MAYO CLINIC

SO YOU THINK YOU CAN'T BREATHE

HOSPITAL RESPIRATORY CASES

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Adult Hospital Medicine Boot Camp
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DISCLOSURES

Relevant Financial Relationships

None

Off-Label Investigational Uses

None

LEARNING OBJECTIVES

1. Define and classify acute respiratory failure.
2. Review oxygen supplementation techniques.
3. Discuss appropriate use of NPPV.
4. List initial therapeutic strategies for a patient with hemoptysis.
5. Outline the updated CAP guidelines.
6. Diagnose acute respiratory distress syndrome and review the best treatment options for this condition.

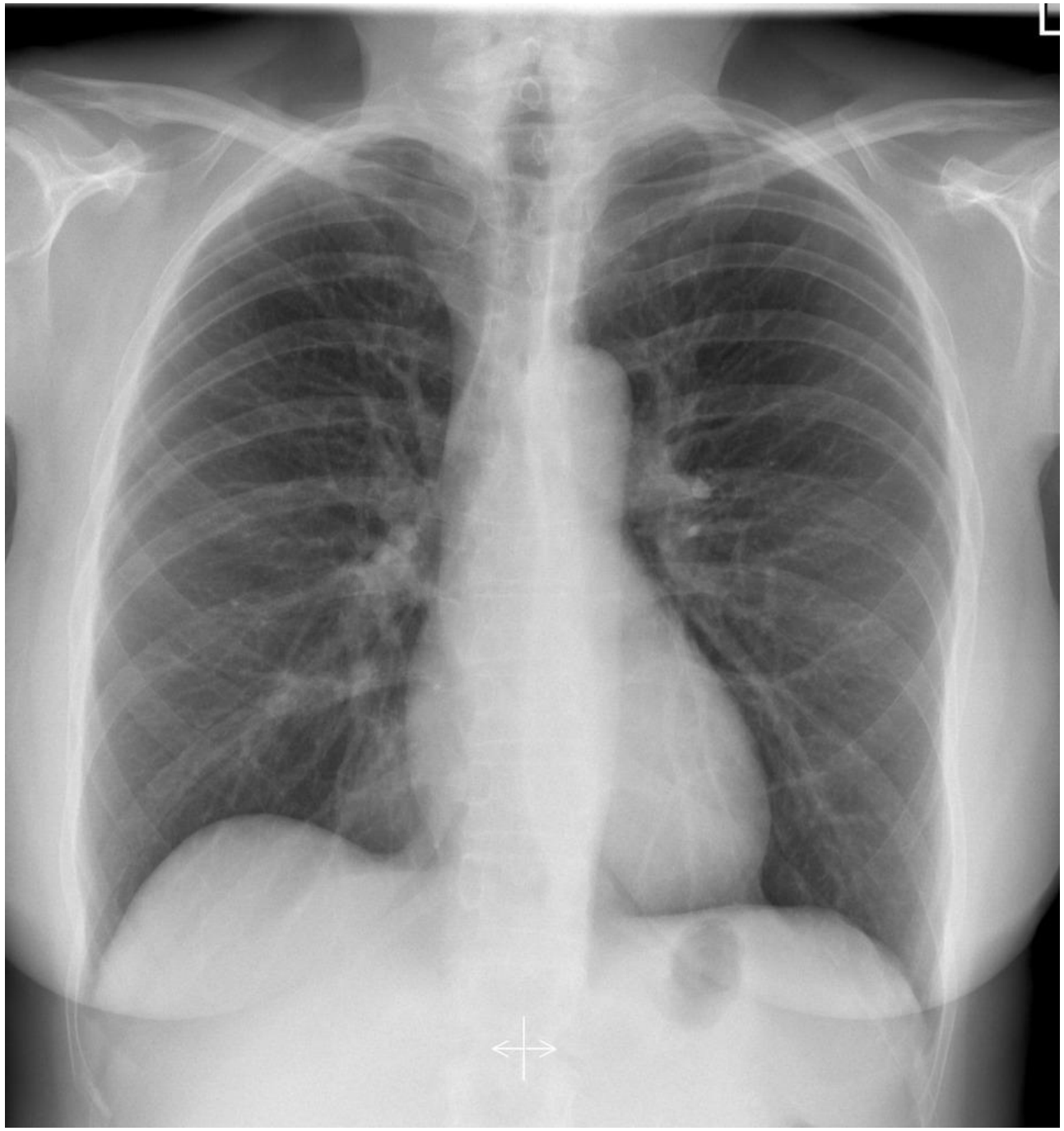
MRS. KENT

42yo female, with a past medical history of breast cancer, presents to the hospital with a 5 hour history of **chest pain and shortness of breath**.

- PMH: Breast CA s/p R mastectomy (in remission), hypothyroidism
- Medications: Ortho Tri-Cyclen Lo, Levothyroxine
- SH: Smokes ½ pack of cigarettes per day, occasional EtOH use. She just came back from a vacation to Hawaii with her family.
- Vitals: **HR**: 116, **RR**: 30, **BP**: 110/69, **Temp**: 37.5^{o}C, **O2 sat:** 85% on RA
- PE: She is is moderate respiratory distress and clutching her chest. Feels like she “can’t catch her breath”. Lungs sound clear.

MRS. KENT

ABG	
pH	7.34
PaCO2	31
PaO2	48
Bicarb	25



WHICH TYPE OF RESPIRATORY FAILURE DOES THIS PATIENT HAVE?

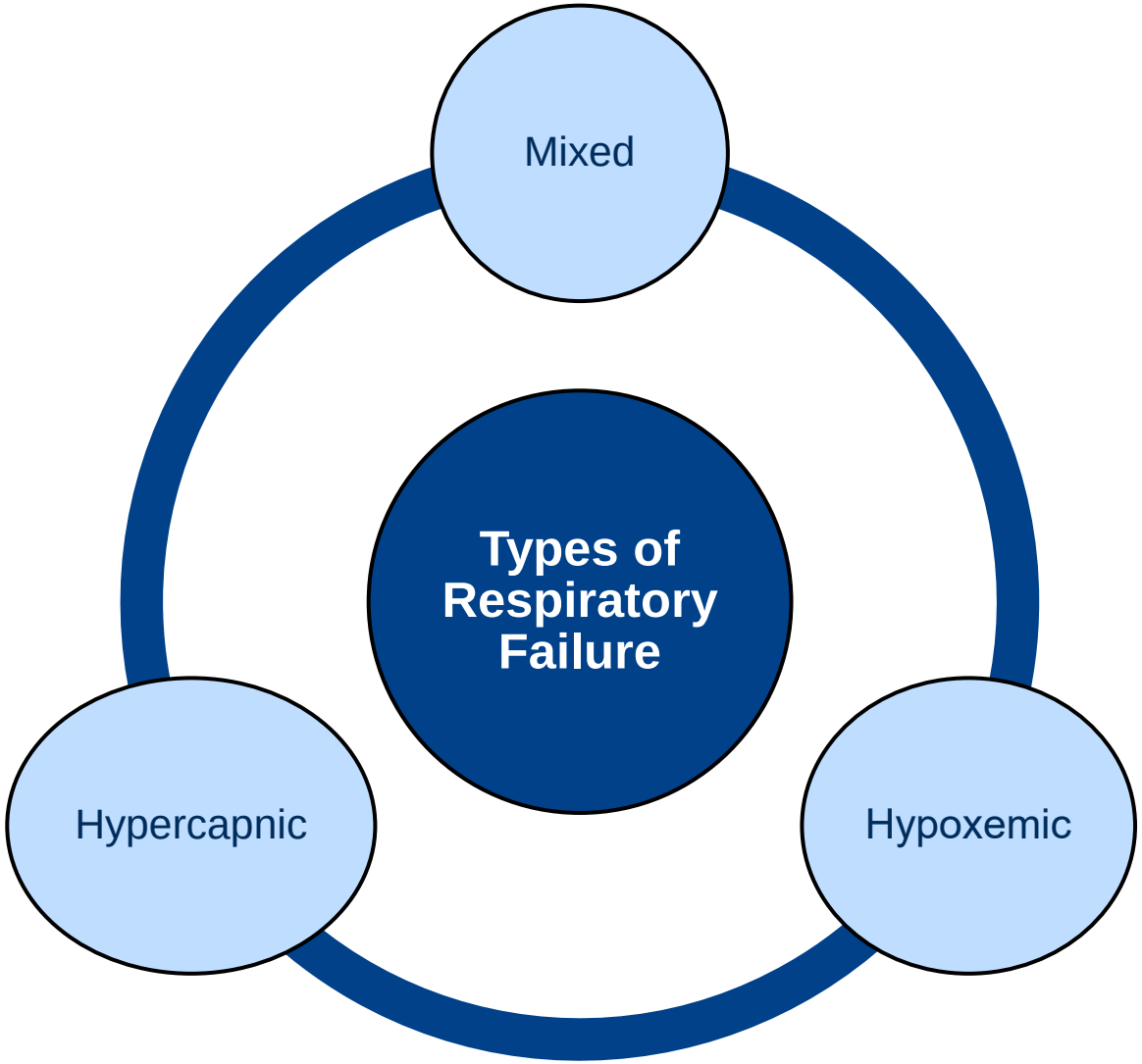
A. HYPOXEMIC

B. HYPERCAPNIC

C. MIXED

D. “I HAVE NO IDEA…BUT I’M WORRIED”

RESPIRATORY FAILURE



HYPOXEMIC RESPIRATORY FAILURE

- **PaO2 < 80mmHg**
- Abnormal PaO2/FiO2 ratio

Hypoxia = low tissue O2 concentration
(state of low O2 supply)

Hypoxemia = low arterial O2 tension
(state of low arterial O2 supply)

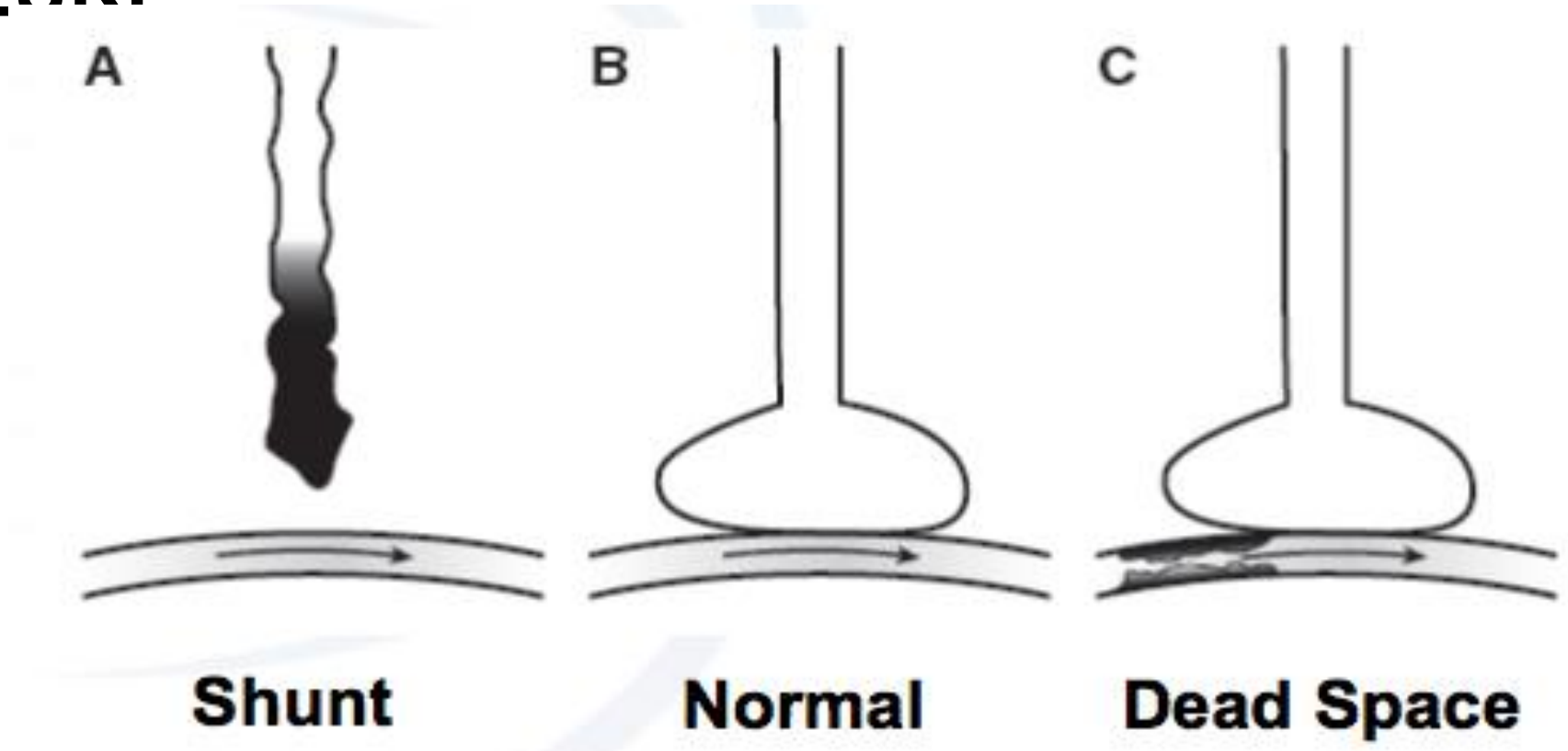
Common causes of hypoxia:

- High altitude
- **Ventilation/perfusion mismatch**
- Impaired gas diffusion
  - Usually associated with an infiltrate on imaging
- Right to left intra-cardiac shunting
  - Typically doesn't improve with supplemental O2
- Hypoventilation
  - Alveolar to arterial (A-a) oxygen gradient should not change

FCCS 5th Ed. SCCM, 2012. pp 5-7

HYPOXEMIC RESPIRATORY FAILURE

Most common cause of hypoxemia is ventilation/perfusion (V/Q) mismatch.



Perfusion without ventilation

Ventilation without perfusion

FCCS 5th Ed. SCCM, 2012. pp 5-7

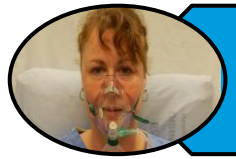
OXYGEN DELIVERY DEVICES

Nasal Cannula

Provides 1-6 L/min O2 flow, 0.24-0.44 FiO2

Face Mask

Delivers humidified O2
6-10 L/min of O2 flow, 0.4– 0.6 FiO2



Non-rebreather Mask

10-15 L/min O2, 0.6 – 0.9 FiO2

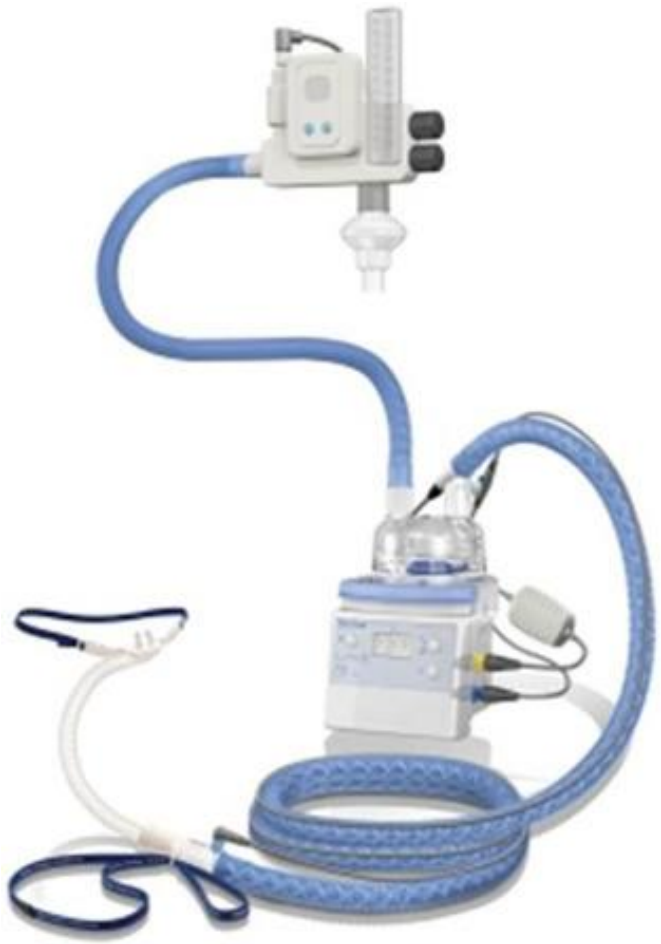
Face Tent

Up to 15 L/min, 0.4 – 0.5 FiO2

Venturi Mask

Provide a constant, preset level of O2
Up to 15L/min, 0.24-0.6 FiO2

FCCS 5th Ed. SCCM, 2012.



OXYGEN DELIVERY DEVICES

HIGH FLOW NASAL CANNULA

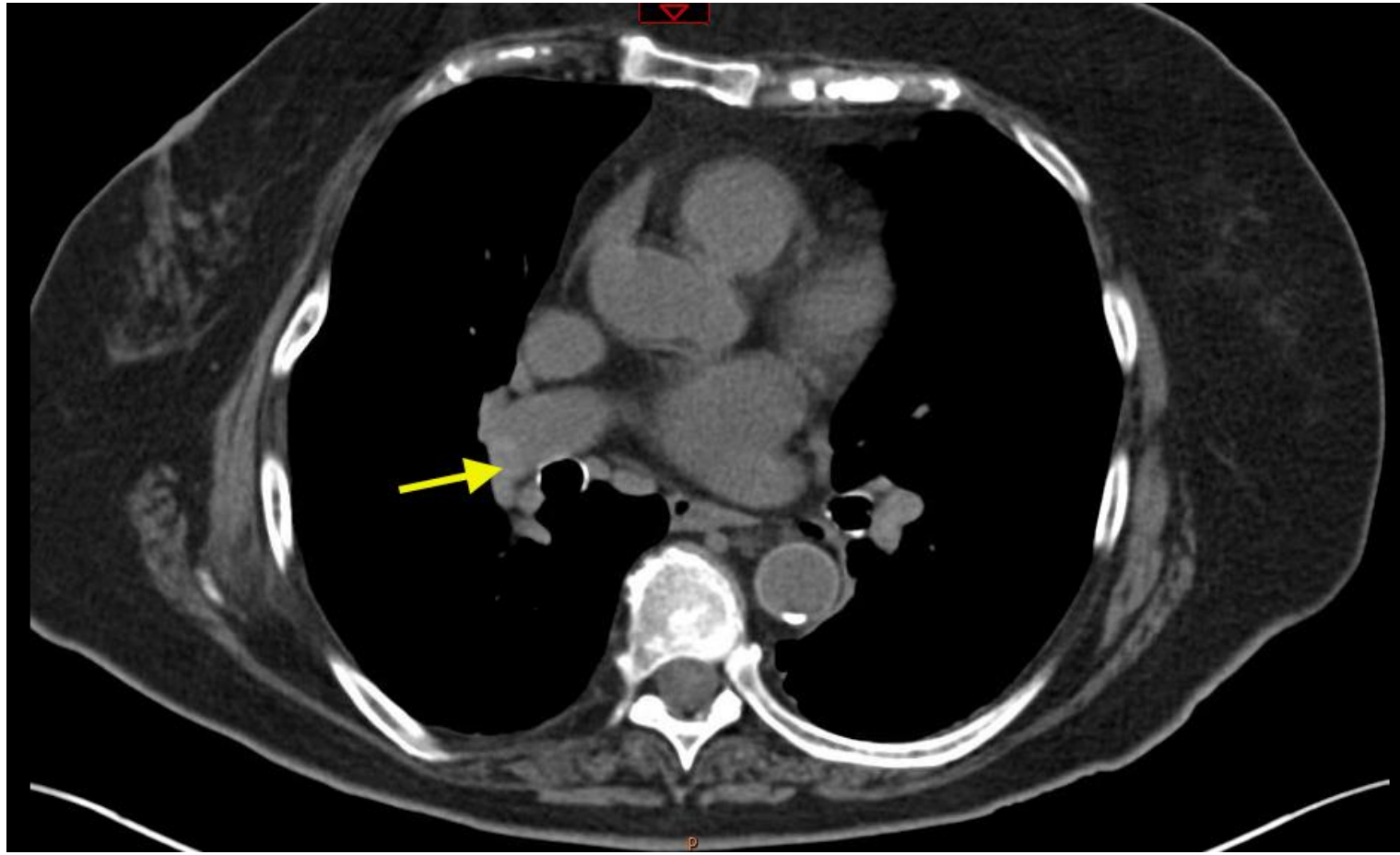
- Heated & humidified oxygen
- Rates up to **60** L/min & **1.0** FiO2 (100%)

- Reduced intubation rates
- Reduced rates of extubation failure and reintubation
- Might have some beneficial effect on outcomes/mortality, though data is variable.

Si-ming Lin, et all. Respiratory Medicine, Volume 131, 2017, Pages 58-64.
Yue-Nan Ni, et al. The American Journal of Emergency Medicine, Volume 36, Issue 2, 2018, Pages 226-233.
Xu, Z. Et al. *Respir Res* **19,** 202 (2018).

MRS. KENT

- Diagnosed with an **acute pulmonary embolism.**
- Initially placed on nasal cannula, but with ongoing hypoxia was transitioned to high-flow nasal cannula.
- Heparin drip initiated.



UPDATES IN PULMONARY EMBOLISM TREATMENT

- An **age-adjusted cut-off** level of D-dimers can be used for screening instead of a **fixed** cut-off value

- Evaluation of RV function is important for risk assessment
  - RV dysfunction is associated with ↑ short-term mortality in hemodynamically stable patients
  - Screen with either echo or prognostic biomarkers (troponin, BNP,) even if the PESI score is low

- Recommendation to implement PE response teams (PERT)

- Outpatient treatment (vs. hospitalization) is recommended in low risk patients with good follow up

Konstantinides,et al. *European Heart Journal*, Volume 41, Issue 4, 21 January 2020, Pages 543–603

UPDATES IN PULMONARY EMBOLISM TREATMENT

- **Thrombolysis** is recommended in patients who are hemodynamically unstable and high risk
  - If contraindicated or unsuccessful, consider surgical pulmonary embolectomy or percutaneous catheter-directed therapy
- **Direct-acting oral anticoagulants** are the treatment of choice except in pregnancy, severe renal impairment, and antiphospholipid syndrome
- IVC filter should be considered only in patients with absolute contraindications to anticoagulant treatment.
  - However, they do not appear to reduce the risk of PE recurrence or PE-related mortality
- All patients with PE should have regular follow up due to:
  - ↑ cancer risk (which might not be detectable at the time of PE)
  - Risk of bleeding complications
  - Risk for developing chronic thromboembolic pulmonary hypertension

Konstantinides,et al. *European Heart Journal*, Volume 41, Issue 4, 21 January 2020, Pages 543–603
Erythropoulou-Kaltsidou A, et al. *World J Cardiol*. 2020;12(5):161-166

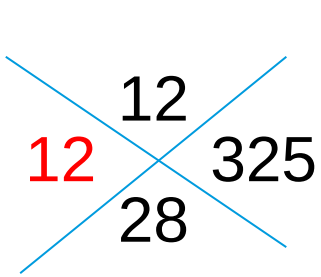
MR. JONES

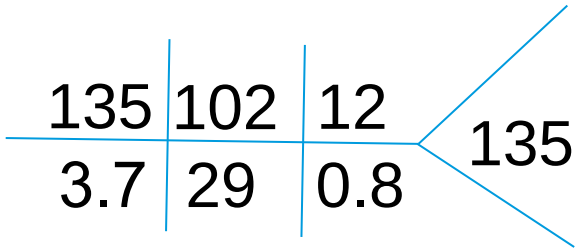
75yo male, with a past medical history of **COPD,** type 2 **diabetes,** and HLD presents to the ER with a 3 day history of **"worsening shortness of breath".**

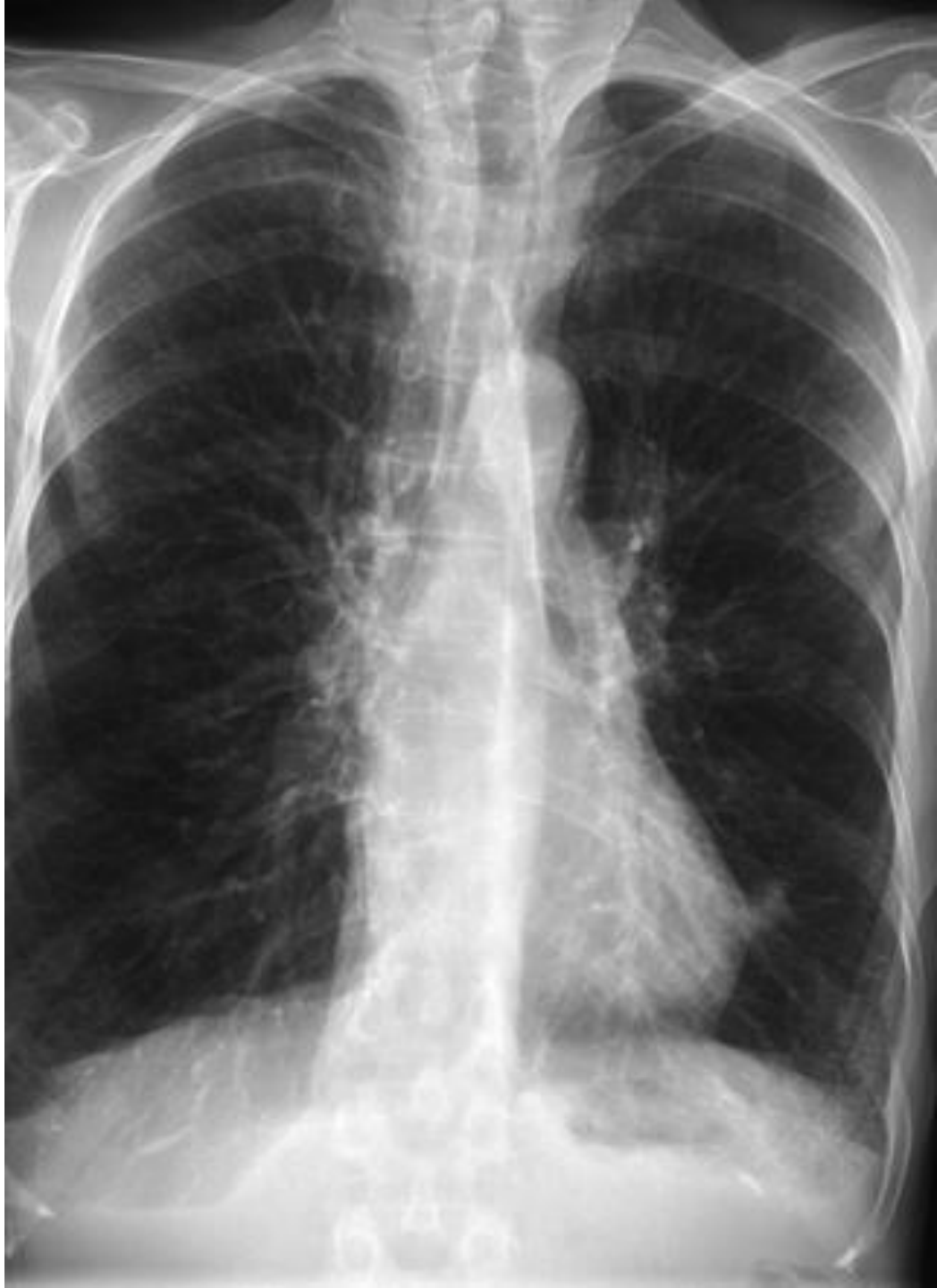
- Medications: Metformin, Albuterol PRN, Advair Diskus
- SH: 50 pack year history of smoking cigarettes and cigars. Daily EtOH use. He is retired and lives at home with his wife.
- Vitals: **HR**: 105, **RR**: 34, **BP**: 119/75
  Temp: 37.8^{o}C **O2 sat**: 87% on RA
- He is in moderate distress, using accessory muscles, and wheezing.

MR. JONES

ABG	
pH	7.36
PaCO2	51
PaO2	53
Bicarb	33







MR. JONES

- In the ER, he received:
  - Albuterol/ipratropium nebulizer
  - IV Solu-medrol
  - IV Ceftriaxone + Azithromycin

- Despite this, he continues to be hypoxic. His O2 sat is 83% on 4L NC.

WHAT WOULD BE THE NEXT STEP IN YOUR TREATMENT PLAN?

A. ↑ O2 to 6L VIA NASAL CANNULA

B. START HIGH-FLOW NASAL CANNULA

C. START BIPAP

D. INTUBATE

RESPIRATORY SUPPORT FOR COPD EXACERBATIONS

With acute compensated hypercapnic resp failure,
early HFNC was better than COT at preventing intubation

Also in patients with mild-mod hypercarbic resp. failure,
HFNC compared to NIPPV did not result in increase intubation rates

High-flow nasal cannula

Supplemental oxygen

NIPPV

If ≥ 1 of following:

- $PaCO_2$ ≥ 45 and pH ≤7.35
- Severe dyspnea, increased WOB, accessory muscle use
- Persistent hypoxemia despite ↑ O_2

Shorter LOS, improved survival, decreased hypercarbia/improved ventilation

Mechanical ventilation

Xu-Yan, L et al. Int J Chron Obstruct Pulmon Dis. 2020 Nov 24;15:3051-3061
Sun J et al. Int J Chron Obstruct Pulmon Dis. 2019 Jun 5;14:1229-1237

MR. JONES

- You decide to place Mr. Jones on HFNC and he starts to improve.
- However, a few hours later you get a call that he is more lethargic…

ABG

pH = 7.21

pCO2 = 67

pO2 = 72

WHAT WOULD YOU DO NOW?

A. GO BACK TO NASAL CANNULA

B. CONTINUE HIGH FLOW NASAL CANNULA

C. START BIPAP

D. INTUBATE

NPPV

Advantages

- Reduced need for sedation
- Preservation of airway-protective reflexes
- Avoidance of upper airway trauma
- Decreased incidence of nosocomial sinusitis and pneumonia
- Improved patient comfort
- Shorter length of stays in ICU and hospital
- Improved survival

Disadvantages

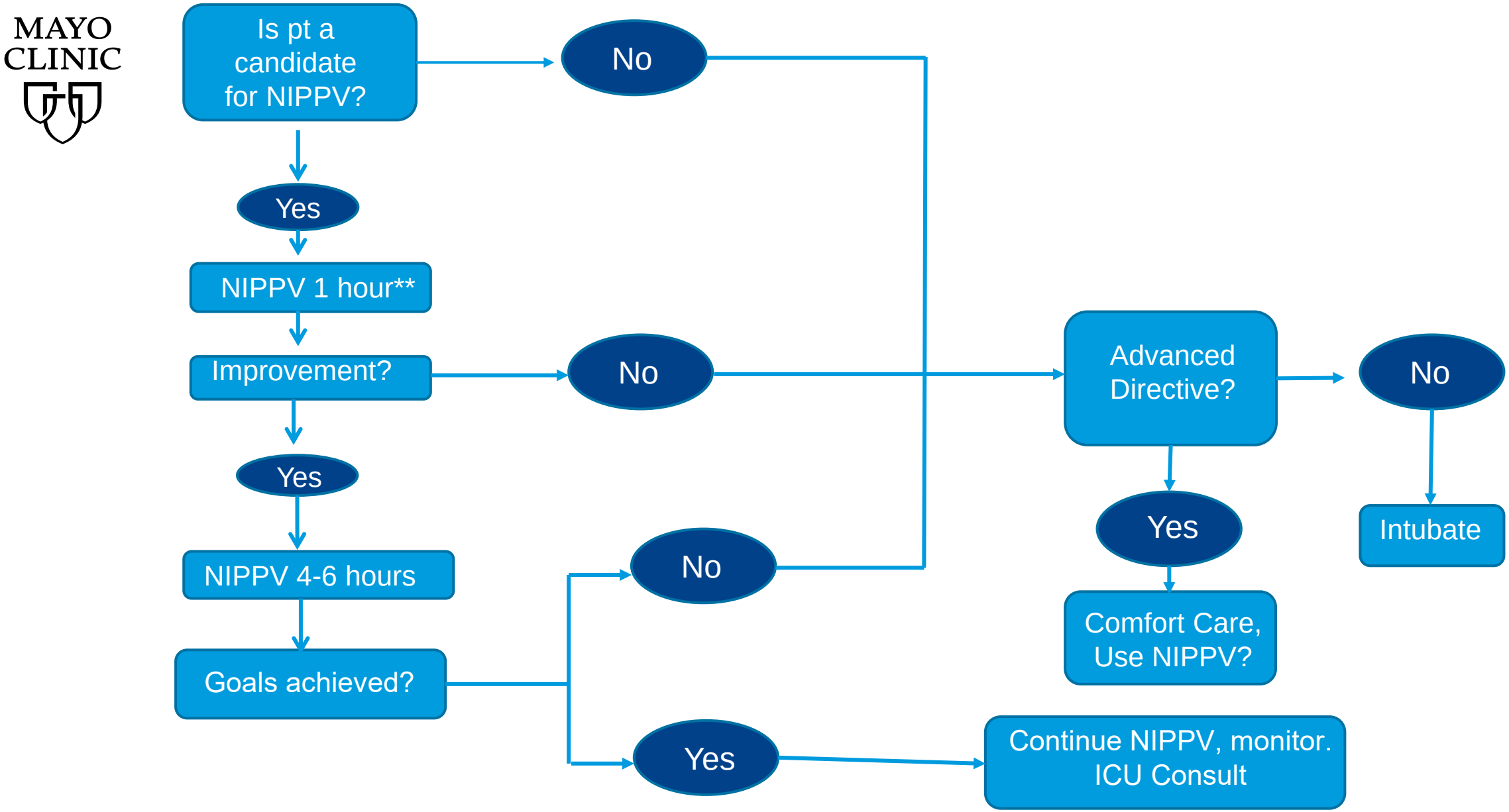
- Claustrophobia
- Increased workload for respiratory practitioner
- Facial/nasal pressure lesions
- Unprotected airway
- Inability to suction deep airway
- Gastric distention
- Delay in intubation

Mechanical Ventilation. FCCS 5th Ed. SCCM, 2012. pp 5-3

BILEVEL POSITIVE AIRWAY PRESSURE (BIPAP)

INDICATIONS	CONTRAINDICATIONS
• Hypercapnia and acidosis • Cardiogenic pulmonary edema • COPD/asthma exacerbation • Weaning and post-extubation failure • Post surgical period • Obesity hypoventilation syndrome • Neuromuscular disorders • Poor alveolar oxygen exchange	• Cardiac or respiratory arrest • Hemodynamic instability • Inability to protect the airway • Patient who is unable to cooperate • Severe encephalopathy • Significant agitation • High risk of aspiration • Active upper GI hemorrhage • Facial trauma, recent surgery and/or burns

Liesching, Timothy et al. CHEST , Volume 124 , Issue 2 , 699 - 713



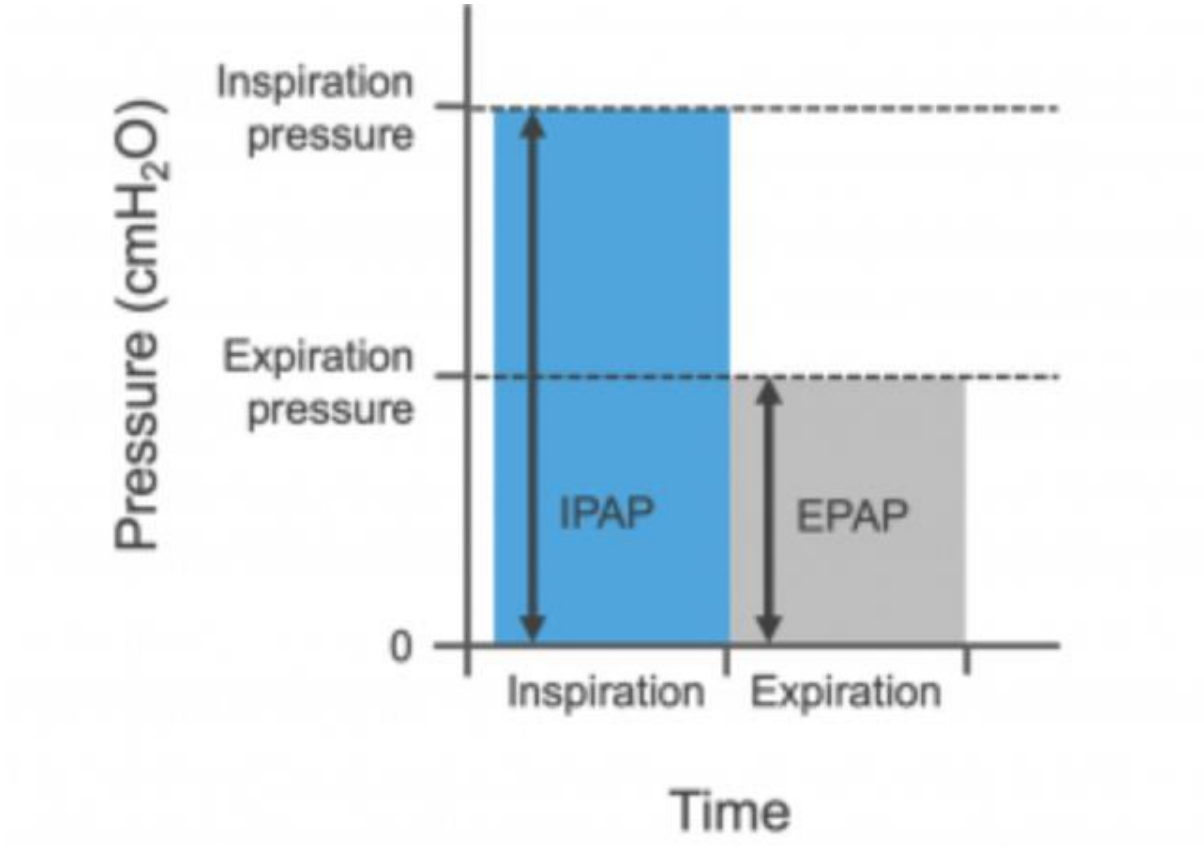
**If no improvement w/i 10 min, consider intubation

Mechanical Ventilation. FCCS 5th Ed. SCCM, 2012. pp 5-7

BIPAP

HOW DOES IT WORK?

- Utilizes two levels of positive airway pressure combining pressure support ventilation (PSV) and continuous positive airway pressure (CPAP)
  - The PSV modality is referred to as IPAP (inspiratory positive airway pressure)
  - The CPAP modality is referred to as EPAP (expiratory positive airway pressure)
- The difference between these two pressure levels (**Δ** P) determines tidal volume generated.



Mechanical Ventilation. FCCS 5th Ed. SCCM, 2012. pp 5-3

Image: https://www.medmastery.com/guide/noninvasive-ventilation-clinical-guide/deciphering-acronyms-noninvasive-ventilation-niv

BIPAP

HOW DOES IT WORK?

- Example for initial BiPAP settings:
  - Mode: Spontaneous
  - Trigger: Maximum sensitivity
  - FiO2: 1.0
  - EPAP: 5 cm H2O
  - IPAP: 10-15 cm H2O
  - Backup rate: 6-8/min

Adjust **Δ** to achieve an effect V_T and CO_2 clearance

if oxygenation needs improving, increase EPAP for alveolar recruitment (however, will then need to also adjust IPAP to keep the same **Δ)

Mechanical Ventilation. FCCS 5th Ed. SCCM, 2012. pp 5-3

MR. JONES

- How long should we continue antibiotics for Mr. Jones??
  - In 2017, the FDA approved procalcitonin to guide clinical decision regarding antibiotic use in acute respiratory infections
    - For hospitalized patients or those treated in the ED
  - Use of procalcitonin can:
    - ↓ mortality
    - Reduce antibiotic exposure by 2.4 days
    - ↓ risk of antibiotic-related side effects

Remains a controversial topic, since the literature evidence is variable…
Other studies have shown no change in outcomes/mortality with PCT guided antibiotic use.

Cochrane Database Syst Rev. 2017 Oct 12;10:CD007498. doi 10.1002/14651858.CD007498.pub3.

MS. SANDS

- A 28yo female presented as a transfer from an outside hospital with **shortness of breath, cough and occasional hemoptysis.**

- She was recently diagnosed with **SLE** the previous year, but was not on any immunosuppression at this time.

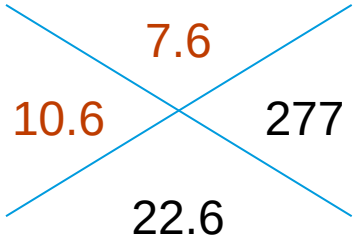
MS. SANDS

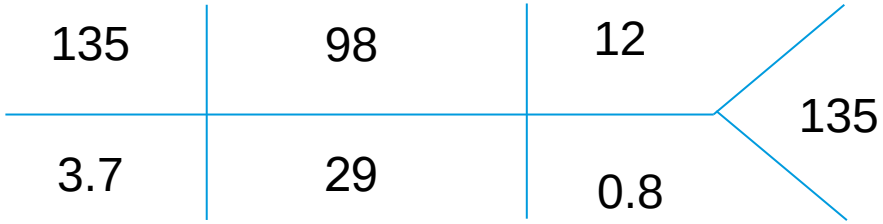
- She was hemodynamically stable when she was admitted to the hospital.
- Only 2 episodes of hemoptysis in the past 24 hours.

- She was given 1g IV Solu-Medrol.
- The next day, she was taken for an elective bronchoscopy to work up the hemoptysis.

MS. SANDS

- During the bronchoscopy, she developed massive hemoptysis 2/2 **diffuse alveolar hemorrhage**.
- She became hypoxic and hypercapnic, as well as hemodynamically unstable.





HEMOPTYSIS

Causes of Hemoptysis	
Cryptogenic	
Pulmonary	• Airway infections (bronchitis, viral and bacterial PNA, lung abscess) • Bronchial carcinoma/Mets • Bronchiectasis/CF • Pulmonary edema/mitral stenosis • TB • Invasive aspergillosis • Benign bronchial tumors • Vasculitis
Cardiovascular	• Pulmonary artery embolism • Vascular malformations • Idiopathic pulmonary hemosiderosis • Septic embolism/right heart endocarditis • Pulmonary HTN
Other	• Iatrogenic: lung biopsy, R heart cath, CT placement, thoracentesis, radiation therapy Medications, anticoagulation treatment, thrombolytic therapy • Trauma/lung contusion • Foreign body • Coagulopathy • Thrombocytopenia

Dtsch Arztebl Int 2017; 114; 371-81.

HEMOPTYSIS

- **Massive hemoptysis** = 100 – 600 ml of blood loss in 24h
  - Conservatively treated massive hemoptysis has a **mortality of 50-100%.**
  - Death is usually secondary to asphyxia, as opposed to blood loss/hemorrhagic shock.

INITIAL MANAGEMENT OF HEMOPTYSIS

- Monitor vital signs closely
- Give oxygen
- Place the patient with the **bleeding side down**
- Secure the airway (intubation)
  - Use a large diameter ET tube, or consider unilateral intubation if indicated.
- Sedation/anxiolysis or paralytics if necessary
- Reverse any coagulopathy that may be present.
  - Transfuse blood products if indicated.

TREATMENT OF HEMOPTYSIS

- Mild - moderate hemoptysis can be treated conservatively
- **Bronchoscopy**
  - Typically first line for diagnostic (localize site of bleeding) and therapeutic intervention
  - Can help remove the blood to help with gas exchange
  - Stop bleeding with laser or cryotherapy, electrocautery, or argon plasma coagulation
- **Bronchial artery embolization**
- Surgery

Dtsch Arztebl Int 2017; 114; 371-81.

MRS. SANDS

- Upon close workup, her SLE labs were negative, but she was p-ANCA and MPO positive
  - Rheumatology diagnosed her with **DAH 2/2 microscopic polyangiitis**.

- She received a prolonged high-dose steroid taper, plasma exchange, and Rituximab.
  - She improved clinically, and was able to be discharged.

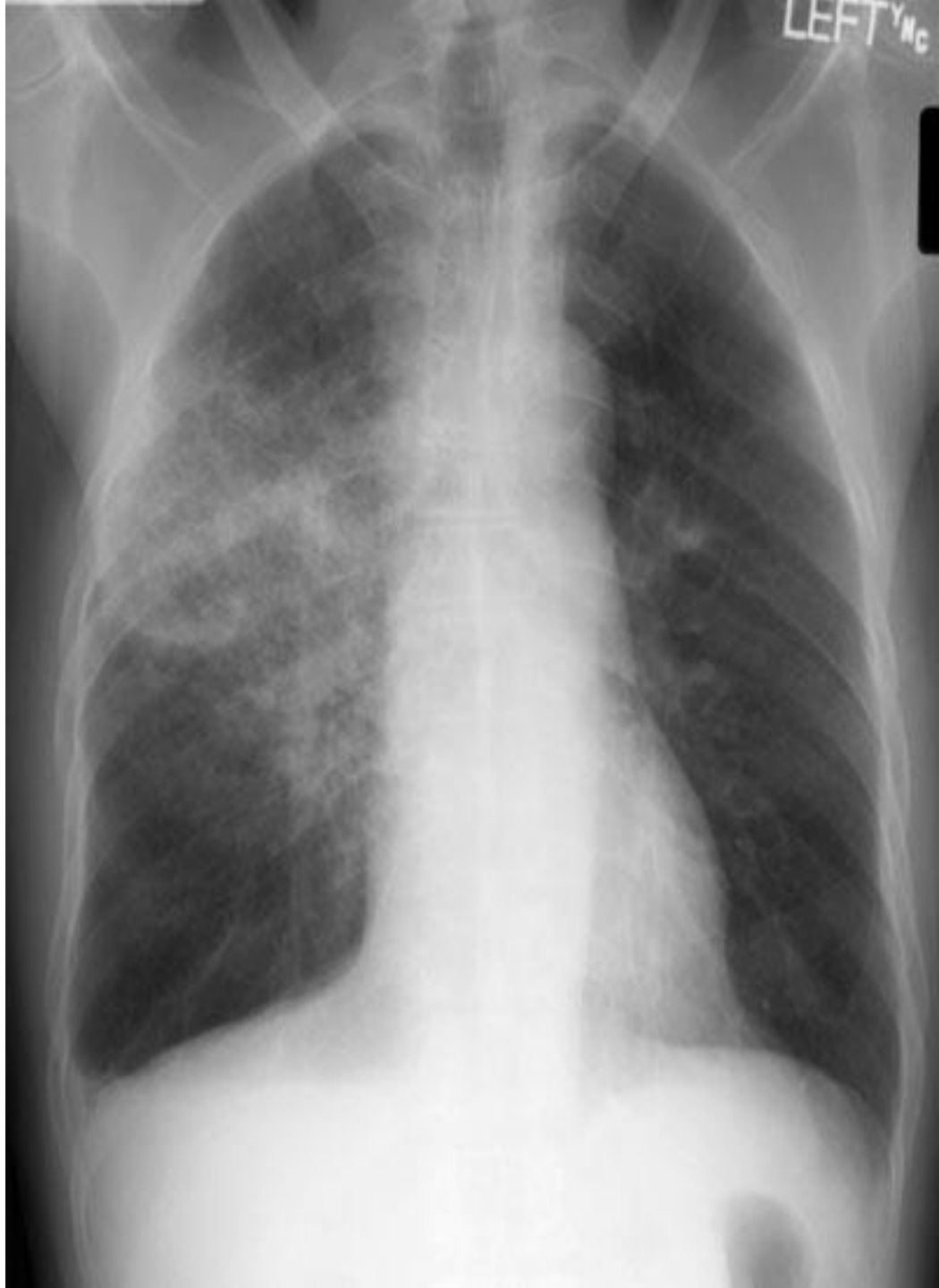
NEW TREATMENT FOR HEMOPTYSIS?

- December 2018, CHEST published an article that suggests that **inhaled tranexamic acid** treatments could be helpful in non-massive hemoptysis
  - Shorter length of stay
  - Required less invasive procedures such as bronchoscopy or angiographic embolization
  - Reduced recurrence rate at 1-year follow-up
  - The tranexamic acid group didn’t have any increased side effects

CHEST, Volume 154, Issue 6, 1379-1384

MR. WILSON

- 60yo male, with a history of HTN, HLD, atrial fibrillation, TIA, and diabetes, presents to the ED with 2 days of cough and fevers.
- Vitals: **HR:** 101, **RR:** 27, **BP:** 110/79 **Temp:** 38.9 C, **O2 sat:** 87% on RA



WHAT IS THE MOST APPROPRIATE DIAGNOSIS?

A. Community-Acquired Pneumonia (CAP)

B. Ventilator-Associated Pneumonia (VAP)

C. Hospital-Acquired Pneumonia (HAP)

D. Healthcare-associated pneumonia (HCAP)

CLASSIFICATION OF PNEUMONIA

Community-acquired pneumonia (CAP)

Hospital-acquired pneumonia (HAP)

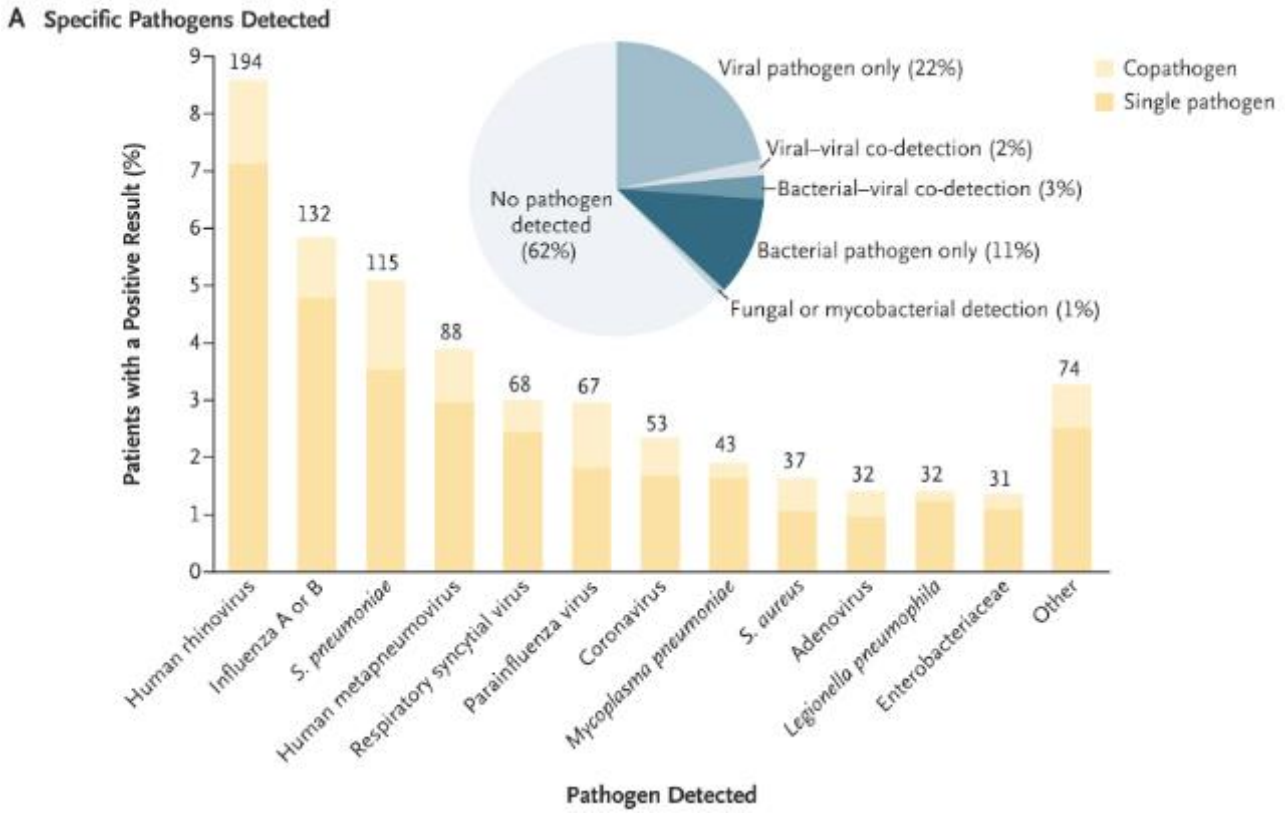
Ventilator-associated pneumonia (VAP)

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

2016 HAP/VAP Clinical Practice Guidelines by the IDSA and ATS. CID 2016:1-43. a

EPIDEMIOLOGY OF PNEUMONIA

- **>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 isolated in 1%** of patients admitted with CAP



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

TREATMENT OF CAP

- Ineffective/delayed initial antimicrobial therapy is the most significant predictor of poor outcomes.
- In patients who are being hospitalized for pneumonia, empiric antibiotic coverage is indicated at admission.
  - With early de-escalation when appropriate (consider using procalcitonin).

MR. WILSON

- Mr. Wilson was started on IV Levofloxacin treatment for his CAP.
- You place him on 4 L/min of O2 via nasal cannula, and his saturations improve slightly.
- However, he is still tenuous from a respiratory standpoint. What else can we consider?

WAS LEVOFLOXACIN THE BEST CHOICE ANTIBIOTIC FOR MR. WILSON?

A. YES, OF COURSE

B. NO!!!

FLUOROQUINOLONE WARNING!

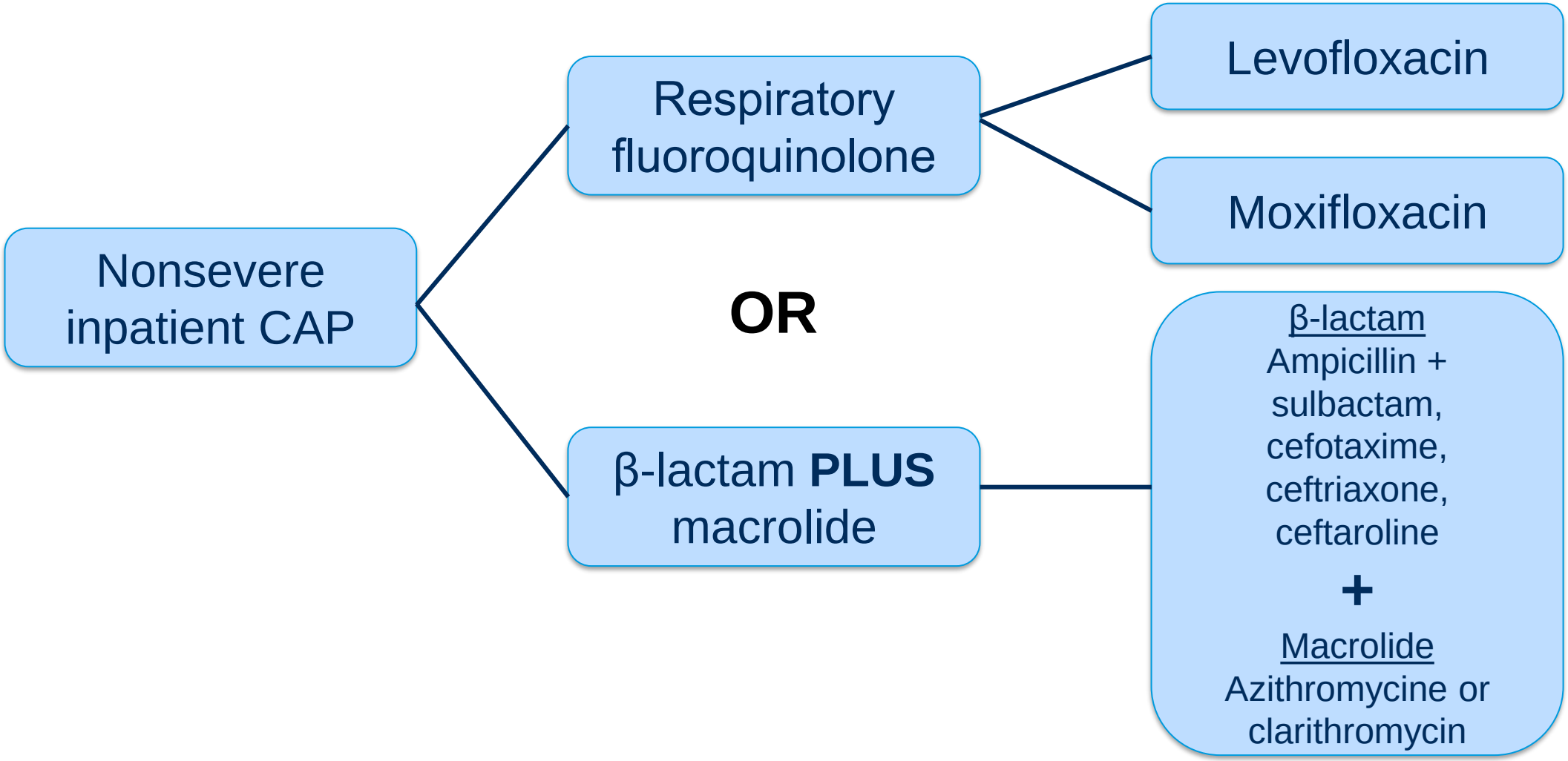
2018 FDA Safety Warning Update

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.

UPDATED CAP TREATMENT GUIDELINES

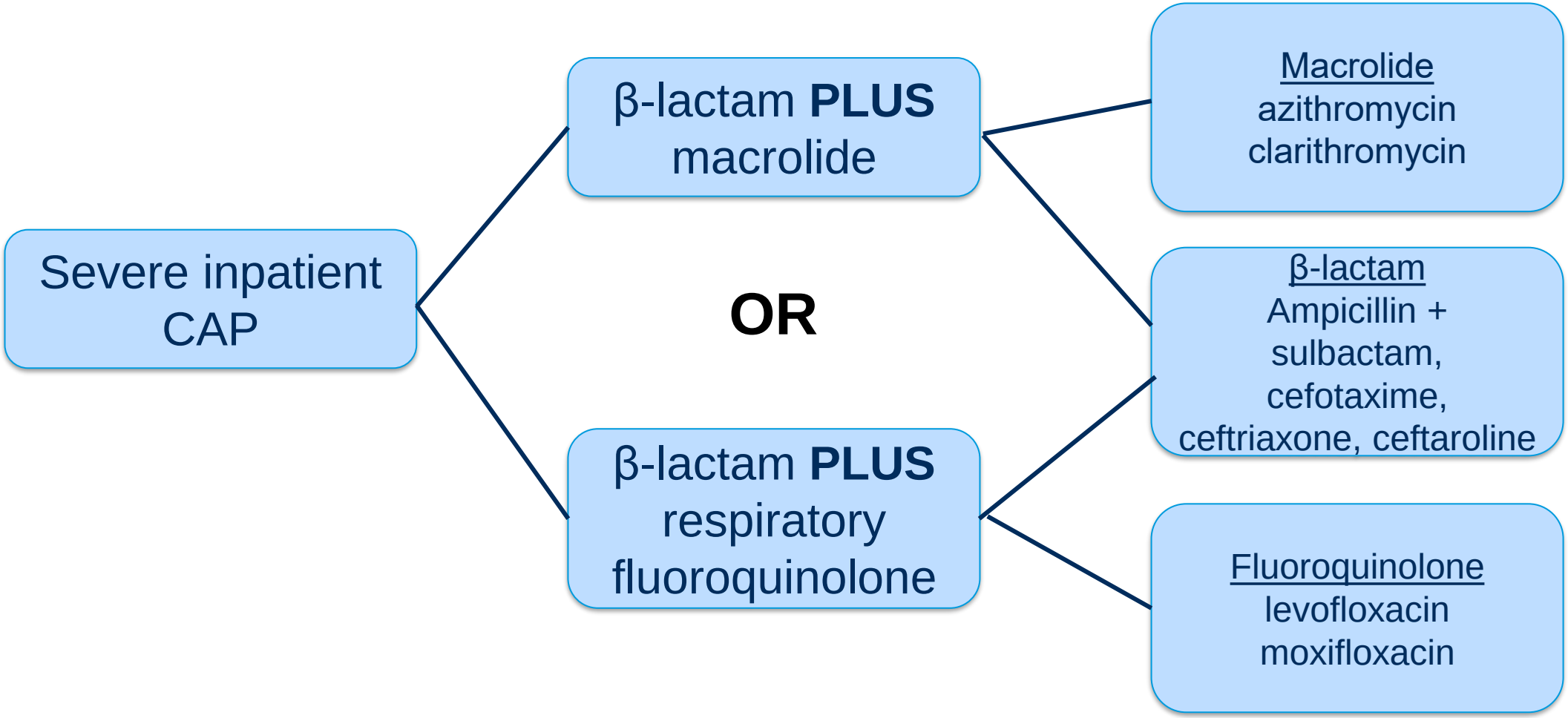
NON-SEVERE INPATIENT CAP W/O RISK FACTORS FOR MRSA & PSEUDOMONAS



Metlay JP, et al. Amer Journal of Resp and Crit Care Medicine, 2019

UPDATED CAP TREATMENT GUIDELINES

SEVERE INPATIENT CAP W/O RISK FACTORS FOR MRSA & PSEUDOMONAS



Metlay JP, et al. Amer Journal of Resp and Crit Care Medicine, 2019

RISK FACTORS FOR MRSA & PSEUDOMONAS

MRSA Risk Factors

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

Empiric Treatment
Vancomycin
Linezolid

Pseudomonas Risk Factors

- Prior use of antibiotics (within 90 days)
- H/o Pseudomonas infection w/in 1 year
- Longer hospital stay
- ICU
- Mechanical ventilation
- Immunosupression
- Cystic Fibrosis
- HIV/AIDS
- Alcohol abuse
- COPD

Empiric Treatment
Pipercillin-tazobactam
Cefepime
Ceftazidime
Aztreonam
Meropenem
Imipenem

WHERE DID HCAP GO?

- The Drug-Resistance in Pneumonia (DRIP) score was found to be more effective than the HCAP criteria for identifying risk of drug-resistant pathogens in pneumonia, and the need for broad-spectrum antibiotic use in CAP
  - Combined with the use of nasal MRSA swab for de-escalation, which showed reduction in vancomycin use

Webb BJ, et al. CHEST. Volume 156, Issue 5, P843-851, 2019.

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 with MDR pathogen (prior 12 months)	2
Minor 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

Webb BJ, et al. Antimicrobial Agents and Chemotherapy 2016, 60 (5) 2652-2663

WHAT ABOUT ASPIRATION?

- New guidelines **no longer support adding anaerobic coverage** for suspected aspiration pneumonia, unless lung abscess or empyema is suspected.
  - Most patients who aspirate gastric contents develop aspiration pneumonitis, which typically only requires supportive treatment (without antibiotics) and resolves within 24-48 hours.
  - More recent studies have shown that anaerobes are uncommon in patients hospitalized with suspected aspiration

Metlay JP, et al. Amer Journal of Resp and Crit Care Medicine, 2019

TREATMENT OF CAP

DURATION OF TREATMENT

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

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

Metlay JP, et al. Amer Journal of Resp and Crit Care Medicine, 2019

STEROIDS FOR CAP

- A 2017 Cochrane Review recommends **steroids** for CAP patients.
  - Prednisone was found to : ↓ early clinical failure rates and LOS in hospitalized patients with CAP, and ↓ mortality and morbidity in severe CAP.
    - Hyperglycemia was increased (but the overall harm did not seem to outweigh the benefit).

- However, the updated 2019 CAP guidelines **do not** recommend routine use of steroids in non-severe or severe CAP.
  - They endorse the Surviving Sepsis Campaign recommendations for stress does steroids in septic shock.

Cochrane Database Syst Rev 2017;12:CD00772

SEVERE CAP

- **Late admission to ICU significantly ↑ 30 day mortality**

- Severe CAP Criteria → Direct ICU admission when:
  - Any 1 major criteria or any 3 minor criteria

Major Criteria

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

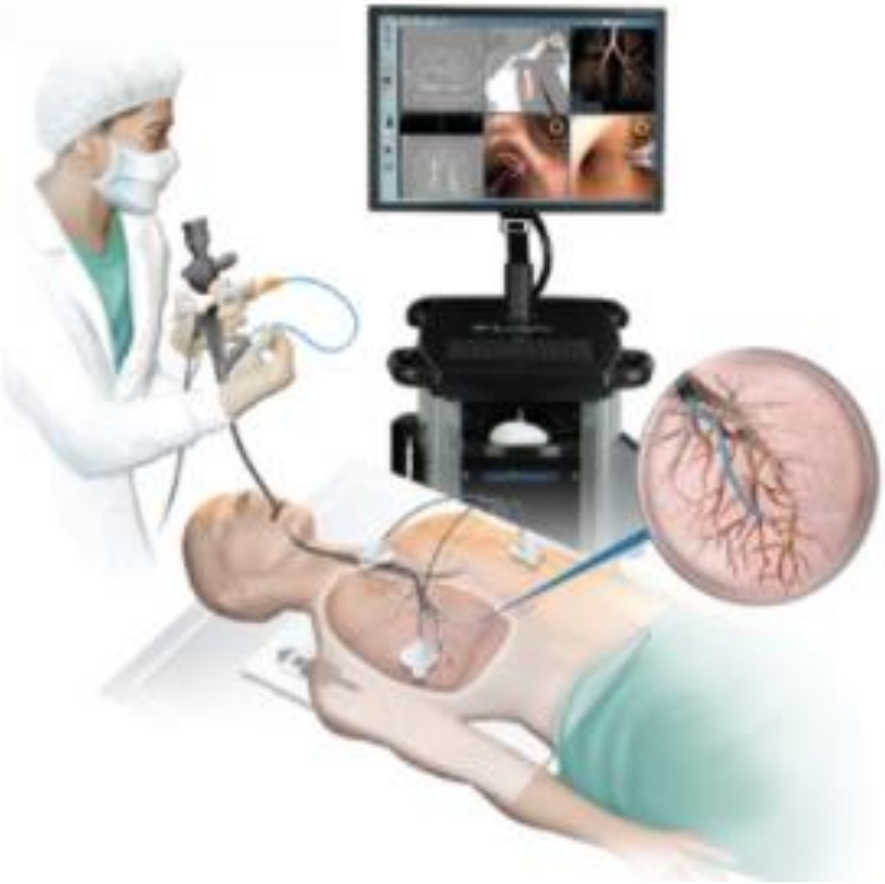
Minor Criteria

- Respiratory rate ≥ 30 breaths/min
- PaO2/FiO2 ratio ≤ 250
- Multilobar infiltrates
- Confusion/disorientation
- Uremia (BUN≥20)
- Leukopenia (WBC <4,000)
- Thrombocytopenia (Platelets <100,000)
- Hypothermia (Core temp <36°C)

CID **2007**:44 (Suppl 2)

BRONCHOSCOPY

- When should you consider bronchoscopy?
  - Immunocompromised host
  - Non-resolving pneumonia
  - Nodular/cavitary lesions on imaging
- Can be both diagnostic and therapeutic
- Consider risk of airway/respiratory compromise in patients with high O2 requirement.
- Risks of Bronchoscopy:
  - Difficult to truly assess
  - Operator and patient dependent
  - Risks increase when biopsies are performed



2007 VS. 2019 CAP GUIDELINES

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

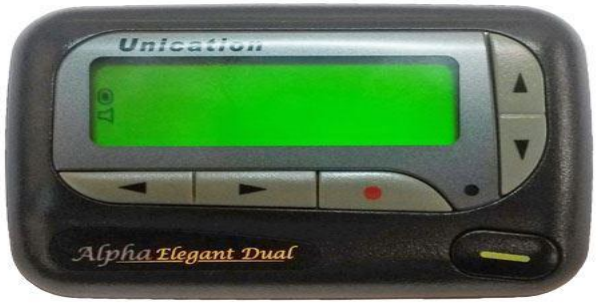
Recommendation	2007 ATS/IDSA Guideline	2019 ATS/IDSA Guideline
Sputum culture	Primarily recommended in patients with severe disease	Now recommended in patients with severe disease as well as in all inpatients empirically treated for MRSA or *Pseudomonas aeruginosa*
Blood culture	Primarily recommended 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*.

Metlay JP, et al. Amer Journal of Resp and Crit Care Medicine, 2019

MR. WILSON

- 2 days after admission, you get a page from his nurse:
  - “Mr. Wilson has increased WOB, please come evaluate ASAP”

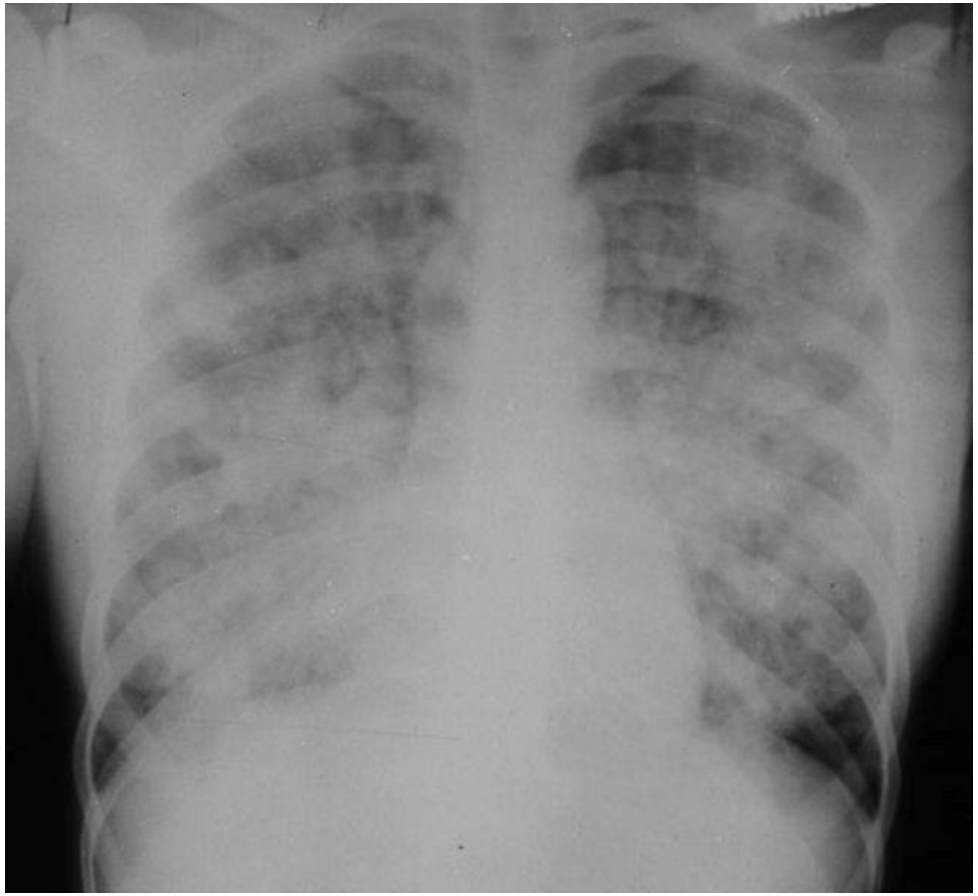


MR. WILSON

- Vitals:
  HR: 112, **RR:** 32, **BP:** 108/73, **Temp:** 37.6
  O2: 83% on 6L NC

- ABG: pH = 7.37, pCO2 = 35, pO2 = 40

- Echo (from earlier in the day): EF 65%, 1/4 diastolic dysfunction, normal RV function, L atrial enlargement



WHAT IS THE MOST APPROPRIATE DIAGNOSIS?

A. PNEUMONIA

B. PULMONARY EDEMA

C. ARDS

D. “I HAVE NO IDEA…BUT I’M **VERY** WORRIED”

ACUTE RESPIRATORY DISTRESS SYNDROME (ARDS)

Berlin Criteria

- **Acute onset**
- **Bilateral opacities** on CXR or CT within 24 hours
- No evidence of left heart failure or **fluid overload**
- Moderate to severe impairment of oxygenation (**PaO2/FiO2 ≤300**)
- Presence of a **predisposing condition**

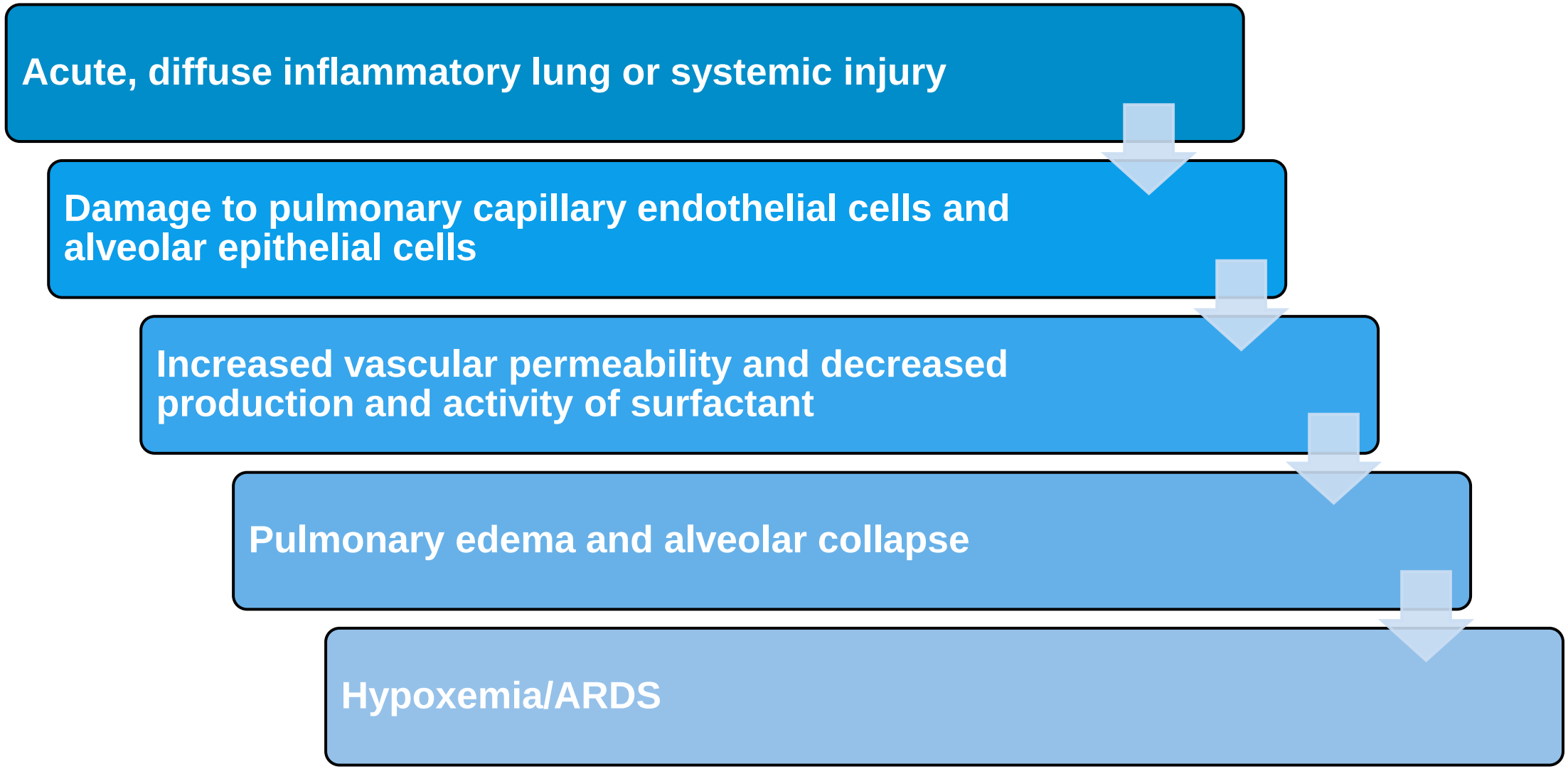
ARDs Definition Task Force. ARDS. JAMA 2012; 307:2526-2533

ACUTE RESPIRATORY DISTRESS SYNDROME (ARDS)

Severity of ARDS	PaO2/FiO2 (mmHg)
Mild	200 – 300
Moderate	100 – 200
Severe	≤100

ARDs Definition Task Force. ARDS. JAMA 2012; 307:2526-2533

PATHOPHYSIOLOGY



ARDs Definition Task Force. ARDS. JAMA 2012; 307:2526-2533

CAUSES OF ARDS

Systemic Insult

- Sepsis
- Shock
- Trauma
- Blood transfusions
- Burns
- Drug overdose
- Cardiopulmonary bypass

Pulmonary Insult

- Severe pneumonia
- Aspiration
- Lung contusion
- Toxic inhalation
- Near-drowning
- Pulmonary embolus

*If idiopathic, it is considered **Acute Interstitial Pneumonia***

ARDs Definition Task Force. ARDS. JAMA 2012; 307:2526-2533

TREATMENT OF ARDS

- Identify the initial systemic or pulmonary insult, and treat underlying cause

Supportive Care

- Corticosteroids
- Conservative fluid strategy (vs. liberal fluid resuscitation)
- Lung protective ventilation (low tidal volumes, high PEEP)
- Prone positioning
- +/- ECMO (in select patients)

Griffiths MJD, et al. BMJ Open Respiratory Research 2019.

ONE LAST THING BEFORE I GO…

LUNG POINT OF CARE ULTRASOUND (POCUS)

- Lung US can assess for:
  - Pulmonary edema
  - Consolidation/pneumonia
  - Pleural effusions
  - Pneumothorax

	CXR (sensitivity)	US (sensitivity)
Pulmonary edema	56.9%	85-92%
Pneumonia	38-64%	85-96%
Pneumothorax	39-50%	78-90%

Lung ultrasound provided the correct diagnosis in **90.5%** of cases.

Lichtenstein DA, Mezière GA. Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure. Chest. 2008;134(1):117-125. doi:10.1378/chest.07-2800.

TAKE HOME POINTS

- When a patient is in respiratory distress, first determine if it is hypoxic, hypercapnic, or mixed respiratory failure.
- Use the most appropriate form of supplemental O2.
- Consider high-flow nasal cannula, even in COPD exacerbations (under the right conditions).
- NPPV can be an extremely helpful tool when used in the right clinical setting.
- With hemoptysis, turn patient bleeding side down, and secure an airway first.
- There is no longer a “healthcare-associated” classification of pneumonia. Use the DRIP score to assess for need for broad-spectrum antibiotics in CAP.
- In a patient with refractory hypoxemia, consider ARDS in your differential – and try to recognize and treat as quickly as possible.

QUESTIONS?

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