감염성 COPD 악화

바이러스와 세균

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손은정

강의 목차

01 COPD악화의 유발요인

02 세균 악화

03 바이러스 악화

04 AECOPD 치료와 예방

05 Summary

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AECOPD 정의

An exacerbation of COPD is an acute event with symptoms worsening over a few days (up to 14 days) and characterized by increased dyspnea and/or cough and sputum that may be accompanied by tachypnea and/or tachycardia and is often associated with increased local and systemic inflammation caused by infection, pollution, or other insult to the airways.

AECOPD 임상적 영향

Exacerbations of COPD are important events because they negatively impact health status, worsen airflow obstruction, disease progression, rates of hospitalization and readmission, and risk of death.

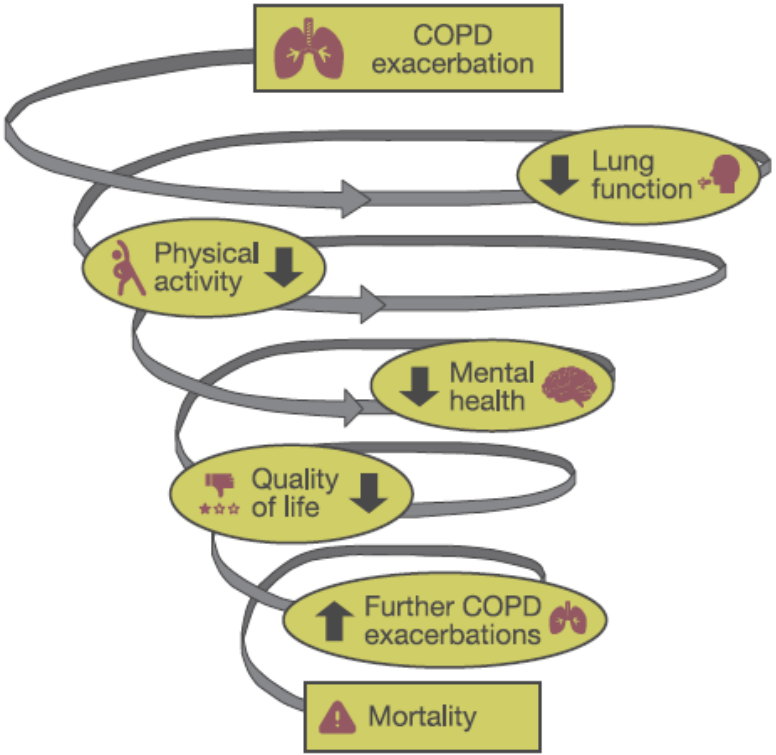
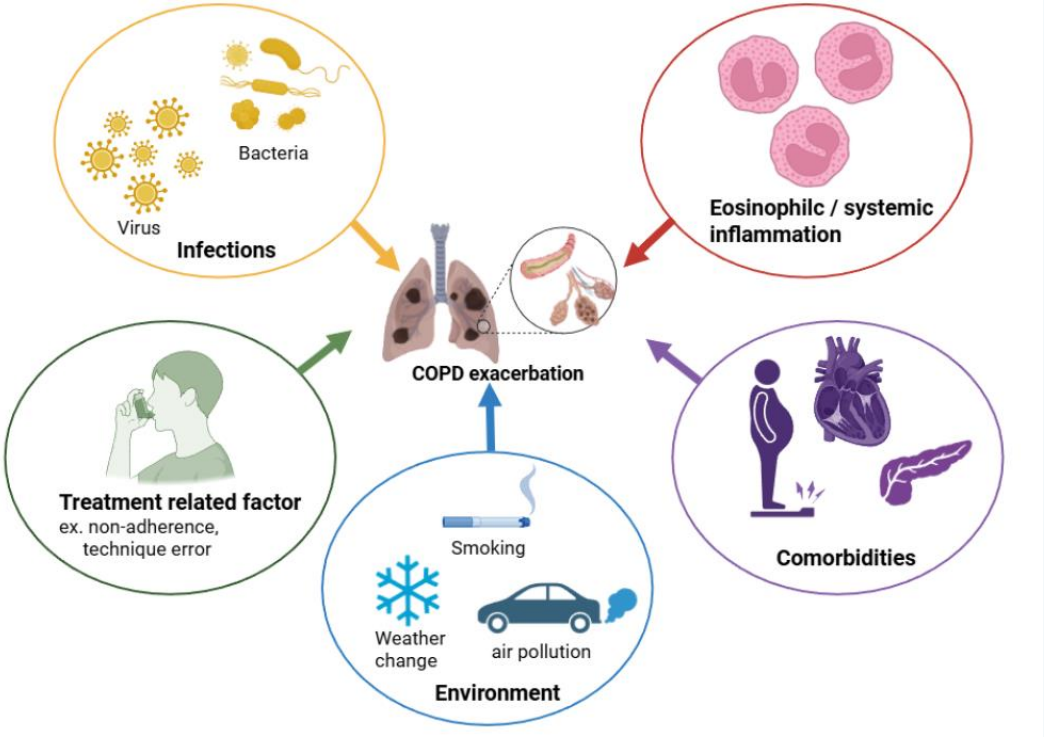


Fig. 2. Downward spiral of COPD exacerbations. COPD, chronic obstructive pulmonary disease.

AECOPD의 유발 요인



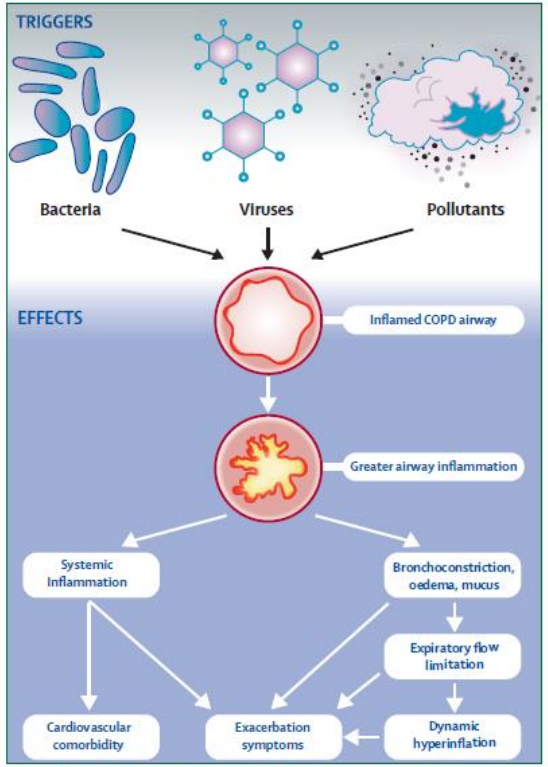


Figure 1: Triggers of COPD exacerbations and associated pathophysiological changes leading to increased exacerbation symptoms

Papi A et al. Thorax 2006 | GOLD 2024

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Bacterial Infections in AECOPD

48.2%

안정기 COPD에서 세균 검출률

69.6%

악화 시 세균 검출률 (안정기 대비 증가)

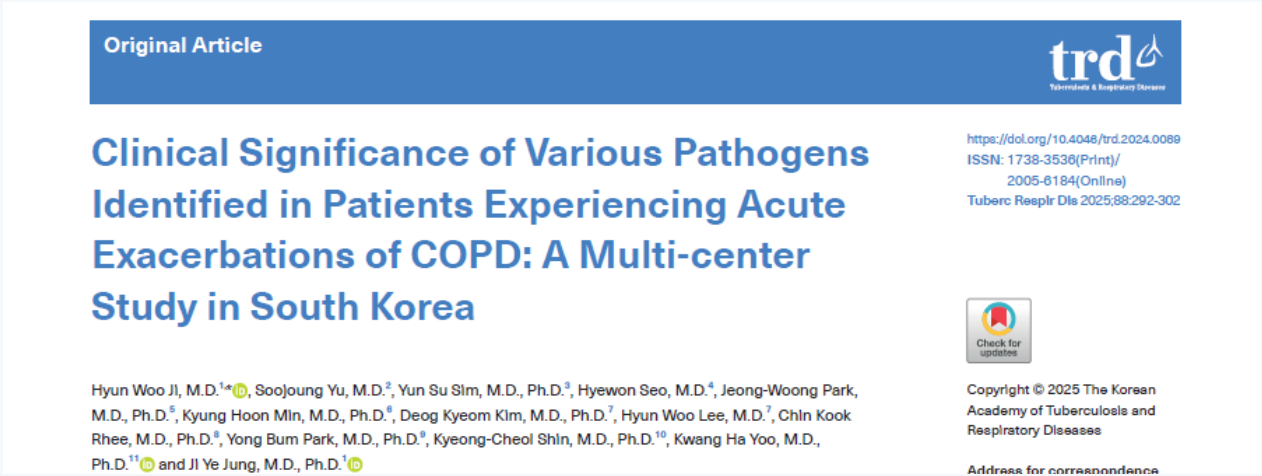
New Pathogen

출현이 악화 위험 증가와 연관
(Sethi et al., NEJM 2002)

주요 세균 병원체 및 특징

병원체	특징 / 임상적 의의
Haemophilus influenzae	가장 흔한 분리 균; rhinovirus 동시 감염 시 악화 심화
Streptococcus pneumoniae	흔한 병원체; 폐렴구균 백신으로 CAP 예방 효과 입증
Moraxella catarrhalis	안정기-악화기 동시 검출; New strain change시 악화 연관
Pseudomonas aeruginosa	중증 COPD에서 빈도 증가; 광범위 항생제 내성 문제
Staphylococcus aureus	특히 인플루엔자 후 이차 감염 시 주의

Wedzicha JA et al. Lancet 2007; 370: 786–96.



Original Article

trd Tuberculosis & Respiratory Diseases

Clinical Significance of Various Pathogens Identified in Patients Experiencing Acute Exacerbations of COPD: A Multi-center Study in South Korea

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Tuberc Respir Dis 2025;88:292-302

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Address for correspondence

Study design

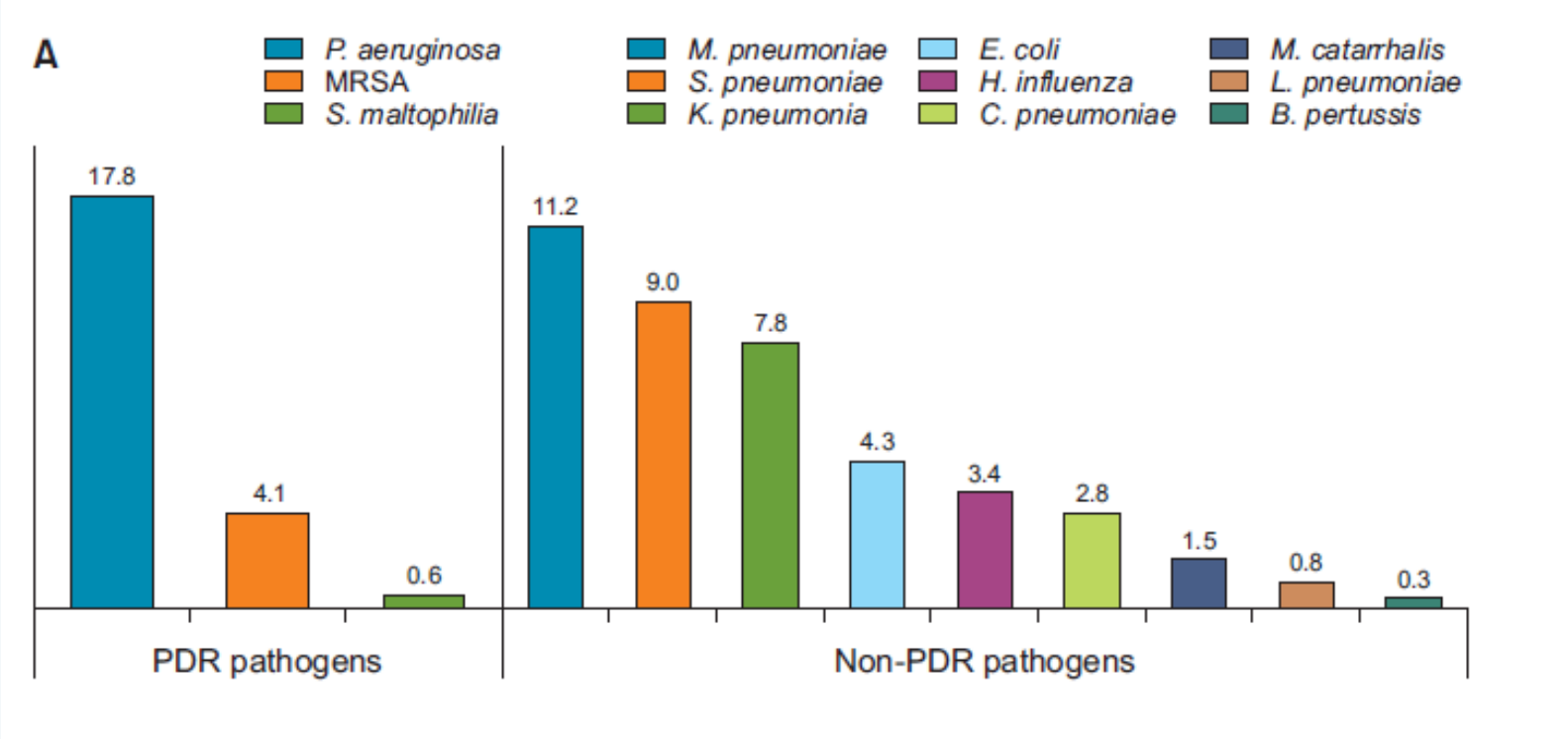
- retrospective, multi-center observational study conducted at 28 hospitals in South Korea between 2015 and 2018.
- Population: 1,186 patients (age ≥40 years) diagnosed with moderate-to-severe AECOPD
- Evaluation: Microbiological tests (culture, PCR, RAT, ELISA) performed within 48 hours of AECOPD diagnosis.
- Pathogen Groups: Bacterial, Viral, and Potentially Drug-Resistant (PDR) pathogens.
- PDR Definition: included Pseudomonas aeruginosa, MRSA, and Stenotrophomonas maltophilia.

병원체 검출 결과: 세균, 바이러스, 혼합 감염

Pathogen type	n	%
Bacteria only	262	22.1
Virus only	265	22.5
Bacteria + Virus	129	10.9
Total	**656**	**55.5**

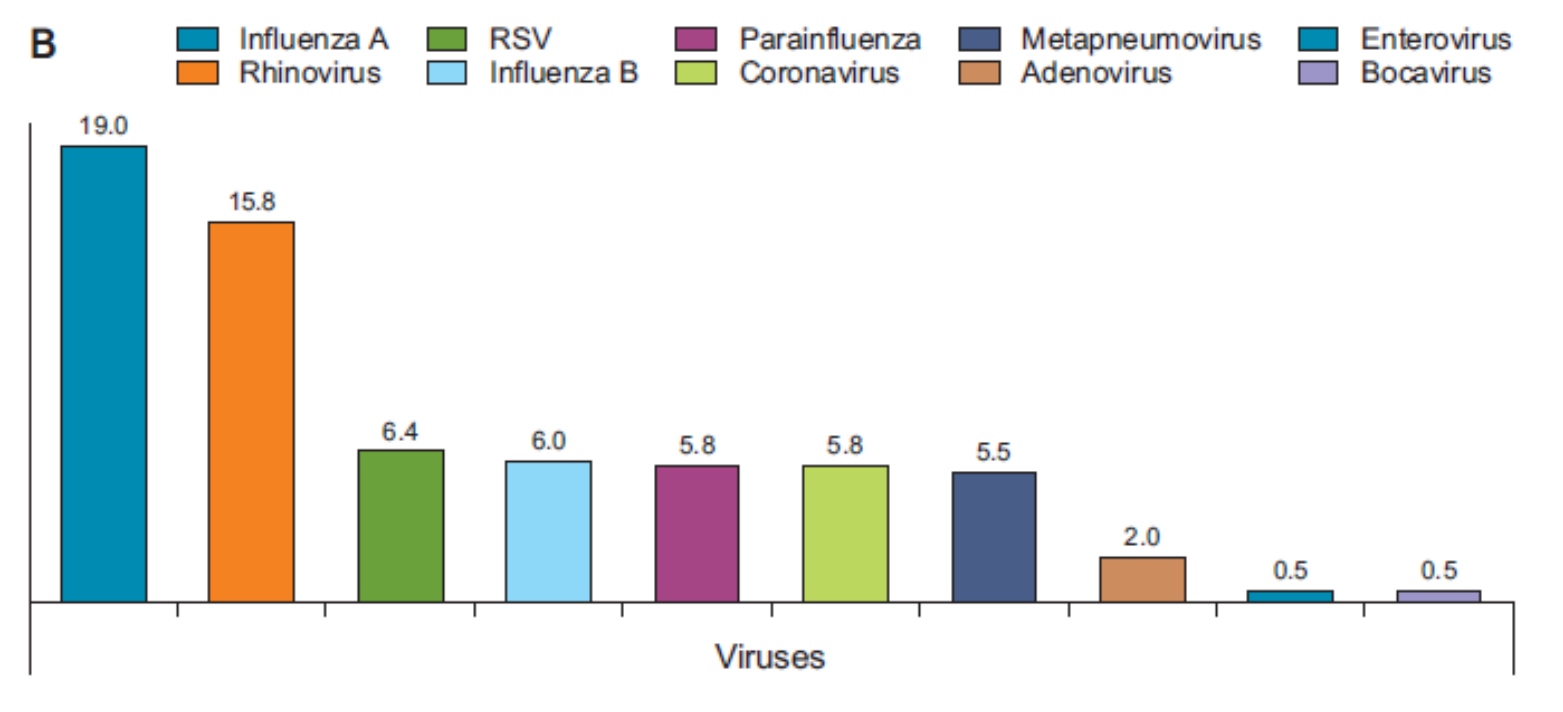
Ji HW et al. Tuberc Respir Dis 2025;88:292-302 .

AECOPD에서 세균성 병원체의 분포



Ji HW et al. Tuberc Respir Dis 2025;88:292-302 .

AECOPD에서 바이러스 병원체 분포



Ji HW et al. Tuberc Respir Dis 2025;88:292-302 .

PDR pathogen의 임상적 영향

Table 2. Baseline characteristics and clinical features of patients during AECOPD according to PDR pathogen identification

Characteristic	Non-PDR pathogens (n=511)	PDR pathogens (n=142) 12%	p-value
Baseline characteristics			
Male sex	417 (81.6)	106 (74.6)	0.066
BMI, kg/m^2	21.6±3.8	20.7±3.6	0.017
Pack-yr	36.6±23.3	40.6±32.3	0.270
FEV_1, %	50.0±21.2	44.6±19.1	0.021
Exacerbation frequency	1.5±2.0	2.2±2.1	0.001
CAT score	21.4±11.0	25.3±6.9	0.044
Comorbidities			
Diabetes mellitus	150 (29.4)	38 (26.8)	0.546
Hypertension	259 (50.7)	75 (52.8)	0.653
Liver cirrhosis	10 (2.0)	2 (1.4_	0.667
Congestive heart failure	74 (14.5)	20 (14.1)	0.905
Chronic kidney disease	30 (5.9)	10 (7.0)	0.607
Cardiovascular disease	36 (7.0)	5 (3.5)	0.126
Cancer	70 (13.7)	11 (7.7)	0.057
Tuberculosis	149 (29.2)	65 (45.8)	0.001
Bronchiectasis	65 (12.7)	36 (25.4)	0.001
Interstitial lung disease	11 (2.2)	3 (2.1)	0.977
Length of hospitalization, day	12.4±14.7	15.9±17.3	0.018
Length of exacerbation, day	12.2±7.9	13.3±9.8	0.185
ICU admission	47 (9.5)	22 (15.9)	0.030
Duration of steroid use, day	12.8±14.9	19.7±44.2	0.107

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PDR 감염 관련 인자

Table 3. Multivariate logistic analysis of the associated factors for infection with PDR pathogens during AECOPD

Associated factors	ICS model		Triple inhaler model	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age, yr	1.01 (0.98–1.03)	0.638	1.01 (0.98–1.04)	0.573
Male sex	1.41 (0.78–2.55)	0.261	1.50 (0.82–2.74)	0.189
BMI, kg/m^2	0.97 (0.91–1.04)	0.405	0.97 (0.91–1.04)	0.355
FEV_1 >60%	0.74 (0.41–1.34)	0.319	0.79 (0.44–1.43)	0.435
Comorbidities				
Tuberculosis	1.66 (1.01–2.75)	0.046	1.64 (0.99–2.72)	0.054
Bronchiectasis	1.99 (1.06–3.75)	0.032	1.94 (1.02–3.67)	0.043
Treatment status				
Systemic steroids	1.47 (0.85–2.57)	0.172	1.45 (0.84–2.53)	0.186
ICS	1.62 (0.97–2.71)	0.066	NA	NA
Triple therapy	NA	NA	2.04 (1.24–3.35)	0.005

PDR: potentially drug-resistant; AECOPD: acute exacerbation of chronic obstructive pulmonary disease; ICS: inhaled corticosteroid; OR: odds ratio; CI: confidence interval; BMI: body mass index; FEV_1: forced expiratory volume in 1 second; NA: not applicable.

Ji HW et al. Tuberc Respir Dis 2025;88:292-302 .

Infections and Airway Inflammation in Chronic Obstructive Pulmonary Disease Severe Exacerbations

Alberto Papi, Cinzia Maria Bellettato, Fausto Braccioni, Micaela Romagnoli, Paolo Casolari, Gaetano Caramori, Leonardo M. Fabbri, and Sebastian L. Johnston

Research Center on Asthma and COPD, University of Ferrara, Ferrara; Section of Respiratory Diseases, University of Modena and Reggio Emilia, Modena, Italy; and National Heart and Lung Institute, Imperial College London, London, United Kingdom

Study design

- Subjects: 64 patients hospitalized with severe COPD exacerbations.
- Comparison
    - Prospective longitudinal study
    - Exacerbation at admission vs. 8–10 weeks after recovery in the same subjects.
- Group Classification
    - V: Virus alone
    - B: Bacteria alone
    - VB: Co-infection (Virus + Bacteria)
    - N: Non-infectious (No pathogen detected)

Papi A et al. Am J Respir Crit Care Med. 2006;173:1114-1121.

바이러스/세균 검출률

Infection Rates in Severe AECOPD (N=64 입원 환자)

78%

감염 확인 악화

바이러스 and/or 세균

48.4%

바이러스 검출률

안정기 6.2% vs 악화기

54.7%

세균 검출률

안정기 37.5% vs 악화기

25% 혼합감염 (VB 동시 감염)

바이러스 (Virus-associated)

17건	*Rhinovirus*
7건	*Influenza virus*
4건	*RSV*
3건	*hMPV*
2건	*Coronavirus/Parainfluenza*

$p < 0.001$ vs 안정기 (6.2%)

세균 (Bacteria-associated)

9건	*H. influenzae*
8건	*S. pneumoniae*
7건	*M. catarrhalis*
4건	*S. aureus*
4건	*P. aeruginosa*

$p = 0.08$ vs 안정기 (37.5%)

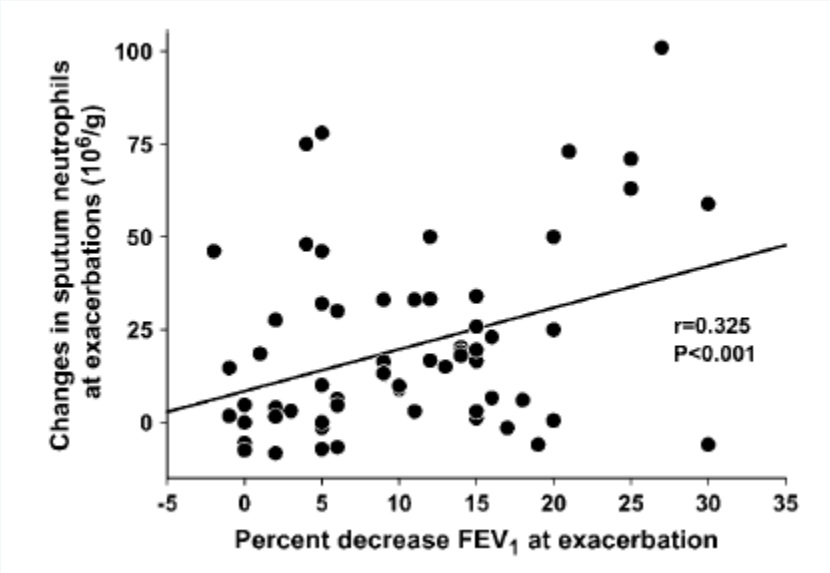
Papi A et al. Am J Respir Crit Care Med. 2006;173:1114-1121.

TABLE 1. PATIENT CHARACTERISTICS, PULMONARY FUNCTION, ARTERIAL BLOOD GASES, AND SPUTUM INFLAMMATORY CELL COUNTS AT EXACERBATION AND WHEN IN STABLE CONVALESCENCE

Patient Characteristics ($n = 64$)			
Age, yr	70.6 ± 2.5		
Male/female, n	56/8		
Smoking history, n	61 ex smokers 3 current smokers		
Pack/yr	48.3 ± 5.7		
Chronic bronchitis/no chronic bronchitis, n	43/21		
Pulmonary Function	**Exacerbation**	**Convalescence**	**p Value**
FEV_1, L	0.96 ± 0.05	1.18 ± 0.07	< 0.001
FEV_1, % pred	39.4 ± 2.2	49.5 ± 2.3	< 0.01
FEV_1/FVC, %	41.7 ± 1.32	48.6 ± 1.6	< 0.01
RV, % pred	157.1 ± 6.3	131 ± 4.6	< 0.05
TLC, % pred	111.9 ± 8.3	108.2 ± 5.1	NS
K_{CO}, % pred	45.23 ± 2.6	58.7 ± 2.9	< 0.001
NO, ppb	15.18 ± 1.85	10.32 ± 1.6	< 0.05
Blood gases			
Pa_{O_2}, mm Hg	54.7 ± 1.5	69.3 ± 1.4	< 0.001
Pa_{CO_2}, mm Hg	43.58 ± 1.12	40.93 ± 0.97	0.07
pH	7.388 ± 0.007	7.403 ± 0.005	< 0.001
Sputum Cell Type	Cell Number ($\times 10^6/g$)		
Neutrophils	26.7 (7.7–32.9)	9.5 (3.8–18.9)	< 0.001
Macrophages	3.6 (0.7–4.2)	2.4 (0.5–4.1)	NS
Eosinophils	1.65 (0–3.0)	1.01 (0–2.1)	NS
Lymphocytes	0.11 (0–0.16)	0.04 (0–0.06)	0.06

Definition of abbreviations: NO = exhaled nitric oxide; NS = not significant; RV = residual volume; TLC = total lung capacity. Values are mean ± SE.

Airway Neutrophils and COPD Exacerbation Severity



Blood Neutrophils and Exacerbation Severity

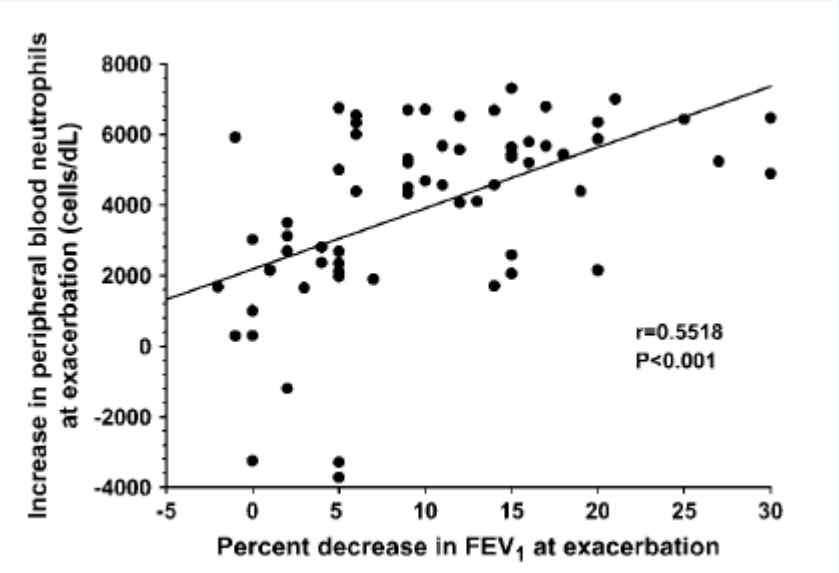


TABLE 2. SPUTUM SOLUBLE MARKERS OF NEUTROPHILIC AND EOSINOPHILIC INFLAMMATION

Subgroups	Group V	Group VB	Group B	Group N	p Value
NE, μg/ml					
Exacerbation,	4.1* (2.7–5.88)	3.4* (1.7–5.1)	3.3* (1.2–8.1)	2.4† (1.1–5.6)	NS
Convalescence	0.78 (0.5–0.86)	0.62 (0.35–1.1)	0.61 (0.2–1.12)	0.41 (0.23–1.36)	NS
ECP, μg/ml					
Exacerbation	3.79* (0.86–5.32)	4.08* (0.5–5.56)	0.92 (0.06–1.78)	1.24 (0.2–2.48)	$p < 0.05$, V vs. N $p < 0.01$, VB vs. B
Convalescence	0.70 (0.02–0.96)	0.74 (0.02–0.92)	0.78 (0.03–0.94)	0.88 (0.1–1.08)	NS

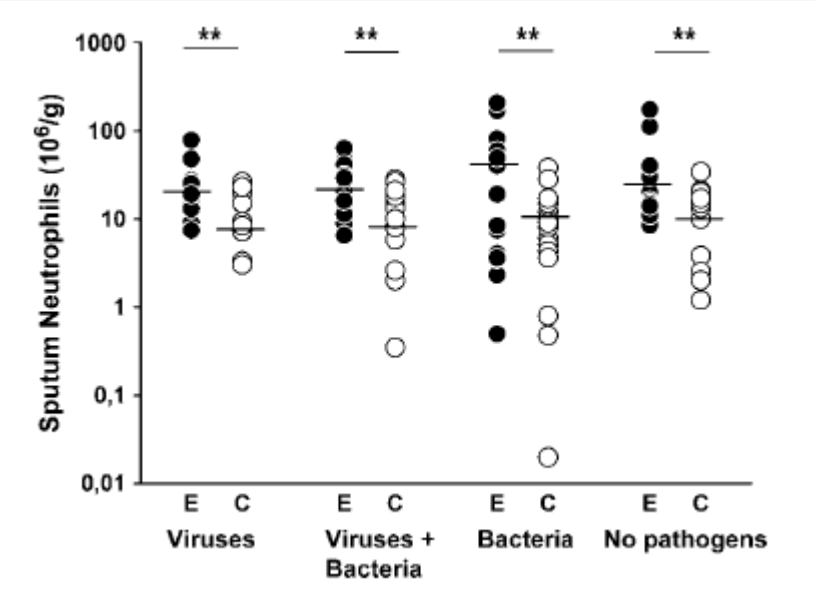
Definition of abbreviations: B = bacteria at exacerbation; ECP = eosinophil cationic protein; N = no pathogen at exacerbation; NE = neutrophil elastase; NS = not significant; V = viruses at exacerbation; VB = viruses + bacteria at exacerbation.

* $p < 0.05$ versus convalescence.

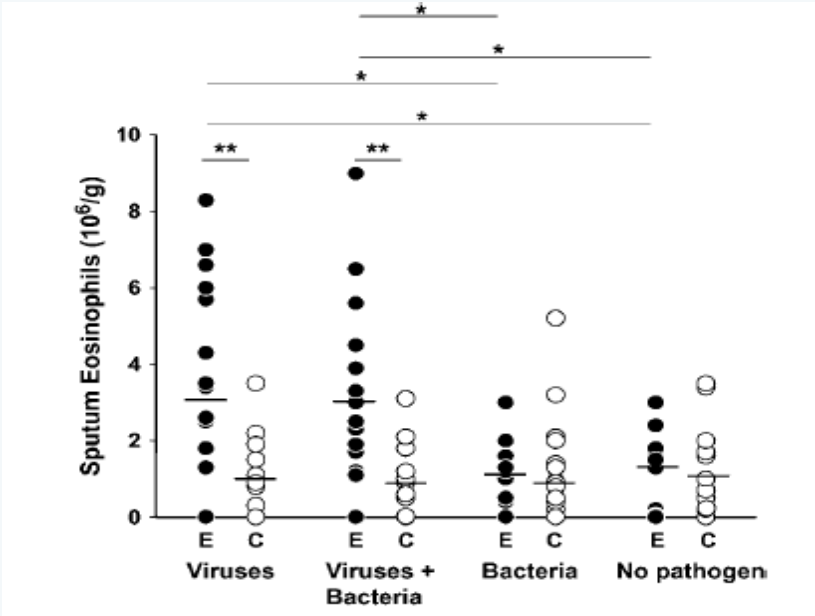
† $p < 0.01$ versus convalescence.

Papi A et al. Am J Respir Crit Care Med. 2006;173:1114-1121.

Sputum Neutrophil Counts by Pathogen Type



Sputum Eosinophil Counts by Pathogen Type



감염 유무별 입원 기간

비감염성 exacerbation
(n=14, 22%)

8.8일

감염성 exacerbation
(n=50, 78%)

11.6일

+2.8d

p < 0.02
입원 기간 32% 연장

Key message
감염이 확인된 악화는
비감염 악화보다 입원이 길고
FEV₁ 감소·확산능 저하도
유의하게 크다 (all p<0.05)

입원 10일 이상 — 그룹 비교

비감염군 (N)
n=14
29%
4/14명

VS

혼합감염군 (VB)
n=16
81%
13/16명

p = 0.001
혼합감염군에서 약 2.8배 더 높음

Key message
바이러스+세균 혼합감염(VB) 시
10일 이상 장기 입원 비율이
비감염군의 약 3배에 달한다
→ 혼합감염 = 중증도의 최대 결정인자

Papi A et al. Am J Respir Crit Care Med. 2006;173:1114-1121.

COPD에서 만성 기관지 감염(CBI)은 임상적으로 중요한가?

POINT:

Is Chronic Bacterial Infection Clinically Relevant in COPD? Yes

Miguel Ángel Martínez-García, MD
Valencia, Spain
Alvar Agusti, MD
Barcelona, Spain

VS.

COUNTERPOINT:

Is Chronic Bacterial Infection Clinically Relevant in COPD? No

Holly R. Keir, PhD
James D. Chalmers, PhD
Dundee, Scotland

Chest . 2022 Nov;162(5):970-972.

배경: CBI(만성 기관지 감염)란?

주요 Potentially Pathogenic Microorganisms

- Haemophilus influenzae / parainfluenzae
- Streptococcus pneumoniae
- Moraxella catarrhalis
- Pseudomonas aeruginosa
- Staphylococcus aureus
- Enterobacteriaceae

CBI 진단 기준 (제안)

Primary infection
→ 안정기 환자에서 첫 번째 PPM 분리

CBI
→ 1년 내 1개월 이상 간격으로 동일 PPM 2회 이상 배양

Eradication
→ 치료 후 1년간 PPM 미검출

⚠ COPD 환자의 기도 검체 중 **>50%**에서 PPM 검출 — 특히 중증 기류제한 및 기관지확장증 동반 시

CBI의 임상적 영향

- 악화 빈도·중증도 ↑
- FEV_1 감소 가속화
- 폐렴 발생 ↑
- 심혈관 사건 ↑
- 삶의 질 저하
- 사망률 ↑ (P. aeruginosa)

Chest . 2022 Nov;162(5):970-972.

POINT: CBI는 임상적으로 중요하다 — YES

Martínez-García & Agusti (Valencia / Barcelona)

① **높은 유병률**

- COPD 환자 기도 검체의 >50%에서 PPM 검출
- 중증 기류제한·기관지확장증 동반 시 더욱 빈번

② **다중 임상 결과와의 연관성**

- 악화 빈도·중증도 ↑, FEV_1 감소 가속, 폐렴·심혈관 사건 증가
- 삶의 질 저하, 사망률 증가 (특히 P. aeruginosa)

③ **ICS 위험 증폭**

- CBI 환자에서 ICS 사용 시 폐렴 위험 추가 상승
- 특히 혈중 호산구 <100/μL인 경우 위험 극대화

④ **기관지확장증 진행에 기여**

- CBI → 기관지벽 비가역적 파괴 → 기관지확장증
- COPD-기관지확장증 overlab형성

CBI는 COPD에서 "Treatable Trait"으로 간주되어야 한다

POINT: CBI 관리를 위한 향후 연구 방향

흡입 항생제 치료

H. influenzae, P. aeruginosa, 내성균 대상
세균 부담 감소 → 악화 빈도·FEV_1 감소율·삶의 질 개선 목표
기관지확장증에서의 경험을 COPD+CBI에 적용

항염증 치료

Neutrophilic elastase inhibitors (brensocatib 등)
호중구 염증 억제 → CBI 환자에 잠재적 효과
아직 COPD+CBI 대상 적절한 임상시험 미실시

미생물 모니터링

객담 생성 COPD 환자 전원에서 정기 미생물 배양 시행
분자적 기법(PCR, 마이크로바이옴 분석) 도입 필요
CBI 유무에 따른 치료 반응 차이 분석

용어 표준화

"bacterial colonization" → "bacterial airway infection"으로 용어 변경 제안
기관지확장증 가이드라인 기준 차용하여 COPD에 적용
HR-CT: 기관지확장증 동반 의심 시 체계적 시행 권고

COUNTERPOINT: CBI 개념은 구시대적이다 — NO

Dundee, Scotland)

①

기도 무균

- 건강한
- 배양 양
  학적으로

(H.

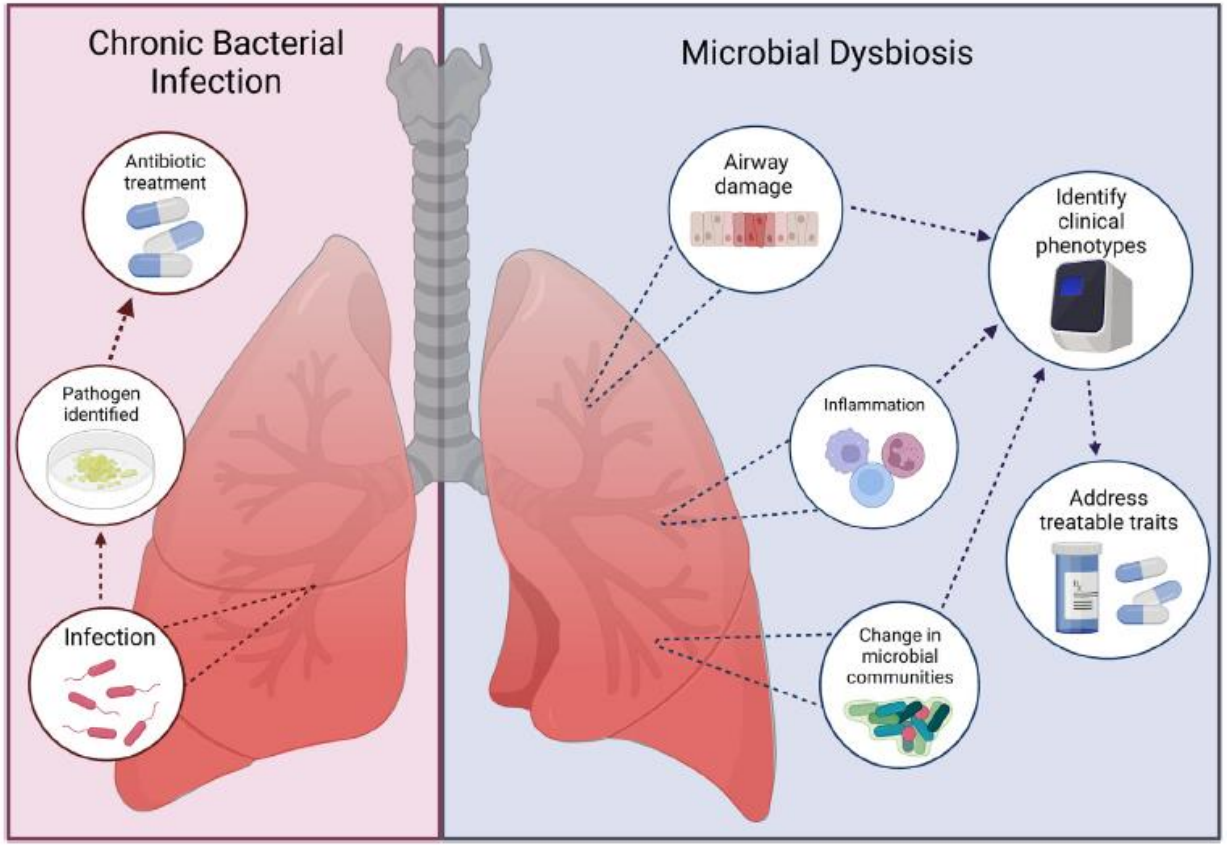
중요도를

③

마이크로바

- 악화가
  류 변경
- '만성 감
  (adapted

COPD에



CBI 대신 "Microbial Dysbiosis" 개념으로 전환하여 다양한 Treatable Traits를 표적 치료해야 한다

TABLE 1] Proposed Concept of "Treatable Traits" That Lead to an Abnormal Microbiome in COPD

Treatable Trait	Clinical Features/Recognition	Treatment
Microbial immigration		
Upper airway infection/ rhinosinusitis	Upper airway symptoms, sinusitis	Nasal douching; nasal corticosteroids; treat nasal polyps
Gastroesophageal reflux	Symptoms, radiologic evidence of hiatus hernia	Diet, weight loss; prokinetics, proton pump inhibitor; fundoplication in severe cases
Micro/macroaspiration	Swallow assessment, radiologic investigations	Speech and language therapy, lifestyle advice and sleep hygiene, dietary change
Dental disease	Poor dentition	Dental hygiene and treatment
Enhanced local growth conditions		
Disruption of resident microbiota	History of repeated antibiotic exposure; isolation of antibiotic resistance pathogens	Optimize nonantibiotic therapy; avoid broad spectrum antibiotic treatment
Nutrient availability/ pH/osmolality	Example: uncontrolled diabetes mellitus leading to increased airway glucose	Glycemic control
Hypoxia	Oxygen saturations, lung function, exercise capacity	Oxygen in patients with hypoxemia; bronchodilators; exercise
Microbial emigration/ elimination		
Mucociliary clearance	Symptoms of cough and sputum production	Physiotherapy, airway clearance exercises and devices
Bronchiectasis	High resolution CT chest and clinical features	Multidisciplinary management as per European Respiratory Society guidelines
Innate and adaptive immunity	Low serum immunoglobulins or functional antibody responses.	Immunoglobulin replacement, avoidance of immunosuppressive drugs where possible.
Immunosuppressive treatments	Treatment with inhaled corticosteroids and/or oral corticosteroids	Reserve inhaled corticosteroids for appropriate patients; consideration of inhaled corticosteroid withdrawal in patients whose condition meets European Respiratory Society guideline criteria
Chronic bronchitis, mucus volume/ viscosity	Chronic bronchitis; mucus production or mucus plugging on CT	Airway clearance; mucoactive treatments; roflumilast
Environmental exposures (including cigarette smoke)	Clinical history	Reduce exposure to pollutants (eg, PM10, PM2.5 NO2); smoking cessation; avoid e-cigarettes

공통점과 미래 과제

✓ 양측이 동의하는 공통점

- 세균은 COPD 병태생리에서 분명히 중요하다
- 폐 마이크로바이옴 분석은 미래 연구의 핵심이다
- 현재 가이드라인은 CBI/세균의 역할을 충분히 반영하지 못하고 있다
- 안정기 COPD에서 항생제 치료의 근거는 아직 불충분하다

진단 도구 고도화

- 배양 → PCR → 정량적 마이크로바이옴 분석
- 세균 부하(load) 기반의 임상 의사결정 체계 필요

RCT 설계

- CBI 유무에 따른 치료 반응 비교 RCT
- 흡입 항생제·neutrophil elastase inhibitor 대상 연구

Precision Medicine

- CBI/dysbiosis를 개인화 치료의 표적으로 통합
- 호산구·PPM 종류·세균 부하 복합 표현형 정의

📌 "Lack of evidence != Evidence of lack" — 현재의 근거 부족은 연구 공백이며, CBI/Dysbiosis 연구는 COPD 정밀의학의 핵심 과제이다

강의 목차

01 COPD악화의 유발요인

02 세균 악화

03 **바이러스 악화**

04 AECOPD 치료와 예방

05 Summary

Viral Infections in AECOPD

~50%

악화에서 바이러스 검출
(PCR 기법 사용 시)

더 심한 증상

바이러스 유발 악화에서
회복기간 연장

겨울철 집중

상기도 감염과 연관
저온에서 FEV_1 감소

주요 바이러스 병원체 및 특성

병원체	특징 / 임상적 의의
Human Rhinovirus (HRV)	가장 흔함; 유도 객담에서 비강 검체보다 높은 검출률; 하기도 직접 감염 확인
Coronavirus	흔한 원인 중 하나; 계절적 유행과 연관
Influenza virus	백신 접종 후 빈도 감소; 유행 시 중요 원인
Respiratory Syncytial Virus (RSV)	안정기 COPD 기도에서도 검출 → 만성 기도 염증과 연관 가능성
Parainfluenza / Adenovirus	Adenoviral E1A 단백질: 흡연 관련 폐 염증 증폭 (잠재 감염)

Wedzicha JA et al. Lancet 2007; 370: 786–96.

Key change of 2026 GOLD

Key Changes

i. In Chapter 1 the section on the **Burden of COPD** has been updated with the latest epidemiological statistics and references.

ii. In Chapter 2 the **Screening and Case-finding** section has been updated and two new figures have been added (**Figures 2.8 and 2.9**)

iii. **Vaccination Recommendations** for people with COPD have been updated with the latest information on RSV and influenza vaccination.

iv. The criteria defining **GOLD A, B and E categories have been adjusted** due to emerging evidence from observational studies that even one moderate or severe exacerbation prior to initiating maintenance pharmacological therapy increases the risk of subsequent events (**Figure 3.7, 3.8 and 3.9**). The threshold of one moderate exacerbation should now be used to consider treatment escalation, with the aim of achieving a low disease activity state characterized by no exacerbations.

Current Allergy and Asthma Reports (2025) 25:14
https://doi.org/10.1007/s11882-025-01194-w

REVIEW

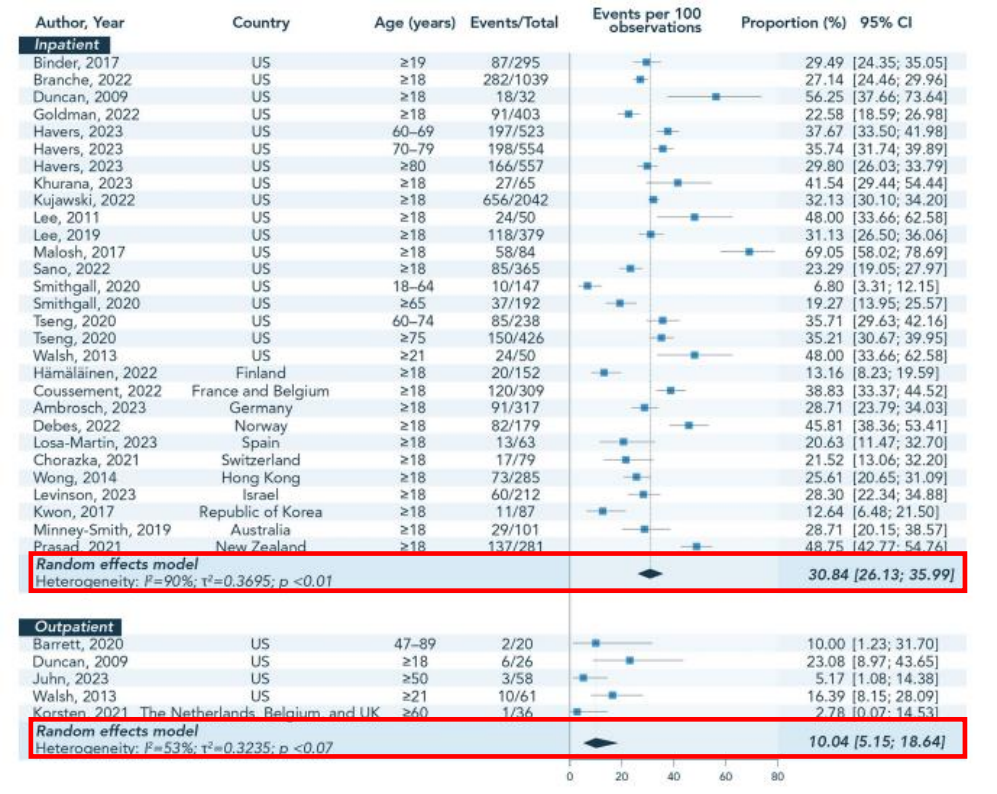
Burden of Respiratory Syncytial Virus Disease in Adults with Asthma and Chronic Obstructive Pulmonary Disease: A Systematic Literature Review

Yolanda Penders[1] · Guy Brusselle[2] · Ann R. Falsey[3] · Gernot Rohde[4] · Estefania Betancur[5] · Maria Elena Guardado[5] · Juan Luis Ramirez Agudelo[5] · Pouya Saeedi[1] · Lauriane Harrington[1] · Jean-Philippe Michaud[1]

Study design

- A systematic literature review (SLR) and meta-analysis of 40 studies published between 2000 and 2023
- Inclusion Criteria:
  - Adults ≥18 years old with asthma or COPD in high-income countries
  - Laboratory-confirmed RSV infection (mostly via PCR)

COPD Prevalence in RSV-Infected Adults



RSV Hospitalization Risk in COPD

Table 1 RSV-related hospitalization rates and hospitalization risk among adults with asthma or COPD

Reference (study location)	Patient settings (population description)	Age group	Total sample size	Number of patients with the comorbidity of interest	Hospitalization rate per 100,000 persons (95% CI)	IRR or OR (95% CI)
Asthma						
Branche, 2022 [41] (US)	Inpatient (community cohort of adults who sought care for ARI in outpatient clinics or hospital settings)	18–49 YOA	NYC: 91 Rochester: 57	NYC: 143 Rochester: 133	NYC: 15.6 Rochester: 14.7	NYC (crude IRR): 2.0 (1.0–4.1) Rochester (crude IRR): 2.4 (0.7–7.9)
		50–64 YOA	NYC: 147 Rochester: 133		NYC: 110.9 Rochester: 90.2	NYC (crude IRR): 3.6 (2.2–5.8) Rochester (crude IRR): 2.3 (0.7–7.4)
		≥65 YOA	NYC: 332 Rochester: 279		NYC: 369.9 Rochester: 261.4	NYC (crude IRR): 2.3 (1.7–3.1) Rochester (crude IRR): 2.5 (0.8–7.9)
Prasad, 2021 [62] (New Zealand)	Inpatient (hospitalized patients, suspected ARI cases, and those who met the World Health Organization SARI case definition)	18–49 YOA	597,167[a]	61,110	13.6 (8.6–18.6)	Adjusted IRR[b]: 6.7 (4.1–11.0)
		50–64 YOA	188,157[a]	26,676	49.8 (36.3–63.3)	Adjusted IRR[b]: 7.6 (4.9–11.6)
		65–80 YOA	98,675[a]	18,603	119.6 (92.1–147.1)	Adjusted IRR[b]: 8.2 (5.5–12.2)
COPD						
Branche, 2022 [41] (US)	Inpatient	18–49 YOA	NYC: 91 Rochester: 57	NYC: 126 Rochester: 156	NYC: 46.8 Rochester: 24.9	NYC (crude IRR): 5.6 (1.7–18.1) Rochester (crude IRR): 3.2 (1.0–10.2)
		50–64 YOA	NYC: 147 Rochester: 133		NYC: 210.3 Rochester: 204.8	NYC (crude IRR): 6.3 (3.8–10.6) Rochester (crude IRR): 6.4 (2.0–20.1)
		≥65 YOA	NYC: 332 Rochester: 279		NYC: 529.2 Rochester: 1,077.4	NYC (crude IRR): 3.5 (2.6–4.7) Rochester (crude IRR): 13.4 (4.3–42.0)
Duncan, 2009 [45] (US)	Inpatient and outpatient (independently living adults, hospital employees with ARTI, adults with ARTI evaluated in the emergency department and/or admitted to the hospital)	≥18 YOA	58	24	NR	Adjusted OR[c]: 4.6 (1.2–17.7); $p=0.02$
Prasad, 2021 [62] (New Zealand)	Inpatient	50–64 YOA	188,157[a]	15,046	69.6 (49.0–90.8)	Adjusted IRR[b]: 9.6 (6.2–14.8)
		65–80 YOA	98,675[a]	16,606	135.2 (101.8–168.6)	Adjusted IRR[b]: 9.7 (6.3–14.9)

RSV-Related Complications in COPD Patients

Reference (study location)	Patient settings (population description)	Age group	Sample size in RSV population	Type of complication	Prevalence (%) or risk (HR [95% CI])
Asthma					
Ackerson, 2019 [25] (US)	Inpatient (hospitalized KPSC members with a positive RSV or influenza A/B test)	≥60 YOA	168	Asthma exacerbation	64.9%
Goldman, 2022 [46] (US)	Inpatient (adults hospitalized with laboratory-confirmed RSV infection)	≥18 YOA	103	Severe clinical outcomes[a]	20.4%
Tseng, 2020 [69] (US)	Inpatient (hospitalized KPSC members with a positive RSV test)	≥60 YOA	190	Asthma exacerbation	49.5%
Wong, 2014 [71] (Hong Kong)	Inpatient (adults hospitalized with laboratory-confirmed RSV infection)	≥18 YOA	23	Mechanical ventilation	8.7%
COPD					
Ackerson, 2019 [25] (US)	Inpatient	≥60 YOA	192	COPD exacerbation	56.8%
Goldman, 2022 [46] (US)	Inpatient	≥18 YOA	91	Severe clinical outcomes[a]	26.4%
Mehta, 2013 [59] (US)	Inpatient and outpatient (cohort of adults ≥ 21 YOA at increased risk, hospitalized cohort of adults ≥ 65 YOA with ARI symptoms or cardiopulmonary condition, patients ≥ 40 YOA with physician-diagnosed COPD and past or active smoking)	≥21 YOA	42	COPD exacerbation	≥83.0%[b]
Mulpuru, 2022 [61] (Canada)	Inpatient (adults hospitalized with ARI)	≥50 YOA	145	ICU admission Mechanical ventilation	17.9% 9.0%
Stolz, 2019 [66] (Switzerland)	Outpatient (adults with COPD and a smoking history of ≥ 10 pack-years)	>40 YOA	29	COPD exacerbation	RSV-A: 1.2 (0.2–8.8) RSV-B: 1.9 (0.4–8.9)
Tseng, 2020 [69] (US)	Inpatient	≥60 YOA	235	COPD exacerbation	80.4%
Wong, 2014 [71] (Hong Kong)	Inpatient	≥18 YOA	71	Mechanical ventilation	21.1%

RSV-Associated Mortality in COPD

Reference (study location)	Patient settings (population description)	Age group	Sample size in RSV population	Case fatality rate	Place, cause, and time of death
Asthma					
Hämäläinen, 2022 [47] (Finland)	Inpatient (patients treated due to influenza and RSV)	≥18 YOA	39	2.6%	All-place and all-cause mortality during hospitalization and 30 days after hospital discharge
Wong, 2014 [71] (Hong Kong)	Inpatient (adults hospitalized with laboratory-confirmed RSV infection)	≥18 YOA	23	4.3%	In-hospital mortality
COPD					
Hämäläinen, 2022 [47] (Finland)	Inpatient	≥18 YOA	20	10.0%	All-place and all-cause mortality during hospitalization and 30 days after hospital discharge
Mulpuru, 2022 [61] (Canada)	Inpatient (adults hospitalized with ARI)	≥60 YOA	145	2.8%	Inpatient mortality 30 days after hospital discharge
Wong, 2014 [71] (Hong Kong)	Inpatient	≥18 YOA	73	17.8%	In-hospital mortality

Review

trd

https://doi.org/10.4046/trd.2025.0173
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2005-6184(Online)
Tuberc Respir Dis 2026;89:18-28

Expert Consensus Statement on the Disease Burden and Vaccination for Respiratory Syncytial Virus Infection in Adults

Joon Young Choi, Chin Kook Rhee, Yong-Il Hwang, Ji-Yong Moon, Kwang Ha Yoo and Hyoung Kyu Yoon

Burden of Respiratory Syncytial Virus(RSV) in Adults

[Meta-analysis]
RSV accounted for approximately

5.2 million	470,000	33,000
Acute Respiratory Infection	Hospitalizations	In-hospital deaths

Among adults aged 60 years and older in major high-income countries

[Meta-analysis]
COPD/Asthma prevalence among adults with RSV

27.7%	17.7%
COPD	Asthma

South Korea

Annual incidence of RSV

1-7%	4–10%
in the general adults	in the elderly and high-risk group

RSV infection rate

3.5–14.8%	3.4–25.0%
among COPD patients	among asthma patients

RSV attributed

6.4%	5.1–6.1%
of AE-COPD	Adults admitted to the ICU for severe pneumonia

Table 3. Reported annual positive rate of respiratory viruses from 2015 to 2019 in Korean Influenza and Respiratory Surveillance System (KINRESS)[23]

Year	Rhinovirus	Adenovirus	Human coronavirus	Respiratory syncytial virus	Influenza virus	Parainfluenza virus	Human meta-pneumovirus	Human bocavirus
2015	31.4%	12.2%	3.0%	17.8%	11.7%	11.9%	6.2%	5.8%
2016	24.7%	16.6%	6.6%	17.7%	13.6%	9.2%	5.6%	6.0%
2017	29.8%	9.2%	5.3%	20.1%	12.1%	11.1%	6.1%	6.4%
2018	23.6%	12.4%	6.5%	14.8%	21.5%	9.7%	6.4%	5.0%
2019	29.3%	15.0%	4.3%	11.7%	13.8%	12.6%	6.9%	6.3%

RSV vs. Influenza: 입원 환자 비교

RSV (n=97) vs. Influenza (n=312) | 한국 성인 입원 환자 데이터

	RSV (n=97)	Influenza (n=312)
평균 연령	**70세**	62세
요양시설에서 입원률	**10.3%**	1.9%
COPD 유병률	**12.6%**	4.8%
폐렴 / 이차 세균 감염 / 저산소증	**더 높음 ↑**	상대적으로 낮음
20일 사망률	**18.4%**	6.7%

Choi JY et al. Tuberc Respir Dis 2026;89:18-28

강의 목차

01 COPD악화의 유발요인

02 세균 악화

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04 **AECOPD 치료와 예방**

05 Summary

항생제 선택

2026 GOLD

The choice of the antibiotic should be based on local bacterial resistance patterns. Usually, initial empirical treatment is an aminopenicillin with clavulanic acid, a macrolide, a tetracycline or, in selected patients, a quinolone. In patients with frequent exacerbations, severe airflow obstruction,[1056,1057] and/or exacerbations requiring mechanical ventilation,[1058] cultures from sputum or other materials from the lung should be performed, as gram-negative bacteria (e.g., *Pseudomonas* species) or resistant pathogens that are not sensitive to the above-mentioned antibiotics may be present. The route of administration (oral or intravenous) depends on the condition of the patient and pharmacokinetics of the antibiotic.

2024 진료지침

결론적으로, COPD 급성악화 환자에서 호흡곤란 악화, 가래양의 증가, 화농성 객담의 증가, 3가지 주요증상 중에 3가지를 모두 만족시키는 경우, 또는 객담의 화농성 증가를 포함한 2가지를 만족하는 경우, 또는 기계호흡이 필요한 경우에서 항생제를 처방하여야 한다. 항생제의 치료 기간은 5-7일을 권고하며,[710] 외래에서 치료하는 환자의 경우 5일 이내의 치료를 권고한다[711]. 이 때, 항생제의 선택은 각 지역 세균의 항생제 내성 패턴에 근거해야 하며, 초기 경험적 치료에는 aminopenicillin-clavulanic acid, 3세대 cephalosporin을 사용할 수 있다. 특히, 65세 이상, FEV_1 50% 미만, 잦은 악화, 심장질환 동반 등의 위험인자를 갖고 있는 경우에는 fluoroquinolone (levofloxacin, moxifloxacin 등), *Pseudomonas* 감염의 위험인자가 있는 경우에는 anti-*Pseudomonal* antibiotics을 초기 치료부터 고려할 수 있다[712].

Vaccination for COPD

Vaccination for People with COPD

Figure 3.6

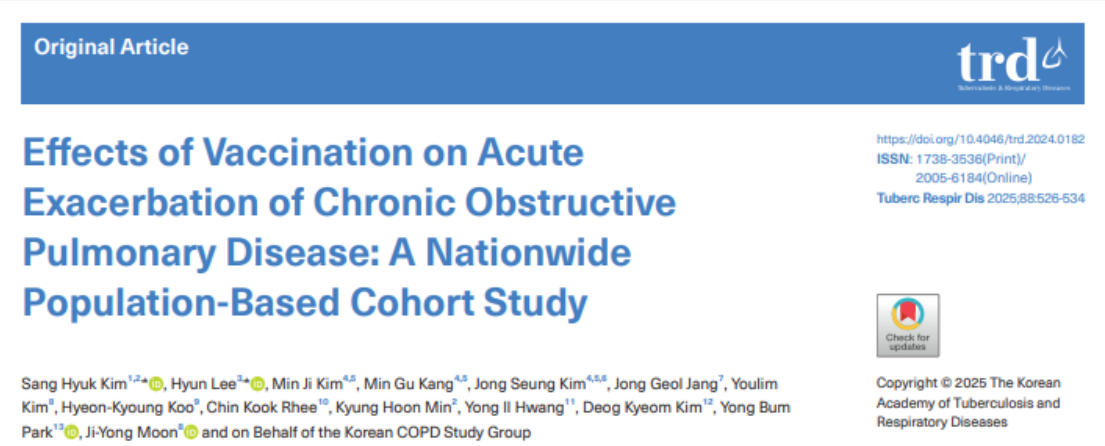
People with COPD should receive all recommended vaccinations in line with the relevant local guidelines:

- Yearly influenza vaccination **(Evidence B)**
- SARS-CoV-2 (COVID-19) vaccination based on WHO and CDC updated recommendations **(Evidence B)**
- We recommend either one dose of 21-valent pneumococcal conjugate vaccine (PCV21) or one dose PCV20 **(Evidence B)**. Pneumococcal vaccination has been shown to reduce the incidence of community-acquired pneumonia and exacerbations for people with COPD **(Evidence B)**
- Respiratory syncytial virus (RSV) vaccination for individuals aged ≥ 50 years and/or with chronic heart or lung disease, as recommended by the CDC **(Evidence A)**
- Tdap (dTaP/dTPa) vaccination to protect against pertussis (whooping cough), in addition to tetanus and diphtheria, for people with COPD that were not vaccinated in adolescence, as recommended by the CDC **(Evidence B)**
- Zoster vaccine to protect against shingles for people with COPD aged > 50 years, as recommended by the CDC **(Evidence B)**

- In a report from the UK, RSV was associated with 8.7% of outpatient managed exacerbations.
- RSV is expected to benefit patients with COPD

Vaccination for COPD in Korea

- 인플루엔자 폐렴구균 백신은 모든 COPD 환자에게 접종해야 한다.
- 65세 이상의 모든 COPD 환자에게 폐렴구균 백신 접종을 권장한다.
- 모든 COPD환자에서 COVID-19 백신 접종을 권장한다.
- 10년간 백일해의 낮은 추정발생률과 백신의 예방효과를 종합해 보면, 모든 COPD환자에게 백일해 백신 접종 권고는 논의가 필요하다.
- RSV 백신은 비교적 최근에 개발되어 주로 고령의 대상자에서 RSV 관련 질환 예방에 효과를 보였다. 해외에서는 75세 이상 노인이나 면역 저하 또는 만성 심장/폐 질환을 가진 60세 이상에서 접종이 권고되고 있다. 국내의 권고 사항은 아직 미정이나 고령 또는 고위험군을 중심으로 접근할 필요가 있다.
- 대상포진 백신은 50세 이상 성인에게 권고되고 있으며 COPD 환자도 이에 따라 접종이 권고된다.



Original Article

trd

Effects of Vaccination on Acute Exacerbation of Chronic Obstructive Pulmonary Disease: A Nationwide Population-Based Cohort Study

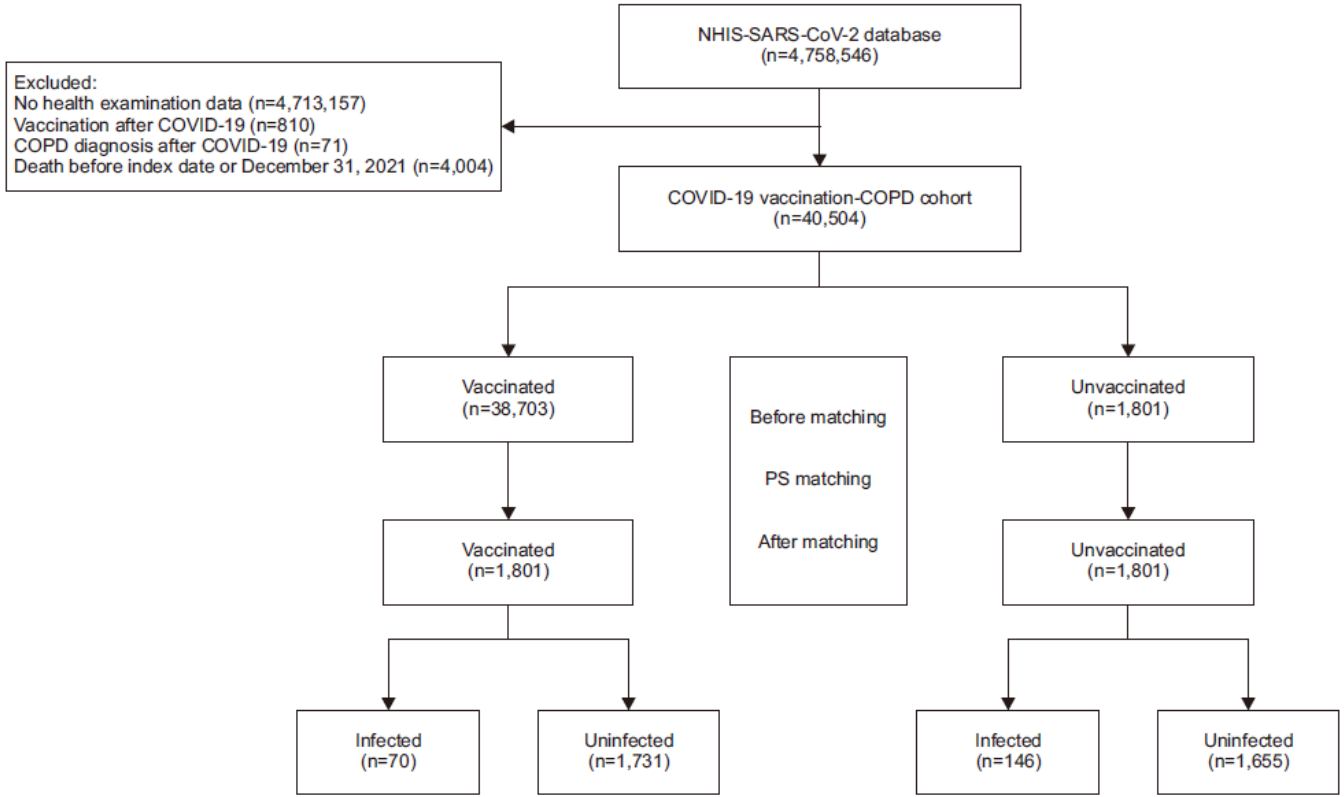
https://doi.org/10.4046/trd.2024.0182
ISSN: 1738-3536(Print)/ 2005-6184(Online)
Tuberc Respir Dis 2025;88:526-534

Sang Hyuk Kim[1,2], Hyun Lee[3], Min Ji Kim[4,5], Min Gu Kang[4,5], Jong Seung Kim[4,5,6], Jong Geol Jang[7], Youlim Kim[8], Hyeon-Kyoung Koo[9], Chin Kook Rhee[10], Kyung Hoon Min[2], Yong Il Hwang[11], Deog Kyeom Kim[12], Yong Bum Park[13], Ji-Yong Moon[5] and on Behalf of the Korean COPD Study Group

Study design

- population-based cohort study using the Korean National Health Insurance System (NHIS) database.
- Population
  - 41,606 patients diagnosed with COPD before the COVID-19 vaccination.
- Matching
  - 1:1 matching: COVID-19 Vaccinated (n=1,801) vs. Unvaccinated (n=1,801) groups.

Figure 1. Flow chart of the study population. NHIS-SARS-CoV-2: National Health Insurance System-Severe Acute Respiratory Syndrome Coronavirus 2; COVID-19: coronavirus disease 2019; COPD: chronic obstructive pulmonary disease; PS: propensity score.



Risk of AECOPD based on COVID-19 vaccination

Table 2. Risk of AECOPD based on COVID-19 vaccination status

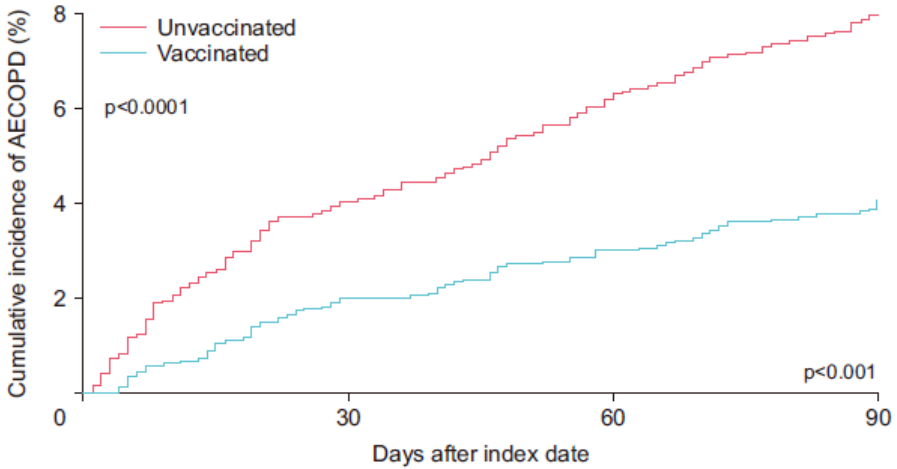
COVID-19 vaccination	Number	Number of AECOPD	AECOPD, /10,000 population	HR (95% CI)
No	1,801	144	3,410	Reference
Yes	1,801	73	1,683	0.55 (0.41–0.72)

AECOPD: acute exacerbation of chronic obstructive pulmonary disease; COVID-19: coronavirus disease 2019; HR: hazard ratio; CI: confidence interval.

Kim SH et al. Tuberc Respir Dis 2025;88:526-534.

Cumulative incidence of AECOPD

Figure 2. Kaplan-Meier curves for acute exacerbation of chronic obstructive pulmonary disease (AECOPD) based on coronavirus disease 2019 (COVID-19) vaccination status.



No. at risk

Unvaccinated	1,801	1,728	1,688	1,655
Vaccinated	1,801	1,765	1,747	1,731

Risk of AECOPD based on COVID-19

Table 3. *Post hoc* analysis for risk of AECOPD based on COVID-19 status

Population	COVID-19	Number	Number of AECOPD	AECOPD, /10,000 population	HR (95% CI)	Adjusted HR (95% CI)
Vaccinated	No	1,731	70	1,679	Reference	Reference
	Yes	70	3	1,781	1.06 (0.33–3.36)	1.35 (0.42–4.36)
Unvaccinated	No	1,655	124	3,190	Reference	Reference
	Yes	146	20	5,966	1.86 (1.16–2.98)	2.06 (1.28–3.33)

AECOPD: acute exacerbation of chronic obstructive pulmonary disease; COVID-19: coronavirus disease 2019; HR: hazard ratio; CI: confidence interval.

Conference Abstract Free

AS01E-adjuvanted RSV prefusion F protein vaccine (adjuvanted RSVPreF3) reduces RSV acute respiratory illness (ARI)-related complications and medication use in participants with COPD or asthma

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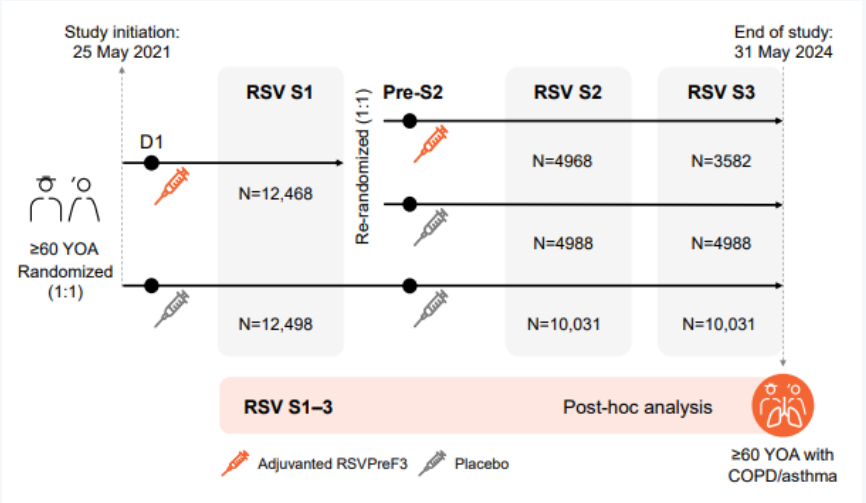
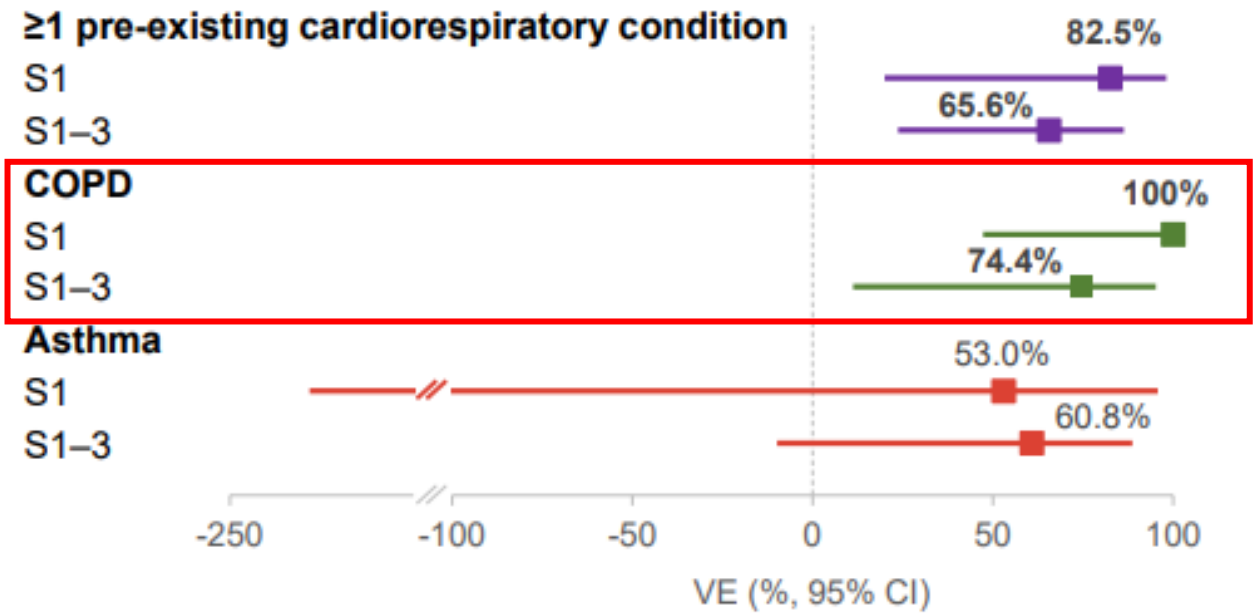
Study design

- Phase 3, randomized, multi-country, placebo-controlled
- Post-hoc VE analysis of single-dose adjuvanted RSVPreF3 over 1–3 RSV seasons (2021–2024) in COPD/asthma patients.
- RSV season is defined as 1 October – 30 April in NH and 1 March – 30 September in SH.
- RSV ARI cases were confirmed by RT-PCR.

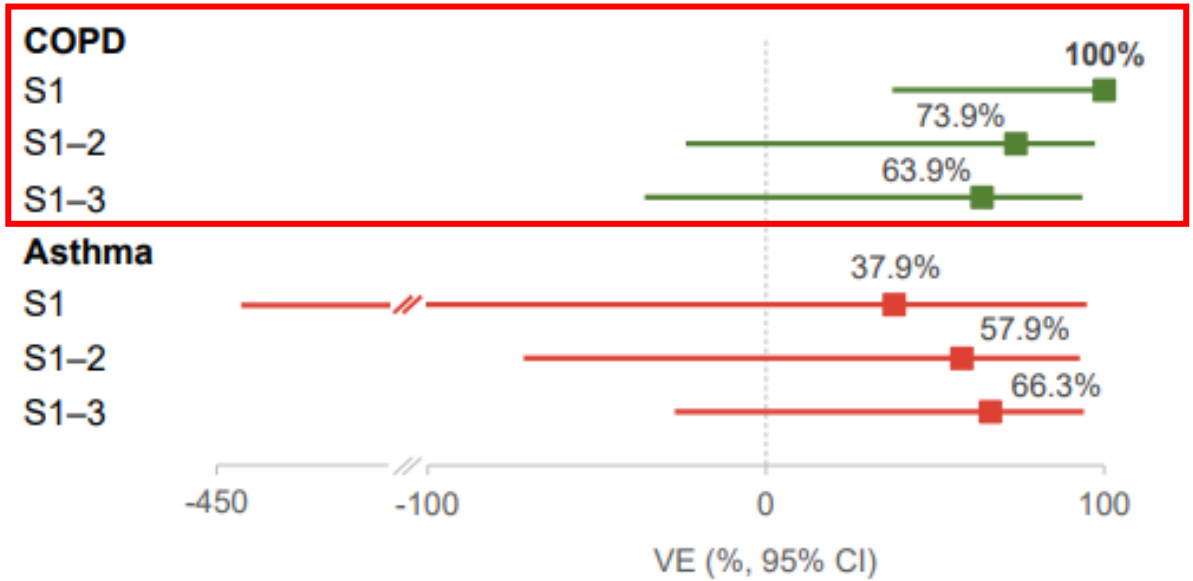


RSV ARI-related complications



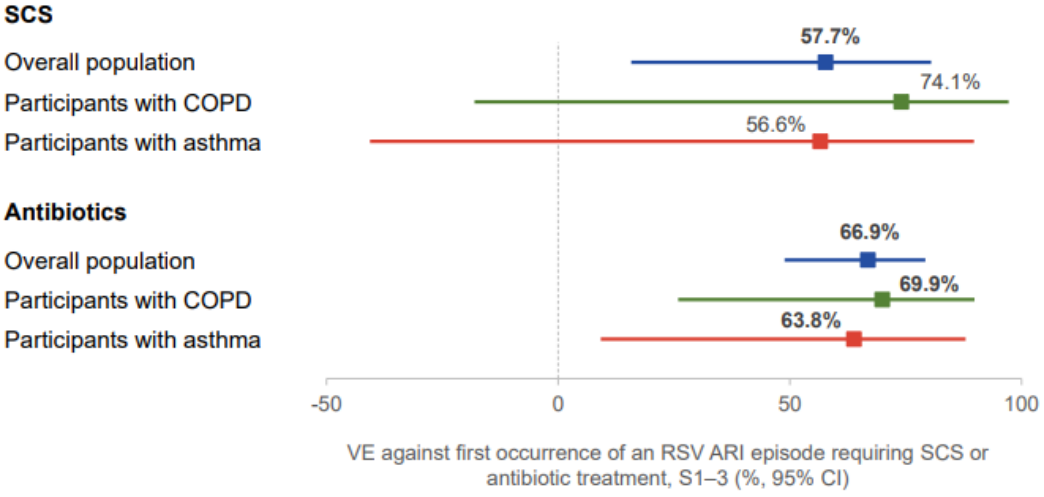
	Number of events/N	
	Adjuvanted RSVPreF3	Placebo
≥1 pre-existing cardiorespiratory condition		
S1	2/2577	11/2504
S1–3	8/2577	35/2504
COPD		
S1	0/1181	7/1161
S1–3	3/1181	19/1161
Asthma		
S1	2/1226	4/1160
S1–3	5/1226	19/1160

RSV ARI-related respiratory disease exacerbations



	Number of events/N	
	Adjuvanted RSVPreF3	Placebo
S1	0/1181	6/1161
S1–2	2/1181	11/1161
S1–3	3/1181	13/1161
Asthma		
S1	2/1226	3/1160
S1–2	3/1226	9/1160
S1–3	3/1226	12/1160

	Overall population		Participants with COPD		Participants with asthma	
	Adjuvanted RSVPreF3	Placebo	Adjuvanted RSVPreF3	Placebo	Adjuvanted RSVPreF3	Placebo
	N=12,468	N=12,498	N=1181	N=1161	N=1226	N=1160
RSV ARI episodes	131	435	13	58	18	61
			SCS			
n (%)	11 (8.4)	42 (9.7)	2 (15.4)	13 (22.4)	4 (22.2)	14 (23.0)
			Antibiotics			
n (%)	26 (19.8)	123 (28.3)	6 (46.2)	32 (55.2)	6 (33.3)	26 (42.6)



Summary

1. COPD 악화의 상당 부분은 세균과 바이러스 같은 감염에 의해 유발될 수 있다.
2. 감염성 COPD 악화는 비감염성 악화보다 입원 위험과 사망 위험이 더 높은, 임상적으로 중요한 위험요인이다.
3. RSV 감염은 COPD 환자에서 악화를 유발할 수 있는 주요 바이러스 원인 중 하나이다.
4. 특히 고령 COPD 환자에서 RSV는 악화뿐 아니라 입원과 중증도 증가와도 밀접하게 관련된다.
5. COPD 환자에서 백신은 감염을 줄이고 악화를 예방하는 핵심적인 관리 전략이다.

감사합니다