Pneumonia Community-Acquired Healthcare-Associated

Edwin Yu

Clin Infect Dis 2007;44(S2):27-72
Am J Respir Crit Care Med 2005; 171:388-416
IDSA / ATS Guidelines

Microbiology

Bacterial
Common
Streptococcus pneumoniae
Staphylococcus aureus
Haemophilus influenzae
Mixed anaerobic bacteria (aspiration)
- *Bacteroides* spp.
- *Fusobacterium* spp.
- *Peptostreptococcus* spp.
- *Peptococcus* spp.
- *Prevotella* spp.

Enterobacteriaceae
- *Escherichia coli*
- *Klebsiella pneumoniae*
- *Enterobacter* spp.
- *Serratia* spp.

Pseudomonas aeruginosa
Legionella spp. (including *L. pneumophila and L. micdadei*)
Uncommon
Acinetobacter var. *anitratus*
Actinomyces and *Arachnia* spp.
Aeromonas hydrophilia
Bacillus spp.
Moraxella catarrhalis
Campylobacter fetus
Eikenella corrodens
Francisella tularensis
Neisseria meningitidis
Nocardia spp.
Pasteurella multocida
Proteus spp.
Pseudomonas pseudomallei
Salmonella spp.
Enterococcus faecalis
Streptococcus pyogenes

Fungal
Aspergillus spp.
Candida spp.
Coccidioides immitis
Cryptococcus neoformans
Histoplasma capsulatum
Agents of mucormycosis
- *Rhizopus* spp.
- *Absidia* spp.
- *Mucor* spp.
- *Cunninghamella* spp.

Rickettsial
Coxiella burnetii
Rickettsia rickettsiae
Mycoplasma and Chlamydia
Mycoplasma pneumoniae
Chlamydophila psittaci
Chlamydia trachomatis
Chlamydophila pneumoniae (TWAR)
Mycobacterial
Mycobacterium tuberculosis
Nontuberculous mycobacteria
Parasitic
Ascaris lumbricoides
Pneumocystis carinii
Strongyloides stercoralis
Toxoplasma gondii
Paragonimus westermani

Viral
CHILDREN
Common
Respiratory syncytial virus
Parainfluenza virus types 1, 2, 3
Influenza A virus
Uncommon
Adenovirus types 1, 2, 3, 5
Influenza B virus
Rhinovirus
Coxsackievirus
Echovirus
Measles virus
Hantavirus
ADULTS
Common
Influenza A virus
Influenza B virus
Adenovirus types 4 and 7 (in military recruits)
Uncommon
Rhinovirus
Adenovirus types 1, 2, 3, 5
Enteroviruses
- Echovirus
- Coxsackievirus
- Poliovirus

Epstein-Barr virus
Cytomegalovirus
Respiratory syncytial virus
Varicella-zoster virus
Parainfluenza virus
Measles virus
Herpes simplex virus
Hantavirus
Human herpesvirus 6
Metapneumovirus
Coronavirus (SARS)

Principles and Practice of Infectious Disease, 6th edition 2005

60M with EtOH cirrhosis presents with fevers and cough x 3 days. No sick contacts. Exam: T 102, P 120, RR 26, O2 Sat 92% RA. Right lung base with crackles and egophony. CXR demonstrates right lung base consolidation. Blood cultures reveal GPC in pairs.

What is the most likely organism responsible for this patient's condition?

A - Staphylococcus aureus

B - Streptococcus pneumoniae

C - Streptococcus pyogenes

D - Haemophilus influenzae

E - Klebsiella pneumoniae

CAP Microbiology

Patient type	Etiology
Outpatient	*Streptococcus pneumoniae* *Mycoplasma pneumoniae* *Haemophilus influenzae* *Chlamydophila pneumoniae* Respiratory viruses[a]
Inpatient (non-ICU)	*S. pneumoniae* *M. pneumoniae* *C. pneumoniae* *H. influenzae* *Legionella* species Aspiration Respiratory viruses[a]
Inpatient (ICU)	*S. pneumoniae* *Staphylococcus aureus* *Legionella* species Gram-negative bacilli *H. influenzae*

Clin Infect Dis 2007; 44(S2):27-72

60M with bronchiectasis presents with fevers and cough x 3 days. No sick contacts. Exam: T 102, P 120, RR 26, O2 Sat 92% RA. Right lung base with crackles and egophony. CXR demonstrates right lung base consolidation. Sputum culture GS with GNRs.

What is the most likely organism responsible for this patient's condition?

A - Staphylococcus aureus

B - Streptococcus pneumoniae

C - Haemophilus influenzae

D - Klebsiella pneumoniae

E - Pseudomonas aeruginosa

Other Pathogens

Pseudomonas

- Structural lung disease
- COPD + abxs/steroids
- Significant immunocompromise

MRSA

- Post-influenza
- Necrotizing pneumonia
- MRSA colonization/exposure

Influenza

- ILI symptoms
- Pregnancy, morbid obesity, IS

Coccidioides

- ~30% of CAP in AZ
- Failed antibiotic therapy
- Eosinophilia
- Mediastinal LAN
- Desert Rheumatism:
  - Erythema nodosum
  - Polyarthralgias
- Disseminated Disease:
  - Skin
  - Joint/Bone
  - Meningitis
- Negative serology - acute disease

80M with HTN and DM presents to ED with fevers and non-productive cough x 3 days. + Diarrhea on day of admission. No sick contacts. Exam: T99, P120, RR24. Right lung base with crackles. CXR neg. After IVF, patient appears better and likely to be d/c'ed home.

What other studies (if any) should be sent to evaluate for pneumonia?

A - Blood cultures

B - Sputum culture

C - Blood and sputum culture

D - Procalcitonin

E - No additional tests required

Diagnosis

- Clinical symptoms + PE + **Radiographic evidence**
- Absence of any vital sign abnormality – rare
  - HR > 100, RR > 20, Temp > 37.8^0C
- Negative CXR – rare
  - Possibly due to early presentation
  - Repeat CXR in 24-48 hours
  - Can miss retrocardiac infiltrate without PA/LAT
- Procalcitonin
  - Should be used adjunctively
  - ↓ Antibiotic use without ↑ mortality or treatment failure[1]

1. Clin Infect Dis 2012; 55:651-62

Diagnostic Testing

Table 5. Clinical indications for more extensive diagnostic testing.

Indication	Blood culture	Sputum culture	*Legionella* UAT	Pneumococcal UAT
Intensive care unit admission	X	X	X	X
Failure of outpatient antibiotic therapy		X	X	X
Cavitary infiltrates	X	X		
Leukopenia	X			X
Active alcohol abuse	X	X	X	X
Chronic severe liver disease	X			X
Severe obstructive/structural lung disease		X		
Asplenia (anatomic or functional)	X			X
Recent travel (within past 2 weeks)			X	

Blood culture:
- Yield ~10% (usually S.pneumo)
- Severe CAP
- Host defect ↑ risk for bacteremia

Sputum culture:
- Yield ~10-50%*
- *Dependent on quality of sample & lab
- Maybe useful if negative (S.aureus)

80M with HTN and DM presents to ED with fevers and cough. Exam: T99, P125, BP 100/60, RR30. Oriented x1, right lung base with crackles. CXR with right lower lung consolidation. WBC 12, BUN 30, Cr 1.1, Alb 3.0. He is diagnosed with CAP.

What is this patient's CURB-65 score and where should he be treated?

A - Score = 1, treat as outpatient

B - Score = 2, treat as inpatient (Gen Med ward)

C - Score = 3, treat as inpatient (Telemetry)

D - Score = 4, treat in ICU

E - Who cares about a score, admit to AMS

Clinical Scoring Tools

- Identify patients at high risk of adverse outcomes
  - Inpatient versus Outpatient treatment
  - ICU versus Medical ward
  - Mortality rate
- Clinical Scoring Tools:
  - Pneumonia Severity Index
  - CURB-65 (or derivative)
  - SMART-COP
- Who cares?
  - 50% of CAP ICU admissions initially admitted to non-ICU
  - Higher mortality rate with late transfer to the ICU

Inpatient versus Outpatient

CHARACTERISTIC	POINTS ASSIGNED*
Demographic factor	
Age	
Men	Age (yr)
Women	Age (yr) − 10
Nursing home resident	+10
Coexisting illnesses†	
Neoplastic disease	+30
Liver disease	+20
Congestive heart failure	+10
Cerebrovascular disease	+10
Renal disease	+10
Physical-examination findings	
Altered mental status‡	+20
Respiratory rate ≥30/min	+20
Systolic blood pressure <90 mm Hg	+20
Temperature <35°C or ≥40°C	+15
Pulse ≥125/min	+10
Laboratory and radiographic findings	
Arterial pH <7.35	+30
Blood urea nitrogen ≥30 mg/dl (11 mmol/liter)	+20
Sodium <130 mmol/liter	+20
Glucose ≥250 mg/dl (14 mmol/liter)	+10
Hematocrit <30%	+10
Partial pressure of arterial oxygen <60 mm Hg§	+10
Pleural effusion	+10

Pneumonia Severity Index:

Risk Class	30d Mortality
Class 1 (0)	0.1%
Class 2 (≤70)	0.6%
Class 3 (71-90)	0.9%
Class 4 (91-130)	9.3%
Class 5 (>130)	27%

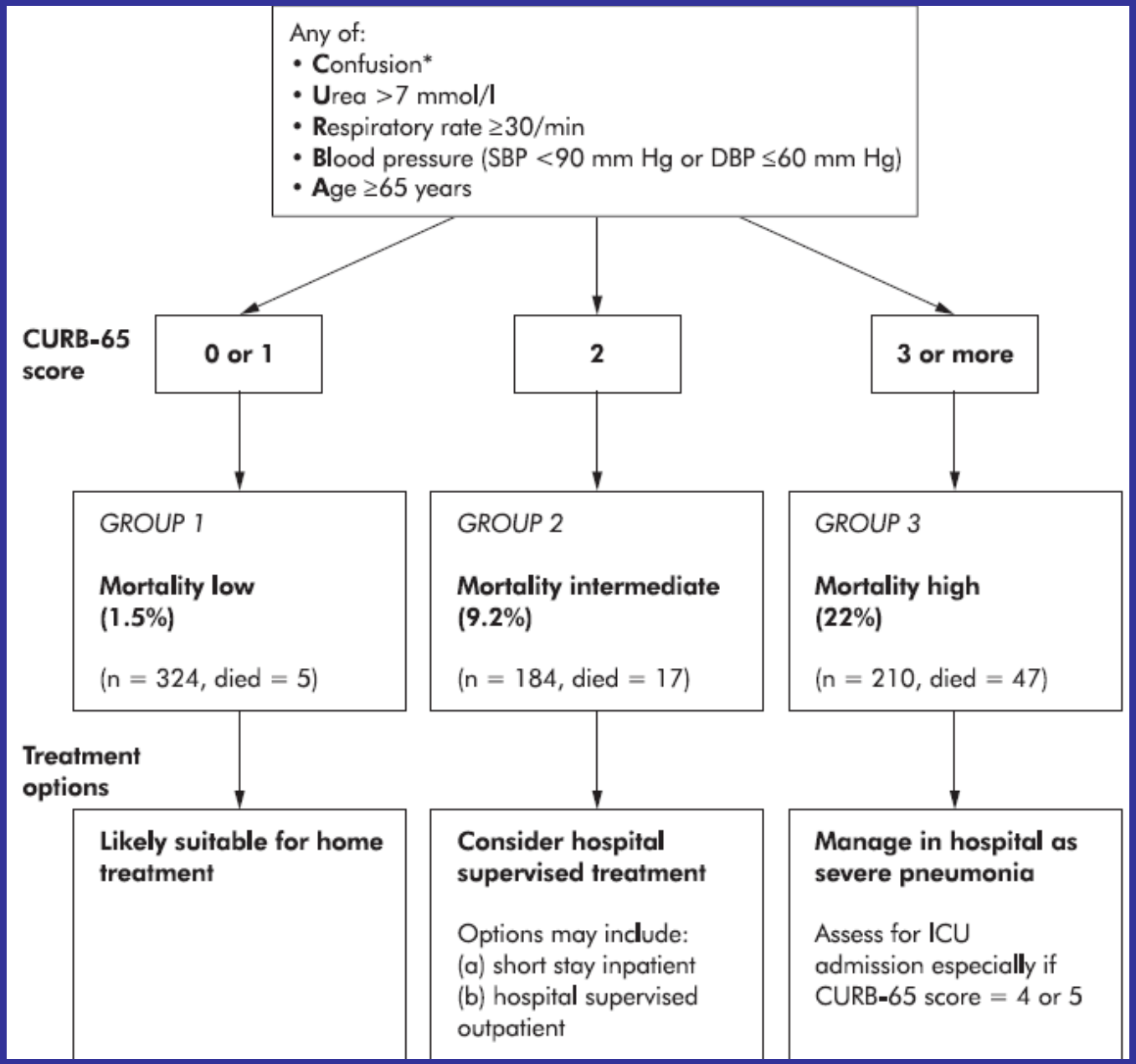
Outpatient: 1 & 2

Observation: 3

Inpatient: 4 & 5

http://pda.ahrq.gov/clinic/psi/psicalc.asp

NEJM 1997; 336:243-250



CURB-65

Confusion

Oriented x3

Urea > 20mg/dL

RR ≥ 30/min

BP

SBP < 90

DBP ≤ 60

Age ≥ 65

Thorax 2003; 58:377-382

Who Should Go to the ICU?

S	Systolic BP <90 mmHg	☐ (2 points)
M	Multilobar CXR involvement	☐ (1 point)
A	Albumin <3.5 g/dL*	☐ (1 point)
R	Respiratory rate – age-adjusted cut-offs	☐ (1 point)

Age	≤50 yo	>50 yo
RR	≥25 br/min	≥30 br/min

T	Tachycardia ≥125 bpm	☐ (1 point)
C	Confusion (new onset)	☐ (1 point)
O	Oxygen low – age-adjusted cut-offs	☐ (2 points)

Age	≤50 yo	>50 yo
PaO_2*	<70 mmHg	<60 mmHg
or: O_2 Saturation	≤93%	≤90%
or (if on O_2): PaO_2/FiO_2*	<333	<250

P	Arterial pH <7.35*	☐ (2 points)

SMART-COP

Score ≥ 3

Sensitivity 92%

ED → ICU 98%

Ward → ICU 84%

CURB-65 (≥3)

Sensitivity 38%

PSI Class 4 or 5

Sensitivity 73%

Clin Infect Dis 2008; 47(3):375-84

80M with HTN and DM presents to ED with fevers and cough. Exam: T99, P125, BP 100/60, RR30. Oriented x1, right lung base with crackles. CXR right lower lung consolidation. Develops respiratory distress in ED and requires intubation, + aspiration event.

What is the optimal antimicrobial therapy for this patient?

A - Vanco + Zosyn

B - Ceftriaxone + levofloxacin

C - Clindamycin

D - Clindamycin + ceftriaxone + levofloxacin

E - Vanco + Zosyn + clindamycin + azithromycin

Treatment

Outpatient:

Macrolide

or

Doxycycline (level III)

- No antibiotic within 3 months

Resp fluoroquinolone

or

β-lactam + macrolide

- Comorbidity (DM, CRI, CHF, etc)
- Abx within 3 months (avoid same class)
- High macrolide-resistant *S.pneumo*

Inpatient:

Resp fluoroquinolone

or

β-lactam + macrolide*

Meta-analysis - mortality benefit[1,2]

RCT BL mono - delayed clinical stability[3]

RCT BL mono - 90d mortality, non-inferior[4]

Inpatient - ICU:

β-lactam + macrolide

or

β-lactam + Resp FQ

1. J Antimicrob Chemother 2014; 69:1441-46
2. Clin Infect Dis 2012; 55:371-80
3. JAMA Intern Med 2014; 174:1894-1901
4. N Engl J Med 2015; 372:1312-23

Duration of Therapy

- Minimum 5 days
  - Typically 5-7 days
  - Can be as short as 3 days[1]
- Afebrile 48-72 hours and clinically stable
  - Pulse ≤ 100
  - RR ≤ 24
  - Systolic BP ≥ 90
  - O_2 Saturation ≥ 90%
  - Normal mental status and can take PO
- Corticosteroids for severe (acute) CAP
  - Probably has a mild mortality benefit[2]
  - Avoid in immunocompromised, influenza, fungal infections

1. BMJ 2006; 332:1355-60

2. Ann Intern Med 2015; 163(7):519-28

HCAP

- Purpose
  - Identify patients at risk for infection with MDRO
- Definition
  - Hospitalization or antibiotics within 90 d
  - Resident in nursing home or extended care facility
  - Chronic dialysis, wound care, home infusion within 30 d
  - Close contacts with documented MDRO
  - Immunocompromised host
- Microbiology
  - MRSA, Pseudomonas, ESBL Enterobacteriaceae
  - Routine CAP pathogens

HCAP Diagnosis

- Clinical Diagnosis
  - Fever
  - Leukocytosis
  - Purulent sputum
  - Decreased oxygenation

At least two clinical
+
Radiographic evidence

- Diagnostic studies
  - Sputum culture
  - Blood culture - not specified, refer to CAP criteria
  - LRT sample if possible
  - Procalcitonin (adjunctive)

60M with DM and ESRD on HD presents to ED with fevers and cough x3 days. Good functional status at baseline. No hospitalization or antibiotics for the past 90 d. Resides at home. Exam: T99, P100, BP 120/60, RR24. Oriented x3, right lung base with crackles. CXR right lower lung consolidation. Admitted to Med ward.

What is the optimal antimicrobial therapy for this patient?

A - Vanco + cefepime

B - Vanco + cefepime + levofloxacin

C - Cefepime + tobramycin

D - Levofloxacin

E - Vanco + ceftriaxone + levofloxacin

Treatment

Antipseudomonal β-lactam

plus

2nd antipseudomonal

(IV abx within 90 days, high risk for mortality)

plus

Anti-MRSA agent

plus (*if suspected****)***

Anti-Legionella agent

- Piperacillin-tazobactam
- Cefepime
- Imipenem

- Ciprofloxacin/Levofloxacin
- Aminoglycoside

- Vancomycin
- Linezolid

- Fluoroquinolone
- Macrolide

60M with DM and ESRD on HD presents to ED with fevers and cough x3 days. No other MDRO risks. Exam: T99, P100, BP 120/60, RR24. Oriented x3, right lung base with crackles. CXR right lower lung consolidation. Admitted to Med ward and treated with Vanco + Zosyn + levofloxacin. On HD #3 he is ready for d/c - afebrile x48 hrs, normal vitals.

What is the optimal management for this patient?

A - Discontinue antibiotics

B - Continue Vanco + Zosyn + levofloxacin

C - Continue Vanco with HD + PO levofloxacin

D - Continue Vanco with HD + PO Augmentin & levoflox

E - Consult ID

HCAP Strategies

- HCAP criteria cannot accurately predict risk for MDRO
  - Initial definition proposed in 2005
  - Defining risks never validated
  - Very poor specificity in multiple subsequent studies
- Risk scores
  - Multiple clinical scoring tools available, but none are optimal
  - Can safely reduce overall use of broad spectrum therapy
  - All of them take into account severity of illness (ie ICU)
- De-escalation
  - No guidelines for de-escalation
  - Can discontinue antibiotics in certain patients after 3d[1]
  - Can safely discontinue vancomycin in certain situations[2]

1. Am J Respir Crit Care Med 2000; 162:505-11

2. Antimicrob Agents Chemother 2013; 57:1163-8

52F with DM develops fever and cough 2d prior to admission. Presents to OSH and CXR with LLL consolidation. Influenza swab neg, WBC 13. Admitted and started on ceftriaxone and azithromycin. Continued daily fevers and malaise for the next 4 days. Transferred here for further evaluation. Exam: T103 F, P130, WBC 12. LLL crackles and egophony. Reports not feeling worse but no improvement in her symptoms.

Further studies from OSH (obtained on admission):

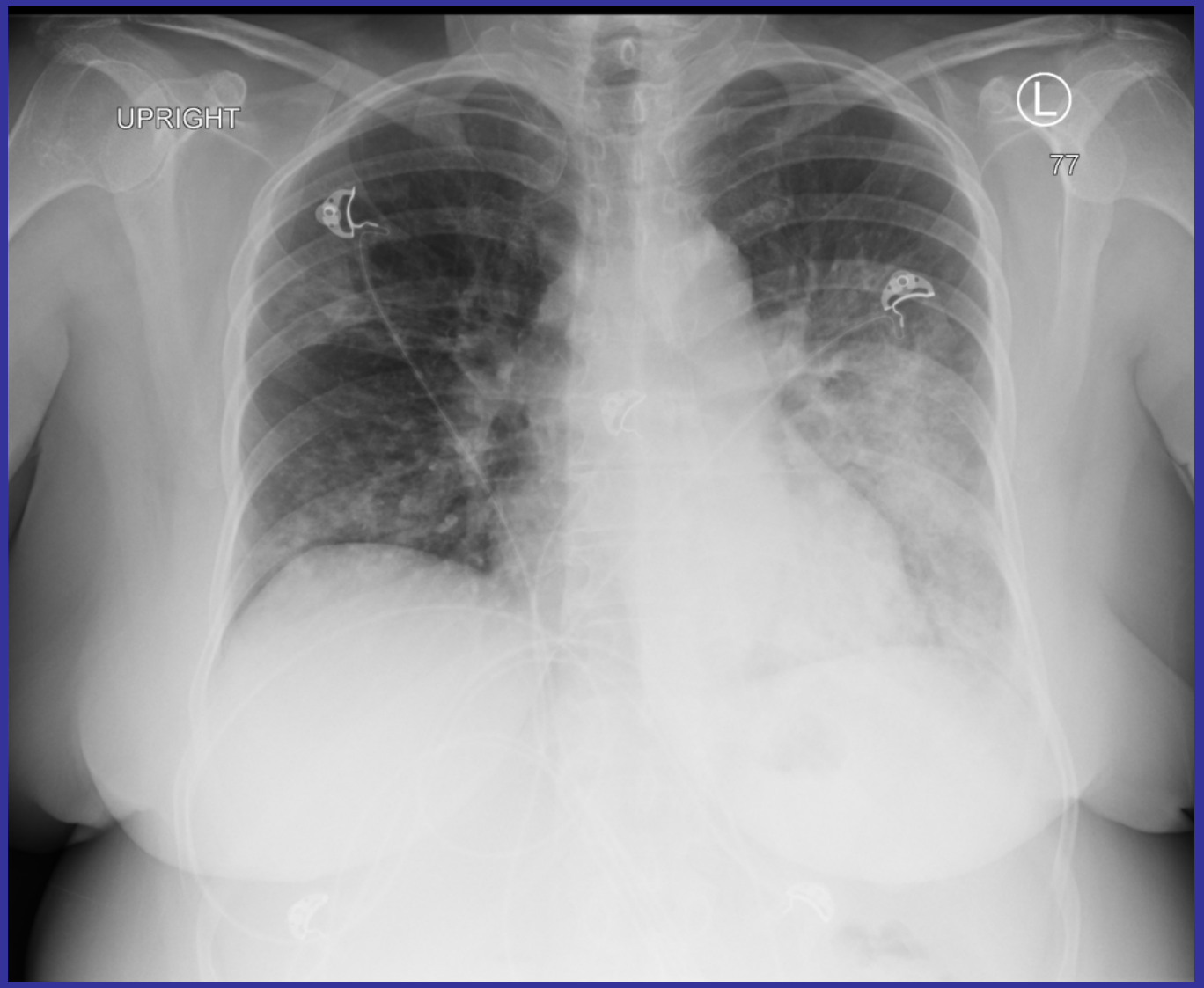
Blood cxs negative

Urine pneumococcal antigen neg

Urine legionella antigen neg

Cocci serologies neg

CXR (next slide)



What is the next best step in management?

A - Add fluconazole
B - Add prednisone
C - Obtain CT chest and repeat blood cultures
D - Change to vanco and Zosyn
E - Perform thoracentesis

Non-responding Pneumonia

- Frequency 6-15%
- Definition – no clear cut definition
  - Failure to improve > 72 hours
  - Deterioration/progression – early or late
  - Persistent pulmonary infiltrates > 30d
- Differential
  - “Normal” response – severity of illness, comorbidities
  - Uncovered pathogen, resistant microorganism
  - Empyema/parapneumonic effusion
  - Nosocomial superinfection
  - Non-infectious