MAYO CLINIC

FOR THE LOVE OF OXYGEN

HOSPITAL RESPIRATORY CASES

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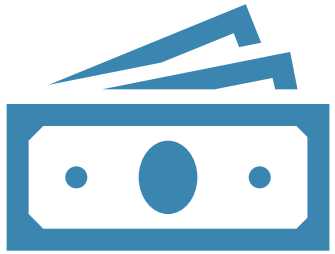
Assistant Professor of Medicine

DISCLOSURES



This presentation has no affiliation or financial arrangements.

There will be no off-label usage references of pharmaceuticals or instruments.

LEARNING OBJECTIVES

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

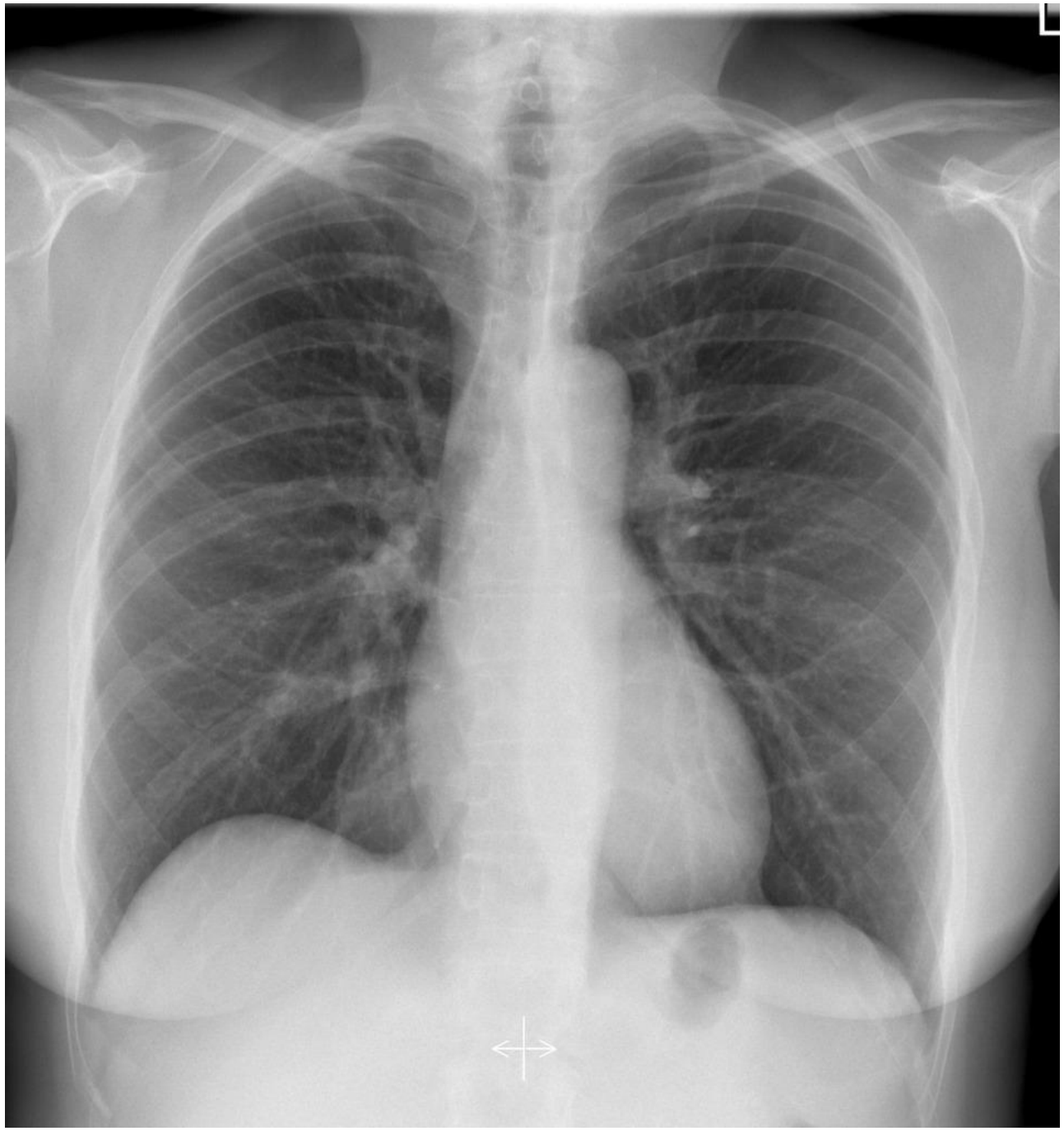
MRS. KENT

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?

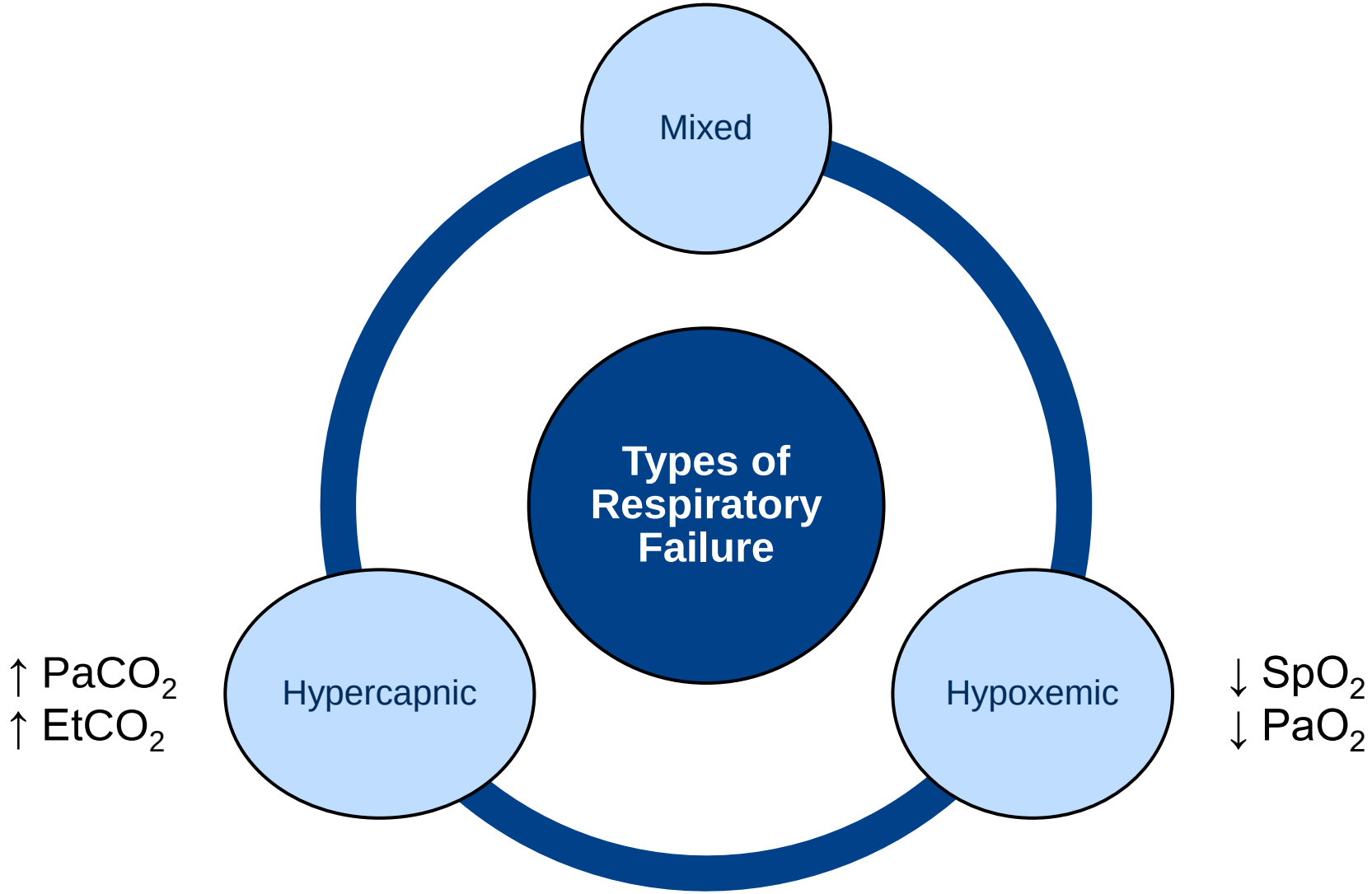
A. HYPOXEMIC

B. HYPERCAPNIC

C. MIXED

D. “I HAVE NO IDEA…BUT I’M WORRIED”

RESPIRATORY FAILURE



HYPOXEMIC RESPIRATORY FAILURE

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

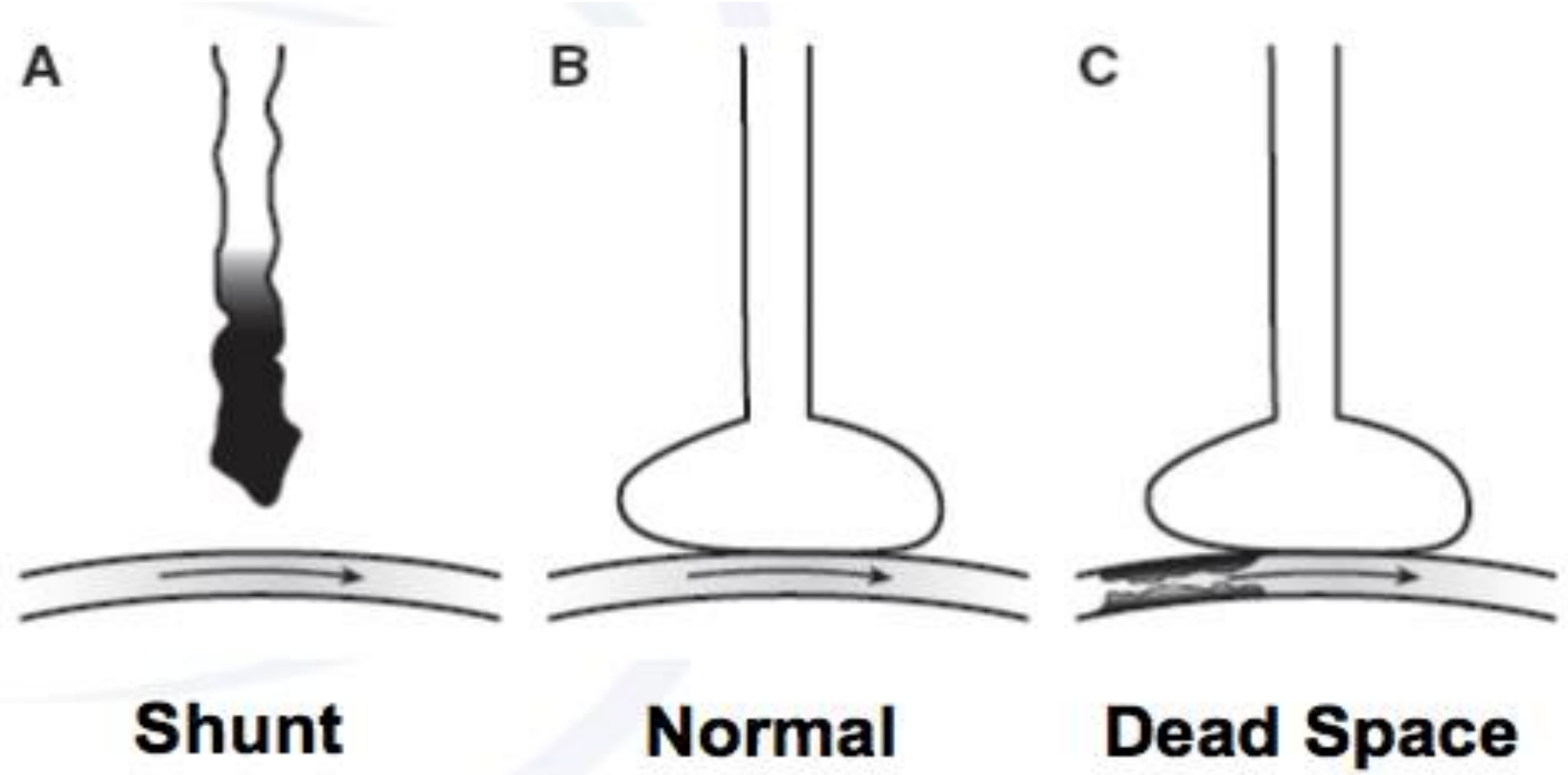
Common causes of hypoxia:

- 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

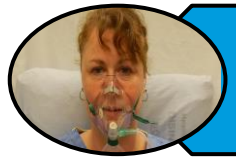
OXYGEN DELIVERY DEVICES

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

Up to 15 L/min O2, 0.6 – 0.9 FiO2

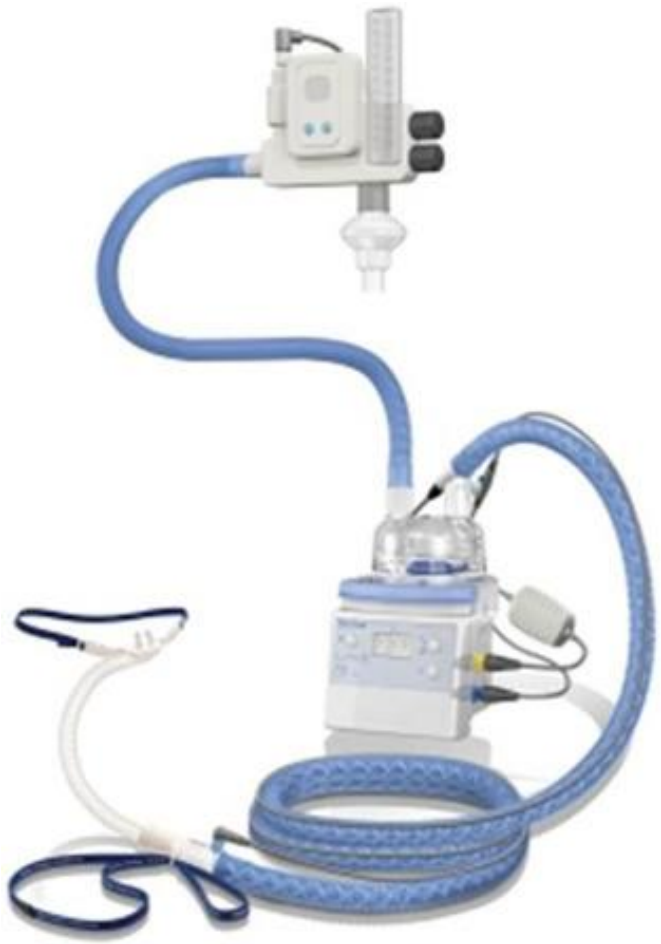
Face Tent

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

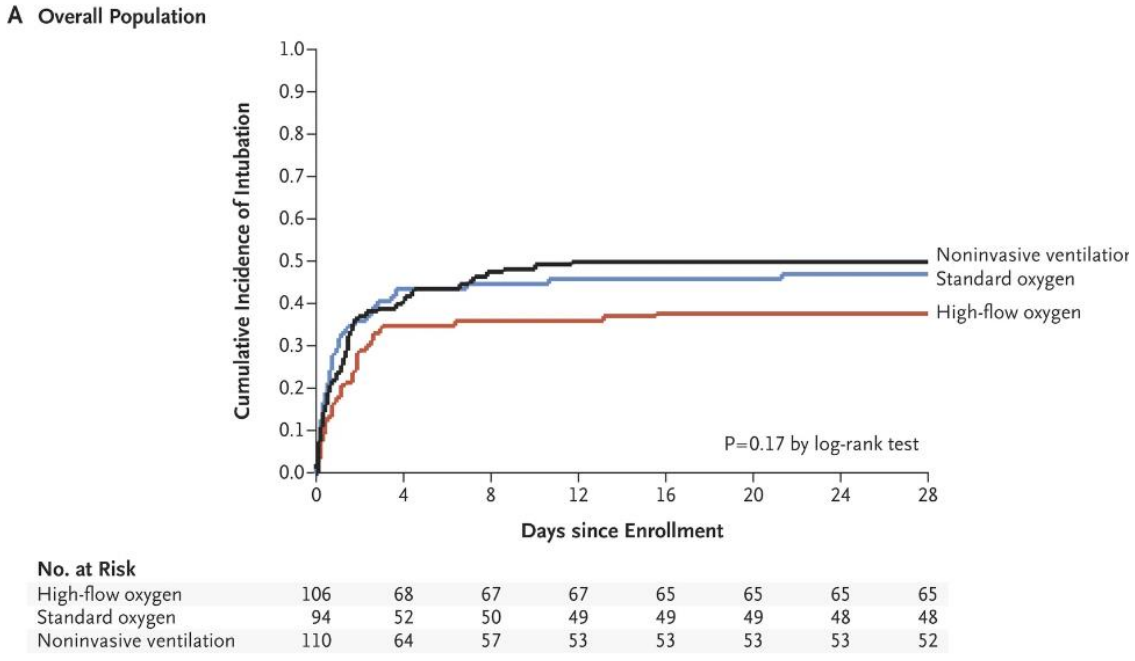
HIGH FLOW NASAL CANNULA (HFNC)

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

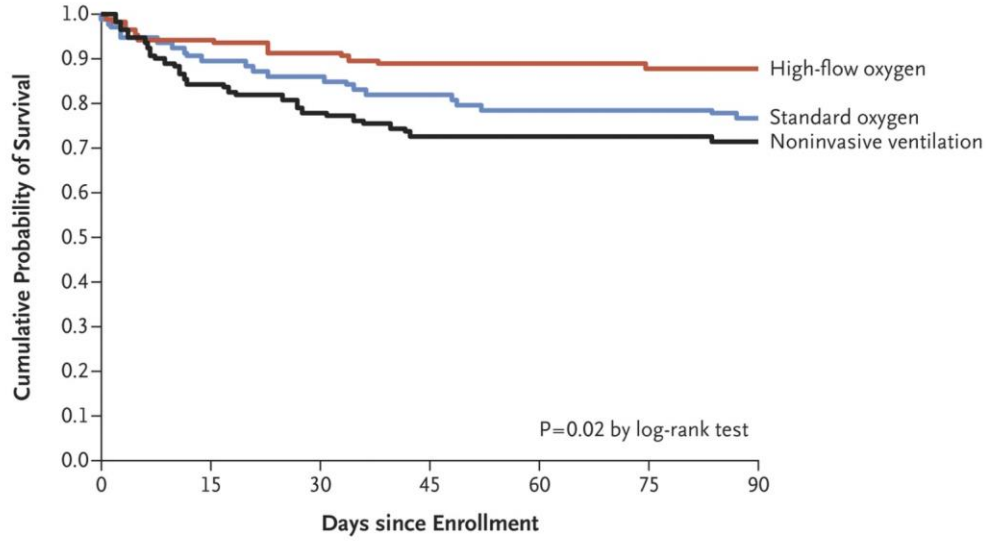
- Improves work of breathing
- Enhances gas exchange
- Provides some positive pressure
- Reduces dead space
- May help improve mucociliary clearance

HIGH FLOW NASAL CANNULA

FLORALI Trial



No. at Risk								
High-flow oxygen	106	68	67	67	65	65	65	65
Standard oxygen	94	52	50	49	49	49	48	48
Noninvasive ventilation	110	64	57	53	53	53	53	52



No. at Risk							
High-flow oxygen	106	100	97	94	94	93	93
Standard oxygen	94	84	81	77	74	73	72
Noninvasive ventilation	110	93	86	80	79	78	77

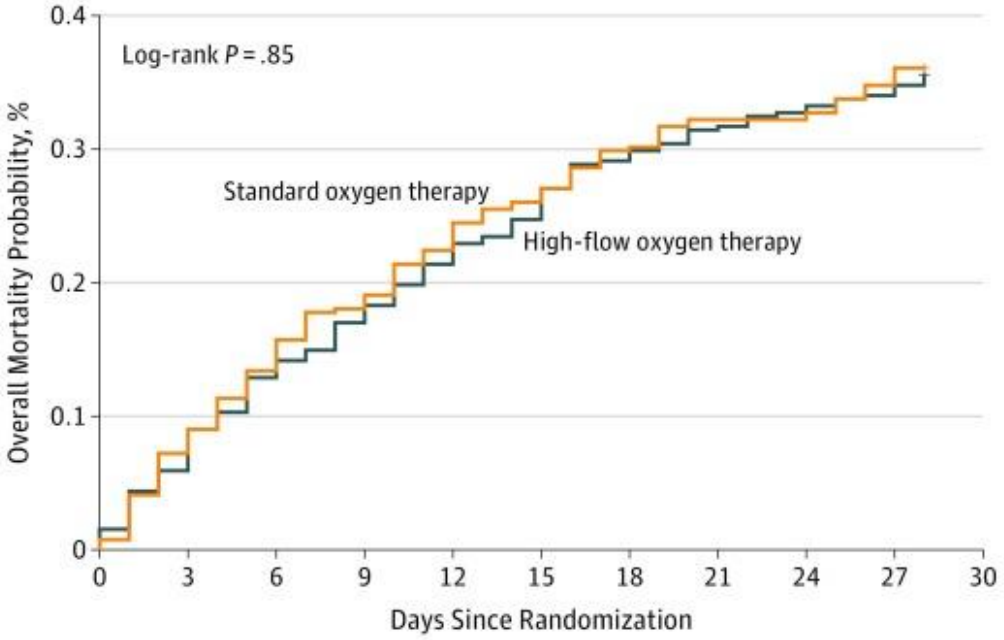
No significant difference in intubation rates

Improved survival with HFNC

NEJM 2015;372:2185

HIGH FLOW NASAL CANNULA

- **HIGH Trial**
  - High flow vs standard oxygen in **immunocompromised** patients with acute respiratory failure
  - NO difference in mortality, intubation or ICU LOS



No. at risk

High-flow oxygen therapy	388	365	338	322	305	292	275	266	261	256	0
Standard oxygen therapy	388	360	336	318	301	287	272	263	263	253	0

JAMA 2018;320(20):2099

HIGH FLOW NASAL CANNULA

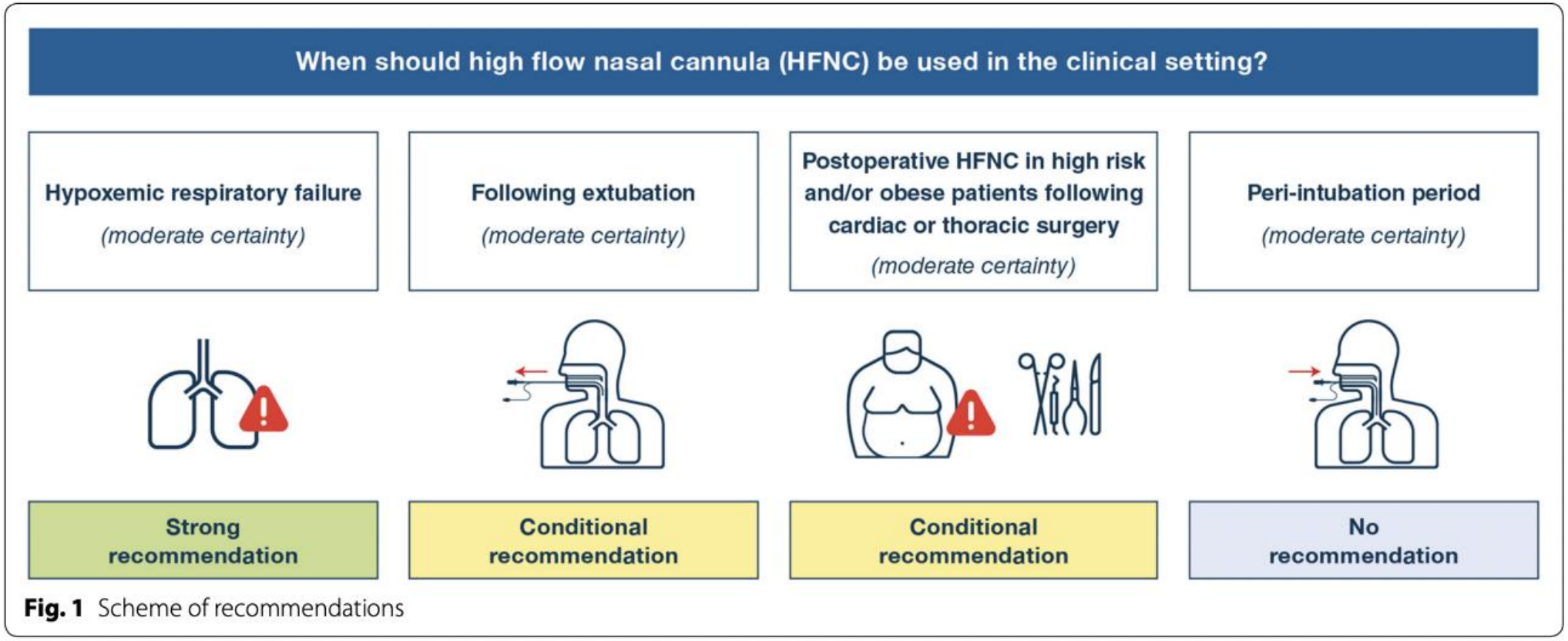


Fig. 1 Scheme of recommendations

↓ intubation rates
↓ escalation of resp. support

Might delay intubation, but no significant change in mortality as a result

Recommended for pts intubated >24hrs & have "high risk" features

Provider to decide BiPAP vs. HFNC

HFNC >> COT
(but no need to use Prophylactically)

No clear recommendations, but for those pts already on HFNC – can continue HFNC in the peri-intubation period

Intensive Care Med (2020) 46:2226–2237

HIGH FLOW NASAL CANNULA

TO FLOW OR NOT TO FLOW? THAT IS THE QUESTION

- FLOW is important!
- Can start patients on **40 L/min** flow and titrate up/down as necessary.

Li et al. Annals of Intensive Care (2021) 11:164

HIGH FLOW NASAL CANNULA

ROX Index

Respiratory rate-OXygenation

Helps determine which patients will fail HFNC and require intubation

$$\frac{SpO2/FiO2}{RR}$$

- ≥4.88 at 2, 6, or 12 hours HFNC start = high chance of success
- ROX < 2.85 at 2 hours
- ROX < 3.47 at 6 hours
- ROX < 3.85 at 12 hours

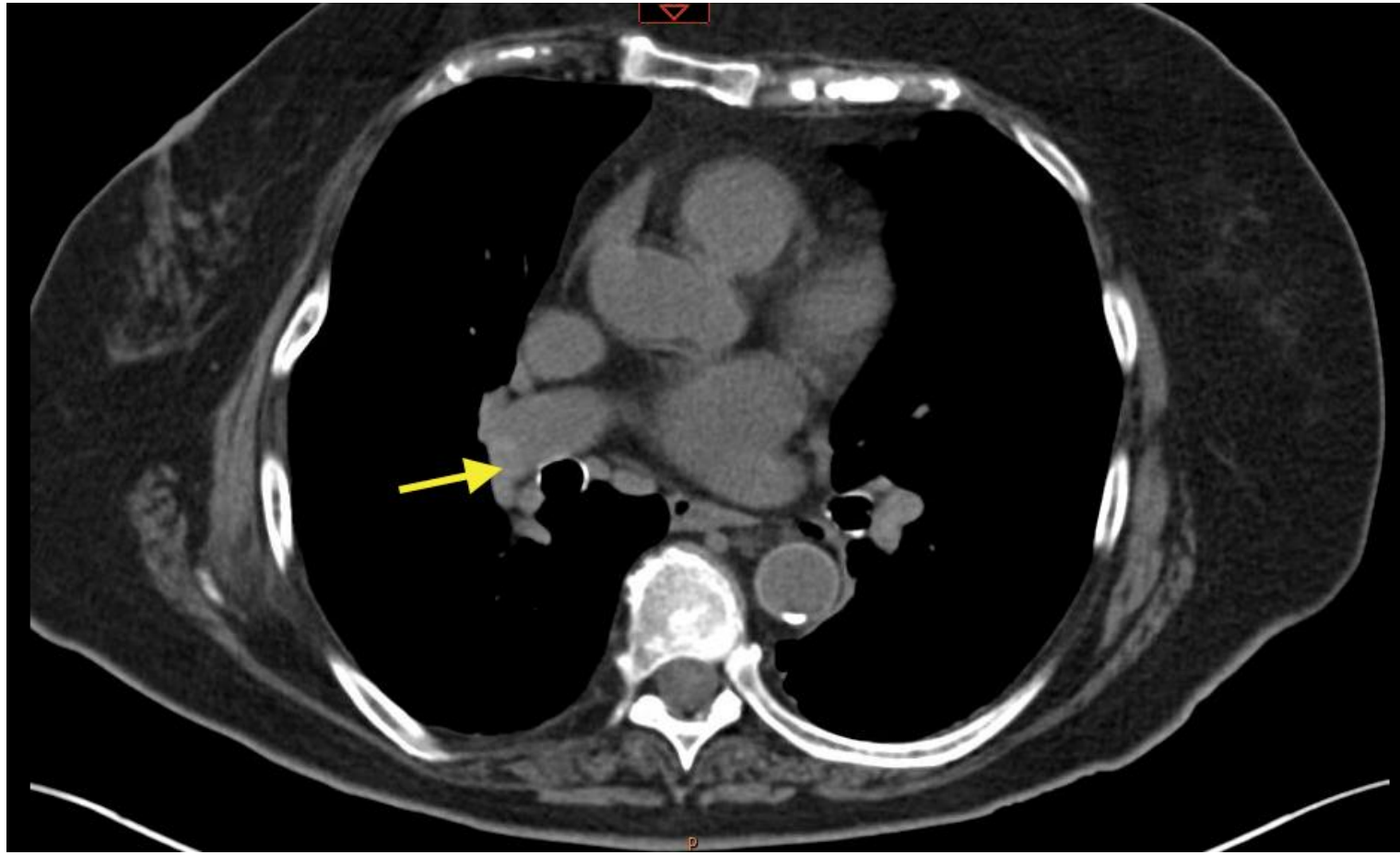
Better to go straight to intubation

- Grey zone is somewhere in between, recommend clinical judgement

Journal of Critical Care, Volume 35, 2016, Pages 200-205
Journal of Critical Care. Volume 66. Dec 2021. Pages 102-108

MRS. KENT

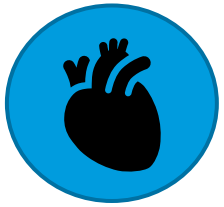
- Diagnosed with an **acute pulmonary embolism.**
- Initially placed on nasal cannula, but with ongoing hypoxia was transitioned to high-flow nasal cannula.
- Heparin drip initiated.



UPDATES IN PE TREATMENT

BIOMARKERS

Use an **age-adjusted** cut-off level for D-dimers (vs. **fixed** cut-off value) for screening



Evaluation of RV function is important for risk assessment

- Can use biomarkers (**troponin, BNP**) and/or echo
- RV dysfunction is associated with ↑ short-term mortality even in hemodynamically stable patients

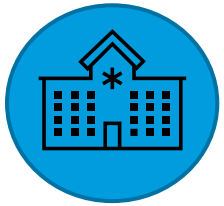
European Heart Journal (2020), 41; 4: 543–603

UPDATES IN PE TREATMENT

SETTING

Recommendation to implement PE response teams (PERT)

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



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

European Heart Journal (2020), 41; 4: 543–603

PULMONARY EMBOLISM

DEFINITIONS

SUBMASSIVE PE	MASSIVE PE
Intermediate-risk PE	High-risk PE
RV dysfunction and/or troponin elevation, but no hypotension	Sustained hypotension (SBP<90 for at least 15 minutes or requiring inotropic support, not due to a cause other than PE), pulselessness, or persistent profound bradycardia

PULMONARY EMBOLISM

TREATMENT

SUBMASSIVE PE	MASSIVE PE
Anticoagulation alone	Thrombolytic therapy
• Thrombolysis offers no immediate survival advantage • Benefits (improved hemodynamics) appear to be offset by major bleeding (hemorrhagic stroke)	• Systemic thrombolytics favored over catheter-directed • If contraindicated or unsuccessful, consider surgical pulmonary embolectomy or percutaneous catheter-directed therapy • Thrombolytic therapy should be followed by anticoagulation

Blood Advances (2020) 4;19:4693-4738
European Heart Journal (2020), 41: 4: 543–603

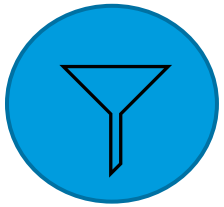
UPDATES IN PE TREATMENT

TREATMENT

1st Line Therapy = **Direct-acting Oral Anticoagulants**

Exceptions:

- Severe renal insufficiency
- Antiphospholipid syndrome
- Pregnancy



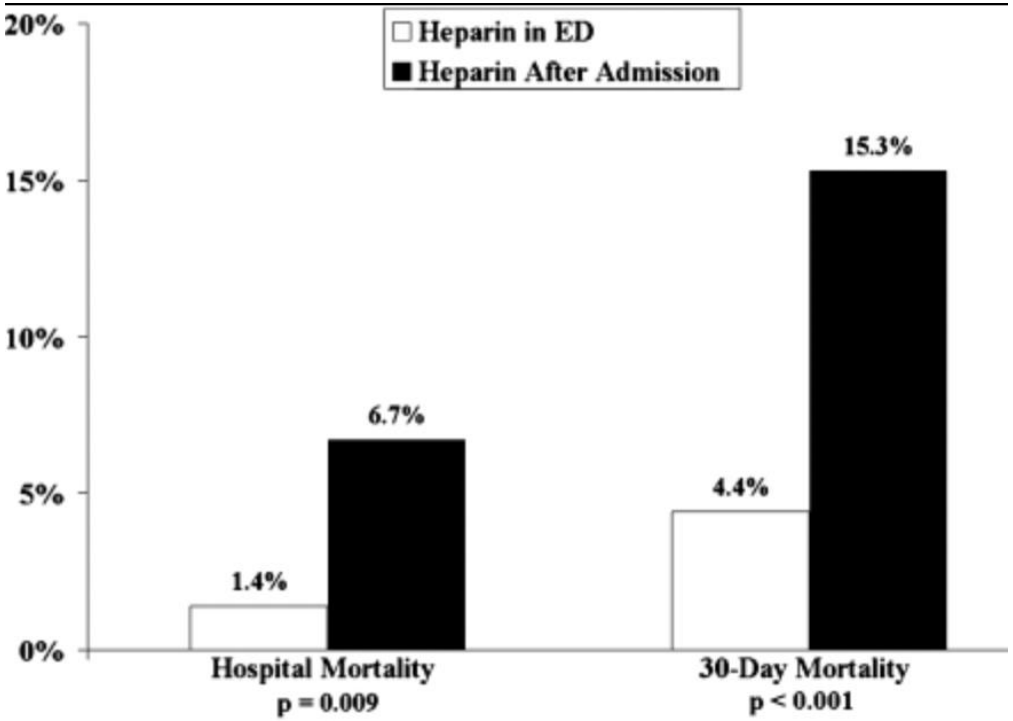
IVC filter should be considered only in patients with absolute contraindications to anticoagulation

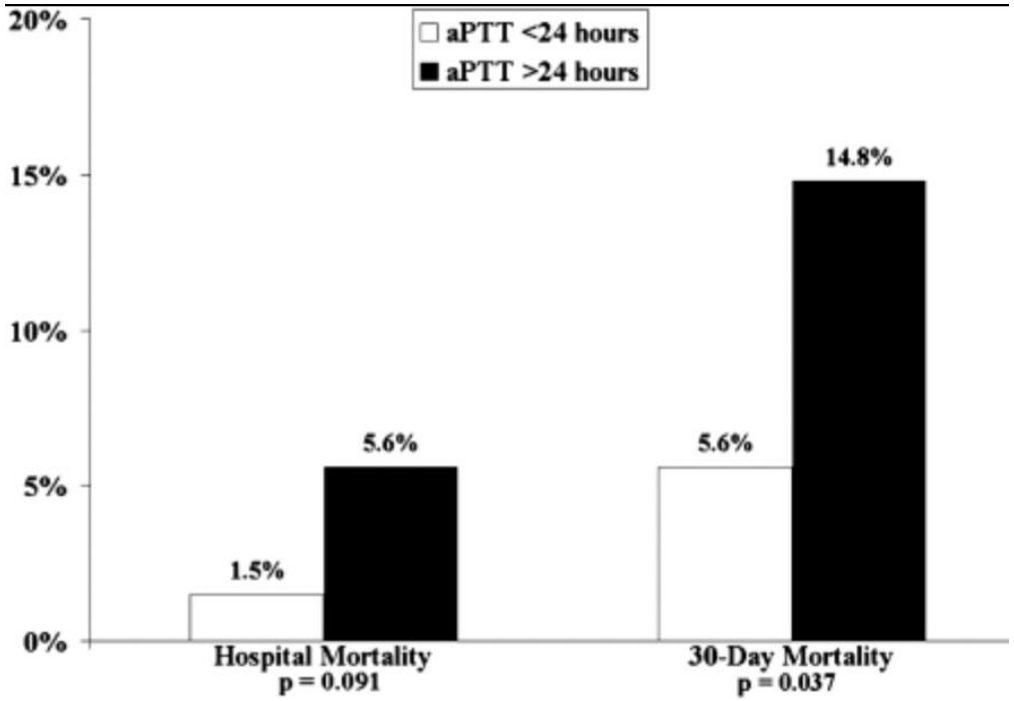
- However, they do not appear to reduce the risk of PE recurrence or PE-related mortality

European Heart Journal (2020), 41; 4: 543–603

PULMONARY EMBOLISM

TREATMENT





Prompt anticoagulation reduces short-term mortality after PE!

CHEST. 2010;137:1382

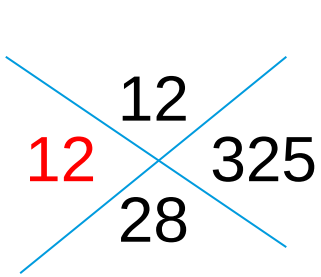
MR. JONES

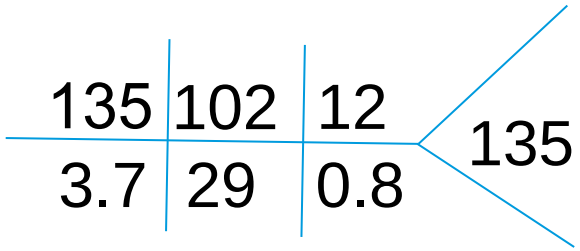
75yo male, with a past medical history of **COPD,** type 2 **diabetes,** and HLD presents to the ER with a 3 day history of **"worsening shortness of breath".**

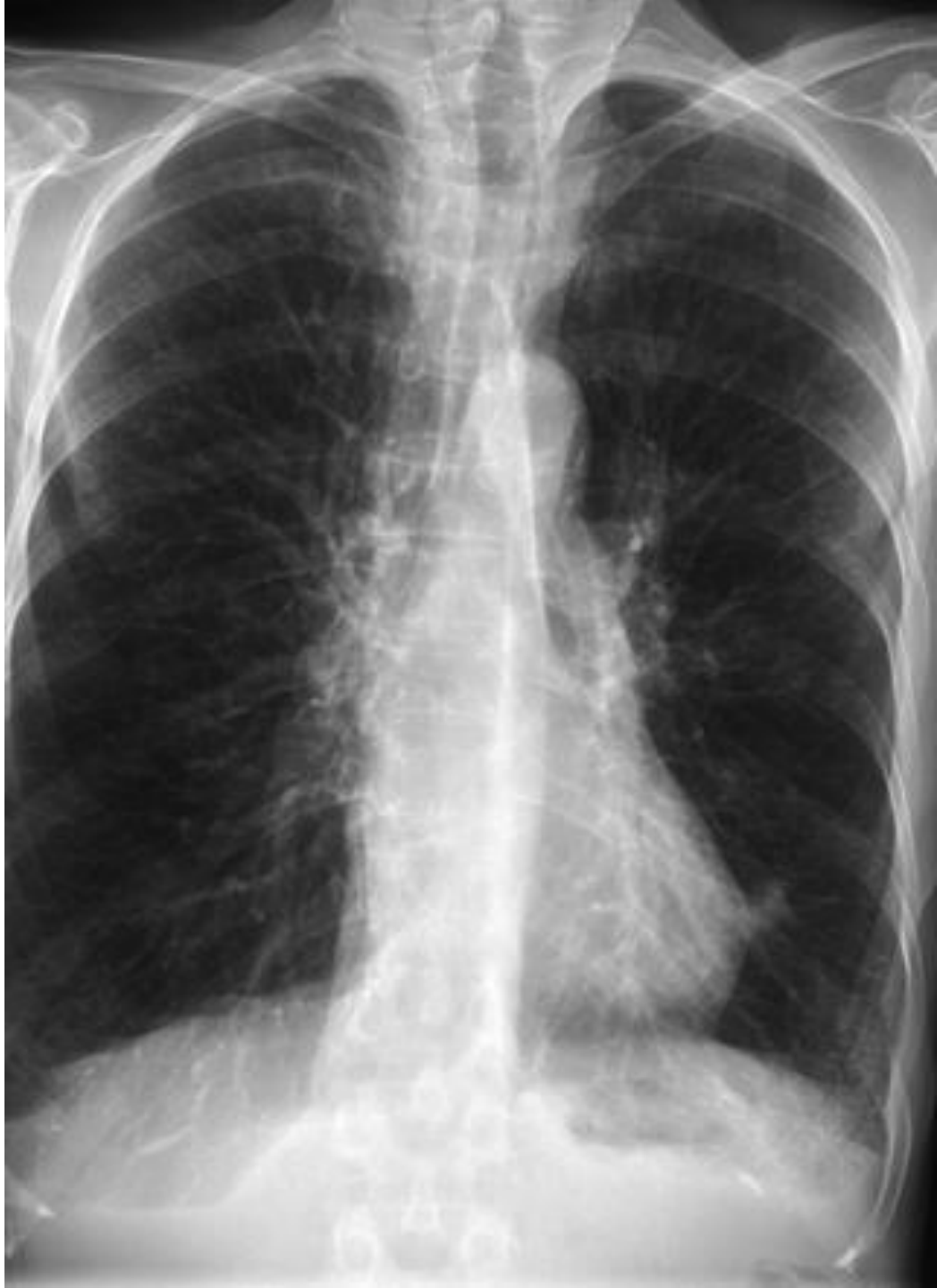
- Medications: Metformin, Albuterol PRN, Advair Diskus
- SH: 50 pack year history of smoking cigarettes and cigars. Daily EtOH use. He is retired and lives at home with his wife.
- Vitals: **HR**: 105, **RR**: 34, **BP**: 119/75
  Temp: 37.8^{o}C **O2 sat**: 87% on RA
- He is in moderate distress, using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

MR. JONES

ABG	
pH	7.36
PaCO2	51
PaO2	53
Bicarb	33



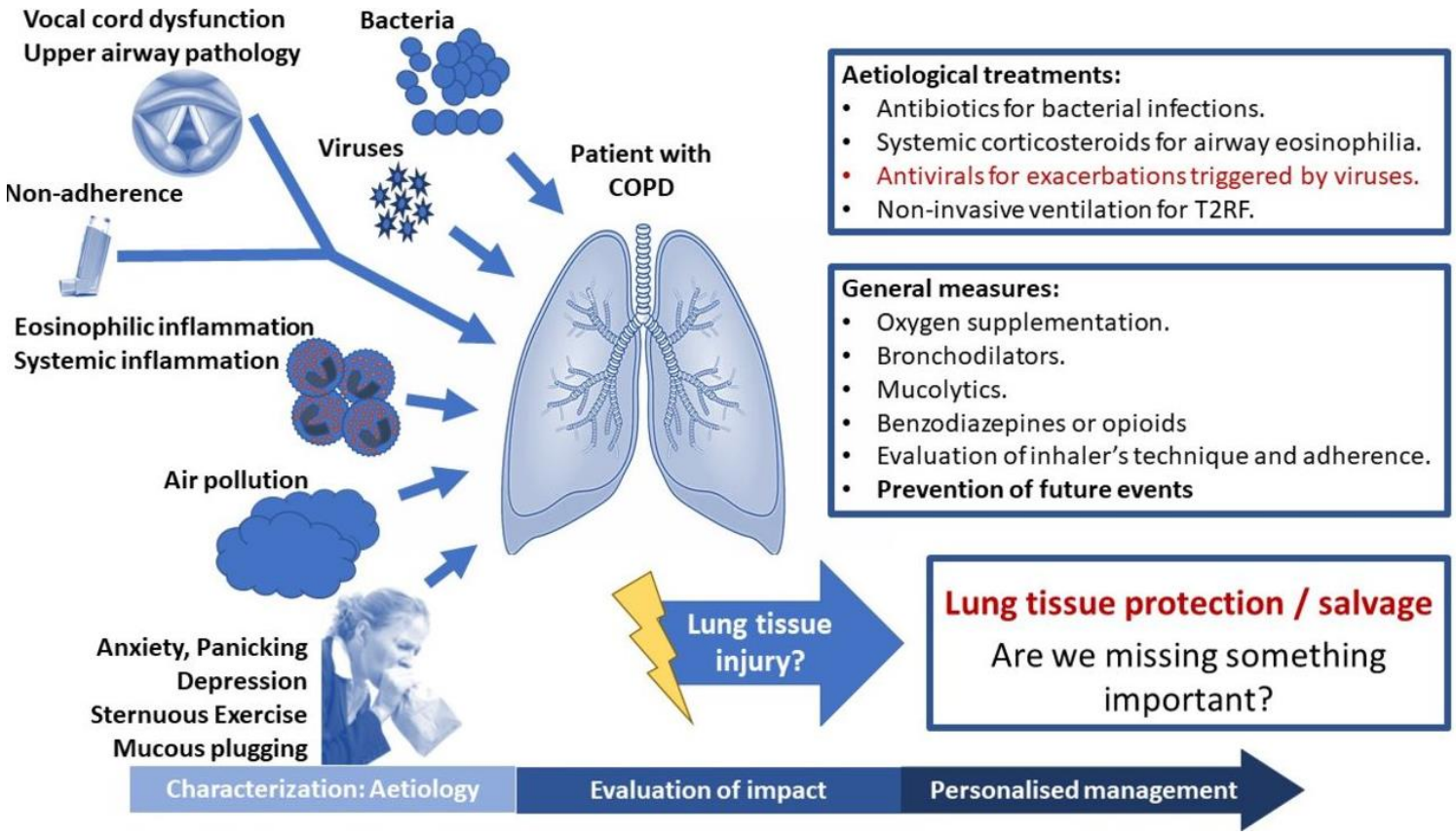




COPD EXACERBATION

- **GOLD definition**: An acute worsening of respiratory symptoms that results in additional therapy.

- Exacerbations cause disease progression by contributing to >25% of excess decline of lung function.



Thorax 2020;**75:**520-527.

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 increased 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

International Journal of Chronic Obstructive Pulmonary Disease 2019:14 1411–1421
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

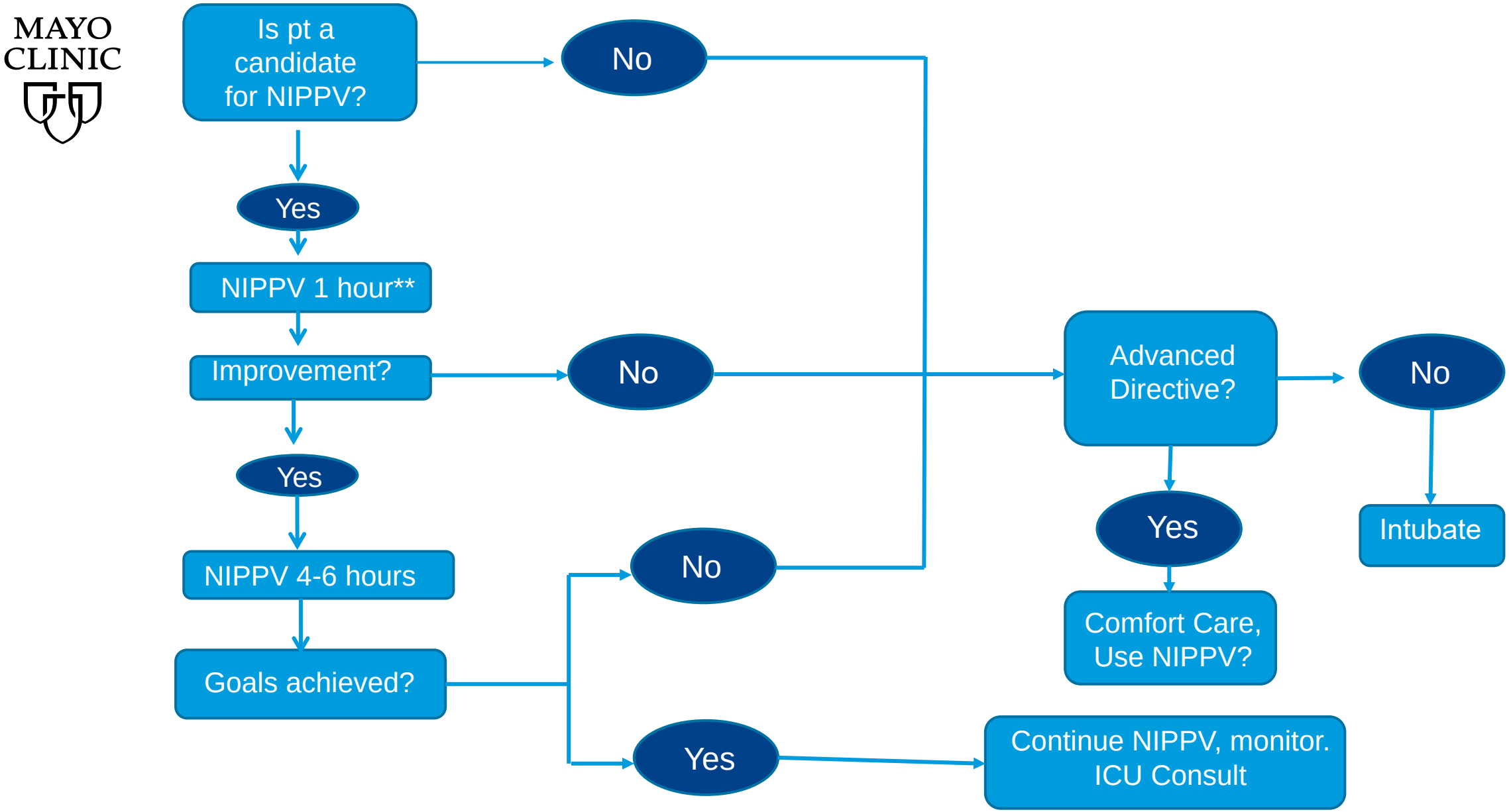
- Claustrophobia
- Increased workload for respiratory practitioner
- Facial/nasal pressure lesions
- Unprotected airway
- Inability to suction deep airway
- Gastric distention
- Delay in intubation

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

MAGNESIUM FOR COPD EXACERBATIONS?

- IV magnesium compared to placebo:
  - ↓ hospital admissions
  - ↓ hospital length of stay
  - Improved dyspnea scores
  - BUT:
    - NO difference in: use of NIV, lung function, or adverse events
    - There wasn’t enough data about ICU admission, intubation, or mortality

- Not enough data about nebulized magnesium treatment to make any recommendations.

Cochrane Database of Systematic Reviews 2022, Issue 5. Art. No.: CD013506.
DOI: 10.1002/14651858.CD013506.pub2.

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.

- She was hemodynamically stable on arrival. Given IV Solu-Medrol.
- The next day, during the bronchoscopy, she developed massive hemoptysis 2/2 **diffuse alveolar hemorrhage**.

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
- Secure airway first!
  - If intubation is required, use a large diameter ET tube, or consider unilateral intubation/lung isolation, if indicated.
- Place patient **bleeding side down**
- Sedation/anxiolysis or paralytics if necessary
- Reverse any coagulopathy - 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
  - Cryotherapy probe can be necessary for clot extraction
- Bronchial artery embolization
- Surgery

Dtsch Arztebl Int 2017; 114; 371-81.

TREATMENT OF HEMOPTYSIS

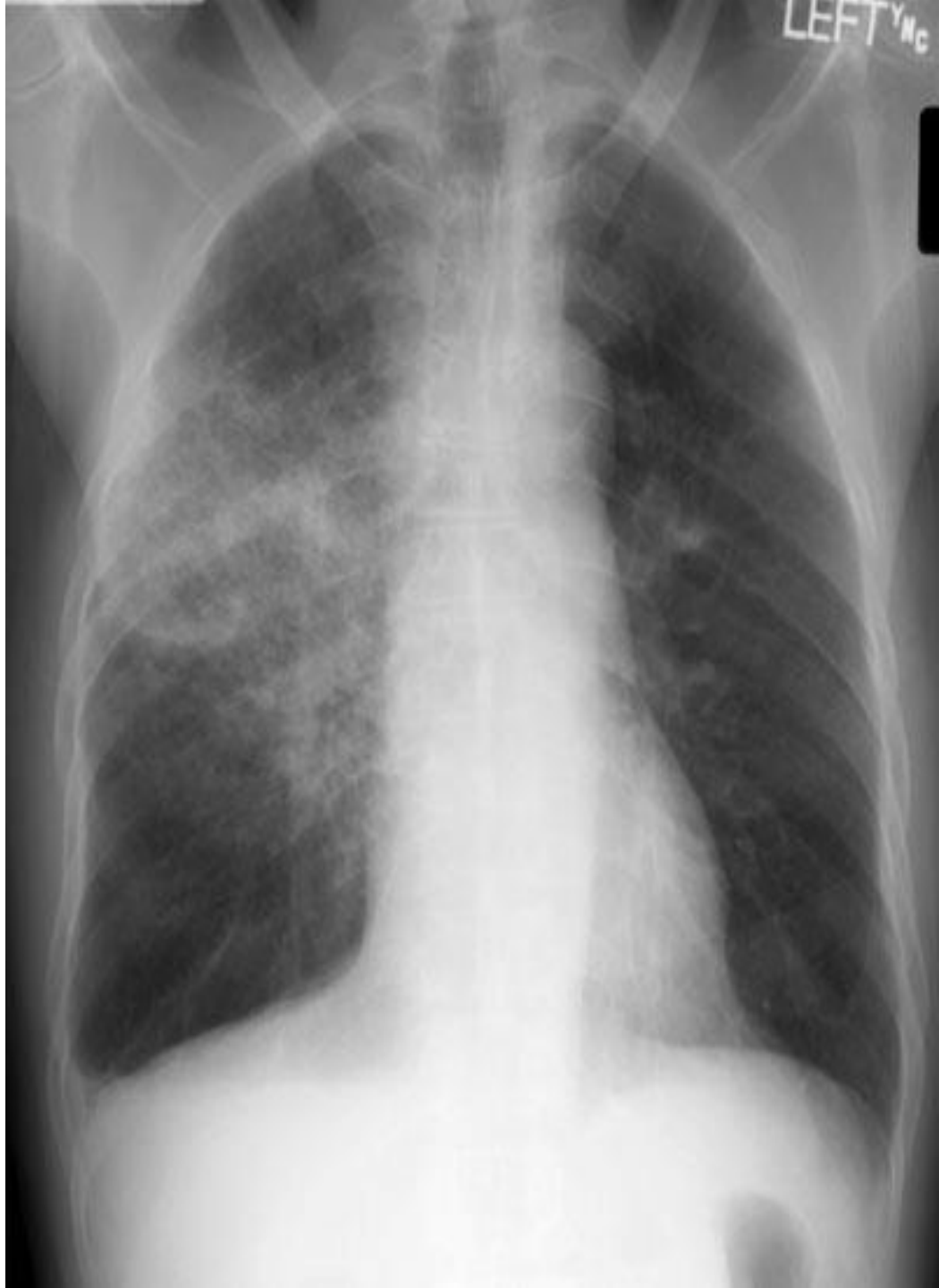
- **Inhaled tranexamic acid** treatment can be helpful in non-massive hemoptysis
  - Shorter length of stay
  - Required less invasive procedures
  - Reduced recurrence rate at 1 year follow-up
  - The tranexamic acid group didn’t have any increased side effects

- IV and inhaled TXA has been studied for management of submassive hemoptysis, with decrease in hemoptysis with either option

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)

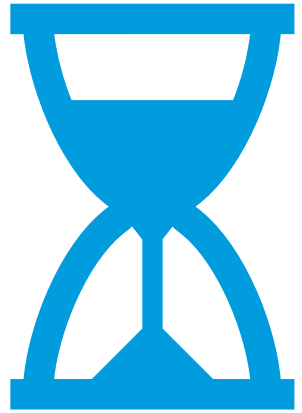
Ventilator-associated pneumonia (VAP)

*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

TREATMENT OF CAP

- Ineffective/delayed initial antimicrobial therapy is the most significant predictor of poor outcomes.
- Start empiric antibiotics as soon as diagnosis is made!



WHICH ANTIBIOTICS SHOULD WE START FOR MR. WILSON?

A. Piperacillin-tazobactam and Vancomycin

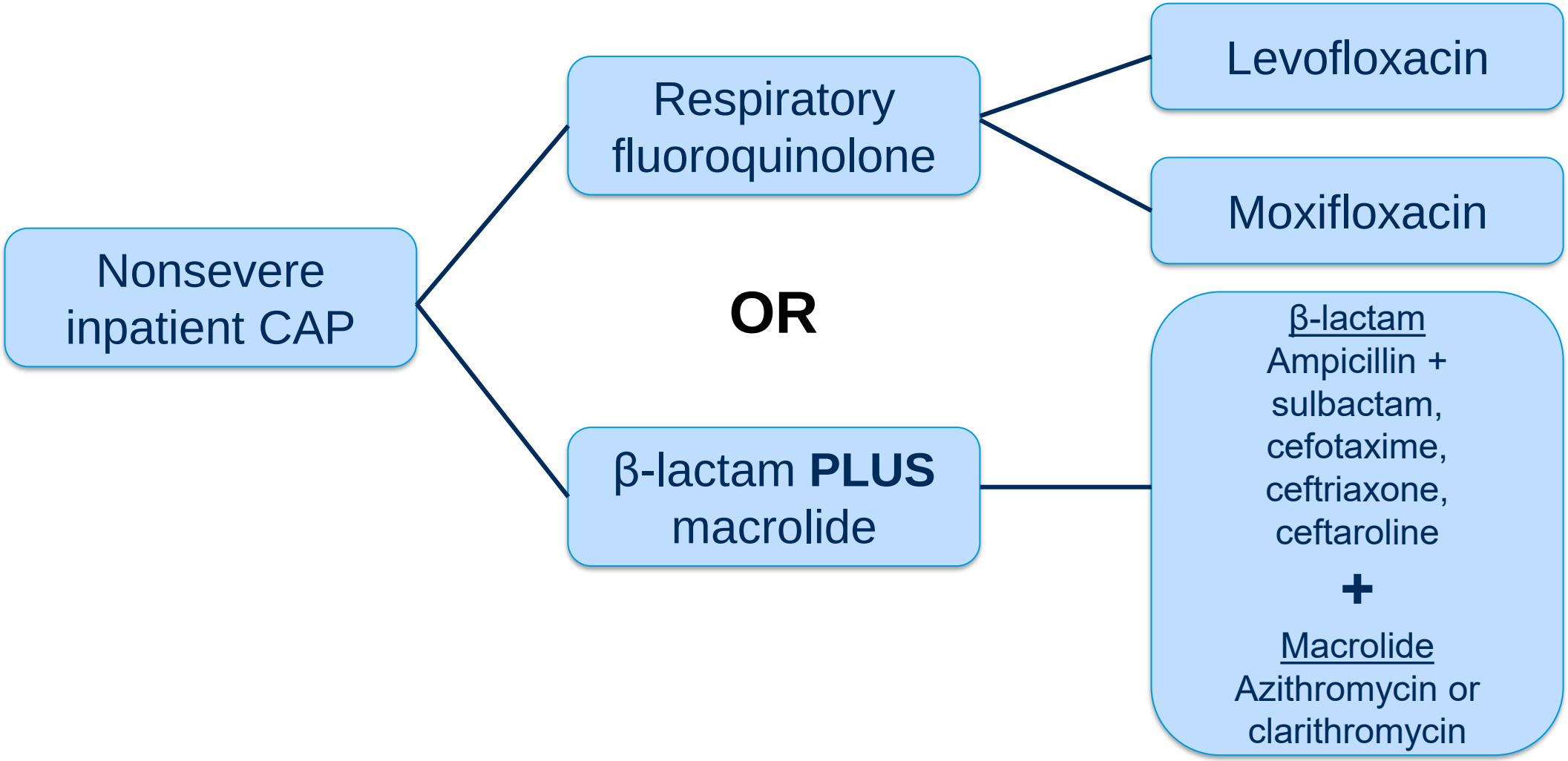
B. Ciprofloxacin

C. Ceftriaxone and Azithromycin

D. Azithromycin

UPDATED CAP TREATMENT GUIDELINES

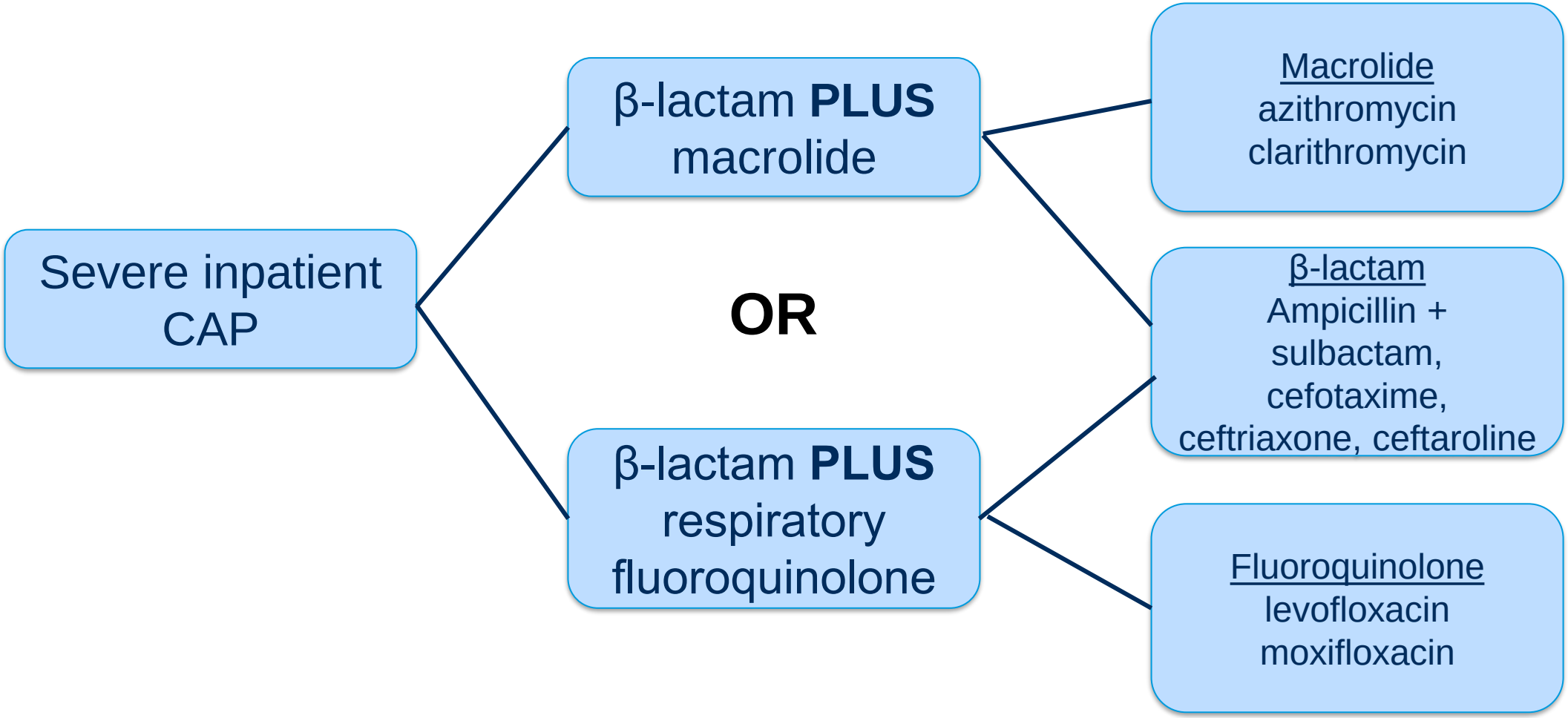
NON-SEVERE INPATIENT CAP W/O RISK FACTORS FOR MRSA & PSEUDOMONAS



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

ASM journals 2016. 60;5: https://doi.org/10.1128/AAC.03071-15

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

ASM journals 2016. 60;5: https://doi.org/10.1128/AAC.03071-15

WHAT ABOUT ASPIRATION?

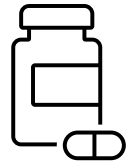
- **Anaerobic** antibiotic coverage isn't indicated, unless **lung abscess** or **empyema** is suspected.
  - Most patients who aspirate gastric contents develop aspiration pneumonitis, which typically only requires supportive treatment (without antibiotics) and resolves within 24-48 hours.
  - More 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



Early de-escalation of antibiotics! (after 48 hrs if cultures negative)

- 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

PROCALCITONIN?

- Still controversial! No clear evidence to support better outcomes with procalcitonin guided antibiotic use.
- Even in COPD exacerbations, PCT had a poor accuracy to distinguish between bacterial and nonbacterial infection.

- **Recommendation:** Do not delay initiation of antibiotics regardless of procalcitonin value
  - Procalcitonin can be helpful in de-escalating antibiotic therapy.

Daubin et al. Ann. Intensive Care (2021) 11:39

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

STEROIDS?

- Routine use of steroids in non-severe or severe CAP is **not** recommended
  - Exceptions:
    - Refractory shock
    - If concomitant COPD/asthma exacerbation or autoimmune illness

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

SEVERE CAP

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

- Severe CAP =
  1 Major or **3+** Minor Criteria

Major Criteria

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

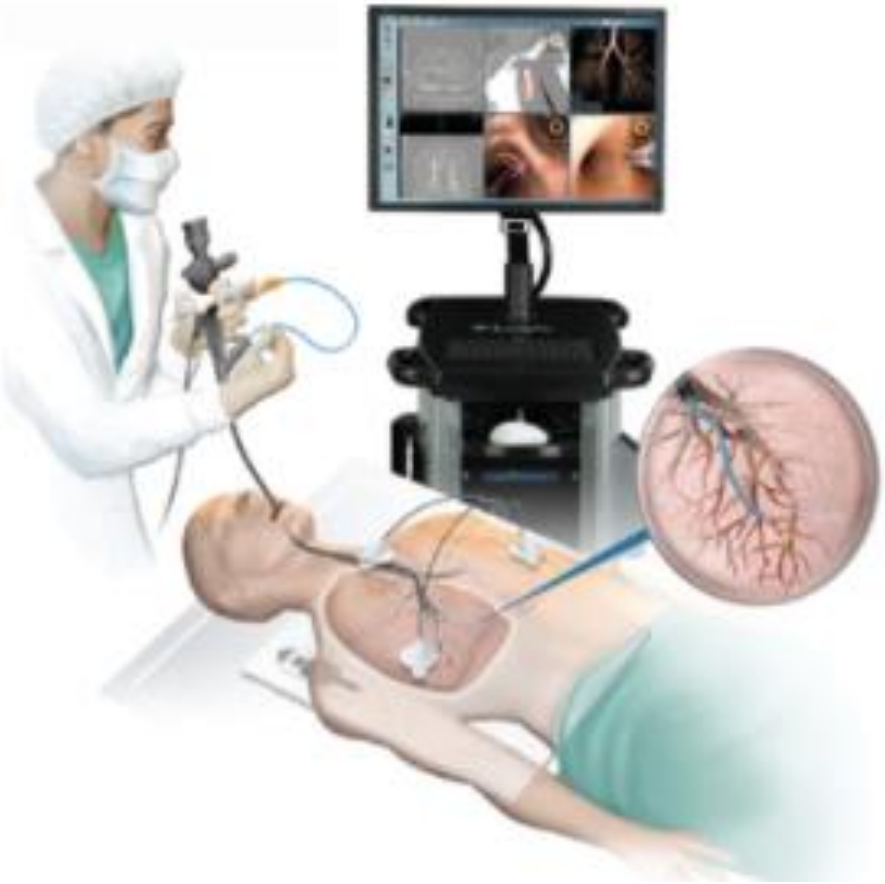
Minor Criteria

- 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^{o}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

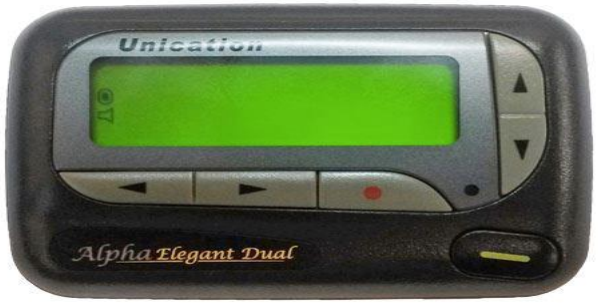
Recommendation	2007 ATS/IDSA Guideline	2019 ATS/IDSA Guideline
Sputum culture	Primarily recommended in patients with severe disease	Now recommended in patients with severe disease as well as in all inpatients empirically treated for MRSA or *Pseudomonas aeruginosa*
Blood culture	Primarily recommended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

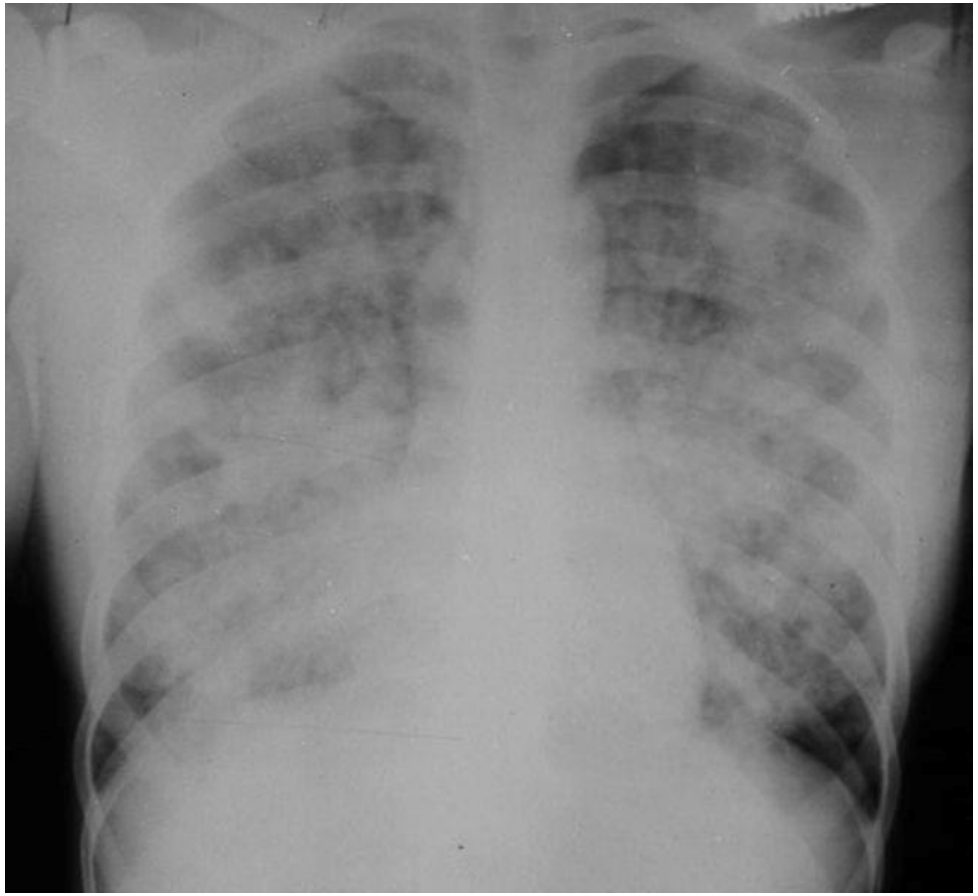


MR. WILSON

- 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**

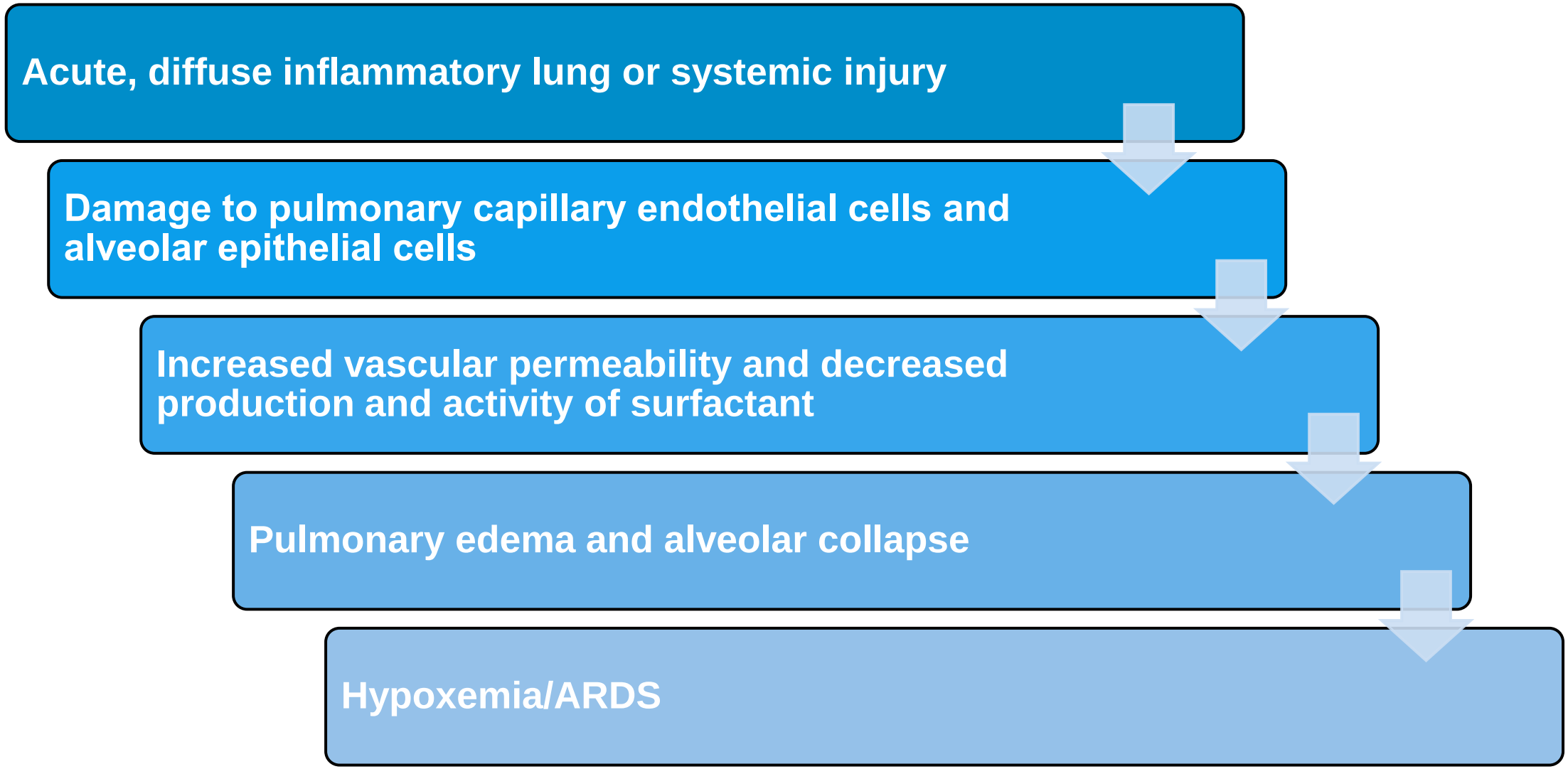
ARDs Definition Task Force. ARDS. JAMA 2012; 307:2526-2533

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

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

PULMONARY

- 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
- Lung protective ventilation (low tidal volumes, high PEEP)
- Prone positioning
- +/- ECMO (in select patients)

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

HFNC IN ARDS

- Recommendation to **use** HFNC (vs. COT) to reduce risk of intubation in ARDS
  - This includes AHRF 2/2 COVID-19

- Unable to make a recommendation for or against HFNC compared to CPAP/BiPAP in non intubated ARDS patients (to reduce mortality or intubation rates)
  - They do **suggest** that CPAP/BiPAP (instead of HFNC) can be considered to reduce risk of intubation in AHRF 2/2 COVID-19.
  - **No recommendation** on whether CPAP/BiPAP can decreased mortality compared to HFNC in COVID-19.

Intensive Care Med (2023) 49:727–759
https://doi.org/10.1007/s00134-023-07050-7

ONE LAST THING BEFORE I GO…

LUNG POINT OF CARE ULTRASOUND (POCUS)

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

	Sensitivity	
	CXR	**US**
Pulmonary edema	56.9%	85-92%
Pneumonia	38-64%	85-96%
Pneumothorax	39-50%	78-90%

Lung ultrasound can provide 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 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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