



Brigham and Women's Hospital

Founding Member, Mass General Brigham

Pneumonia in Hospitalized Patients

Intensive Review of Internal Medicine

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Disclosures

- Grant funding
 - Centers for Disease Control and Prevention
 - Agency for Healthcare Research and Quality
 - Massachusetts Department of Public Health
 - Royalties
 - UpToDate for chapters on pneumonia
 - Honoraria
 - PriMed, Inc.
-

AMERICAN THORACIC SOCIETY DOCUMENTS

Diagnosis and Management of Community-acquired Pneumonia An Official American Thoracic Society Clinical Practice Guideline

Barbara
Daniel
Joshua
Leila S
Kevin

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based clinical practice guidelines on four key questions
for the diagnosis and management of adult patients

1. Is lung ultrasound an acceptable alternative to chest x-ray?
2. Should patients with CAP who test positive for a respiratory virus get empiric antibacterials?
3. Can patients with CAP be treated with <5 days of antibiotics?
4. Should patients with CAP receive corticosteroids?

systemic corticosteroids.

Case Study

- A 74-year-old man with a history of atrial fibrillation, congestive heart failure, and mild dementia is admitted to hospital from his nursing home with confusion. He is tachypneic, has a non-productive cough, and looks short of breath.
- On exam, he is lethargic but easily arousable. Temperature 100°F (37.8°C), HR 118 irregular, BP 108/64, RR 24, SaO2 90% RA. JVP difficult to see. Possible crackles in the bases. Mild lower extremity edema.
- Labs are notable for WBC count of 10.2, hct 32, plt 240, Na 130, creatinine 1.4, liver function tests normal. CRP 42mg/mL. PCR for influenza is positive.
- Urinalysis with 4-6 WBC/hpf
- Portable chest x-ray with edema +/- LLL infiltrate



Does this patient have pneumonia?

Would you start antibiotics?

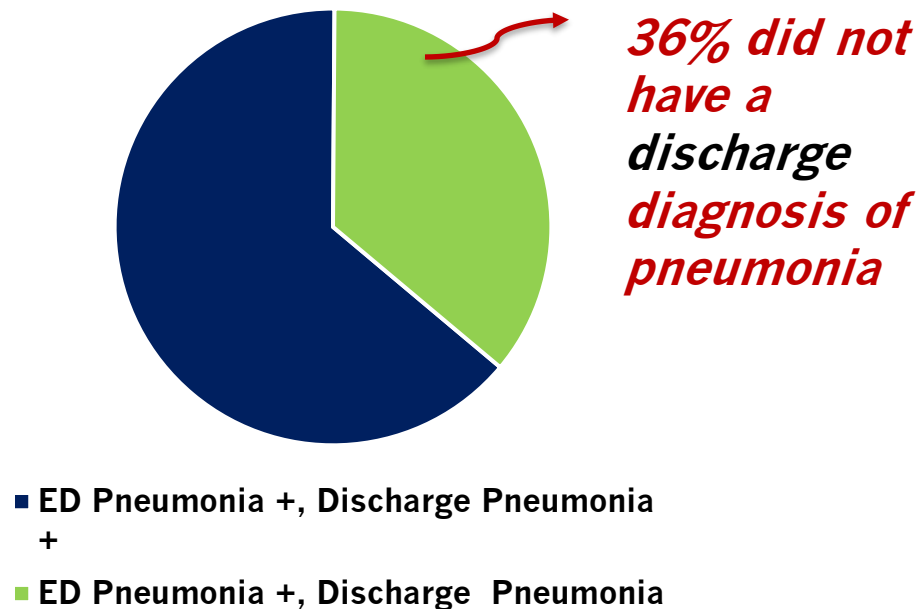
Why is Pneumonia So Difficult to Diagnose?

- Many medical conditions in hospitalized patients present with the same clinical signs as pneumonia
 - Radiographic opacities
 - Fever
 - Abnormal white blood cell count
 - Impaired oxygenation
 - Increased pulmonary secretions
-

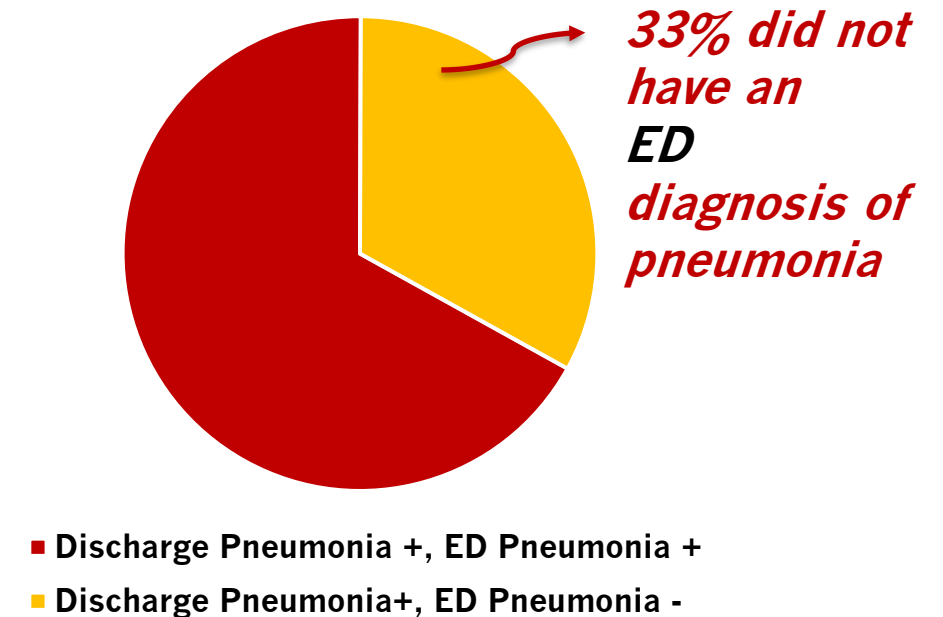
Diagnostic Uncertainty in Pneumonia

Analysis of ED vs discharge diagnoses in 2,383,899 patients admitted to 118 VA hospitals, 2015-2022

ED Diagnosis of Pneumonia



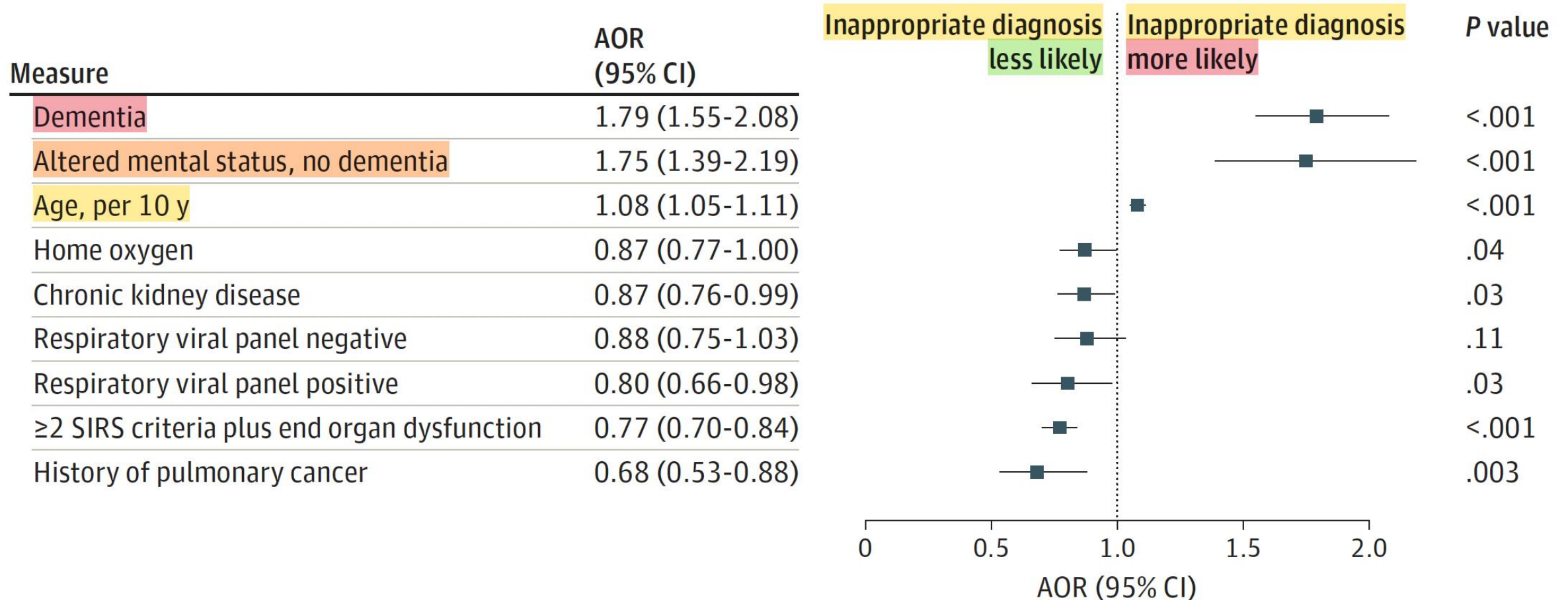
Discharge Diagnosis of Pneumonia



Uncertainty common! 51-58% of patients' clinical notes expressed uncertainty; 24% treated with diuretics, 38% treated with corticosteroids, 10% treated with all 3 of diuretics, steroids, and antibiotics

Predictors of Inappropriate Diagnosis

*Analysis of 17,290 patients admitted to 48 Michigan hospitals, 2017-2020.
Inappropriate diagnosis defined as <2 signs or symptoms of CAP or negative chest imaging.*



Could further imaging help?

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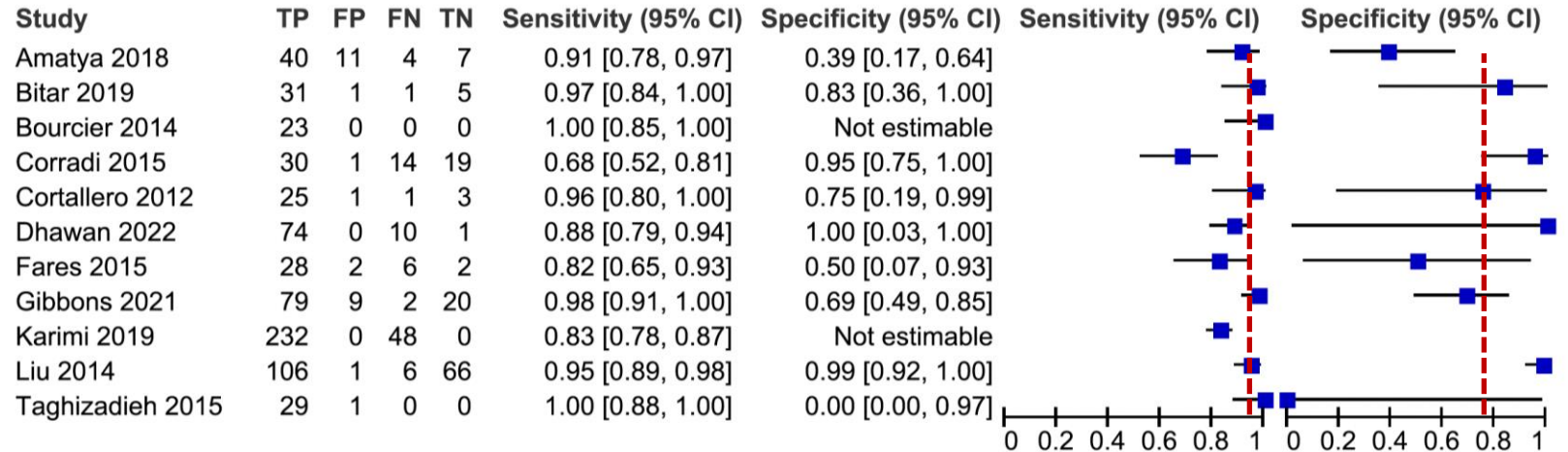
Accuracy of Ultrasound and CXR vs Chest CT

Meta-analysis of 11 studies, 939 patients. Chest CT used as reference standard

Accuracy of Ultrasound vs CT

Sensitivity: 95%

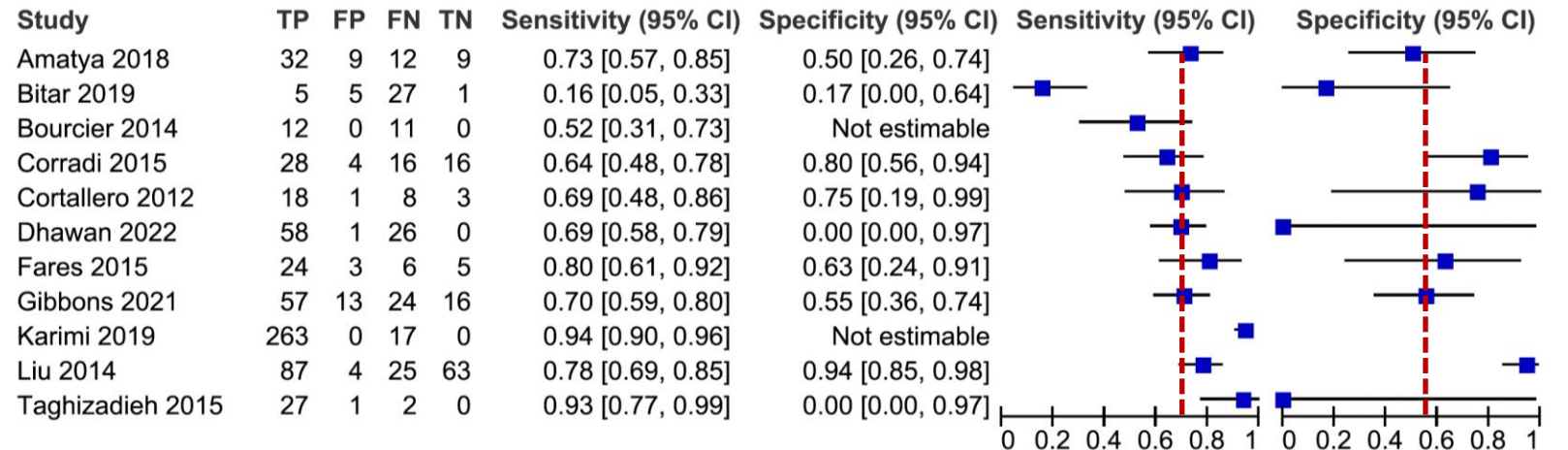
Specificity: 75%



Accuracy of Chest X-Ray vs

Sensitivity: 70%

Specificity: 55%



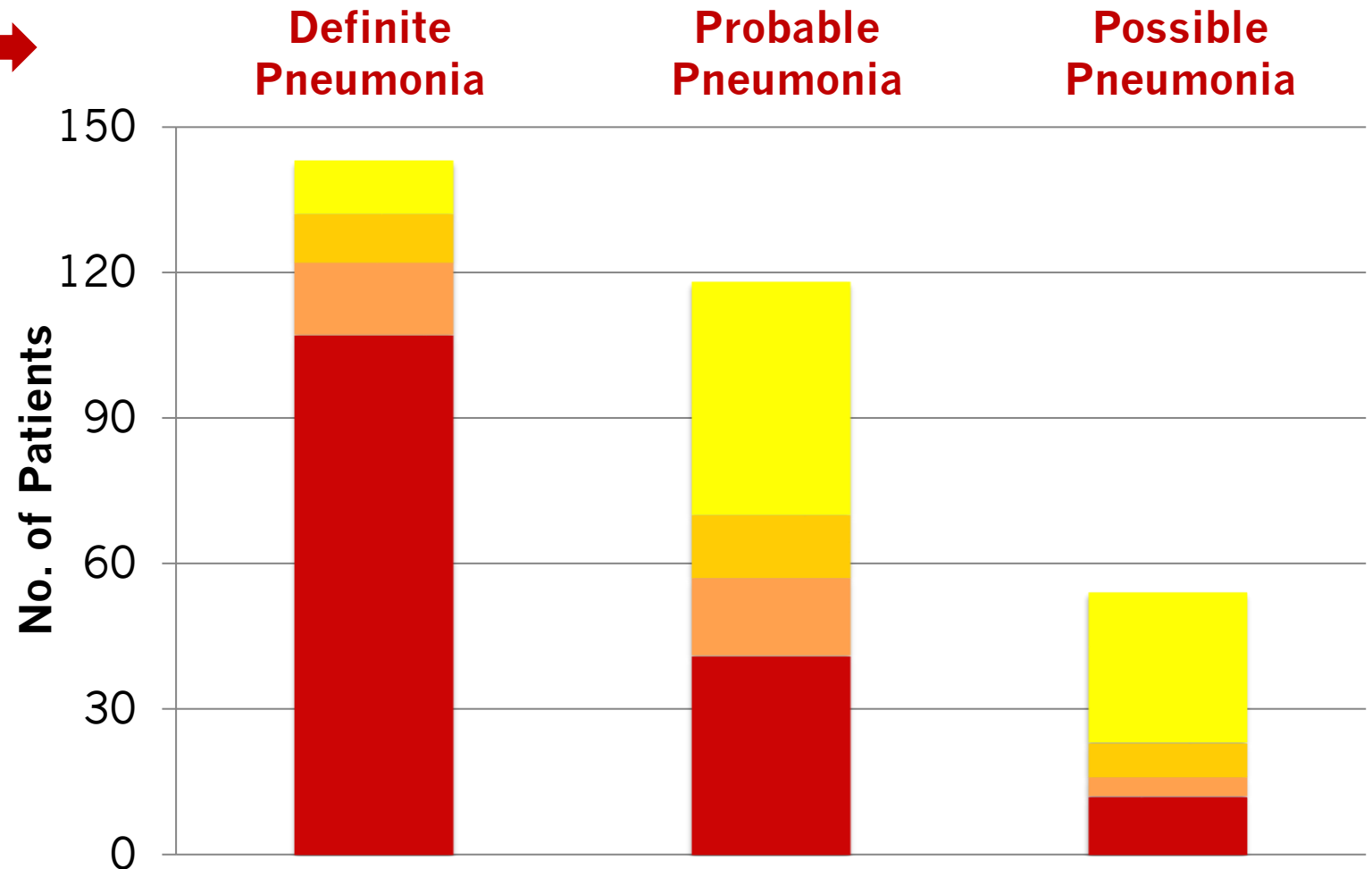
Chest X-Ray vs CT Scan

319 patients with clinically suspected community-acquired pneumonia referred for immediate CT chest to confirm or rule out pneumonia, 4 tertiary emergency departments, France

Pneumonia certainty before CT:

Pneumonia certainty after CT:

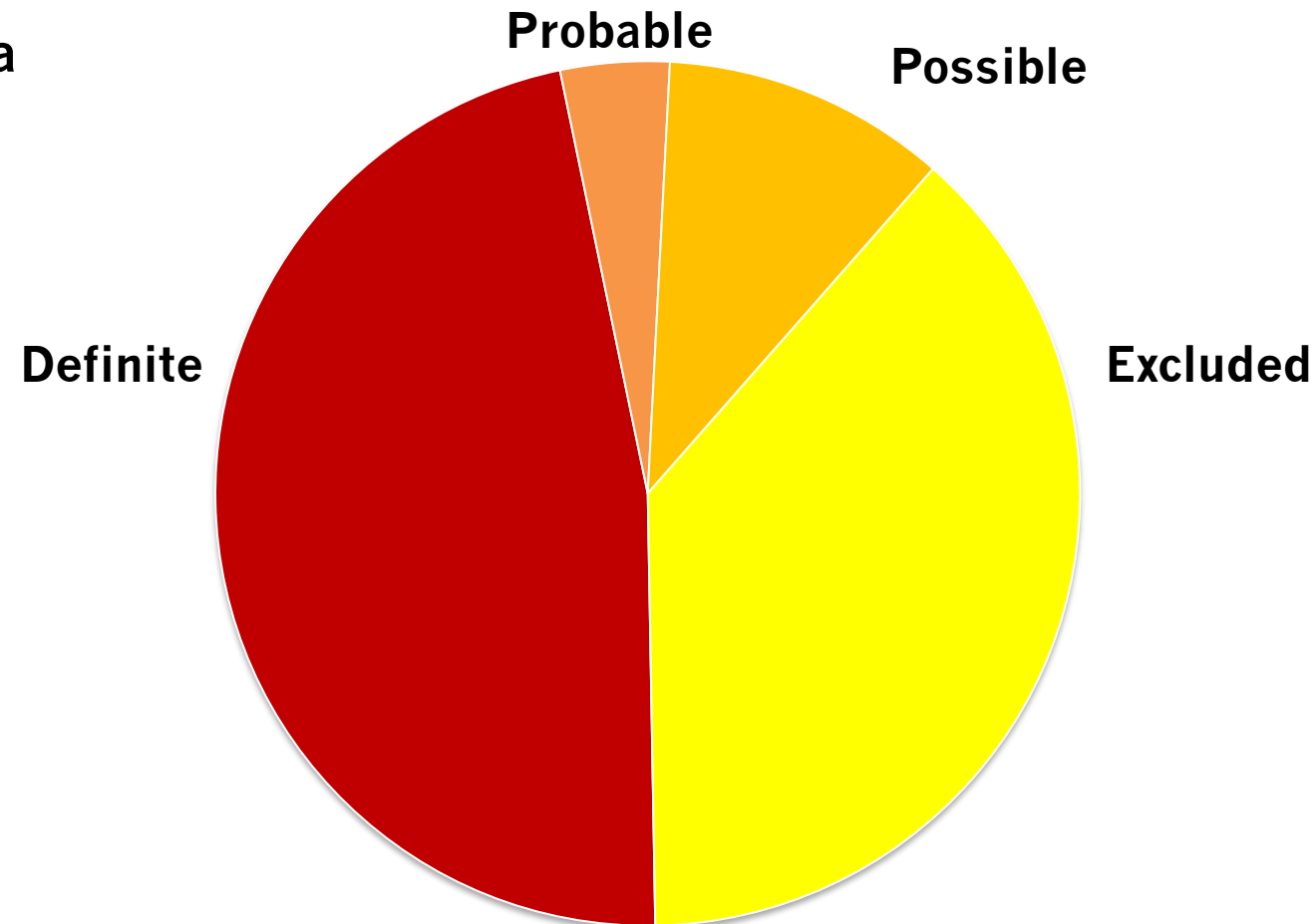
- Excluded
- Possible
- Probable
- Definite



Chest X-Ray vs CT Scan

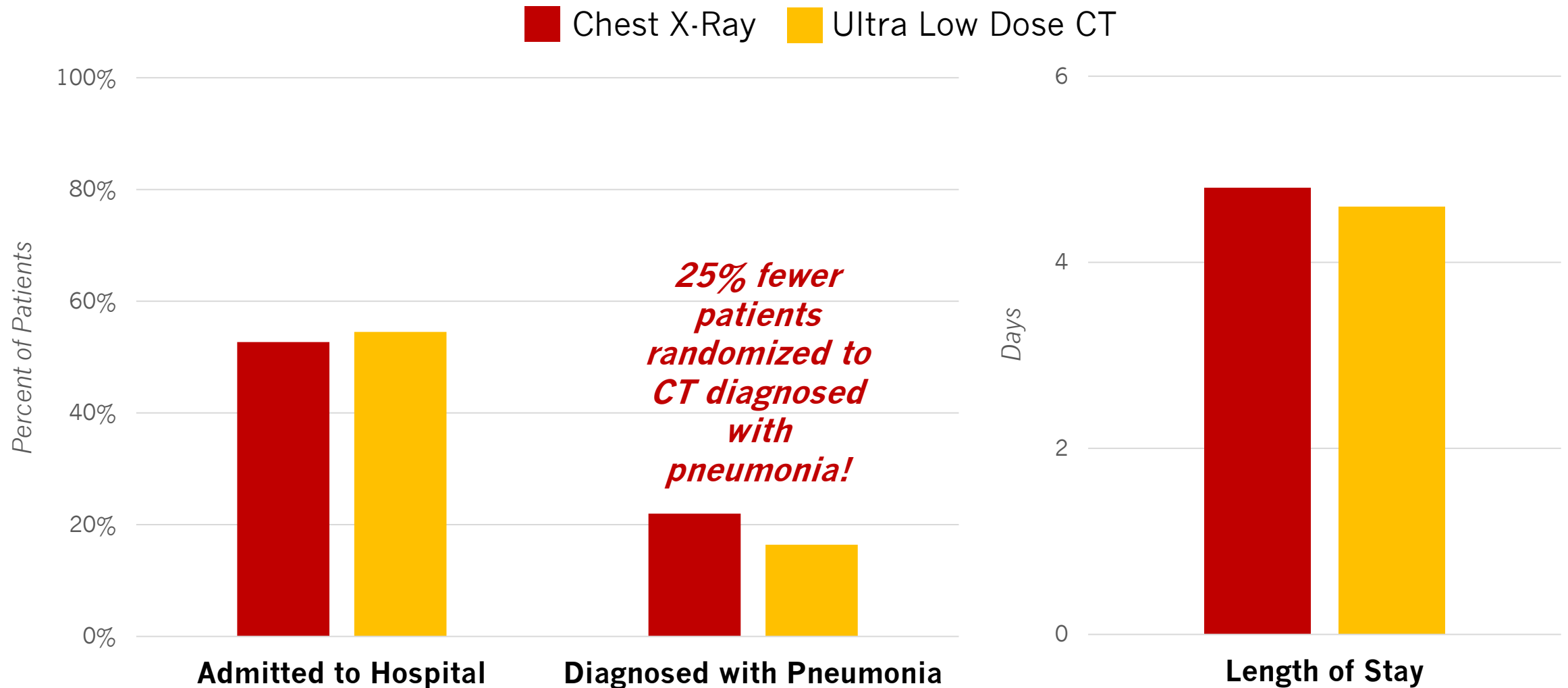
319 patients with clinically suspected community-acquired pneumonia referred for immediate CT chest to confirm or rule out pneumonia, 4 tertiary emergency departments, France

Final Pneumonia Classification:



CT vs CXR for Suspect Pulmonary Disease in the ED

2,418 ED patients with suspected pulmonary disease randomized to ultra-low dose CT vs CXR, Netherlands, 2017-8



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“For adults with suspected CAP, we suggest lung ultrasound is an acceptable diagnostic alternative to chest radiography in medical centers where appropriate clinical expertise exists (conditional recommendation, low-quality evidence).”

Abstract

Background

of adult patients has evolved with emerging technologies. This document updates evidence-based clinical practice guidelines on four key questions for the diagnosis and management of adult patients

that for a respiratory virus is positive, antibiotic duration, and the use of systemic corticosteroids.

**Our patient tested positive for influenza.
Does he need antibiotics?**

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“For adult inpatients with clinical and imaging evidence of non-severe CAP who have a positive test result for a respiratory virus, we suggest prescribing empiric antibiotics (conditional recommendation, very low-quality evidence).”

Abstract

Background

of adult
has evolved

emerging technologies. This document updates evidence-based clinical practice guidelines on four key questions for the diagnosis and management of adult patients

diagnosis, empiric antibacterial therapy if a test result for a respiratory virus is positive, antibiotic duration, and the use of systemic corticosteroids.

ATS

IDSA



Infectious Diseases Society of America (IDSA) Position Statement: Why IDSA Did Not Endorse the Community-Acquired Pneumonia Guidelines 2025 Update

Michael Klompas,^{1,2,●} Majdi Al-Hasan,^{3,4,●} Mayar Al Mohajer,^{5,6} Robert Colgrove,^{7,8,●} Shira Doron,^{9,●} Thomas File,^{10,11,●} Natasha N. Pettit,^{12,●} Michael Pulia,^{13,●} and Sharon Weissman^{3,4,●}

¹Harvard Pilgrim Health Care Institute and Harvard Medical School, Boston, Massachusetts, USA; ²Brigham and Women's Hospital, Boston, Massachusetts, USA; ³University of South Carolina School of Medicine, Columbia, South Carolina, USA; ⁴Prisma Health Midlands, Columbia, South Carolina, USA; ⁵Baylor College of Medicine, Houston, Texas, USA; ⁶Baylor St. Luke's Medical Center, Houston, Texas, USA; ⁷Mount Auburn Hospital, Cambridge, Massachusetts, USA; ⁸Harvard Medical School, Boston, Massachusetts, USA; ⁹Tufts Medical Center and Tufts University School of Medicine, Boston, Massachusetts, USA; ¹⁰Summa Health, Akron, Ohio, USA; ¹¹Northeast Ohio Medical University, Rootstown, Ohio, USA; ¹²University of Chicago Medicine, Chicago, Illinois, USA; and ¹³BerbeeWalsh Department of Emergency Medicine, University of Wisconsin-Madison, School of Medicine and Public Health, Madison, Wisconsin, USA

The American Thoracic Society recently released updated community-acquired pneumonia (CAP) guidelines. The Infectious Diseases Society of America (IDSA) agreed with 8 of the 10 recommendations in the guidelines but declined to endorse the guidelines because they include recommendations for use of antibiotics in outpatients with comorbidities and inpatients with nonsevere CAP who test positive for respiratory viruses. It is noted in the guidelines that bacterial coinfections are common and that delaying antibiotics may be harmful. IDSA notes, however, that nondiscriminatory use of antibiotics for patients with CAP and positive viral assays confers more risks than benefits. Most patients do not have bacterial coinfections, and briefly withholding antibiotics for patients with nonsevere illness to clarify the diagnosis is safe. In this era of precision medicine, IDSA instead recommends individualized, dynamic decision-making that takes into account each patient's evolving trajectory, severity of illness and balance of clinical features for and against coinfection.

ATS CAP Guidelines

**Outpatient
No Comorbidities**



*We suggest
NOT
prescribing
antibiotics*

IDSA Agreed

**Outpatient
With Comorbidities**



*We suggest
prescribing
antibiotics*

IDSA Disagreed

**Inpatient
Non-Severe Disease**



*We suggest
prescribing
antibiotics*

**Inpatient
Severe Disease**



*We suggest
prescribing
antibiotics*

IDSA Agreed



**BE
ANTIBIOTICS
AWARE**

SMART USE, BEST CARE

**Antibiotics do not
work on viruses such
as colds and flu.**





**EUROPEAN
ANTIBIOTIC
AWARENESS DAY**



A EUROPEAN
HEALTH INITIATIVE

**Antibiotics
don't work
on viruses**

#keepantibioticsworking

ANTIBIOTICS DON'T WORK ON THE FLU VIRUS



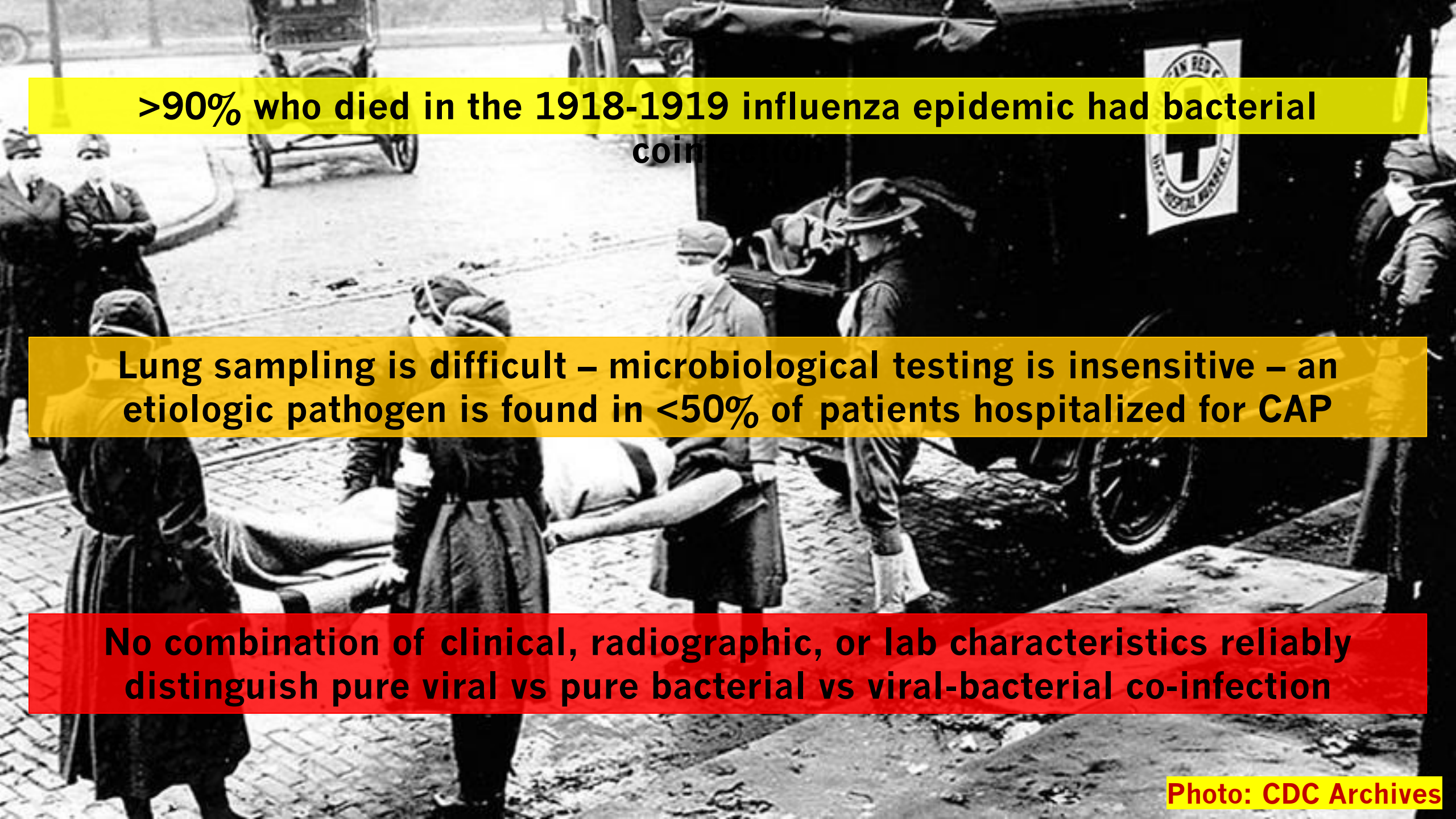
American Thoracic Society Rationale

Empiric antibiotics hinge on the “risks and consequences of viral-bacterial coinfection”



Risk of missed or delayed treatment in patients with bacterial coinfection (adverse outcomes, death)

Risks of unnecessary antibiotics for both individuals (side effects, microbiome harm, costs) and the public (antibiotic resistance)



>90% who died in the 1918-1919 influenza epidemic had bacterial coinfection

Lung sampling is difficult – microbiological testing is insensitive – an etiologic pathogen is found in <50% of patients hospitalized for CAP

No combination of clinical, radiographic, or lab characteristics reliably distinguish pure viral vs pure bacterial vs viral-bacterial co-infection

Two Key Questions

- 1. What is the probability of bacterial co-infection?**
 - 2. What is the risk of harm if occult co-infection is present and treatment is delayed?**
-

Two Key Questions

1. **What is the probability of bacterial co-infection?**
 2. What is the risk of harm if occult co-infection is present and treatment is delayed?
-

ATS on Probability of Co-Infection

- “A systematic review of epidemiologic studies evaluating the etiology of pneumonia ... reported that in studies in which ... a respiratory virus was identified ... bacteria were detected in 25-35% of these cases”

Source study: Shoar 2020

Shoar 2020 cites 3 studies:

- Musher 2013: 11/42 (26%) co-infection
- Jain 2015: 59/589 (**10%**) co-infection →
- Musher 2020: 14/40 (**35%**) co-infection →



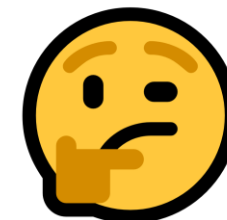
excluded pts with purulent sputa per gram

- “A separate study that evaluated all patients hospitalized for CAP found to have a viral illness reported an 18–39% rate of bacterial detection”

Source study: Falsey 2013

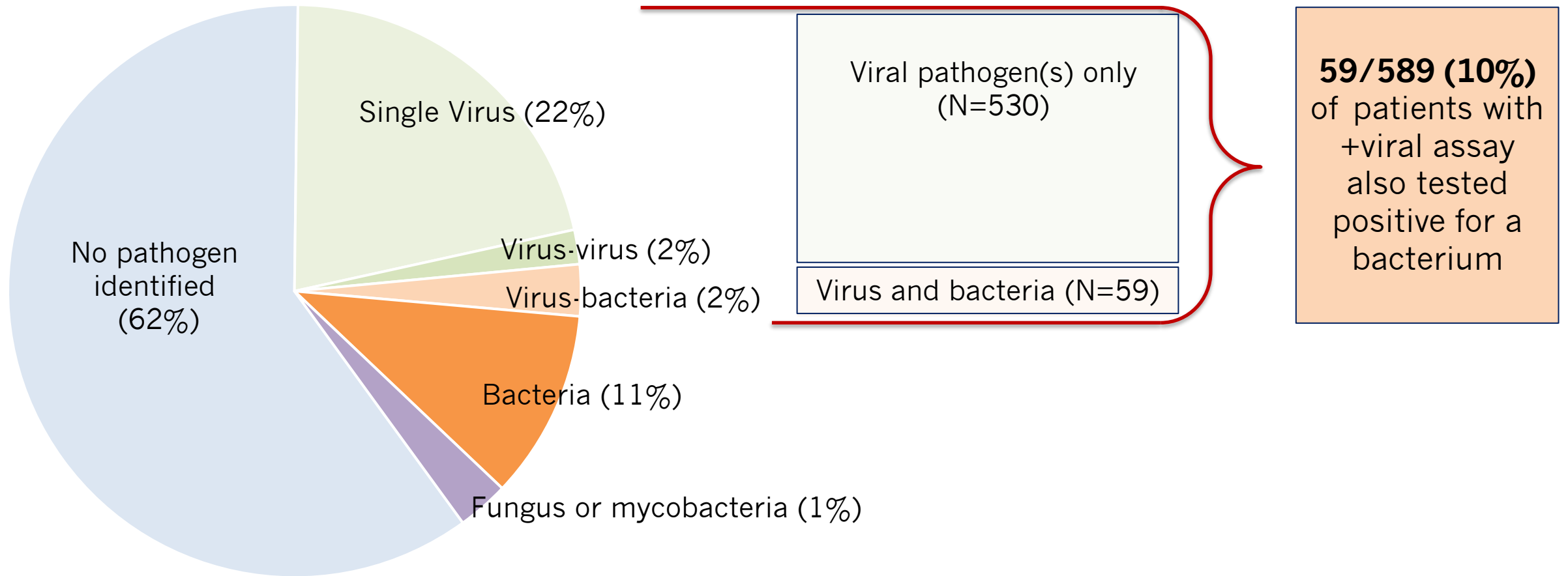
Falsey 2013 analyzed 348 pts with CAP and +virus:

- Bacteria identified: 64/348 (18%)
- Bacteria identified OR procalcitonin ≥ 0.25 : 136/348 (**39%**)



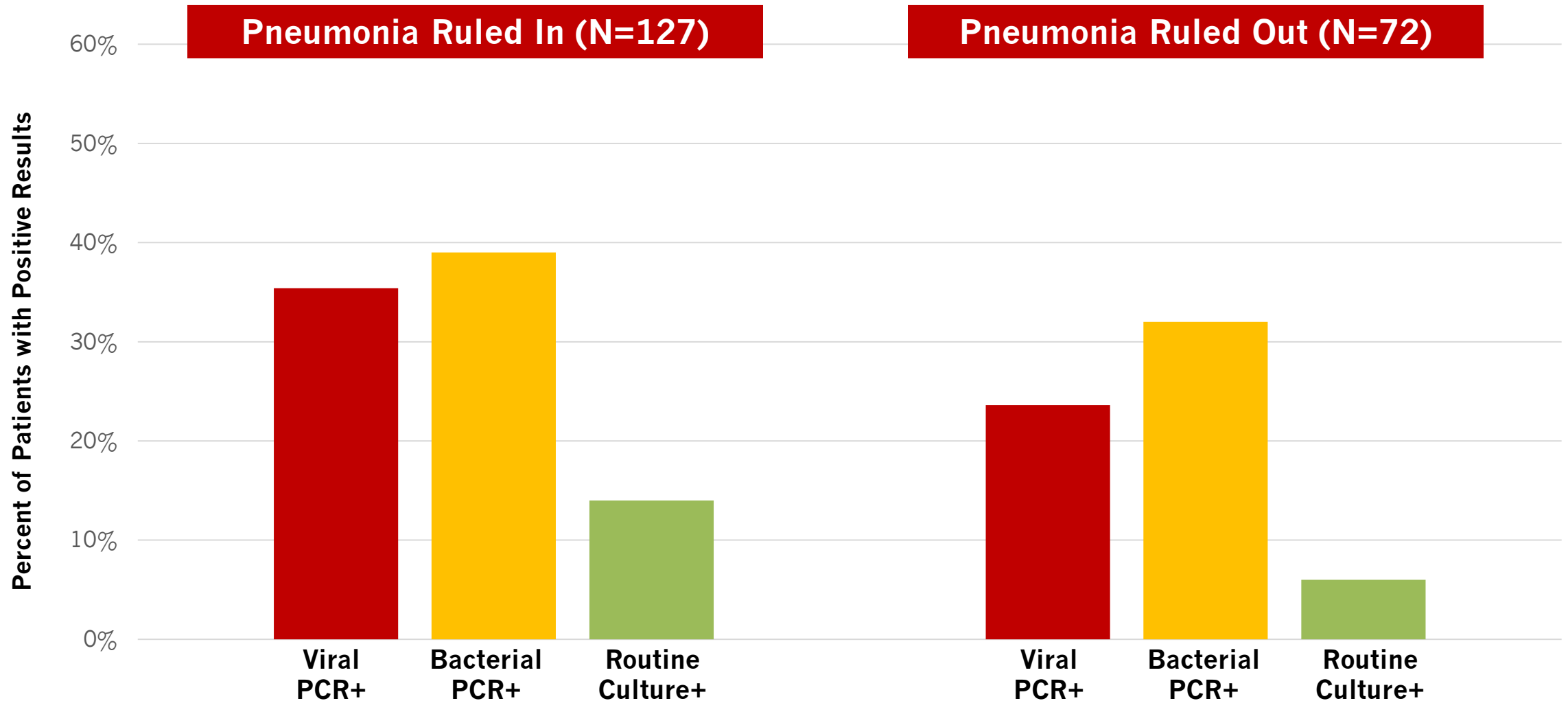
Etiology of Community-Acquired Pneumonia

CDC prospective analysis of the etiology of CAP, 2320 adults, 5 hospitals in Chicago & Nashville, 2010-2012



Not every positive test indicates pneumonia...

199 elderly patients started on antibiotics for suspected pneumonia; pneumonia then ruled in or out by chest CT

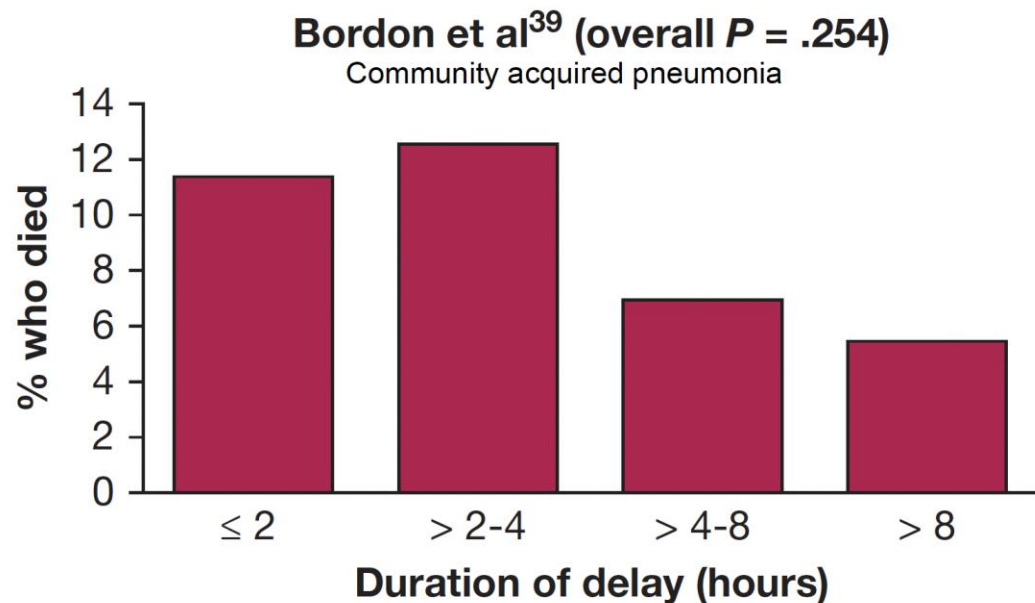


Two Key Questions

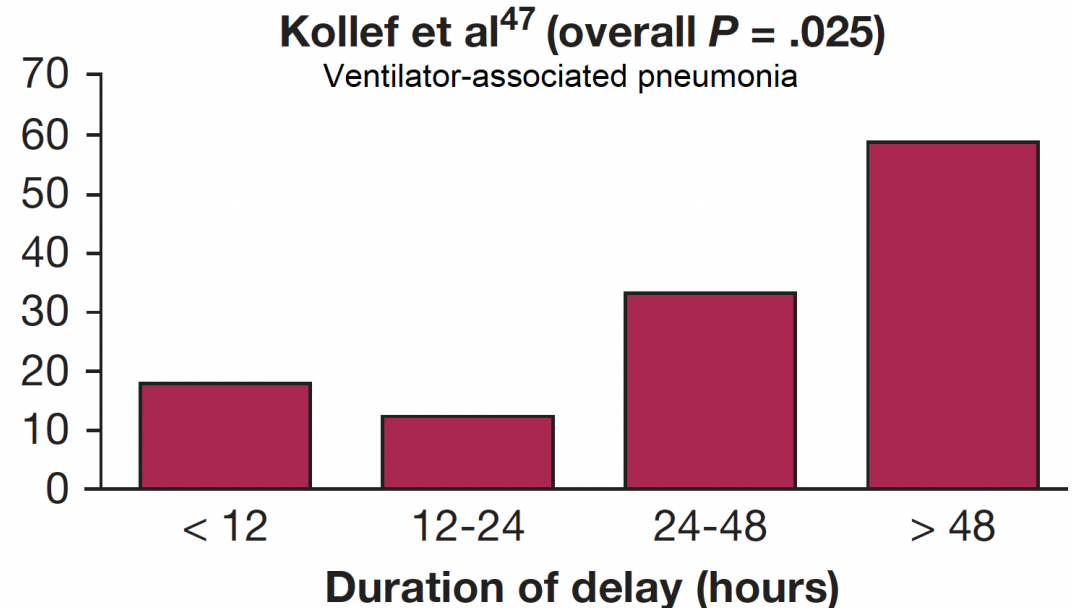
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-

What is the Risk of Harm with Antibiotic Delay?

Community Acquired Pneumonia

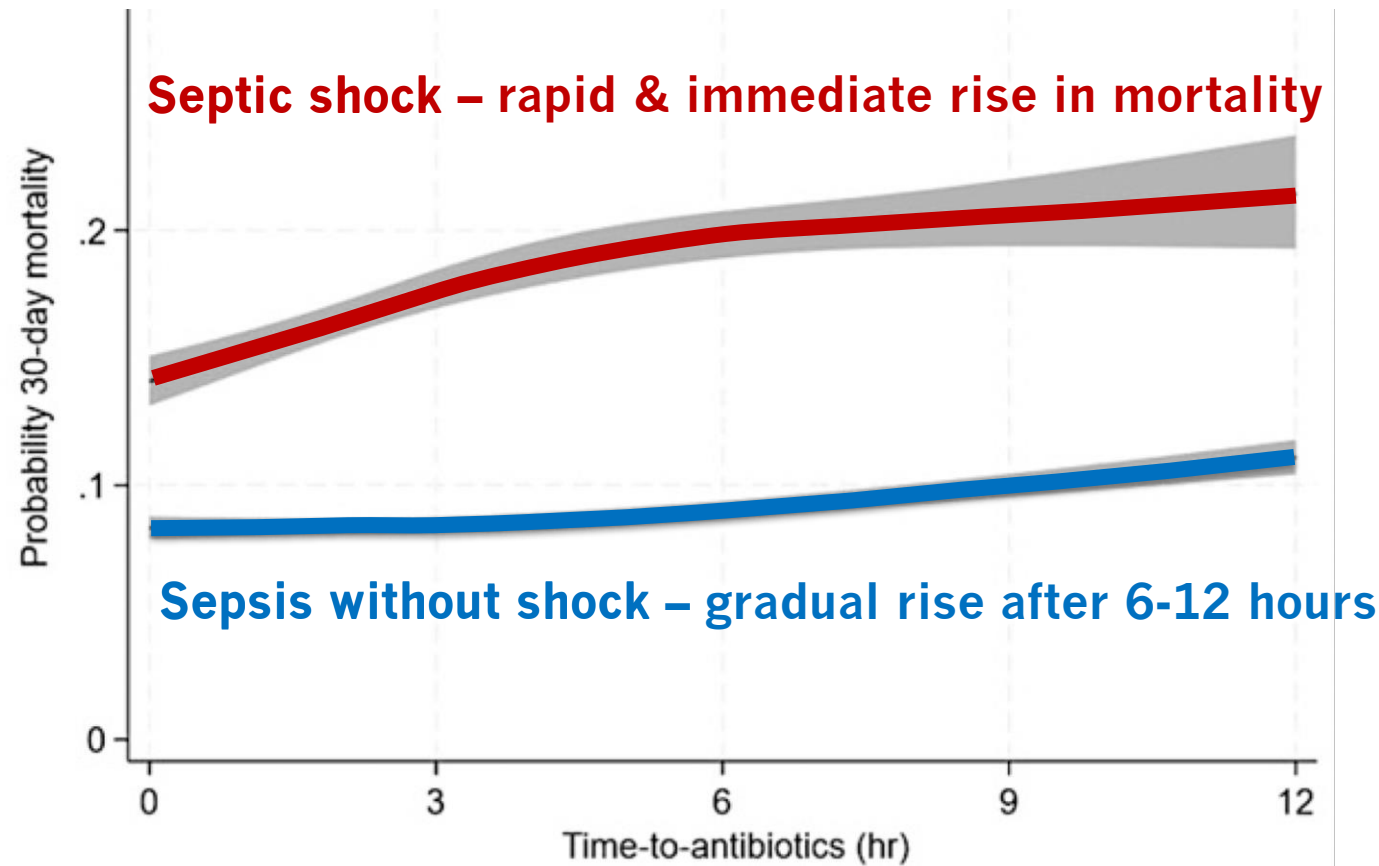


Ventilator Associated Pneumonia



What is the Risk of Harm with Treatment Delay?

Retrospective analysis of the association between time-to-antibiotics and 30-day mortality amongst 273,255 patients with community-onset sepsis, 173 US hospitals, 2013-2018

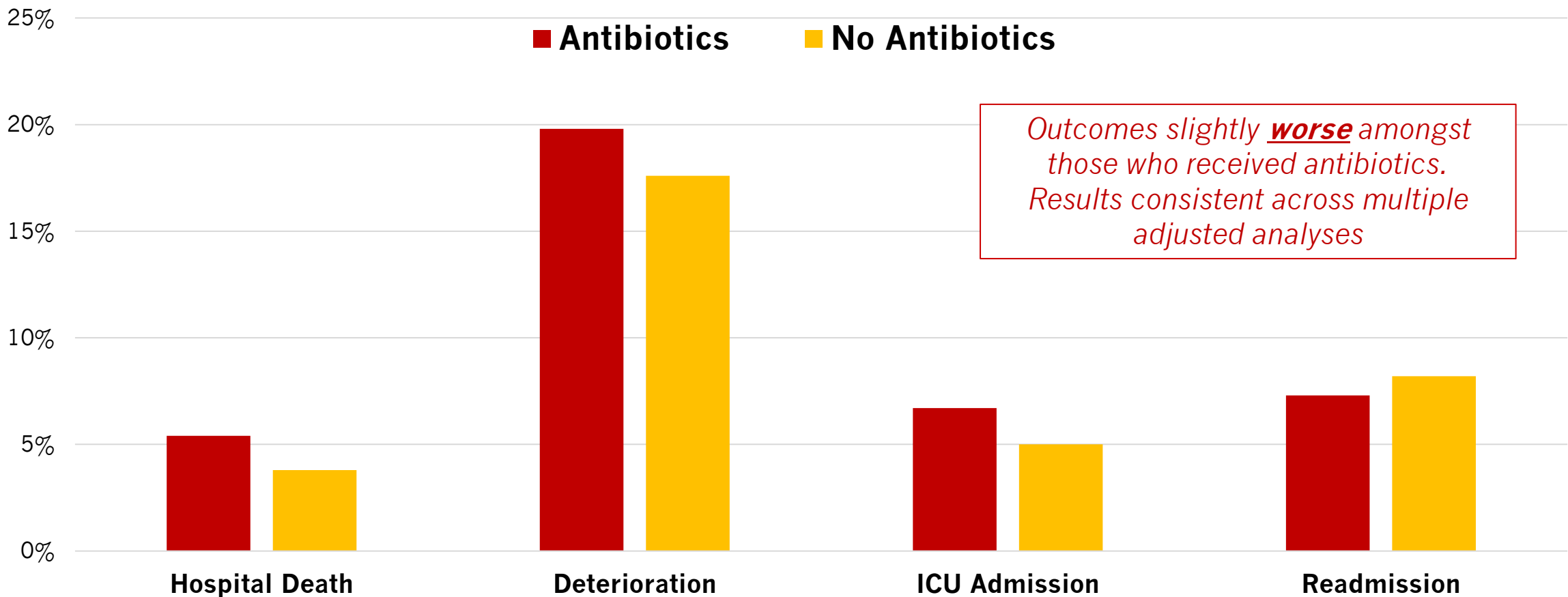


**But what does the literature say on
antibiotics vs no antibiotics for patients with
CAP and a positive viral assay?**

*“No published studies were identified to inform the
committee’s recommendations”*

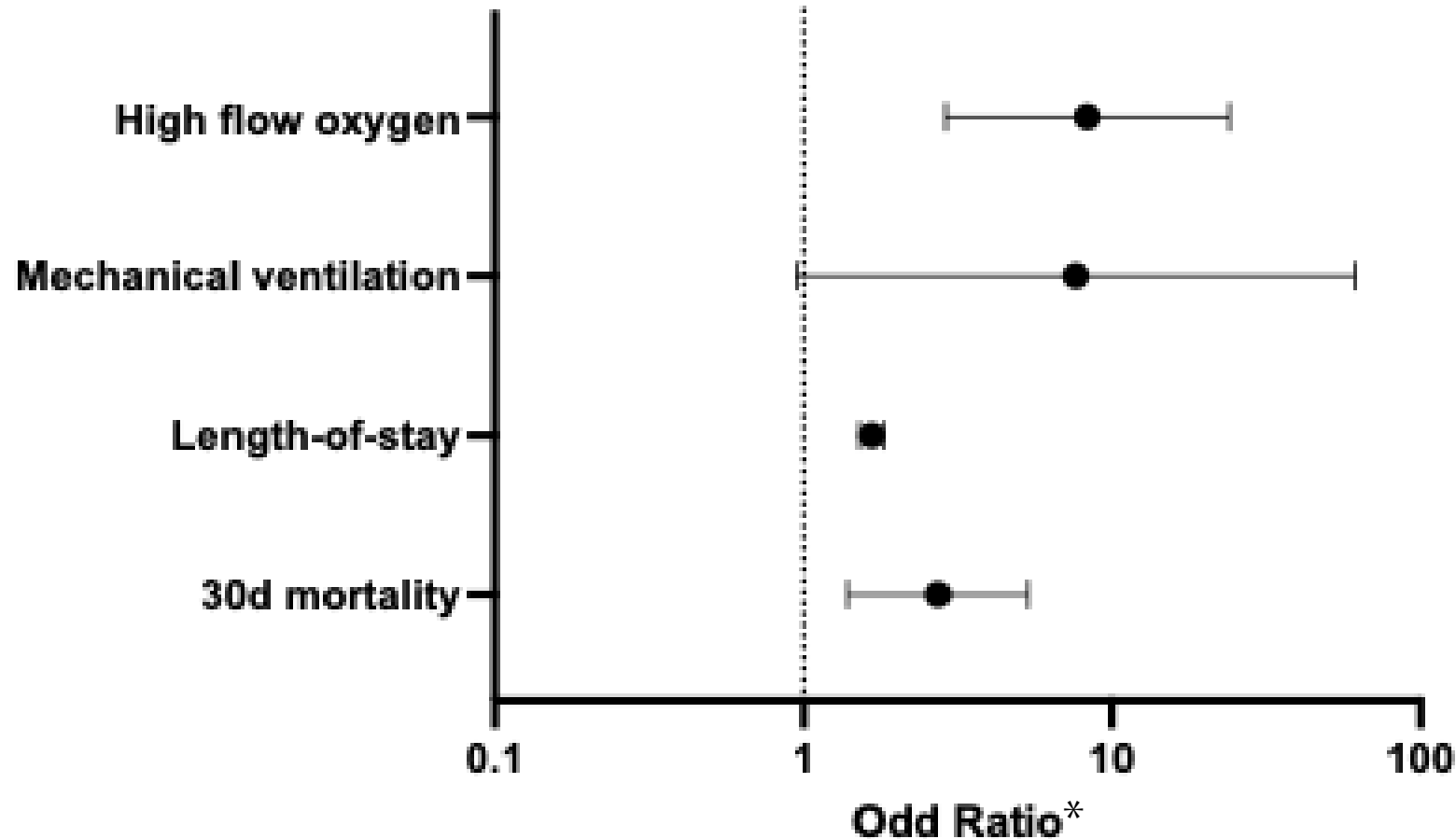
Impact of Antibiotics in Patients Hospitalized with Covid

Retrospective comparison of 160,482 Covid patients treated with antibiotics versus 359,923 treated without antibiotics, 1,053 US hospitals, April 2020 – December 2023



Empiric Antibiotics and Outcomes in Flu and RSV

Associations between early antibiotic use and outcomes amongst 986 patients with RSV or influenza admitted to 2 Danish tertiary care hospitals, Mar 2017- Apr 2020. 622/986 (63%) received antibiotics.



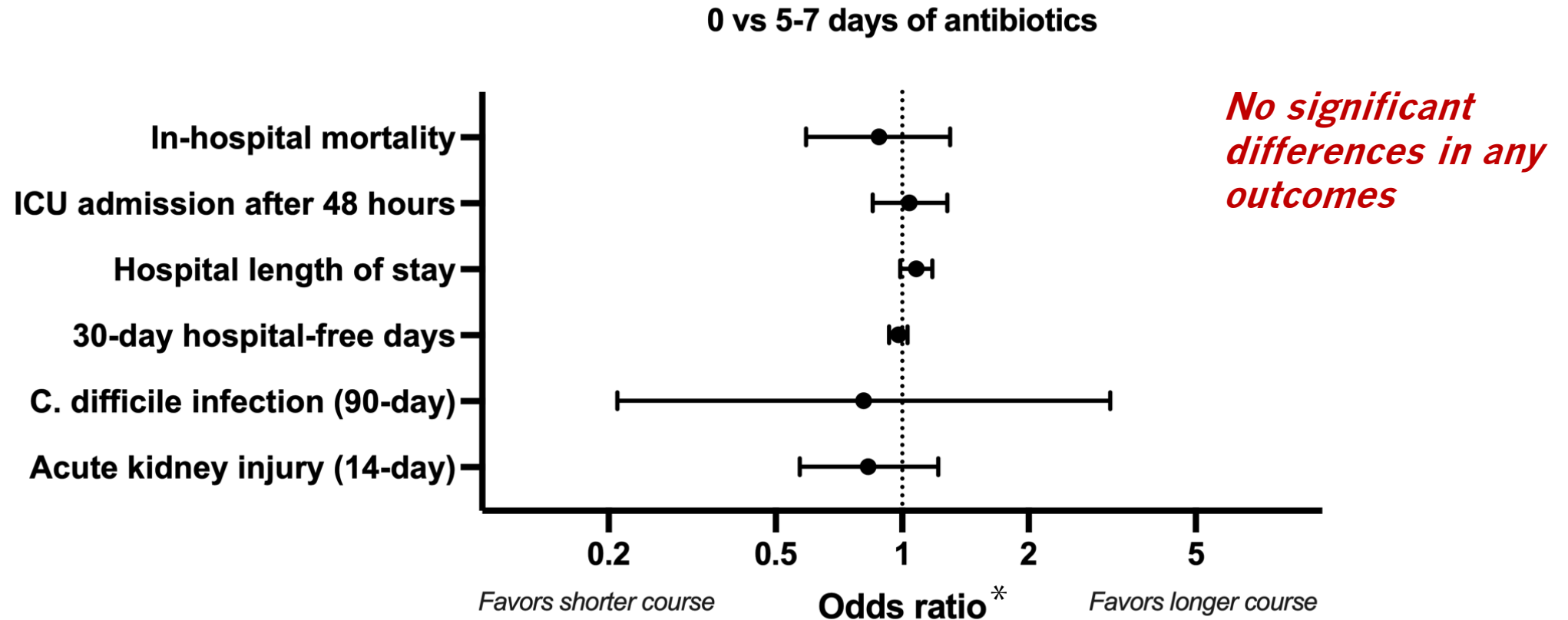
Patients who received early antibiotics had worse outcomes.

Treated patients sicker (probable residual confounding by indication).

*adjusted for age, no. of comorbidities, pneumonia on imaging, and type of virus

Impact of Antibiotics in Viral CAP

Propensity-weighted retrospective analysis of 2088 patients with possible CAP & a positive respiratory viral assay.
1190 patients treated with 0 days antibiotics vs 894 treated with 5-7 days of antibiotics



*propensity weights incorporated age, sex, race, comorbidities, vital signs, oxygen support, lab values, vasopressors, ICU, steroids

American Thoracic Society

Treat all hospitalized patients with possible CAP and a positive test for a respiratory virus with antibacterials

ATS's rationale:

- Bacterial coinfection is common and potentially deadly
- Delays in antibiotics may lead to worse outcomes

Infectious Disease Society of America

Use your judgement.

Reserve antibiotics for patients with severe illness or clinical signs suggestive of co-infection

- High WBC, positive sputum gram stain, + molecular assays, high procalcitonin...

IDSA's rationale:

- Most patients with +viral assays do not have bacterial coinfection. The vast majority will not benefit.
- Retrospective analyses show similar outcomes in patients who do and don't get antibiotics

Should we give steroids?

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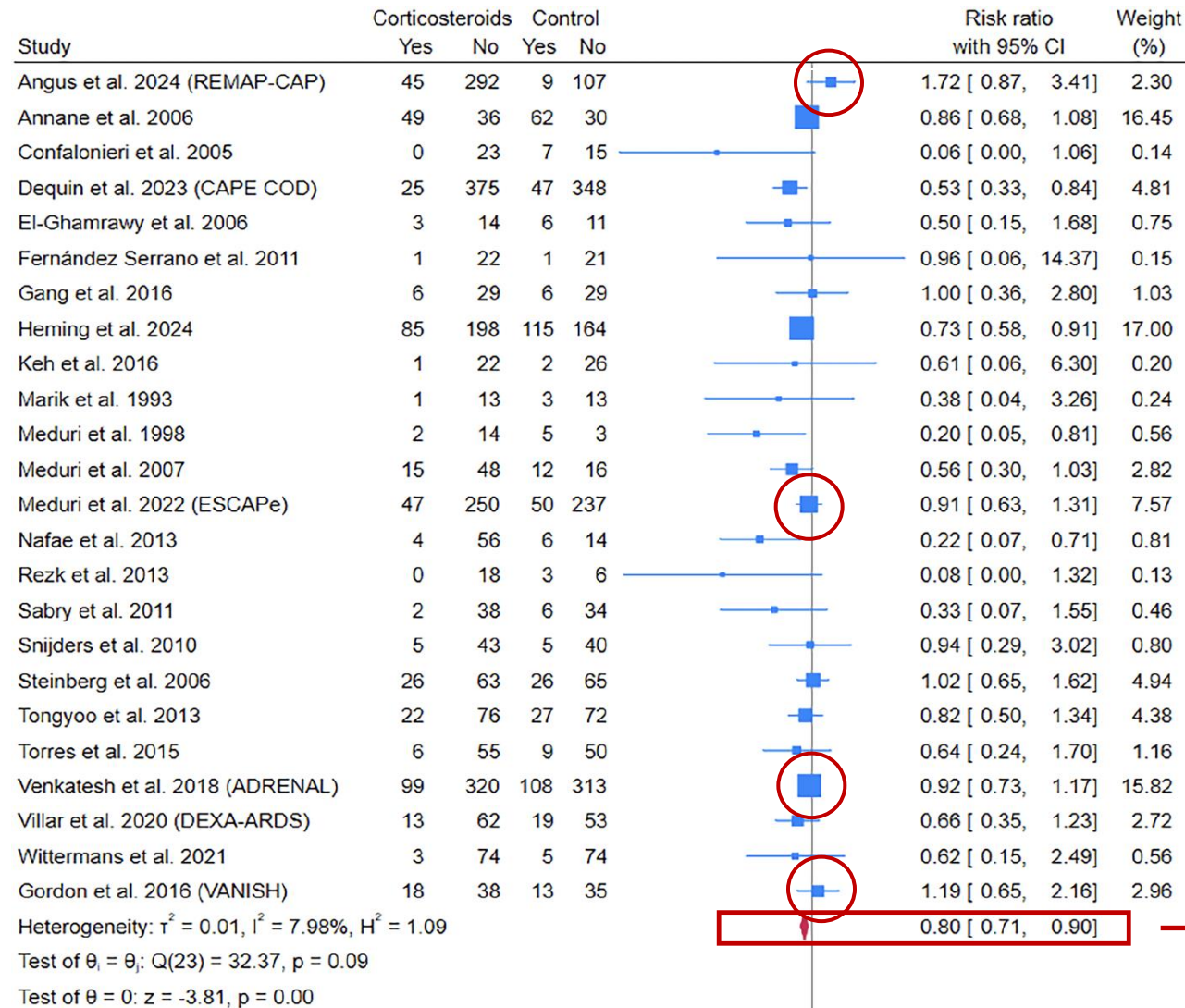
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systemic corticosteroids.

Steroids for **Non-Viral Severe** Community Acquired Pneumonia

Meta-analysis of 30 randomized trials of corticosteroids for suspected or probable CAP, N=7519 patients



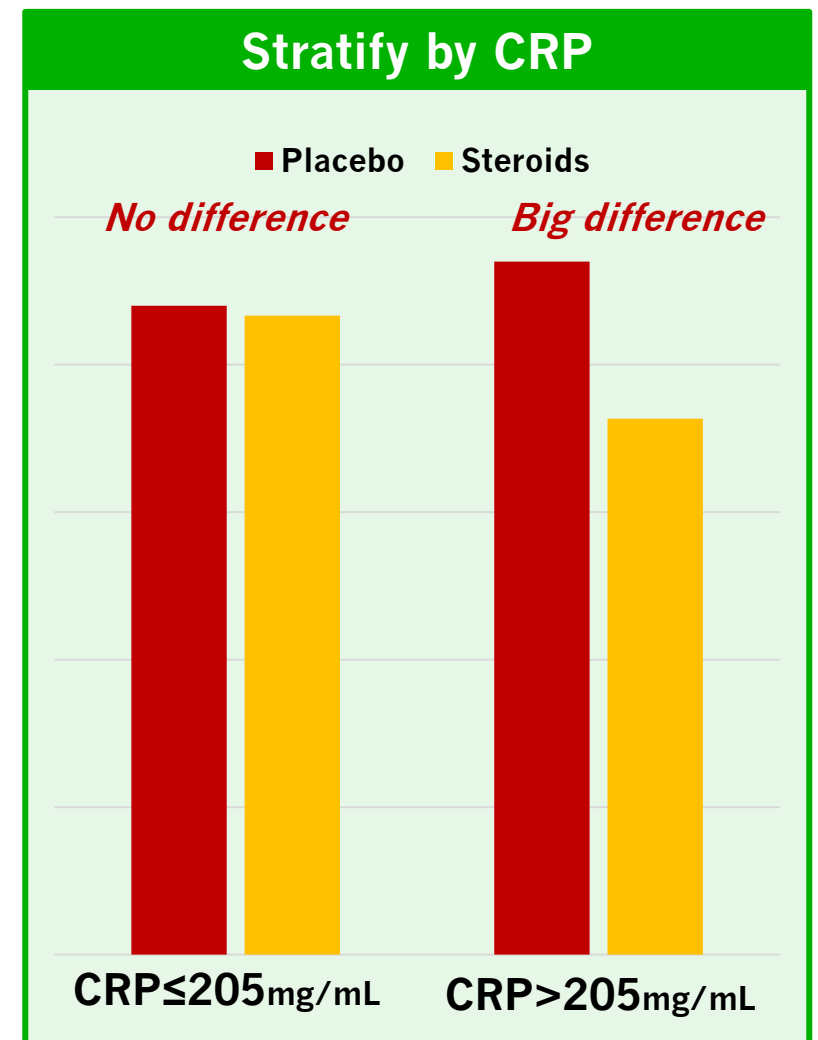
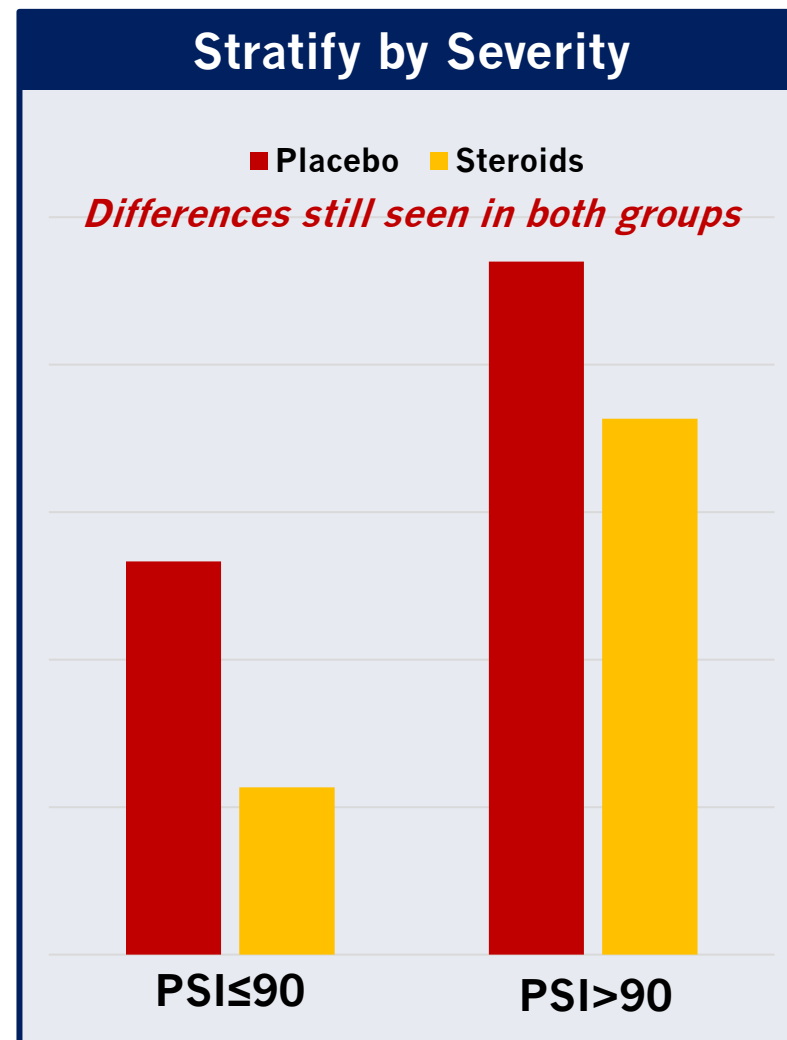
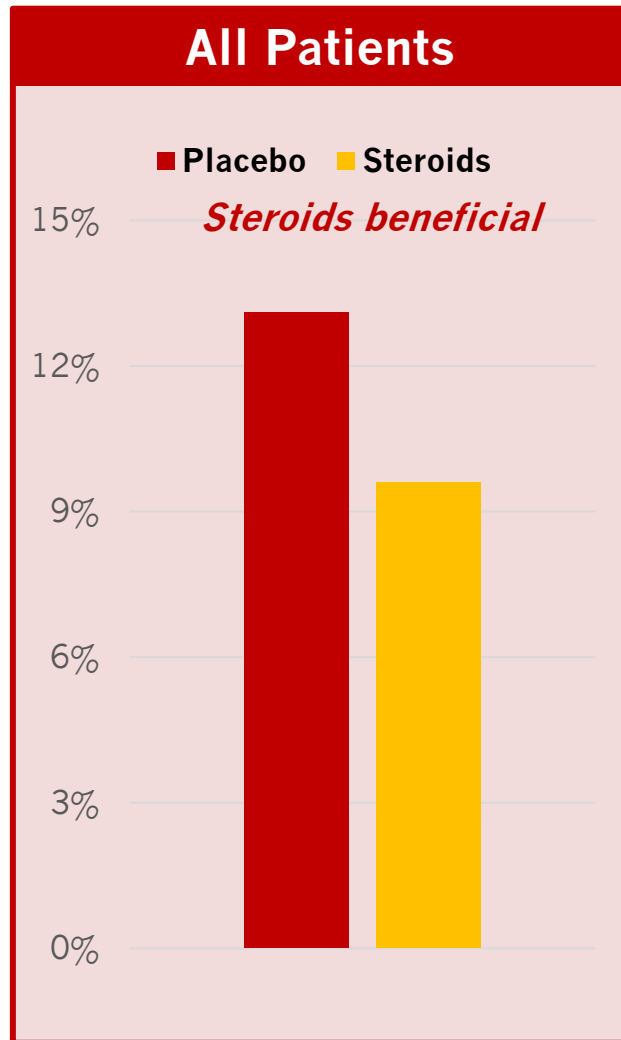
Steroids associated with significantly **lower** short-term mortality

Also associated with less need for mechanical ventilation, shorter ICU length-of-stay, and shorter hospital length-of-stay

**Mortality Risk Ratio
0.80 (95% CI 0.71-0.90)**

High CRP Levels Predict Steroid Responsiveness

Machine learning used to identify predictors of steroid responsiveness with patient-level data from 8 randomized trials



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Corticosteroids:

Non-severe CAP:

steroids not recommended
(strong recommendation)

Severe CAP:

steroids suggested
(conditional recommendation)

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respiratory virus is positive, antibiotic duration, and the use of
systemic corticosteroids.

How long should we treat for?

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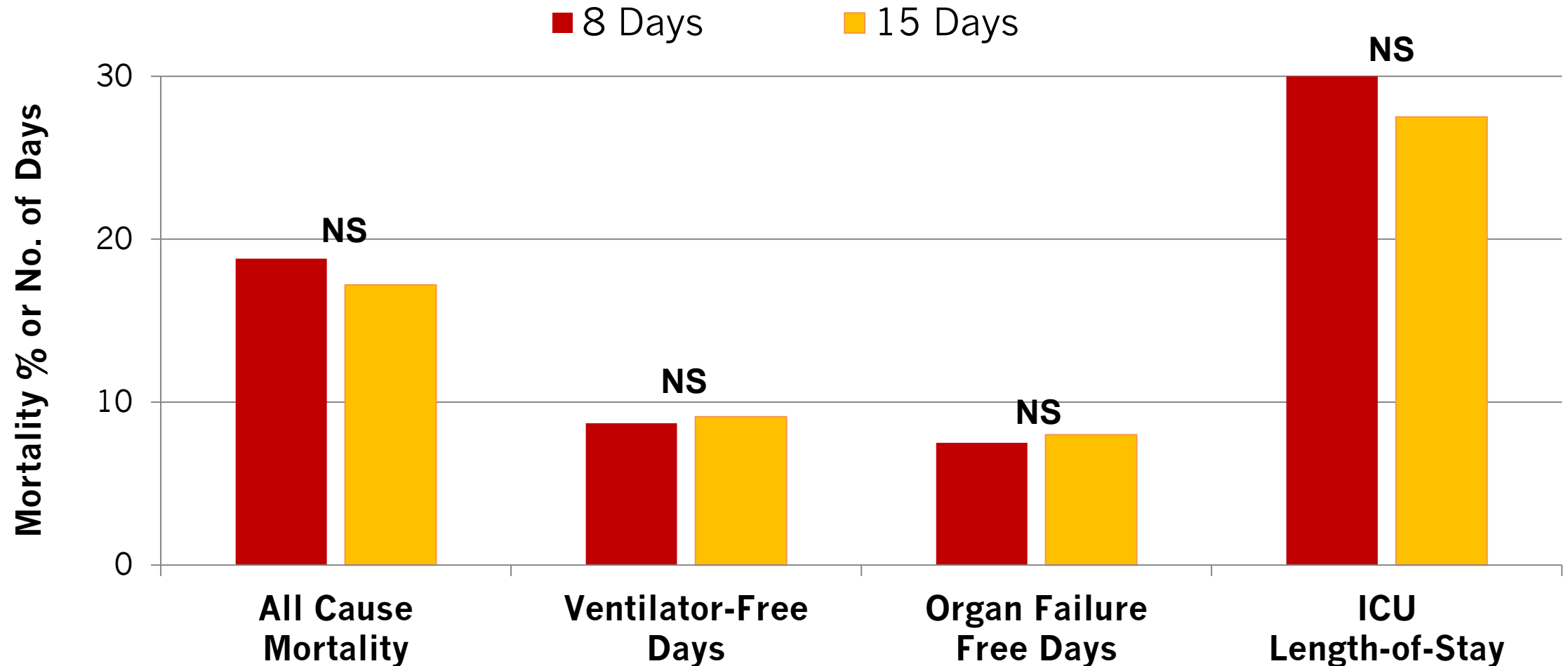
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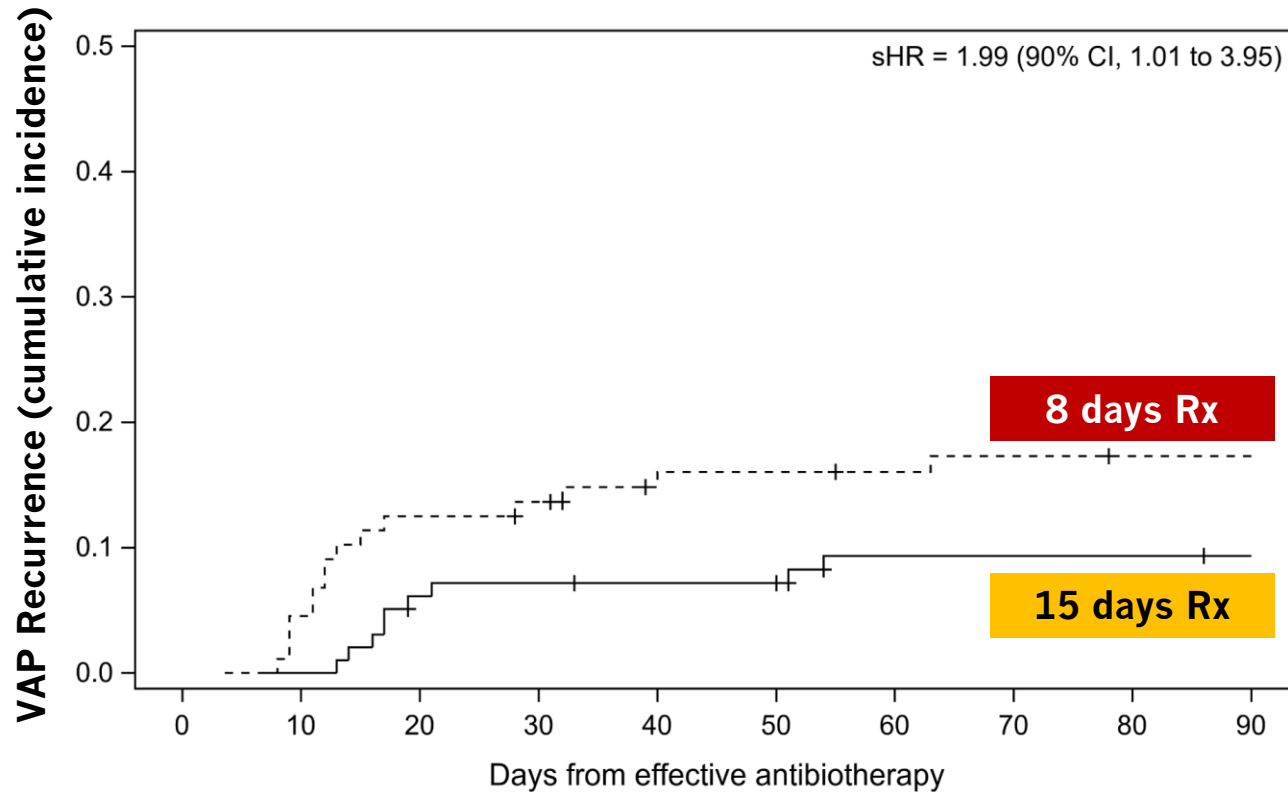
401 patients with ventilator-associated pneumonia randomized to 8 vs 15 days of antibiotics



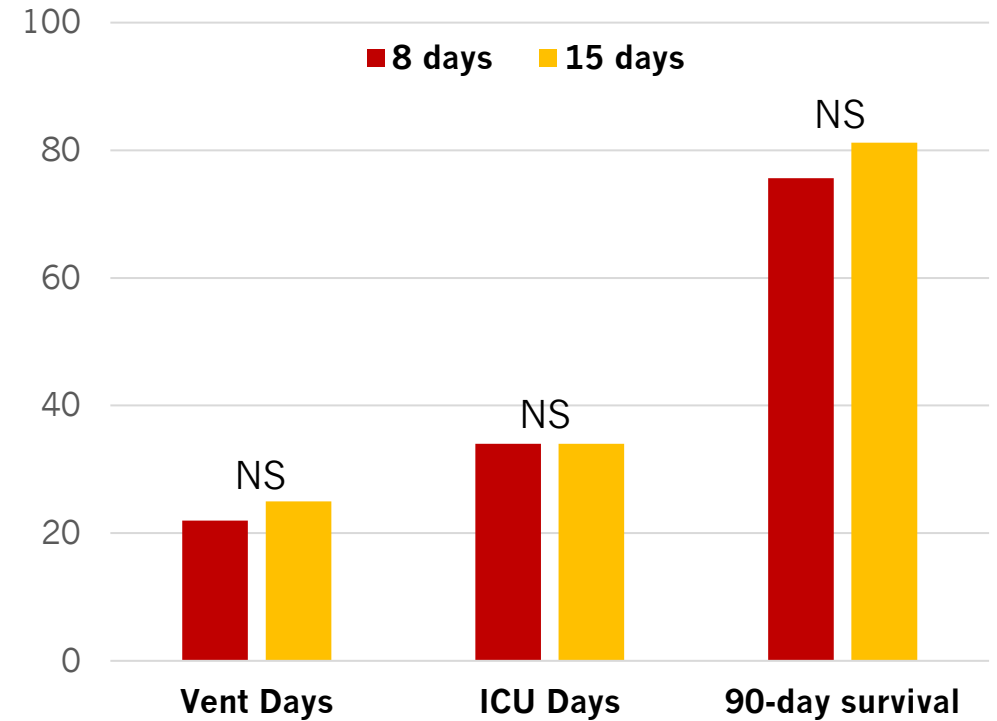
What about Pseudomonas???

186 patients with VAP due to non-fermenting gram negatives randomized to 8 vs 15 days of antibiotics

Recurrent Pneumonia



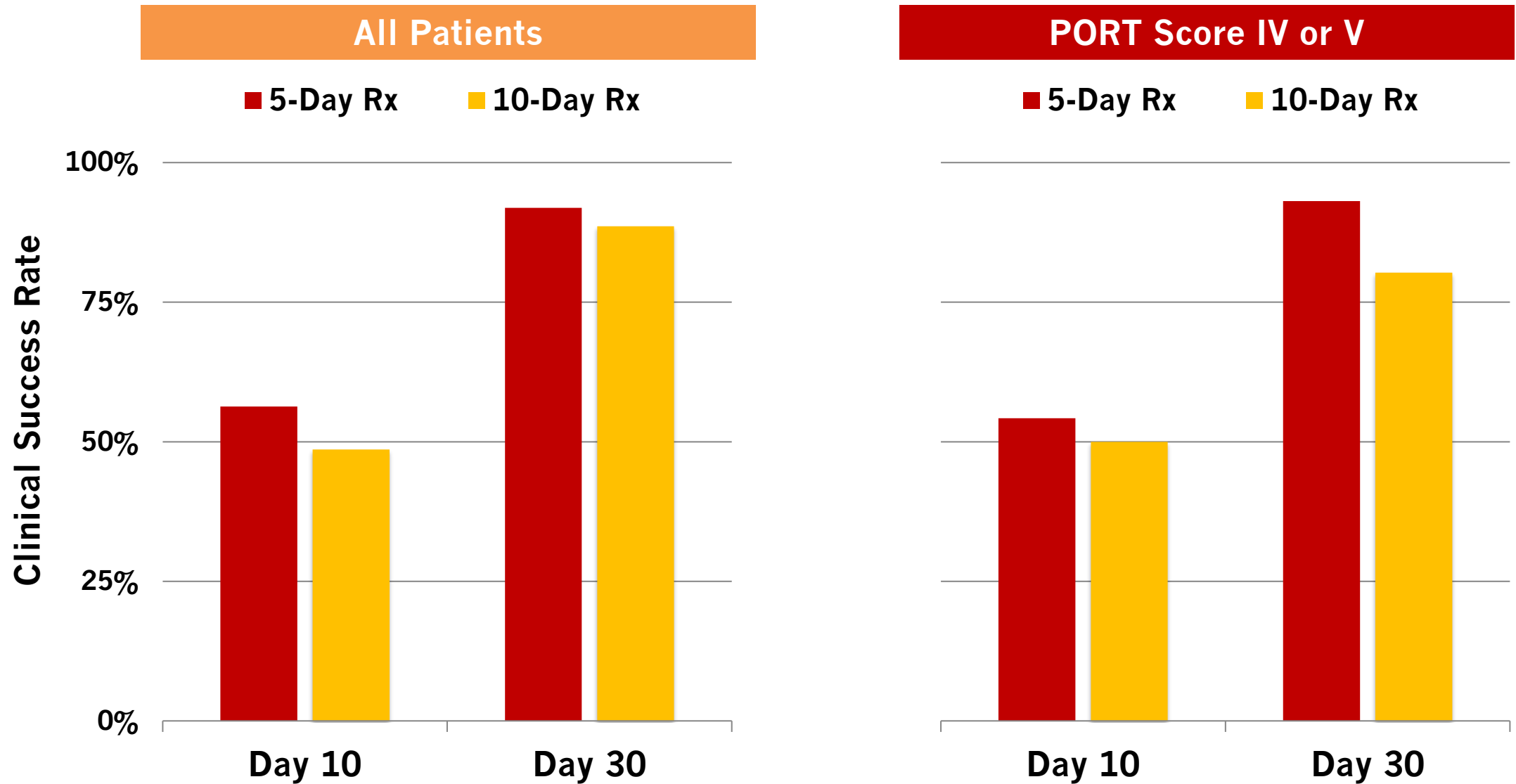
Length of Stay and Mortality



Is less than 8 days feasible?

5 vs 10 Days for Community Acquired Pneumonia

Randomized controlled trial, 312 patients, 4 hospitals in Spain



Is less than 5 days feasible?

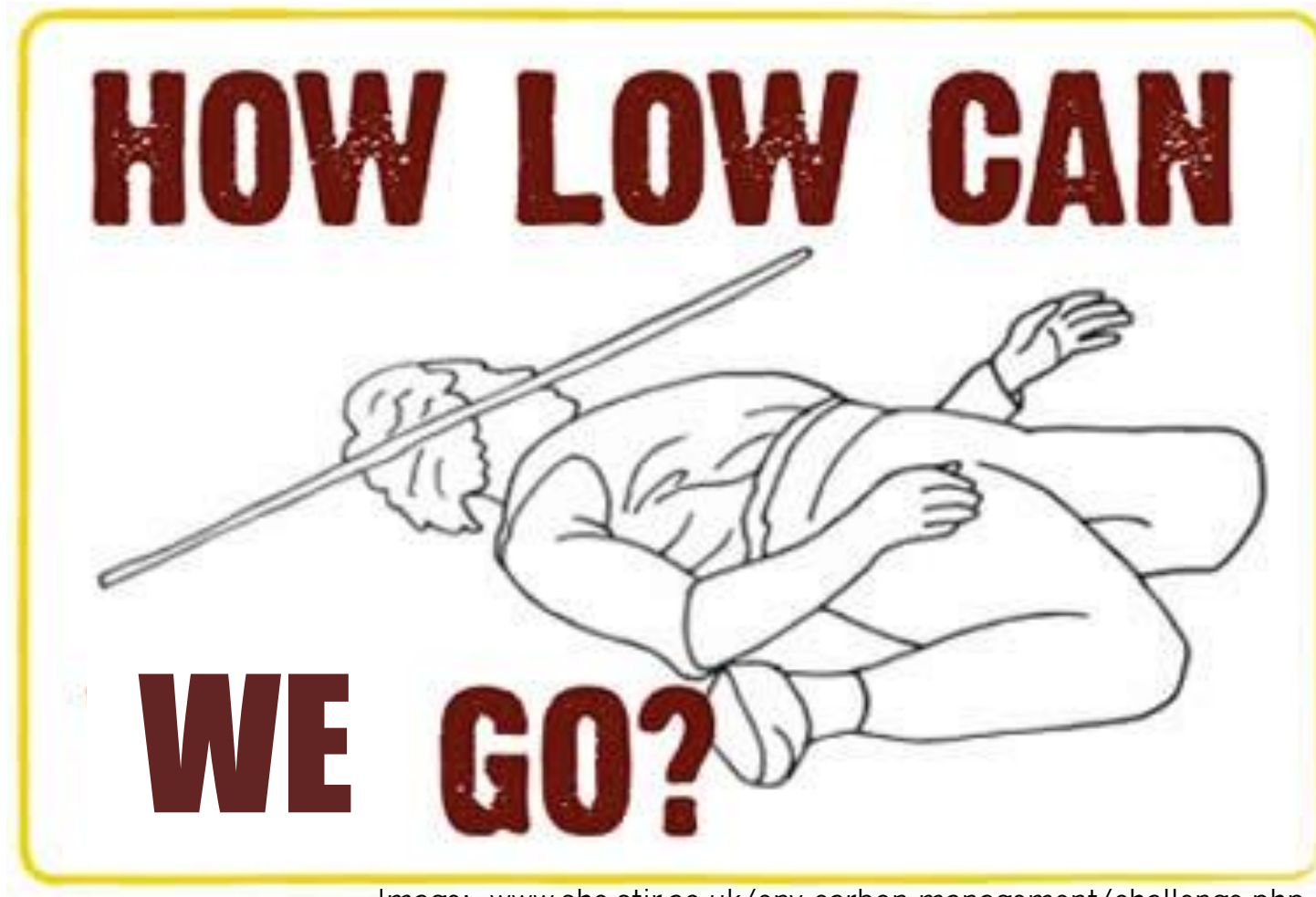
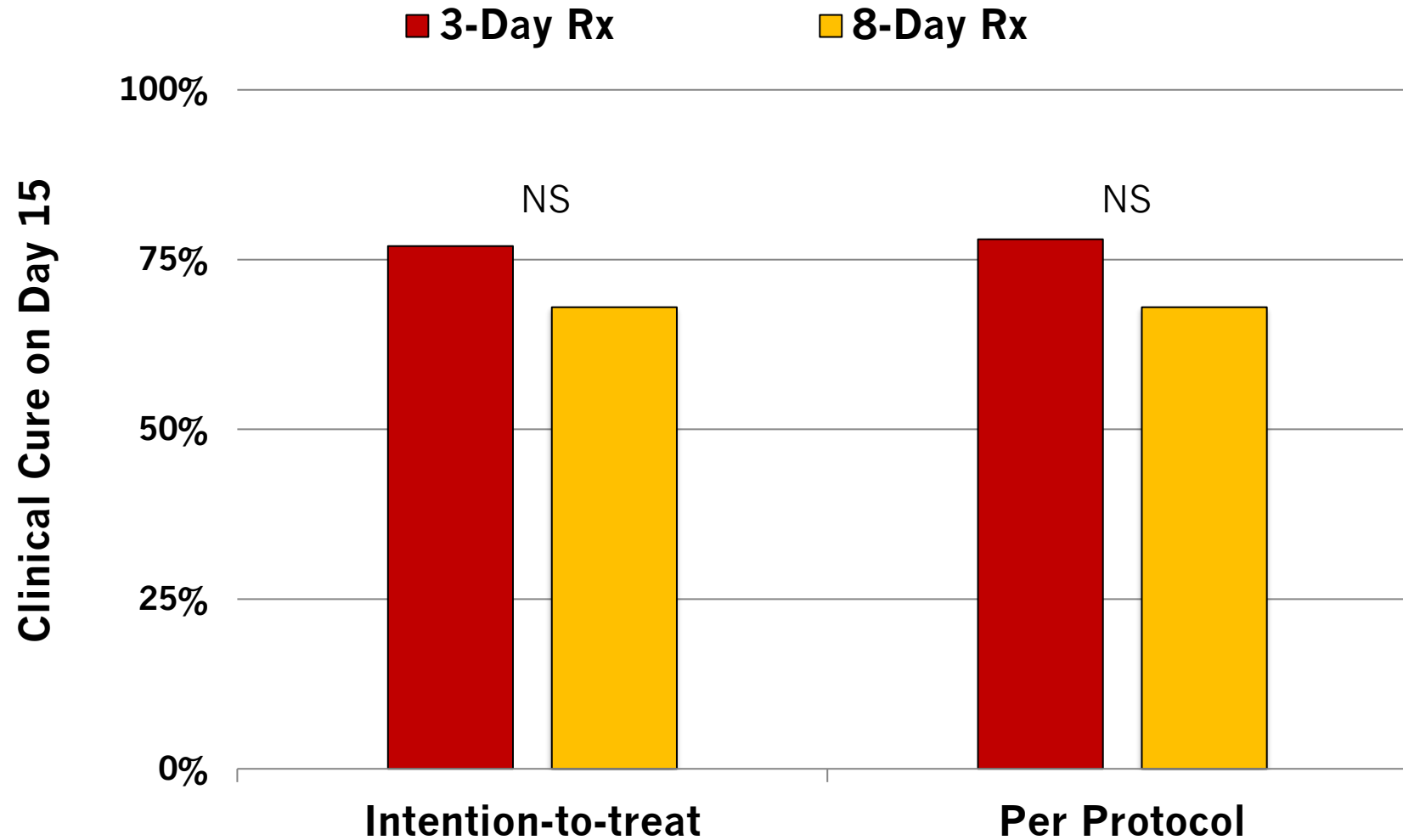


Image: www.she.stir.ac.uk/env-carbon-management/challenge.php

3 vs 8 Days for Community Acquired Pneumonia

Randomized double-blind multicenter trial, 310 patients, 20 hospitals in France



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Duration of Treatment:

(in patients who have stabilized)

Non-severe CAP: <5 days of antibiotics

- minimum 3 days
- conditional recommendation

Severe CAP: ≥5 days of antibiotics

- strong recommendation

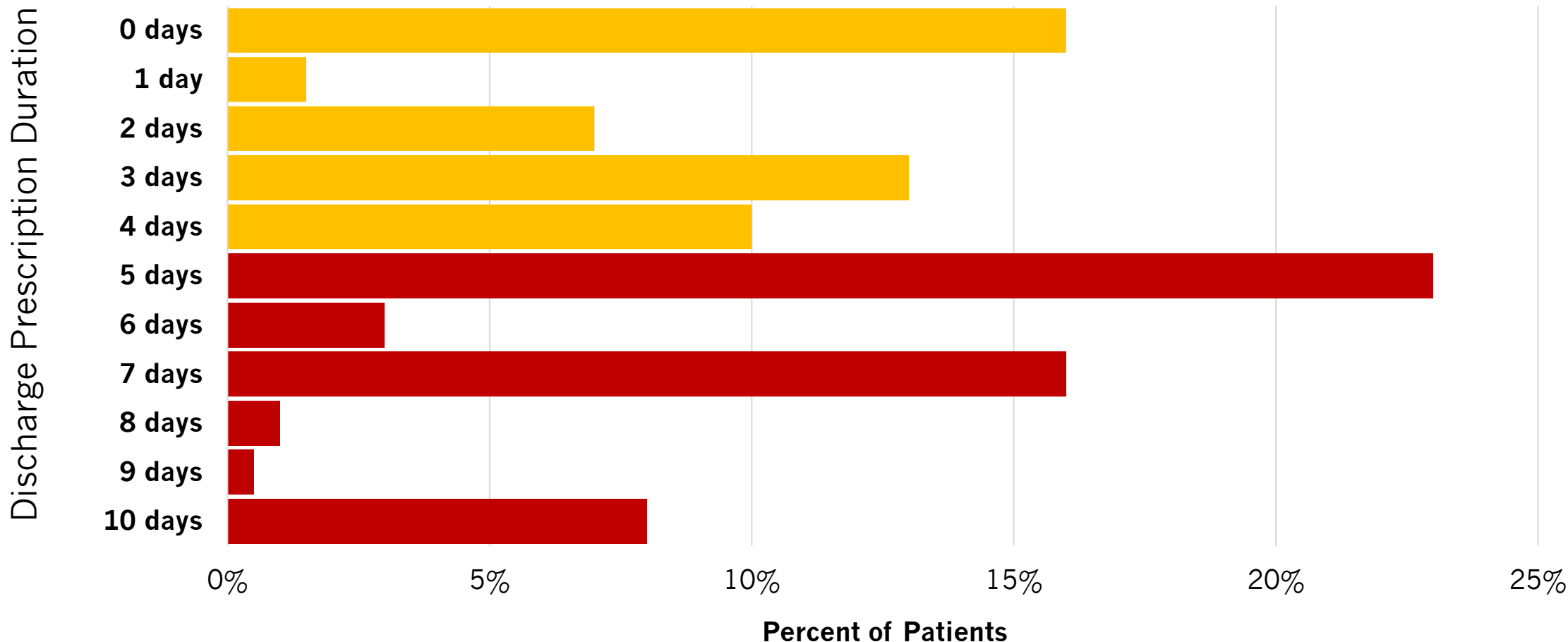
Contraindications to shorter courses: bronchiectasis, necrotizing pneumonia, empyema, resistant or necrotizing organisms such as *Staphylococcus aureus* or *Pseudomonas aeruginosa*

systemic corticosteroids.

Typical Discharge Prescription Durations

6,481 patients treated for pneumonia in 43 Michigan hospitals

*68% Overtreated. Discharge antibiotics accounted for 93% of unnecessary antibiotic days
Each additional day of treatment associated with 5% increase in risk of adverse events*



Take Home Points

- Diagnosing pneumonia is challenging. **We're often wrong.** Ultrasound is a reasonable alternative to x-ray. CT can be helpful in uncertain cases.
 - Many pneumonias are caused by **viruses**. Test for them.
Most patients with viruses are **NOT** do not have bacterial co-infection and do not benefit from antibiotics but use your judgement.
 - Consider **steroids** in patients with **severe CAP (ICU-level) with elevated CRP within 24h of arrival**
 - **Short course regimens (3-5 days) usually adequate.**
Don't reset the clock at discharge!
-

Selected References

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Thank You!

For all the lives we touch

Clean hands protect our patients.

Always perform hand hygiene
and help others do the same.



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