

COPD Exacerbation: Diagnosis & Management

A comprehensive approach to acute respiratory events.



Epidemiology & Significance

🌐 Global Impact

4th leading cause of death worldwide
Disease burden is increasing

👥 Prevalence

10-12% of adults over 40 years

⚠️ Risk Factors

Smoking (85%)
Environmental/occupational pollution
Biomass fuel exposure
Alpha-1 antitrypsin deficiency



🏥 Systemic Inflammatory Disease

During acute exacerbation:

- Increased IL-6 and CRP
- Elevated risk of MI and arrhythmia for 2 weeks (GOLD 2024)

Pathophysiology – High-Level Detail

👉 Small Airway Disease

- Chronic inflammation with macrophage & CD8+ dominance
- Goblet cell hyperplasia → mucus plugging
- Airway wall fibrosis → decreased expiratory flow

💥 Parenchymal Destruction

- Protease-antiprotease imbalance
- Alveolar wall destruction
- Decreased elastic recoil → air trapping + dynamic hyperinflation

! Consequences

Increased work of breathing

V/Q mismatch → hypoxemia

Late hypercapnia

Pulmonary hypertension
→ RV dysfunction → cor pulmonale

Definition of Acute Exacerbation

Definition

Acute **worsening** of respiratory symptoms beyond normal day-to-day variation, requiring **change in treatment**.

— Rosen & GOLD

Triggers

 Viral/bacterial infection (70-80%)

 Air pollution

 Poor adherence

 Important mimickers: CHF, PE, pneumothorax (Rosen)

TABLE 60.1 Severity Classification of Airflow Limitation in Patients With COPD ($FEV_1/FVC < 0.7$)

GOLD Classification of Airflow Limitation Severity in COPD (based on post-bronchodilator FEV_1)

GOLD 1	Mild	$FEV_1 \geq 80\%$ predicted
GOLD 2	Moderate	$50\% \leq FEV_1 < 80\%$ predicted
GOLD 3	Severe	$30\% \leq FEV_1 < 50\%$ predicted
GOLD 4	Very Severe	$FEV_1 < 30\%$ predicted

COPD, Chronic obstructive pulmonary disease; *FEV₁*, forced expiratory volume in one second; *FVC*, forced vital capacity; *GOLD*, Global Initiative for Chronic Obstructive Lung Disease.

Adapted from GOLD 2020 guidelines. Gold Reports for Personal Use. Global Initiative for Chronic Obstructive Lung Disease—GOLD. <https://goldcopd.org/gold-reports/>. Accessed January 17, 2020.

Emergency Department Evaluation - Initial Assessment

Critical Assessment Parameters for COPD Exacerbation



Level of Consciousness

Monitor for **CO₂ narcosis** — altered mental status indicating severe hypercapnia



Work of Breathing

Assess **respiratory rate** and effort — increased work indicates impending failure



Accessory Muscle Use

Look for **sternocleidomastoid** and intercostal muscle activation



Paradoxical Movement

Abdominal retraction during inspiration — critical sign of respiratory fatigue



Cyanosis

Check lips, tongue, nail beds — indicates significant hypoxemia



Pulsus Paradoxus

>10 mmHg drop in systolic BP during inspiration — sign of severe hyperinflation

Emergency Department Evaluation - Investigations

ABG – Critical for Decision Making

- **Indications:** severe distress, mental status change, hypoxemia despite O₂
- **Findings:** acute-on-chronic hypercapnia
- pH < 7.35 → need for NIV
- pH < 7.25 → high probability of failure
- pH dynamics in 1-2 hours is most important outcome predictor (*UpToDate*)

Chest X-ray

- **Rule out:** pneumonia, pneumothorax, CHF, bullae
- **COPD findings:** hyperinflation, flattened diaphragm
- Bullae can cause misdiagnosis (*Tintinalli*)

ECG

- Tachyarrhythmias
- P-pulmonale (right atrial enlargement)
- RV strain patterns
- Differentiating COPD vs ACS (*Harrison*)

Labs

- CBC, BMP for baseline assessment
- BNP for CHF differentiation (*Harrison*)
- Procalcitonin for antibiotic decision (*UpToDate*)
- Procalcitonin < 0.1 → antibiotics not recommended
- Procalcitonin > 0.25 → high probability of infection

BOX 60.1 Classification of Respiratory Failure in COPD Exacerbation

No respiratory failure

- Mild tachypnea with rate of 20–30 breaths per minute
- Normal work of breathing
- Baseline mental status
- Mild hypoxemia responsive to oxygen by nasal cannula
- No hypercapnia

Acute respiratory failure

- Significant tachypnea with rate >30 breaths per minute
- Increased work of breathing with accessory muscle use
- Baseline mental status
- Hypoxemia responsive to supplementation with <35% FiO₂
- Hypercapnia with PaCO₂ 50–60 mmHg and pH >7.25

Severe respiratory failure

- Altered mental status
- Hypoxemia requiring supplementation with >35% FiO₂
- PaCO₂ >60 mm Hg or pH ≤7.25

ED Management - Part 1



Controlled Oxygen Therapy

- Target:

88-92%

- Reasons:

- Prevent O₂-induced hypercapnia
- Maintain hypoxic pulmonary vasoconstriction
- Reduce dead space

- Venturi mask is most accurate ED method *(Rosen & GOLD)*



Bronchodilators

- SABA: Albuterol q20min × 3 initial, then q1-4h
- SAMA: Ipratropium 0.5 mg neb
- Reduces admission & improves FEV1 *(Rosen + Tintinalli)*
- Combination Therapy:
 - SABA + SAMA = Standard of care
 - Synergistic effect *(Rosen, Tintinalli)*



Systemic Corticosteroids

- Regimen Options:

- Prednisone 40 mg PO × 5 days
- Methylprednisolone IV (if PO not possible)

- Benefits:

- Reduce length of stay
- Reduce relapse rate
- Improve FEV1

- Level A evidence *(Rosen + UpToDate)*

ED Management - Part 2



Antibiotics

- Indications:
 - Increased purulent sputum
 - Increased dyspnea + volume
 - Severe exacerbation
 - Need for NIV
 - Pneumonia
- Options:
 - Azithromycin
 - Doxycycline
 - Amoxicillin/clavulanate
 - Respiratory fluoroquinolones (special cases)



Non-Invasive Ventilation

- Indications: *(Rosen + GOLD)*
 - $\text{pH} < 7.35$ + $\text{PaCO}_2 > 45$
 - Severe dyspnea
 - $\text{RR} > 25$
 - Accessory muscle use
 - Hypoxemia despite O_2
- Benefits:
 - Reduce mortality
 - Reduce intubation rate
 - Improve gases in 60-120 min
(Rosen)

▲ Predictors of NIV Failure

- $\text{pH} < 7.25$ at start
- Worsening pH/PaCO_2 after 1 hour
- $\text{GCS} < 11$, $\text{RR} > 35$
- High volume secretions
(UpToDate)



High-Flow Nasal Cannula

- Position:
 - Not a replacement for NIV
 - *(UpToDate 2024)*
- Useful in:
 - Mild hypercapnia
 - NIV intolerance
- Benefits:
 - Dead space washout
 - Mild CO_2 reduction
 - High humidification
 - Ideal for high-secretion patients

Intubation and Differential Diagnosis



Intubation – Expert Level

- Indications:
 - Respiratory arrest
 - Agonal breathing
 - Severe acidosis ($\text{pH} < 7.25$)
 - Failure of NIV
- Exhaustion Signs:
 - Paradoxical abdominal movement
 - Reduced accessory muscle use (pre-collapse)
- Other Indications:
 - Arrhythmia or hypotension from hypercapnia
 - Airway protection failure



Ventilator Strategy

Hedges – Golden Points



Low RR (10-12)



Low tidal volume (6-8 ml/kg)



Prolonged expiratory time



Low PEEP (0-5)

- I:E ratio = 1:3-1:4
- Permissive hypercapnia ($\text{pH} \geq 7.20$)
- Avoid auto-PEEP
- Disconnect briefly before initial settings for deflation in severe hyperinflation



Differential Diagnosis – Critical in ED

30-40%

of "COPD exacerbation" cases are not actually COPD exacerbations (Rosen)

- Key Mimickers:
 - Pneumonia
 - Pulmonary embolism
 - Congestive heart failure
 - Pneumothorax (especially in emphysema)
 - Upper airway obstruction
 - Metabolic acidosis
 - Neuromuscular weakness

! Critical Point

Always rule out these mimickers before labeling as COPD exacerbation — misdiagnosis leads to inappropriate treatment and worse outcomes

Disposition, GOLD Classification, and Phenotype-Directed Management

+ Disposition — Evidence-Based Criteria

🏠 Discharge

- Appropriate clinical response
- No NIV need
- Minimal oxygen requirement
- No acidosis
- Stable comorbidities

🏥 Admission

- NIV need
- Acidosis
- Pneumonia
- Severe comorbidity
- Failure to respond to ED therapy

🏠 ICU

- Intubation
- Severe acidosis
- NIV failure
- Hemodynamic instability
- Multi-organ dysfunction

📊 GOLD 2024–2025 Severity Classification

Mild: SABA only

Moderate: SABA + OCS ± ABX

Severe: Need for ED or admission

Very Severe: NIV or intubation

👤 Phenotype-Directed Management (UpToDate + GOLD)

↕ Frequent Exacerbator
Need for ICS-based therapy

⬆ Eosinophilic COPD
Eos ≥ 300 — high response to ICS

💧 Chronic Bronchitis Phenotype
Consider Roflumilast

α-1 Antitrypsin Deficiency
Referral for augmentation therapy

Key Take-Home Messages

Expert Level

1 Oxygen target 88-92% — most important ED intervention

2 Bronchodilator combination (SABA+SAMA) = first line

3 Short-term 5-day steroids are sufficient

4 NIV is cornerstone of acute respiratory failure management

5 1-2 hour pH evaluation is most important indicator of NIV success/failure

6 Intubation should be based on clinical signs of fatigue and pH, not just PaCO₂

7 Always rule out critical mimickers: PE, pneumonia, CHF, pneumothorax

8 After intubation: low RR, prolonged expiratory time, minimal PEEP

9 COPD is a systemic disease — cardiovascular risk ↑ up to 2 weeks

10 Phenotype-based therapy is the future of management

Adjunctive Treatments & What Not To Do

Key Adjuncts

- Smoking cessation counseling
 - Inhaler technique assessment
 - Influenza & pneumococcal vaccinations
 - Vitamin D supplementation (if deficient)
- **Not Recommended**
 - Methylxanthines
 - Heliox



Medical Case: Progressive Dyspnea in a 68-Year-Old Male

Complex Cardiopulmonary Presentation



Heart Failure



Atrial Fibrillation



COPD

Patient History

Past Medical History

-  Heart failure with **reduced ejection fraction (HFrEF)** — EF 30%
-  Atrial fibrillation on **warfarin**
-  COPD (10 pack-years)
-  Hypertension
-  Hyperlipidemia

Home Medications

- Warfarin** 5 mg daily
- Bisoprolol 5 mg daily
- Furosemide 40 mg daily
- Spironolactone 25 mg daily
- Atorvastatin
-  Tiotropium (LAMA)
-  Formoterol/Budesonide (LABA + ICS)
-  SABA inhaler PRN

Chief Complaint & Associated Symptoms

Chief Complaint



Progressive dyspnea over 2 days, worse today and present even at rest

Associated Symptoms

-  New dry cough
-  **Orthopnea** + paroxysmal nocturnal dyspnea (PND)
-  Chronic mild leg swelling (grade 1)
-  No fever
-  No chest pain

Important Contributing Factors



Warfarin Mis-dosing

Warfarin mis-dosed 5 days ago → suspect **subtherapeutic INR** → ↑ risk of PTE



Recent Viral Illness

Mild viral illness 1 week ago → possible trigger for **COPD exacerbation**



Weight Gain

2 kg weight gain over 2 days → suggests **CHF exacerbation**

Vital Signs



95/60

Blood Pressure
Hypotensive



118

Heart Rate
Irregularly irregular



30

Respiratory Rate
Tachypneic



86%

SpO₂
On room air



36.8°C

Temperature
Afebrile

Physical Examination



Cardiac

- Irregularly irregular rhythm (consistent with AF)
- Faint S3 present



Lungs

- Bibasilar crackles
- Diffuse wheezing
- No dullness to percussion → argues against large pleural effusion



Extremities

- Mild pitting edema
- No unilateral swelling

Golden Clinical Clue



Coexistence of **crackles + wheezing** suggests:

CHF + COPD simultaneously, or

PTE, which can cause tachycardia + wheezing ("wheeze of pulmonary embolism")

Diagnostic Workup

Labs

- ↑ BNP = **1350** ↑ (supports CHF exacerbation)
- ↑ D-dimer: **elevated**, but must be age-adjusted (>50 yrs)
- ▲ INR = **1.4** → subtherapeutic → ↑ likelihood of PTE
- 📄 ABG: pH **7.32** pCO₂ **52** mmHg pO₂ 58 HCO₃ 26

ECG

- AF with RVR
- No ST elevation

Chest X-ray

- Mild pulmonary congestion
- Cardiomegaly
- No lobar infiltrates
- No classic signs of PTE (no Westermark, no wedge infarct)

POCUS (ED bedside echo)

- ↓ EF ~**25–30%**
- IVC mildly plethoric
- RV mildly dilated
- ⚡ Mild RV dilation → makes massive PTE less likely
- ⚡ Does not rule out submassive PTE

1 CHF Exacerbation

✔ Supporting Evidence

- High BNP
- Crackles
- Orthopnea / PND
- Weight gain
- Low EF
- IVC plethoric

✘ Against

- Prominent wheezing
- Hypercapnia (more typical of COPD)

2 COPD Exacerbation

✔ Supporting Evidence

- Wheezing
- Hypercapnia (pCO₂ > 52)
- History of COPD
- Recent viral illness
- Afebrile

✘ Against

- Significant crackles
- High BNP
- Hypotension

3 Pulmonary Thromboembolism (PTE)

✔ Supporting Evidence

- Subtherapeutic INR
- AF + HF = high baseline risk
- Tachycardia
- Hypoxia more severe than expected
- Wheezing (can occur in PTE)
- No chest pain (painless PTE common in elderly)

✘ Against

- RV dilation only mild
- CXR not suggestive
- Hypotension potentially explained by CHF + AF

Emergency Department Management Plan

Immediate Measures

-  O₂ to target >92%
-  Nebulized SABA + SAMA
-  IV furosemide (given **cautiously** due to BP 95/60)
-  BiPAP if:
 - RR > 30
 - Hypercapnia
 - Increased work of breathing

Management if PTE suspected

-  Before CT angiography → IV heparin bolus + infusion
-  (warfarin currently ineffective)

AF with RVR

-  IV amiodarone preferred (due to CHF)
-  Beta-blocker (low dose) may be used later if BP improves
-  **Avoid calcium channel blockers** in HFrEF

Final Expert-Level Teaching Point

This patient almost certainly presents with a mixed picture:



COPD Exacerbation

Wheezing, hypercapnia, recent viral illness



CHF Exacerbation

High BNP, crackles, weight gain, orthopnea



Possible PTE

Subtherapeutic INR, tachycardia, hypoxia

COPD

MIXED
PRESENTATION

PTE

THANK YOU!