clinical response • Extrapulmonary infection • Significantly immunocompromised

*Exception: Azithromycin 500 mg IV/PO daily x 3 days

Patients should be changed to oral therapy when clinically stable and able to tolerate oral medications.

- Exposure to an additional antibiotic class at stepdown and/or discharge should be avoided to minimize collateral damage.

Hospital-acquired Pneumonia (HAP) and Ventilator-associated Pneumonia (VAP)

1. **Definitions**
   a. **HAP**: pneumonia occurring 48 hours or more after admission
   b. **VAP**: pneumonia occurring 48 hours or more after intubation

2. **Microbiology**

	Streptococcus spp. (particularly Streptococcus pneumoniae)	*H. influenzae, M. catarrhalis*	Atypicals (*M. pneumoniae, C. pneumoniae, Legionella spp.*)	Gram-negative bacilli	*Pseudomonas spp.*	MRSA	Oral anaerobes
Setting							
HAP/VAP	-	-	-	++	++	++	-
Expected Coverage							
Piperacillin/tazobactam							
Cefepime							
Aztreonam							
Vancomycin							Gram + only
Linezolid							Gram + only
Clindamycin							Weak Gram -
Metronidazole							

3. **Treatment**

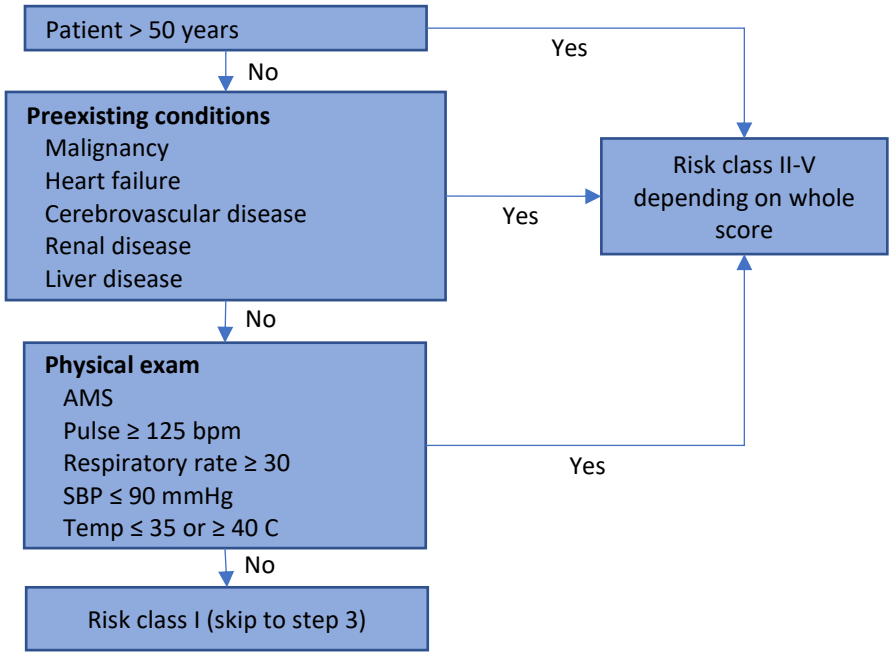
HAP/VAP		
Empiric Coverage	• Cefepime* PLUS • Vancomycin or linezolid • *TRUE β-lactam allergy: Meropenem	
MDR-*Pseudomonas* Risk Factors Present (narrow coverage at 48h if able)	• Consider addition of tobramycin	**Risk Factors for MDR-*Pseudomonas*** • History of MDRO infection • Neutropenia • High local prevalence • Recent ICU admission • Hospitalization ≥ 5 days

4. **Duration of therapy**
   a. Target antimicrobial to any pathogens isolated
      i. Consider ID consultation for organism-specific duration concerns.
   b. Majority of patients should receive 7 days of therapy
      i. Consider extending to 10-14 days depending on clinical improvement
      ii. Non-responders should be evaluated for alternative sources of infection or noninfectious mimics of pneumonia

Appendix

PSI Scoring

- Step 1: Initial risk stratification



- Step 2: Comprehensive scoring as needed per Step 1

	Points assigned
Men	Age (yr)
Women	Age (- 10 year)
Nursing home resident	+10
Coexisting illnesses	
Malignancy	+30
Liver disease	+20
Heart failure	+10
Cerebrovascular disease	+10
Renal disease	+10
Physical exam	
Altered mental status	+20
Respiratory rate ≥ 30 breaths/min	+20
SBP ≤ 90 mmHg	+20
Temp ≤ 35 C or ≥ 40 C	+15
Pulse ≥ 125 bpm	+10
Laboratory/radiographic findings	
Arterial pH ≤ 7.35	+30
BUN ≥ 30 mg/dL	+20
Sodium ≤ 130 mmol/L	+20
Glucose ≥ 250 mg/dL	+10
Hematocrit ≤ 30%	+10
PaO2 ≤ 60 mmHg	+10
Pleural effusion	+10

- Once final score is tallied, see original section for risk stratification of setting (step 3)

Oral Agent Dosing Strategies

Drug/dose	Requires renal adjustment (refer to dosing guideline)
Amoxicillin 1 g PO Q8H	Yes
Amoxicillin/clavulanate 875-125 mg PO BID	Yes
Cefuroxime 500 mg PO BID	Yes
Cefdinir 300 mg PO BID	Yes
Cefpodoxime 200 mg PO BID	Yes
Azithromycin 500 mg PO daily	No
Doxycycline 100 mg PO BID	No
Levofloxacin 750 mg PO daily	Yes
Moxifloxacin 400 mg PO daily	No
Clindamycin 300-450 mg PO Q6H	No
Metronidazole 500 mg PO Q8H	No

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