Management of the Hospitalized Patient with Pneumonia

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Disclosure
None

Off-Label Discussion
None

Learning Objectives

- Differentiate between the following: community-acquired, hospital-acquired, ventilator-associated and aspiration pneumonias.
- Review the diagnostic tools available for hospitalized patients with pneumonia.
- Identify when a patient should be transferred to the ICU.
- Utilize non-invasive ventilation strategies when appropriate.
- Discuss the appropriate treatment of each type of pneumonia.

Hospitalizations for Pneumonia

- Over 1 million hospital admissions/year

- HAP/VAP are two common hospital-acquired infections.

Question

- According the 2016 Infectious Diseases Society of American and the American Thoracic Society guidelines, which of the following is no longer a classification of pneumonia?

A. Community-acquired

B. Healthcare-associated

C. Hospital-acquired

D. Ventilator-associated

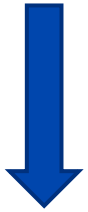
Classifications of Pneumonia

Community-acquired pneumonia (CAP)
Hospital-acquired pneumonia (HAP)
Ventilator-associated pneumonia (VAP)

There is no longer a healthcare-associated pneumonia (HCAP) classification.

Pneumonia Guidelines

- Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults. **2007**



- Diagnosis and treatment of adults with community-acquired pneumonia: An official clinical practice guideline of the ATS and IDSA. **October 2019!**

- Management of Adults with Hospital-acquired and Ventilator-associated Pneumonia: **2016** Clinical Practice Guidelines by the IDSA and ATS.

The New 2019 CAP Guidelines

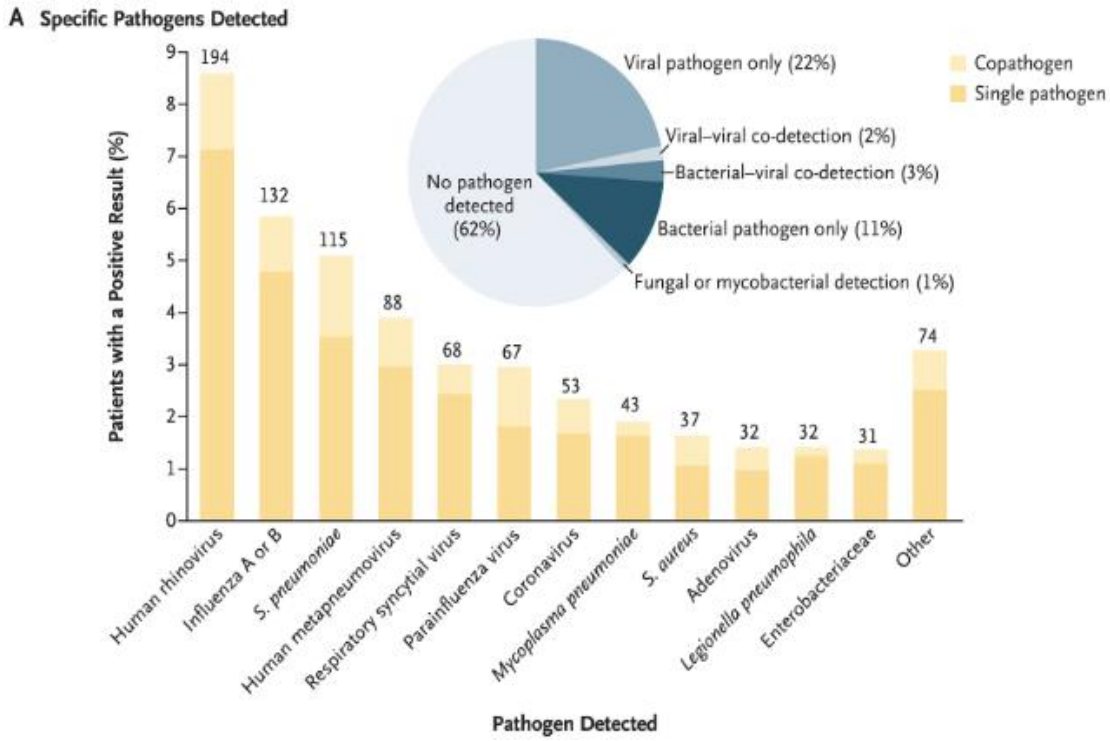
- Are presented as series of questions related to patients with CAP in the outpatient and inpatient settings
- Reconfirms some of the 2007 guidelines, but there are other significant changes.
- ↑ the proportion of patients for which respiratory tract samples are recommended
- Encourages providers to take their spectrum of local pathogens into account
- Uses “We recommend…” and “We suggest...” verbiage.

CAP

- Most common type of pneumonia
- Not HAP or VAP

Epidemiology of CAP

- >50% of CAP has no microbial etiology isolated despite adequate testing.
- Viral pathogens are isolated in ~20% of patients admitted with CAP.
  - Influenza and human rhinovirus are most common.
  - Bacterial and viral pneumonias often co-exist.
- Fungal pathogens are isolated in 1% of patients admitted with CAP.



Jain S, et al. NEJM.2015; 373:415-27.

CAP: Atypical Pneumonia

- **Legionella**
  - Diarrhea/GI symptoms, dry cough
  - Hyponatremia, elevated LDH
  - Treatment: macrolides, fluoroquinolones, β-lactams

- **Chlamydia pneumoniae**
  - Serologic testing /PCR
  - Treatment: doxycycline or macrolides
    - Fluoroquinolones are an alternative.

- **Mycoplasma Pneumonia**
  - **“**Walking pneumonia”, young college students
  - Serum mycoplasma IgM Abs
  - Treatment: macrolides, tetracyclines

HAP

- Pneumonia **not** present at the time of admission and occurring ≥48 hours after admission
  - **NOT** associated with mechanical ventilation

- Common Pathogens
  - Aerobic gram (-) bacilli: *E.Coli, Pseudomonas aeurginosa, Klebsiella Pneumoniae, Acinetobacter*
  - G+ Cocci: MSSA, MRSA
  - Anaerobic
  - Polymicrobial

VAP

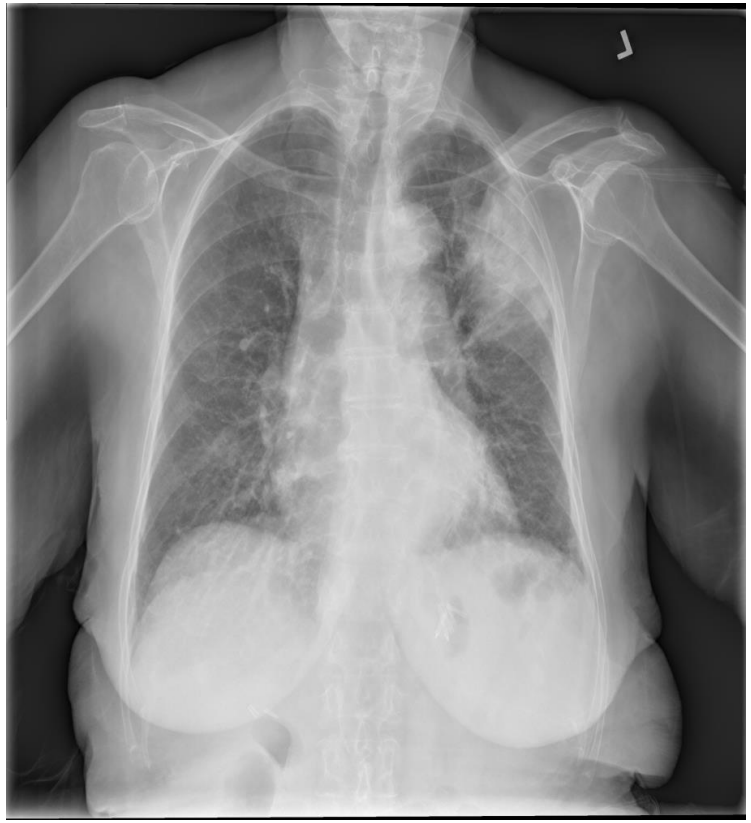
- Develops 48 hours ***after*** intubation
- Microbiology similar to HAP
  - ↑ rate of GNB (Pseudomonas)

HAP & VAP

- HAP and VAP accounts for ≈22% of all hospital-acquired infections.

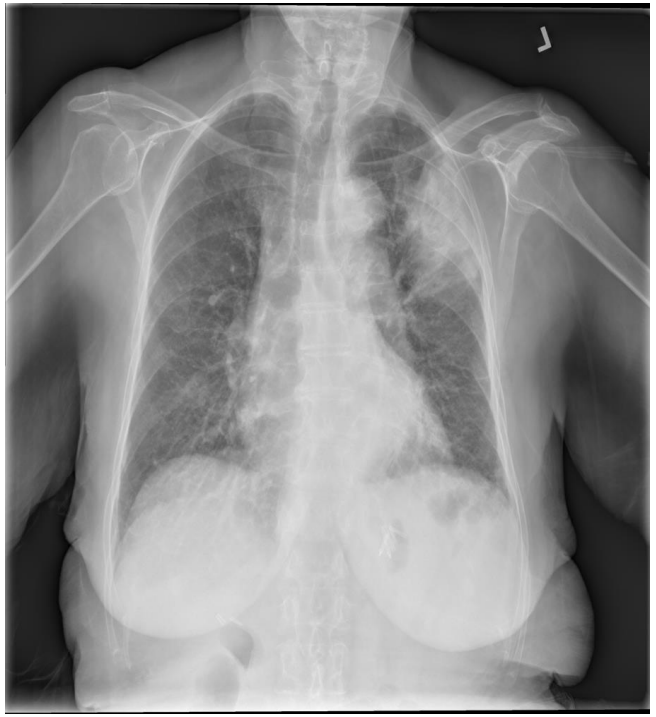
- HAP and VAP ↑ mortality, resource utilization, and LOS.
  - VAP prolongs mechanical ventilation by 7-11 days
    - ↑ hospitalization by 11-13 days
    - ↑ hospital costs by >$40,000/patient

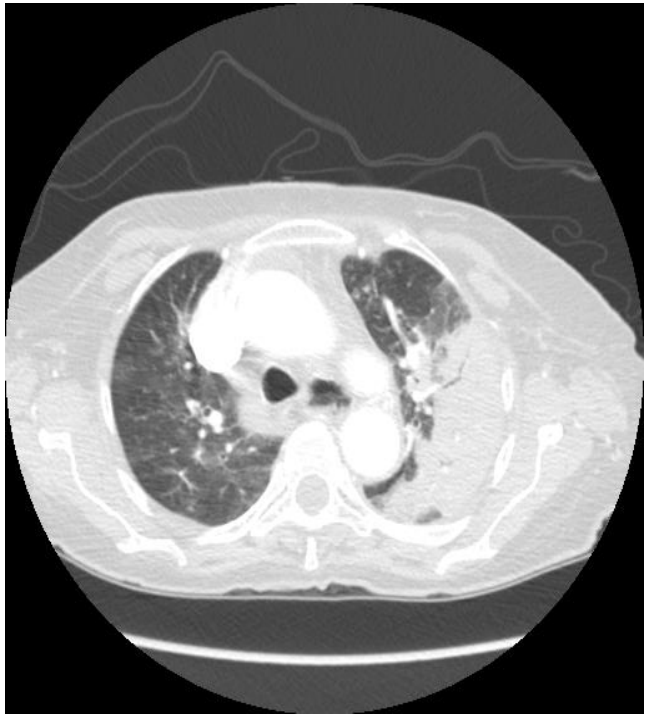
Testing



X-ray vs. CT Scan

- CXR = ALWAYS!
- CT Chest = Maybe?





Blood Cultures

- Hospitalized patients with CAP should have if:
  - Severe CAP
  - Being empirically treated for MRSA or *P. aeruginosa*
  - Previously had MRSA or *P. aeruginosa*
  - Previously hospitalized and received IV antibiotics
    - Either during that hospitalization or w/in the past 90 days
- Other conditions to consider:
  - Admitted to ICU
  - Cavitary infiltrates
  - Leukopenia, immunosuppression

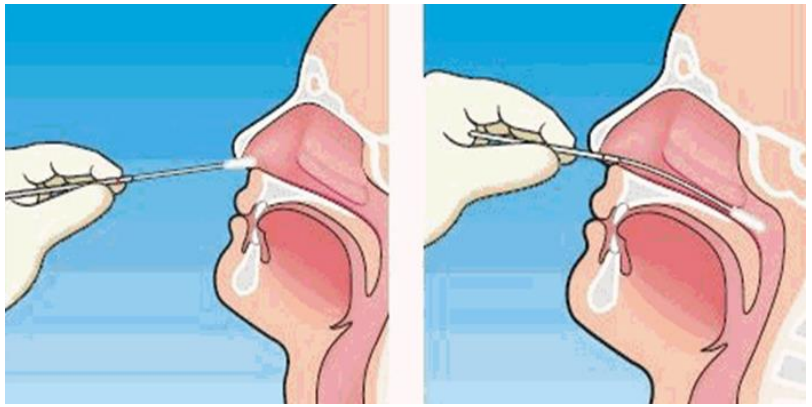
Gram Stains and Sputum Cultures

- Low sensitivity (<10-50%)
- ↑ rates of false positive/poor quality samples

- Hospitalized patients with CAP should have if:
  - Severe CAP (especially intubated patients)
  - Being empirically treated for MRSA or *P. aeruginosa*
  - Previously had MRSA or *P. aeruginosa*
  - Previously hospitalized and received IV antibiotics
    - Either during that hospitalization or w/in the past 90 days

Respiratory Pathogen Panels

- Seasonal viral and bacterial testing
  - Viral: *influenza A&B, RSV, parainflueza, rhinovirus, coronavirus*
  - Bacterial: *S.pneumo, C.pneumo, Mycoplasma, S. aureus, L. pneumophilia, and bordetella pertussis*



Urine Antigens

- *S. Pneumonia* Ag and *Legionella* Ag
  - Benefits
    - Rapid, higher sensitivity rates than cultures
    - Valid even after antibiotics
  - Limitations
    - No antibiotic sensitivity
    - Usually doesn’t change course of care
- Hospitalized patients with CAP should have if:
  - Severe CAP
  - Local *Legionella* outbreak or recent travel

Procalcitonin

- Precursor of calcitonin that is constitutively secreted by C cells of the thyroid gland and K cells of the lung
- In 2017, the FDA approved procalcitonin to guide clinical decisions for antibiotic use in acute respiratory infections (in the hospital or ED).
  - ↓ mortality
  - Treatment failure was not significantly lower.
  - 2.4 day reduction in exposure to antibiotics and ↓ risk of antibiotic-related side effects

P.Scheutz, et al. Cochrane Database Syst Review 2017, Oct 12;10:CD007498

Procalcitonin

- For hospitalized patients with CAP, empiric antibiotics should be given regardless of the procalcitonin.
  - It should not determine the need for initial antibiotics.
  - ? distinguish between bacterial vs. viral etiology
- **Do NOT delay antibiotics.**
- Procalcitonin values should not replace clinical judgement.
- Can be helpful with de-escalation of antibiotics

Additional Diagnostic Testing

- ABG
- Fungal serology
  - Coccidiomycosis, histoplasmosis
- MRSA swab
  - May be helpful with de-escalation of antibiotics

Bronchoscopy

- When should you consider bronchoscopy?
  - Immunocompromised host
  - Non-resolving pneumonia
  - Nodular/cavitary lesions on imaging
- Can be both **diagnostic and therapeutic**
- Risks
  - Operator and patient dependent
  - Risks increase when biopsies are performed
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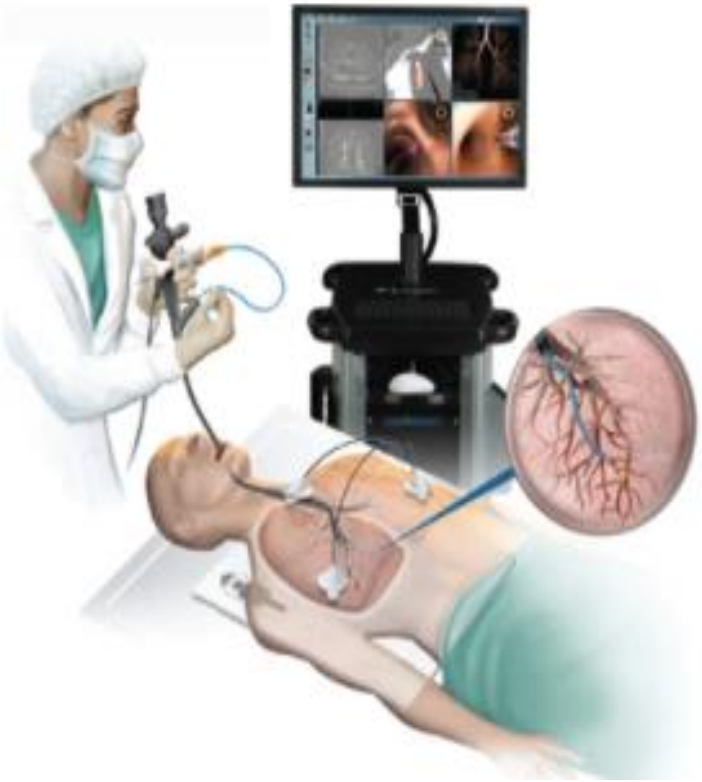


Where to treat?

- Outpatient

- Inpatient
  - Medical/surgical floor
  - +/- Intermediate/step-down floor
  - ICU

Clinical Predictor Tools

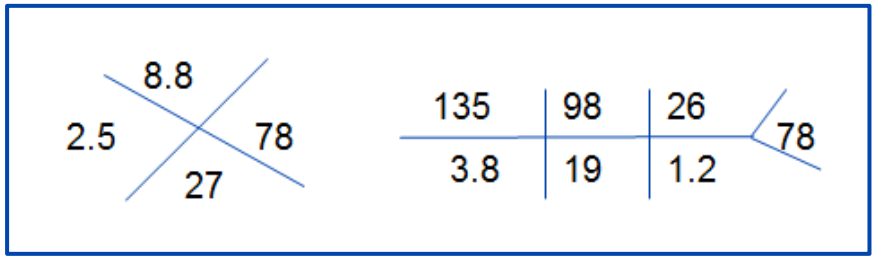
- **Pneumonia Severity Index (PSI)**
- British Thoracic Society (BTS) Criteria AKA “CURB 65”
- A-DROP (Age, Dehydration, Respiratory failure, Orientation, Pressure (shock))
- Severe Community Acquired Pneumonia (SCAP)

Score	Risk	Disposition
≤70	Low risk	Outpatient care
71-90	Low risk	Outpatient vs. Observation admission
91-130	Moderate risk	Inpatient admission
>130	High risk	Inpatient admission

A Word of Caution…

- Other reasons for admission **NOT** scored:
  - Exacerbation of co-morbid condition
  - Unable to take PO medications
  - Unable to receive outpatient care
  - Cognitive impairment
  - Substance abuse

Clinical predictor tools should **NOT** replace clinical judgment!



Question

- A 73-year-old male with lung cancer, currently undergoing chemotherapy, presents to the ER with multilobar pneumonia. Which of the following is the most appropriate plan?

BP 98/62	HR 110	RR 35	O2 88%	T 35.7°C

A. Discharge him home with PO antibiotics

B. Give a bolus of IVF and IV antibiotics in the ED, and then determine whether to admit him.

C. Admit him to Med/Surg and start IV antibiotics

D. Call the intensivist about possible ICU admission

ICU Admission

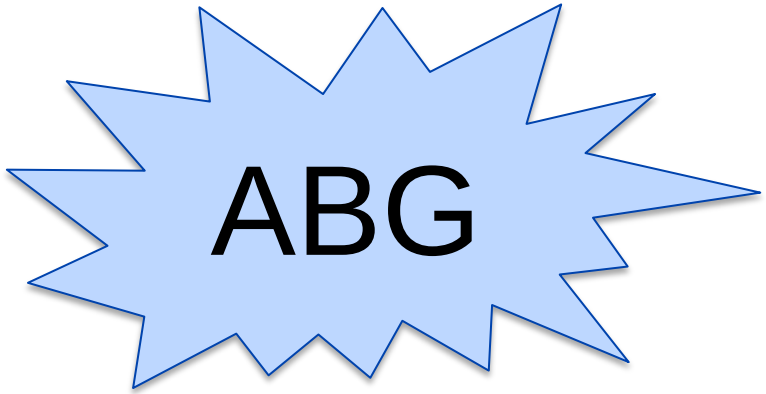
- Late admission/transfer from the ED to the ICU significantly ↑ mortality

- Severe CAP Criteria
  - Direct ICU admission when **any 1 major criterion or ≥3 minor criteria**

Criteria for Severe CAP

Major Criteria

- Need for invasive mechanical ventilation
- Septic shock with need for vasopressors



Minor Criteria

- Respiratory rate ≥ 30 breaths/min
- PaO2/FiO2 ratio ≤ 250
- Multilobar infiltrates
- Confusion/disorientation
- Uremia (BUN≥20 mg/dl)
- Leukopenia (WBC <4,000 cells/μL)
- Thrombocytopenia (platelets <100,000/μL)
- Hypothermia (core temp <36°C)
- Hypotension requiring aggressive fluid resuscitation

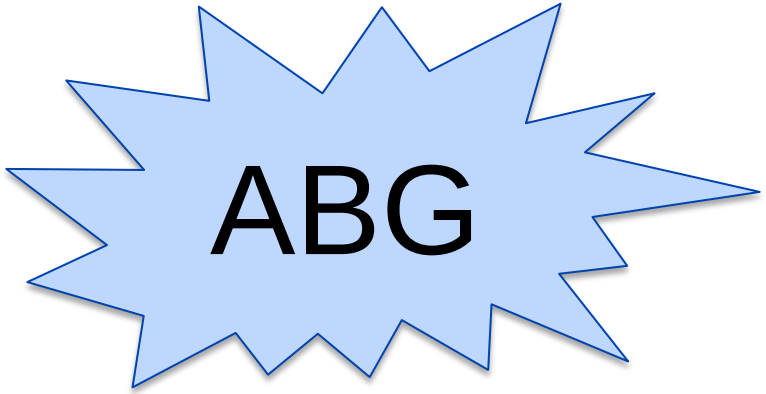
Criteria for Severe CAP

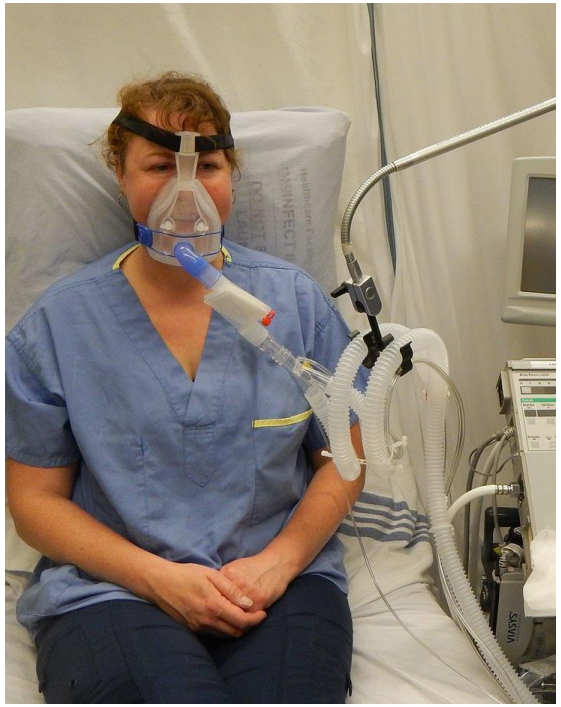
- Other factors to consider
  - Alcohol withdrawal syndrome
  - Hypo/hyperglycemia
  - Hyponatremia
  - Metabolic acidosis
  - Elevated lactate level
  - Cirrhosis
  - Asplenia

Treatment

Non-invasive Ventilation Strategies

- Timing is critical…the earlier the better!
  - Bilevel positive airway pressure (BiPAP)
  - High flow nasal canula

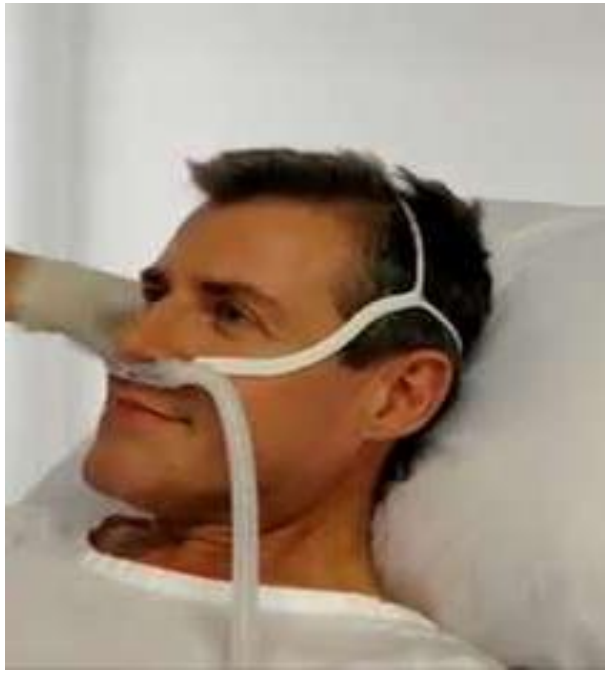




BiPAP

Indications	Contraindications
• Hypercapnea and acidosis • Cardiogenic pulmonary edema • COPD exacerbation • Weaning and post-extubation failure • Post surgical period • Obesity hypoventilation syndrome • Neuromuscular disorders • Poor alveolar oxygen exchange ○ PaO2/FiO2 <200	• Impaired neurological state • Respiratory arrest • Shock or severe cardiovascular instability • Excessive airway secretions • Vomiting • Facial lesions/trauma • Agitation

High Flow Nasal Cannula



- Improves work of breathing
- Enhances gas exchange

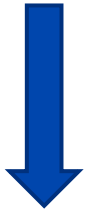
- Greatly decreased intubation rates in hypoxemic respiratory failure

Time to Antibiotic

- Antibiotics should be given as soon as the diagnosis is made…try to minimize delays.
  - Ineffective/delayed initial antimicrobial therapy is a significant predictor of poor outcomes.

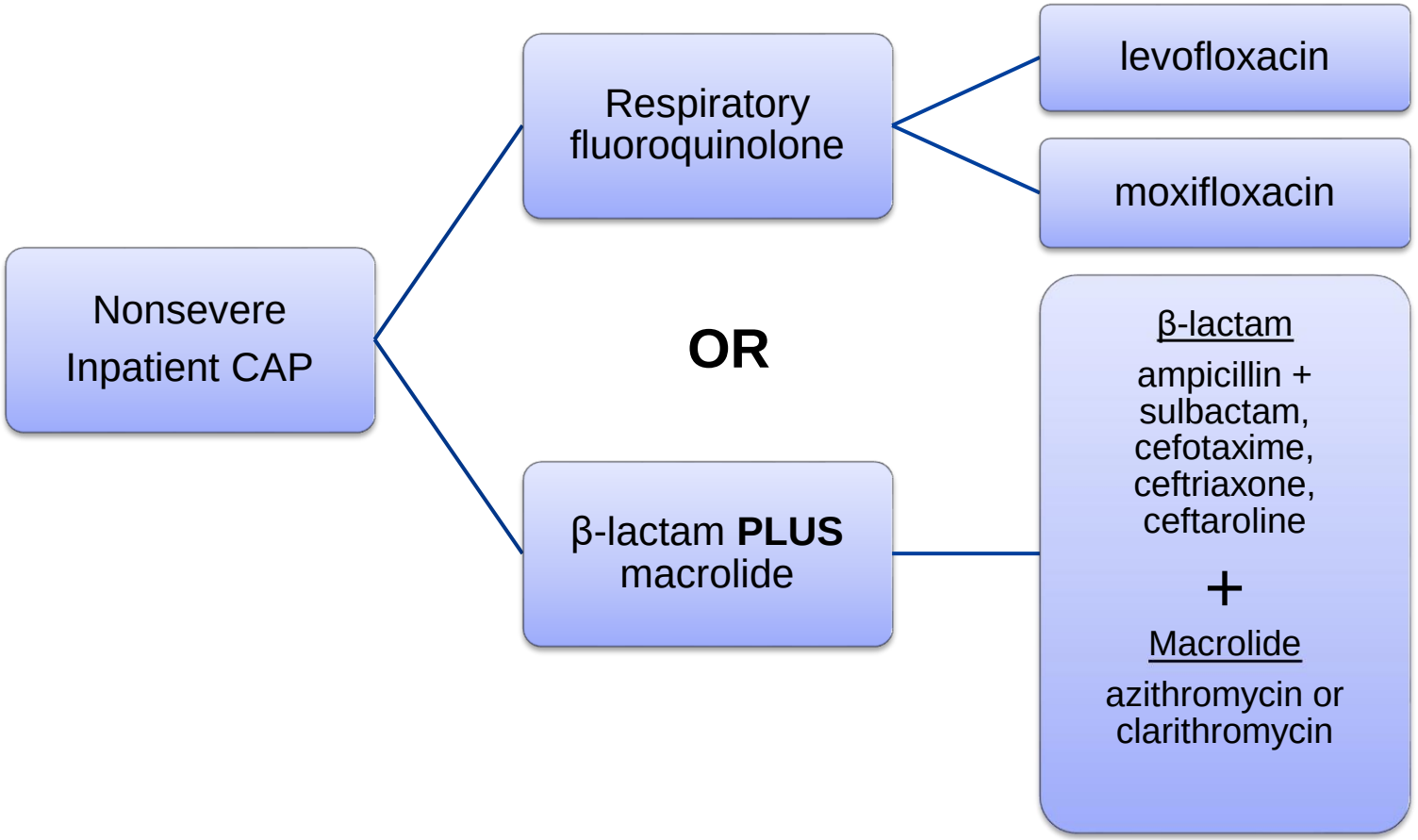
CAP

- Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults. **2007**



- Diagnosis and treatment of adults with community-acquired pneumonia: An official clinical practice guideline of the ATS and IDSA. **October 2019!**
- Adapt treatment regimens for local trends
- A predictor of a good outcome is the right site of care.

Nonsevere Inpatient CAP w/o Risk Factors MRSA or *P. aeruginosa*

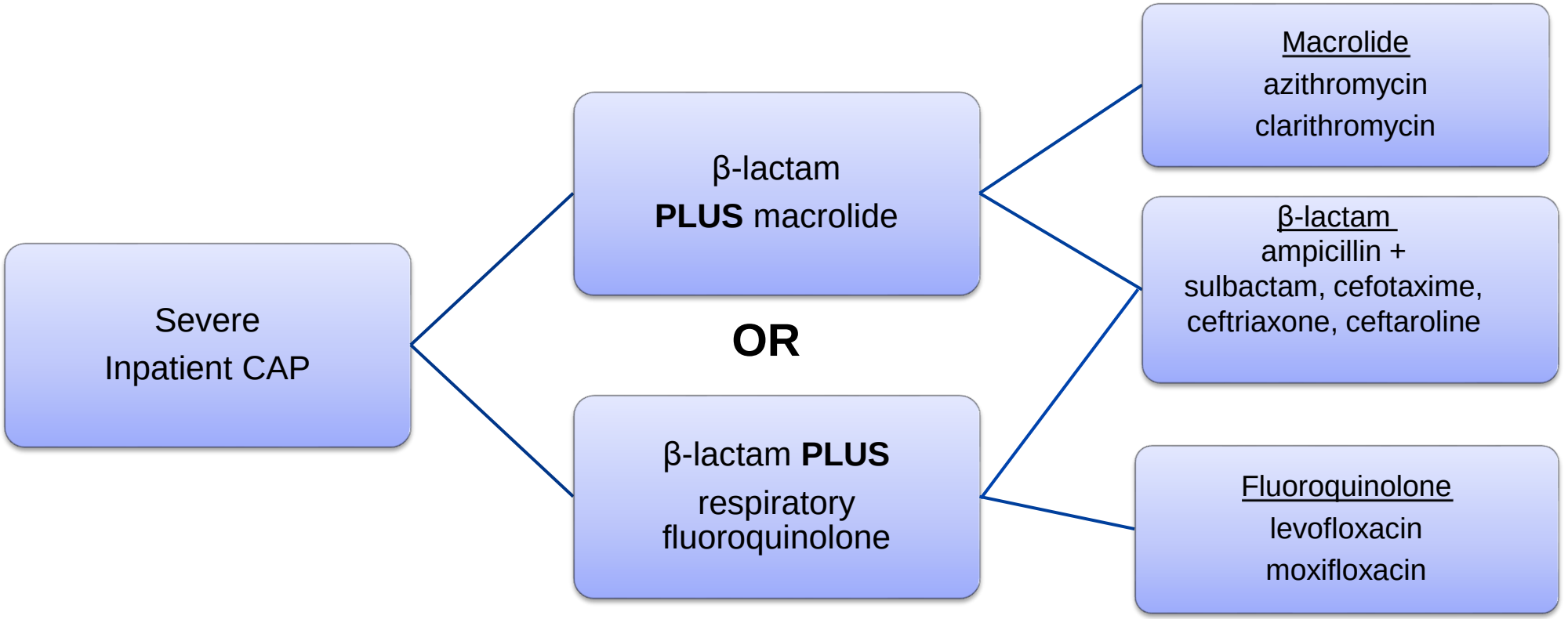


***If prior MRSA or *P. aeruginosa* or recent hospitalizations w/antibiotics, cover for MRSA and/or *P. aeruginosa*.

2018 FDA Fluoroquinolone Safety Warning

- Fluoroquinolone use may cause:
  - Life-threatening hypoglycemia/coma
  - CNS effects including delirium, agitation and memory impairment
  - Previously known to:
    - Cause side effects that involve the tendons, muscles, joints, nerves
    - Increase risk of retinal detachment, and neurotoxicity in the elderly

Severe Inpatient CAP w/o Risk Factors MRSA or *P. aeruginosa*



*****If prior MRSA or *P. aeruginosa* or recent hospitalizations w/antibiotics, cover for MRSA and/or *P. aeruginosa*.

Risk Factors for MRSA

- End stage renal disease
- IV drug abuse
- Prior antibiotic use

<u>Empiric Treatment</u>
Vancomycin
Linezolid

Risk Factors for Pseudomonas

- Prior use of antibiotics
- H/O Pseudomonas w/in 1year
- Longer hospital stay
- Being in the ICU
- Mechanical ventilation
- Immunosuppression
- Cystic Fibrosis
- HIV/AIDS
- Alcohol abuse
- COPD

Empiric Treatment

Pipercillin-tazobactam
Cefepime
Ceftazidime
Aztreonam
Meropenem
Imipenem

Drug-Resistance in Pneumonia (DRIP) Score

Factors	Points
Major Risk Factors	
Antibiotic use (prior 60 days)	2
Long-term care resident	2
Tube feeding	2
H/O infection w/drug-resistant pathogen (prior 12 months)	2
Major Risk Factors	
Hospitalization (prior 60 days)	1
Chronic pulmonary disease	1
Poor functional status	1
Gastric acid suppression	1
Wound care	1
MRSA colonization (prior 12 months)	1
Total Points Possible	**14**

<4 = Can be treated without broad-spectrum antibiotics

≥4 = More likely to require broad-spectrum antibiotics

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Antibiotic Use and Outcomes After Implementation of the Drug Resistance in Pneumonia Score in ED Patients With Community-Onset Pneumonia

Brandon J. Webb, MD; Jeffrey Sorensen, MStat; Ian Mecham, MD; Whitney Buckel, PharmD; Lilian Ooi, PharmD; Al Jephson, BS; and Nathan C. Dean, MD

- Used CURB-65 and the DRIP score
- DRIP score was more effective than HCAP criteria for identifying the risk of drug-resistant pathogens in pneumonia and the need for broad-spectrum antibiotic use in CAP.
  - Combined this with MRSA nasal swab for de-escalation and showed reduction in vancomycin use

CAP and Influenza

- Hospitalized CAP patients should be treated with antinfluenza treatment independent of the duration of illness.

- Hospitalized CAP patients with influenza should be treated with antibiotics, as well.

Corticosteroids for CAP

- A 2017 Cochrane Review recommended steroids for CAP patients.
  - Prednisone significantly ↓ early clinical failure rates and LOS in hospitalized patients with CAP, and ↓ mortality and morbidity in severe CAP.

- CAP guidelines **do not recommend** routine use of corticosteroids in nonsevere CAP or severe CAP.
  - They endorse the Surviving Sepsis Campaign in regard to corticosteroid use in CAP and refractory septic shock.

Cochrane Database Syst Rev 2017;12:CD00772

Aspiration Pneumonia

- Micro: Gram (-) and anaerobic
- Risk factors
  - Post-operative state
  - Elderly
  - Neurologic complications
  - Anatomical defect
  - GERD
- CXR: Most commonly **RLL infiltrate**

Aspiration Pneumonia

- Treatment
  - Aspiration precautions
  - **Swallow evaluation**
  - Elimination of offending etiology
  - Supportive care
- CAP guidelines do not suggest adding anaerobic coverage unless a lung abscess or empyema is suspected.
  - Antibiotics
    - Piperacillin/tazobactam or ampicillin/sulbactam **OR** clindamycin **OR** amoxicillin clavulanate

When can I switch my patients to oral therapy?

- Clinically stable
- Able to tolerate oral medications
- Working GI tract

- Try to use the same antibiotic or class as IV antibiotic used initially.
- Not necessary to observe patients after switching to PO

Duration of Treatment: CAP

- Shorter duration therapy leads to:
  - ↓ antibiotic resistance
  - ↓ complications
  - ↓ cost
  - ↑ patient compliance

- Minimum treatment **5 days**
  - Applies to patients with severe CAP, as well
- If CAP is due to MRSA or *P. aeruginosa*, treat for 7 days.

CAP: 2007 vs. 2019

Table 2. Differences between the 2019 and 2007 American Thoracic Society/Infectious Diseases Society of America Community-acquired Pneumonia Guidelines

Recommendation	2007 ATS/IDSA Guideline	2019 ATS/IDSA Guideline
Sputum culture	Primarily recommended in patients with severe disease	Now recommended in patients with severe disease as well as in all inpatients empirically treated for MRSA or *Pseudomonas aeruginosa*
Blood culture	Primarily recommended in patients with severe disease	Now recommended in patients with severe disease as well as in all inpatients empirically treated for MRSA or *P. aeruginosa*
Macrolide monotherapy	Strong recommendation for outpatients	Conditional recommendation for outpatients based on resistance levels
Use of procalcitonin	Not covered	Not recommended to determine need for initial antibacterial therapy
Use of corticosteroids	Not covered	Recommended not to use. May be considered in patients with refractory septic shock
Use of healthcare-associated pneumonia category	Accepted as introduced in the 2005 ATS/IDSA hospital-acquired and ventilator-associated pneumonia guidelines	Recommend abandoning this categorization. Emphasis on local epidemiology and validated risk factors to determine need for MRSA or *P. aeruginosa* coverage. Increased emphasis on deescalation of treatment if cultures are negative
Standard empiric therapy for severe CAP	β-Lactam/macrolide and β-lactam/fluoroquinolone combinations given equal weighting	Both accepted but stronger evidence in favor of β-lactam/macrolide combination
Routine use of follow-up chest imaging	Not addressed	Recommended not to obtain. Patients may be eligible for lung cancer screening, which should be performed as clinically indicated

Definition of abbreviations: ATS = American Thoracic Society; CAP = community-acquired pneumonia; IDSA = Infectious Diseases Society of America; MRSA = methicillin-resistant *Staphylococcus aureus*.

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

Question

- Appropriate antibiotic coverage for hospital-acquired pneumonia (HAP) without risk factors for multidrug resistant (MDR) pathogens includes which of the following regimens?

A. A fourth generation cephalosporin alone

B. A beta-lactam (antipneumococcal) AND a macrolide

C. An aminoglycoside AND vancomycin

D. An antipneumococcal antipseudomonal beta-lactam, AND respiratory fluoroquinolone or aminoglycoside, AND vancomycin or linezolid

HAP & VAP Guidelines

- Management of Adults with Hospital-acquired and Ventilator-associated Pneumonia: **2016** Clinical Practice Guidelines by the IDSA and ATS.

- Emphasis on all hospitals regularly generating a local **antibiogram**

- Mostly focus on a patient population with a **normal** immune system

First Line

VAP	HAP
Empirically cover for *S. aureus, pseudomonas* and other GNB with: • Piperacillin/tazobactam • Cefepime • Levofloxacin • Imipenem or meropenem	Empirically cover for *S. aureus* with: • Piperacillin/tazobactam • Cefepime • Levofloxacin • Imipenem or meropenem
Oxacillin, nafcillin or cefazolin are preferred agents for treating MSSA once it has been isolated.	

MRSA Coverage

VAP	HAP

Cover for MRSA empirically IF:
• A risk factor for antimicrobial resistance
  • Prior IV antibiotic use within 90d
  • Septic shock at the time of VAP
  • ARDS preceding VAP
  • ≥5 days of hospitalization prior to occurrence of VAP
  • Acute renal replacement therapy prior to VAP onset
• Patient in a unit where **≥10-20%** of *S. aureus* isolates are MRSA
• When the prevalence of MRSA is not known
	Cover for MRSA empirically IF:
	• Prior IV antibiotic use within 90 days of hospitalization
	• In a unit where **≥20%** of *S. aureus* isolates are MRSA
	• When the prevalence of MRSA is not known
	• Patients who are high risk of mortality

Pseudomonas Coverage

VAP	HAP
Double cover for Pseudomonas IF: • Risk factors for antimicrobial resistance (see last slide) • Unit where >10% of Gram negative isolates are resistant to an agents being considered for monotherapy • ICU where local antimicrobial susceptibility rates are not available. *Otherwise ok to use just one empiric anti-pseudomonal	Double cover for Pseudomonas IF: • Prior IV antibiotic use w/in 90 d • High risk of mortality (need ventilator support due to HAP and/or septic shock) *Otherwise ok to use just one empiric anti-pseudomonal
If a patient has structural lung disease, increasing risk of gram (-) infection, provide double coverage.	

Duration of Treatment: HAP/VAP

- Total **7 day** course is recommended
  - Early de-escalation if possible
  - Longer duration of therapy only if patient is not improving clinically

Things to take away…..

- The 2016 recommendations no longer have a designation for “healthcare-associated” pneumonia.
- Identify patients with high risk of MRSA, Pseudomonas and other MDR organisms, and treat them accordingly.
- Hospitals should frequently update their antibiogram, and antibiotics should be chosen based on this.
- Choosing the right site of care for patients with pneumonia directly correlates with improved outcomes.
- Use BiPAP and HFNC when appropriate to provide respiratory support.
- Recommendations favor shorter courses of antibiotic treatment for pneumonia.

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