Pneumonia

Sarah Boyd, MD, FIDSA

October 9, 2024

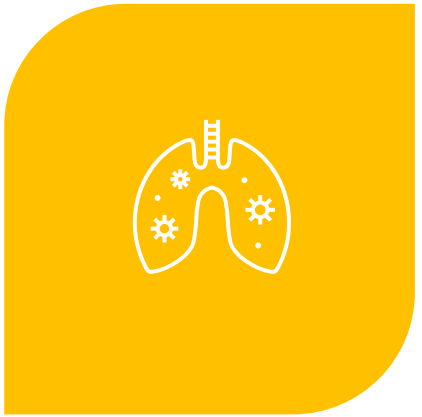
Disclosures

- Nothing to disclosure

Pneumonia

COMMUNITY ACQUIRED
(CAP)

HOSPITAL ACQUIRED
(HAP)



VENTILATOR ASSOCIATED
(VAP)

Community Acquired Pneumonia (CAP)

Community Acquired Pneumonia (CAP)

- Acute Pulmonary infection acquired outside of a hospital setting
- Severe CAP
  - Septic Shock requiring vasopressors
  - Acute Respiratory Failure requiring mechanical ventilation
  - 3 or more:
    - Multilobar infiltrates
    - Confusion/disorientation
    - Uremia (blood urea nitrogen level ≥ 20 mg/dl)
    - Leukopenia* (white blood cell count < 4,000 cells/µl)
    - Thrombocytopenia (platelet count < 100,000/µl)
    - Hypothermia (core temperature < 36°C)
    - Hypotension requiring aggressive fluid resuscitation
    - PaO2/FiO2 ratio ≤ 250

https://www.atsjournals.org/doi/full/10.1164/rccm.201908-1581ST

CAP-Typical Pathogens

Viral	Bacterial
Influenza	*Streptococcus pneumoniae*
SARS-CoV-2	*Moraxella catarrhalis*
Seasonal coronoviruses	*Haemophilus influenzae*
Human metapneumovirus	*Mycoplasma pneumoniae**
Adenovirus	*Chlamydia pneumoniae** *Chlamydia psittaci**
Enteroviruses	*Staphylococcus aureus* (MRSA and MSSA)
RSV	*Legionella* species*
	Gram-negative enteric pathogens
	Anaerobes
	*Coxiella burnetii**

Initial Evaluation Tests for CAP

Severe or at risk for MRSA/Pseudomonas	Labs	Imaging
Sputum Culture	CBC	Chest radiograph
Blood Culture	BMP	CT chest (immunocompromised)
Legionella urine antigen/PCR if available		
Pneumococcal urine antigen		

Inpatient versus Outpatient Site of Care

- Pneumonia Severity Index usual standard for determination of inpatient versus outpatient and mortality risk but decision may also be impacted by social factors or other variables impacting individual situation
- Pneumonia Severity Index
  - Calculators available
  - Class IV and V inpatient, Class III consider observation, Class I and II outpatient
  - Risk for mortality based on Score:
    - Class I 0.1%
    - Class II 0.6%
    - Class III 0.9%
    - Class IV 9.3%
    - Class V 27%

Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. N Engl J Med 1997; 336:243.

Treatment for Outpatient Setting

Focus against Streptococcus pneumonia and atypical pathogens

Beta-lactam (Amoxicillin/Amoxicillin-clavulanate/3rd generation cephalosporin) +macrolide or doxycycline

If not able to use beta-lactam due to allergy: respiratory fluoroquinolone or if local resistance for pneumococcus low can use macrolide/doxycycline alone

Empiric Treatment for Inpatient Setting

- Ceftriaxone +macrolide/doxycycline
- Ceftaroline also provides coverage for MRSA
- Unasyn or ertapenem may be options in setting of severe cephalosporin allergy
- Respiratory fluoroquinolone single agent
- Omadacycline and Lefamulin may be options when the above options are contraindicated

Who needs Coverage for MRSA?

- Septic Shock
- Mechanical Ventilation
- ICU with MRSA risk factors (ESRD, IVDU, recent Influenza-like illness or GPC clusters in sputum gram stain)
- Prior MRSA colonization
- Necrotizing pneumonia
- Empyema
- Recent antibiotic use

MRSA nasal colonization

- Dangerfield et al: MRSA PCR assay demonstrated 88.0% sensitivity and 90.1% specificity, with a positive predictive value of 35.4% and a negative predictive value of 99.2%
- If MRSA PCR is quickly available may wait for mild cases for result to return, but in moderate-severe pneumonia would empirically start but deescalate once negative result returns

Dangerfield B, Chung A, Webb B, Seville MT. Predictive value of methicillin-resistant Staphylococcus aureus (MRSA) nasal swab PCR assay for MRSA pneumonia. Antimicrob Agents Chemother. 2014;58(2):859-64. doi: 10.1128/AAC.01805-13. Epub 2013 Nov 25. PMID: 24277023; PMCID: PMC3910879.

Who needs coverage for *Pseudomonas*?

- Structural lung disease-bronchiectasis, COPD
- Frequent antibiotic use
- Prior colonization with *Pseudomonas*
- Gram negative rods on sputum gram stain
- Frequent steroid use

Role of Procalcitonin

Biomarker that can help determine viral versus bacterial infection in pneumonia and sepsis

Used to help guide stopping antibiotics in lower respiratory infection in conjunction with clinical judgement

0.25-0.5 or greater higher likelihood for bacterial pneumonia

Potential for false positives Shock, burns, surgery, renal failure, certain cancers

Duration of Treatment-CAP

- Clinical improvement and severity drives duration of therapy
- Typical minimum duration 5 days with at least 24 hours without fever and other clinical improvement
- Longer durations needed if the are complicated course (endocarditis, empyema, *Pseudomonas*, parapneumonic effusions, etc)
- Some studies have shown even shorter courses for non-complicated CAP 3 days with ongoing studies (both studies with beta-lactam use and different severities)

Nosocomial Pneumonia

- HAP
- VAP
- Outbreaks

Nosocomial Pneumonia

- Pneumonia that develops while hospitalized and may be associated with mechanical ventilation
- Frequently related to microaspiration of oropharyngeal colonizing microaerophilic pathogens
- Be aware of outbreaks, unusual pathogens presenting in hospitalized patients
- Legionella pneumonia and other water borne pathogens

Nosocomial Pneumonia Pathogens

Viral	Bacterial
Influenza	*Staphylococcus aureus*
SARS-CoV-2	*Pseudomonas*
	Klebsiella
	Enterobacter
	Haemophilus pneumoniae
	Streptococcus
	Escherichia coli
	Acinetobacter

Weiner-Lastinger LM, Abner S, Edwards JR, Kallen AJ, Karlsson M, Magill SS, Pollock D, See I, Soe MM, Walters MS, Dudeck MA. Antimicrobial-resistant pathogens associated with adult healthcare-associated infections: Summary of data reported to the National Healthcare Safety Network, 2015-2017. Infect Control Hosp Epidemiol. 2020 Jan;41(1):1-18. doi: 10.1017/ice.2019.296. Epub 2019 Nov 26. PMID: 31767041; PMCID: PMC8276252.

Hospital Acquired Pneumonia

- Acute onset of pneumonia after being in the hospital setting 48 hours or longer (and not present at time of the admission)

Ventilator Associated Pneumonia

- Pneumonia onset after 48 hours of mechanical ventilation
- Duration for VAP persists for 48 hours after extubation

HAP/VAP treatment

- ATS/IDSA guidelines 2016
- Broad coverage for *Pseudomonas*
- Know local *S. aureus* susceptibilities regarding need for MRSA coverage
- Guideline suggests need for dual coverage for *Pseudomonas* but local resistance trends/antibiograms commonly now used for need of empiric coverage
- Prior respiratory cultures can be helpful to guide empiric coverage

Kalil AC, Metersky ML, Klompas M, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clin Infect Dis 2016; 63:e61

HAP/VAP Empiric Treatment

- Coverage for Gram negatives including *Pseudomonas,* MSSA
- Know local antibiogram regarding quinolone susceptibility
- Piperacillin/tazobactam or cefepime (ceftazidime slightly less gram-positive activity)
- If history of ESBL consider carbapenem
- If other pathogen history then may need to utilize agents with broader agents such as ceftolozone-tazobactam, ceftazidime-avibactam, imipenem-cilastatin-relebactam, meropenem-vaborbactam

Role of Anaerobes and Anaerobic Coverage

- ATS/IDSA Guideline recommend use in presence of lung abscess or empyema
- Frank aspiration is also time that may be needed in empiric coverage
- 2023 Metanalysis of use of anaerobic coverage in aspiration pneumonia is unclear with those 3 studies not showing difference in mortality, length of stay, recurrence, or resolution

Yoshimatsu Y, Aga M, Komiya K, Haranaga S, Numata Y, Miki M, Higa F, Senda K, Teramoto S. The Clinical Significance of Anaerobic Coverage in the Antibiotic Treatment of Aspiration Pneumonia: A Systematic Review and Meta-Analysis. J Clin Med. 2023 Mar 2;12(5):1992. doi: 10.3390/jcm12051992. PMID: 36902779; PMCID: PMC10004249.

Duration of treatment for HAP/VAP

- Typical 7 days duration of therapy if clinical improvement
- Longer durations for complicated courses, slow to respond, metastatic infection, gram positive bacteremia or immunocompromised
- *Pseudomonas* if susceptible strain and clinical improvement duration may be 7-10 days but longer courses may be needed for certain patients

Things to think about

- Immunocompromised patients may present with CAP with opportunistic infections
- HAP/VAP with unusual pathogens or water-borne pathogens should prompt recognition of possibility for outbreak
- Deescalate based on culture results as they return
- Shorter durations of treatment are preferred

References

- Metley et al. Diagnosis and Treatment of Adults with Community-acquired Pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. https://doi.org/10.1164/rccm.201908-1581ST
- Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. N Engl J Med 1997; 336:243.
- Dangerfield B, Chung A, Webb B, Seville MT. Predictive value of methicillin-resistant Staphylococcus aureus (MRSA) nasal swab PCR assay for MRSA pneumonia. Antimicrob Agents Chemother. 2014;58(2):859-64. doi: 10.1128/AAC.01805-13. Epub 2013 Nov 25. PMID: 24277023; PMCID: PMC3910879.
- el Moussaoui R, de Borgie CA, van den Broek P, Hustinx WN, Bresser P, van den Berk GE, Poley JW, van den Berg B, Krouwels FH, Bonten MJ, Weenink C, Bossuyt PM, Speelman P, Opmeer BC, Prins JM. Effectiveness of discontinuing antibiotic treatment after three days versus eight days in mild to moderate-severe community acquired pneumonia: randomised, double blind study. BMJ. 2006 Jun 10;332(7554):1355. doi: 10.1136/bmj.332.7554.1355. PMID: 16763247; PMCID: PMC1479094.Weiner-Lastinger LM, Abner S, Edwards JR, Kallen AJ, Karlsson M, Magill SS, Pollock D, See I, Soe MM, Walters MS, Dudeck MA. Antimicrobial-resistant pathogens associated with adult healthcare-associated infections: Summary of data reported to the National Healthcare Safety Network, 2015-2017. Infect Control Hosp Epidemiol. 2020 Jan;41(1):1-18. doi: 10.1017/ice.2019.296. Epub 2019 Nov 26. PMID: 31767041; PMCID: PMC8276252.
- Dinh A, Ropers J, Duran C, Davido B, Deconinck L, Matt M, Senard O, Lagrange A, Makhloufi S, Mellon G, de Lastours V, Bouchand F, Mathieu E, Kahn JE, Rouveix E, Grenet J, Dumoulin J, Chinet T, Pépin M, Delcey V, Diamantis S, Benhamou D, Vitrat V, Dombret MC, Renaud B, Perronne C, Claessens YE, Labarère J, Bedos JP, Aegerter P, Crémieux AC; Pneumonia Short Treatment (PTC) Study Group. Discontinuing β-lactam treatment after 3 days for patients with community-acquired pneumonia in non-critical care wards (PTC): a double-blind, randomised, placebo-controlled, non-inferiority trial. Lancet. 2021 Mar 27;397(10280):1195-1203. doi: 10.1016/S0140-6736(21)00313-5. Erratum in: Lancet. 2021 Jun 5;397(10290):2150. doi: 10.1016/S0140-6736(21)01157-0. PMID: 33773631.
- Andre C. Kalil, Mark L. Metersky, Michael Klompas, John Muscedere, Daniel A. Sweeney, Lucy B. Palmer, Lena M. Napolitano, Naomi P. O'Grady, John G. Bartlett, Jordi Carratalà, Ali A. El Solh, Santiago Ewig, Paul D. Fey, Thomas M. File, Marcos I. Restrepo, Jason A. Roberts, Grant W. Waterer, Peggy Cruse, Shandra L. Knight, Jan L. Brozek, Management of Adults With Hospital-acquired and Ventilator-associated Pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society, Clinical Infectious Diseases, Volume 63, Issue 5, 1 September 2016, Pages e61–e111, https://doi.org/10.1093/cid/ciw353
- Dragan V, Wei Y, Elligsen M, Kiss A, Walker SAN, Leis JA. Prophylactic Antimicrobial Therapy for Acute Aspiration Pneumonitis. Clin Infect Dis. 2018 Aug 1;67(4):513-518. doi: 10.1093/cid/ciy120. PMID: 29438467.
- Yoshimatsu Y, Aga M, Komiya K, Haranaga S, Numata Y, Miki M, Higa F, Senda K, Teramoto S. The Clinical Significance of Anaerobic Coverage in the Antibiotic Treatment of Aspiration Pneumonia: A Systematic Review and Meta-Analysis. J Clin Med. 2023 Mar 2;12(5):1992. doi: 10.3390/jcm12051992. PMID: 36902779; PMCID: PMC10004249.