Bronchiectasis

Respiratory Review of 2019

전남의대

김유일

Contents

- **Epidemiology**
  - *Characteristics and Health-care Utilization History of Patients With Bronchiectasis in US Medicare Enrollees With Prescription Drug Plans, 2006 to 2014. Chest 2018; 154:1311.*
- **Clinical features**
  - *Characterization of the "Frequent Exacerbator Phenotype" in Bronchiectasis. AJRCCM 2018; 197:1410.*
- **Imaging study**
  - *The BRICS (Bronchiectasis Radiologically Indexed CT Score): A Multicenter Study Score for Use in Idiopathic and Postinfective Bronchiectasis. Chest 2018; 153:1177.*
- **Treatment**
  - *Long-term benefits of airway clearance in bronchiectasis: a randomised placebo-controlled trial. ERJ 2018; 51.*
  - *Treatable traits in bronchiectasis. ERJ 2018; 52*
- **Future research**
  - *US Patient-Centered Research Priorities and Roadmap for Bronchiectasis. Chest 2018; 154:1016.*

Characteristics and Health-care Utilization History of Patients With Bronchiectasis in US Medicare Enrollees With Prescription Drug Plans, 2006 to 2014

Emily Henkle, PhD, MPH; Benjamin Chan, MS; Jeffrey R. Curtis, MD, MPH; Timothy R. Aksamit, MD; Charles L. Daley, MD; and Kevin L. Winthrop, MD, MPH

- -CHEST 2018; 154(6):1311-1320

BACKGROUND

- Bronchiectasis is an **increasingly common chronic inflammatory airway disease**.

- There is an **urgent need to understand the epidemiology** of bronchiectasis in **older adults.**

- We describe the **prevalence and characteristics of patients with bronchiectasis** within the **US Medicare population.**

Method & Result

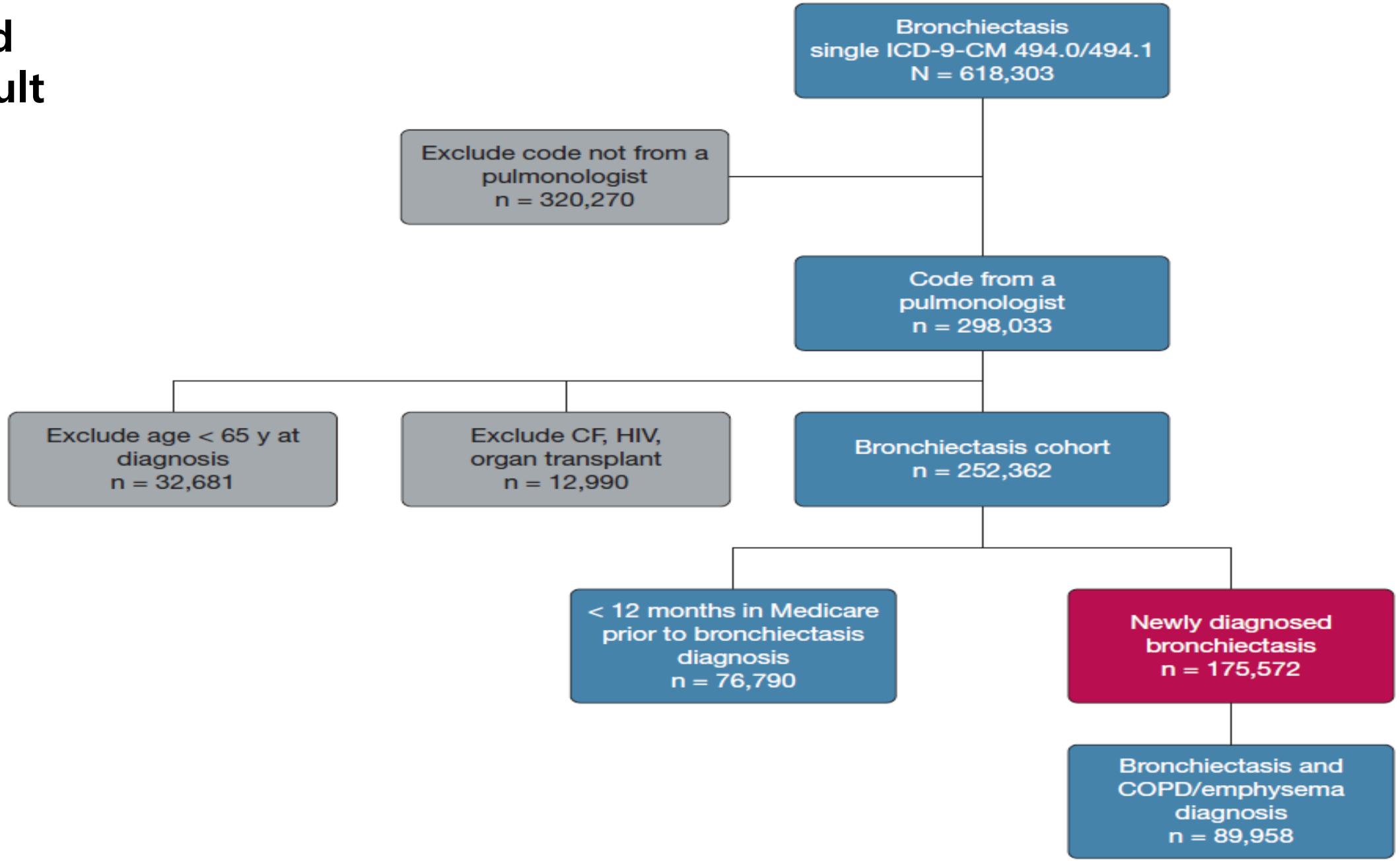


Figure 1 – *Bronchiectasis cohort flow diagram. US Medicare Parts A, B, and D (but not C) enrollees, 2006 to 2014. CF = cystic fibrosis; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification.*

TABLE 1] Demographics of Bronchiectasis Cohort and Newly Diagnosed Patients, US Medicare Parts A, B, and D (but not C) Enrollees ≥ 65 Years of Age at Diagnosis, 2006 to 2014

Demographic Characteristics	Bronchiectasis Base Cohort (n = 252,362)	Newly Diagnosed Bronchiectasis (n = 175,572)
Age at diagnosis, y	76.0 ± 7.2	76.4 ± 7.1
Sex (female)	167,615 (66.4)	113,422 (64.6)
Race		
American Indian or Alaska native	827 (0.3)	633 (0.4)
Asian/Pacific Islander	10,196 (4.0)	7,021 (4.0)
Black	11,656 (4.6)	8,339 (4.7)
Hispanic	14,066 (5.6)	10,136 (5.8)
White (non-Hispanic)	213,170 (84.5)	147,755 (84.2)
Other	1,873 (0.7)	1,343 (0.8)
Unknown	574 (0.2)	345 (0.2)
Median household income	$60,650 ± $26,008	$60,560 ± $25,849
Urban residence	196,084 (77.7)	135,757 (77.3)

Comorbidities, all available history	
Smoking history	55,965 (31.9)
COPD/emphysema	89,958 (51.2)
Asthma	49,653 (28.3)
Interstitial lung disease	8,199 (4.7)
Rheumatoid arthritis	7,812 (4.4)
Underlying immune/genetic condition[a]	6,210 (3.5)
Pseudomonas species infection	6,156 (3.5)
Lung cancer	6,501 (3.7)
NTM infection	3,256 (1.9)

Values are No. (%). NTM = nontuberculous mycobacterium.

[a]Allergic bronchopulmonary aspergillosis, alpha-1 antitrypsin deficiency, primary ciliary dyskinesia, or primary immune deficiency.

TABLE 4] Clinical Characteristics and Health-care Utilization History in Patients Newly Diagnosed With Bronchiectasis With and Without a COPD/Emphysema Dual Diagnosis, US Medicare Parts A, B, and D (but not C) Enrollees, 2006 to 2014

Clinical Characteristics and Health-care Utilization	Bronchiectasis and COPD (n = 89,958)	Bronchiectasis and No COPD (n = 85,614)	SMD
No. of physician office visits	15.69 (10.09)	12.94 (8.95)	**0.29**
No. of pulmonologist office visits	3.24 (3.57)	1.77 (2.35)	**0.49**
No. of hospitalizations	1.08 (1.52)	0.46 (0.91)	**0.49**
Inpatient admissions			
0	42,464 (47.2)	60,236 (70.4)	**0.52**
1	24,156 (26.9)	16,915 (19.8)	
≥ 2	23,338 (25.9)	8,463 (9.9)	
Hospitalization for respiratory infections	14,142 (15.7)	6,134 (7.2)	**0.27**

Comorbidities, all available history			
Smoking history	41,655 (46.3)	14,310 (16.7)	**0.67**
Asthma	36,229 (40.3)	13,424 (15.7)	**0.57**
Interstitial lung disease	5,507 (6.1)	2,692 (3.1)	**0.14**
Lung cancer	5,098 (5.7)	1,403 (1.6)	**0.22**
NTM infection	1,879 (2.1)	1,377 (1.6)	0.04
Pseudomonas species infection	4,881 (5.4)	1,275 (1.5)	**0.22**
Rheumatoid arthritis	4,000 (4.4)	3,812 (4.5)	< 0.001
Underlying immune/genetic condition[a]	3,792 (4.2)	2,418 (2.8)	0.08

Values are No. (%) or as otherwise indicated. Boldface indicates SMD with meaningful difference > 0.1. See Table 2 and 3 legends for expansion of abbreviations.

[a]Allergic bronchopulmonary aspergillosis, alpha-1 antitrypsin deficiency, primary ciliary dyskinesia, or primary immune deficiency.

Limitations of this study

- missing the denominator for a complete prevalence and incidence analysis in medicare, claims-based analysis
- inability to confirm the bronchiectasis diagnosis based on CT scan
- not confirm COPD using established clinical criteria

CONCLUSIONS

- We identified > 250,000 Medicare patients with a bronchiectasis diagnostic claim from a pulmonologist over a 9-year period.

- One-half of patients who were newly diagnosed had a dual COPD/emphysema diagnosis

→associated with poorer health indicators and higher utilization.

- Bronchiectasis is likely no longer an orphan disease in the United States and the burden of disease in the aging population and deserves further attention.

Characterization of the "Frequent Exacerbator Phenotype" in Bronchiectasis

James D. Chalmers[1], Stefano Aliberti[2,3], Anna Filonenko[4], Michal Shteinberg[5], Pieter C. Goeminne[6,7], Adam T. Hill[8,9], Thomas C. Fardon[1], Dusanka Obradovic[10], Christoph Gerlinger[4,11] Giovanni Sotgiu[12], Elisabeth Operschall[4], Robert M. Rutherford[13], Katerina Dimakou[14], Eva Polverino[15], Anthony De Soyza[16,17], and Melissa J. McDonnell[13,17]

-AJRCCM 2018; 197:1410.

Rationale & Objectives

- **Exacerbations are key events** in the natural history of bronchiectasis, but clinical predictors and outcomes of patients with frequently exacerbating disease are **not well described.**

- To establish if there is **a "frequent exacerbator phenotype**" in bronchiectasis and the **impact of exacerbations on long-term clinical outcomes**.

Methods:

- patients with bronchiectasis enrolled from **10 clinical centers in Europe and Israel**, with up to **5 years of follow-up.**

- Patients were categorized by baseline **exacerbation frequency (zero, one, two, or three or more per year**).

- The **repeatability of exacerbation status** was assessed, as well as the independent **impact of exacerbation history on hospitalizations, quality of life, and mortality**.

- **Exacerbations**
  - defined as the **requirement for antibiotics** in the presence of one or more symptoms of **increasing cough, increasing sputum volume, worsening sputum purulence, worsening dyspnea, increased fatigue/malaise, fever, and hemoptysis**

- **severe exacerbations**
  - defined according to British Thoracic Society guidelines as unscheduled **hospitalizations or emergency department visits** for exacerbations or complications

- **three or more exacerbations per year** were regarded as **frequent exacerbations** on the basis of the European Respiratory Society bronchiectasis guidelines

Patient groups and endpoints used in the analysis.

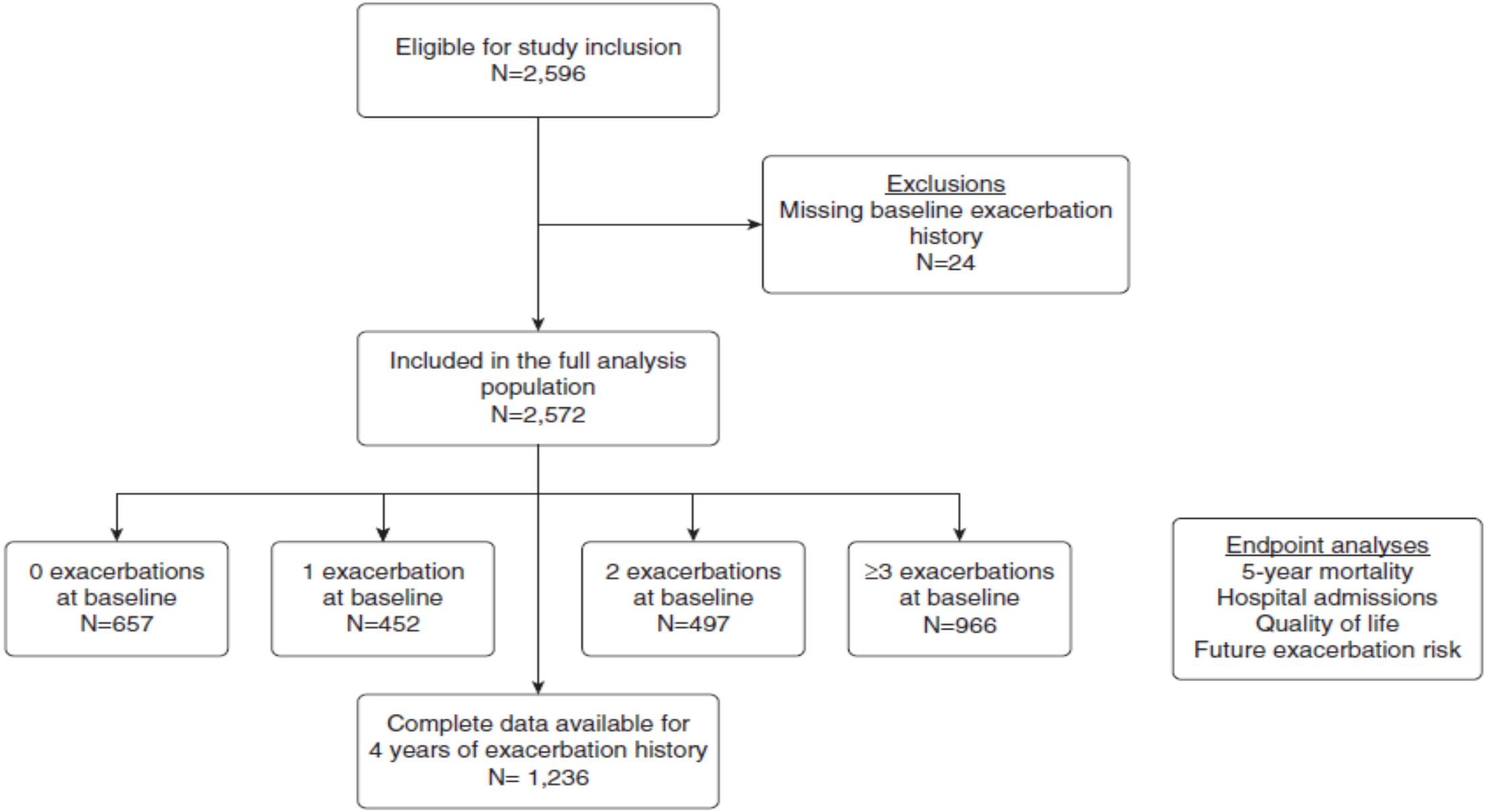
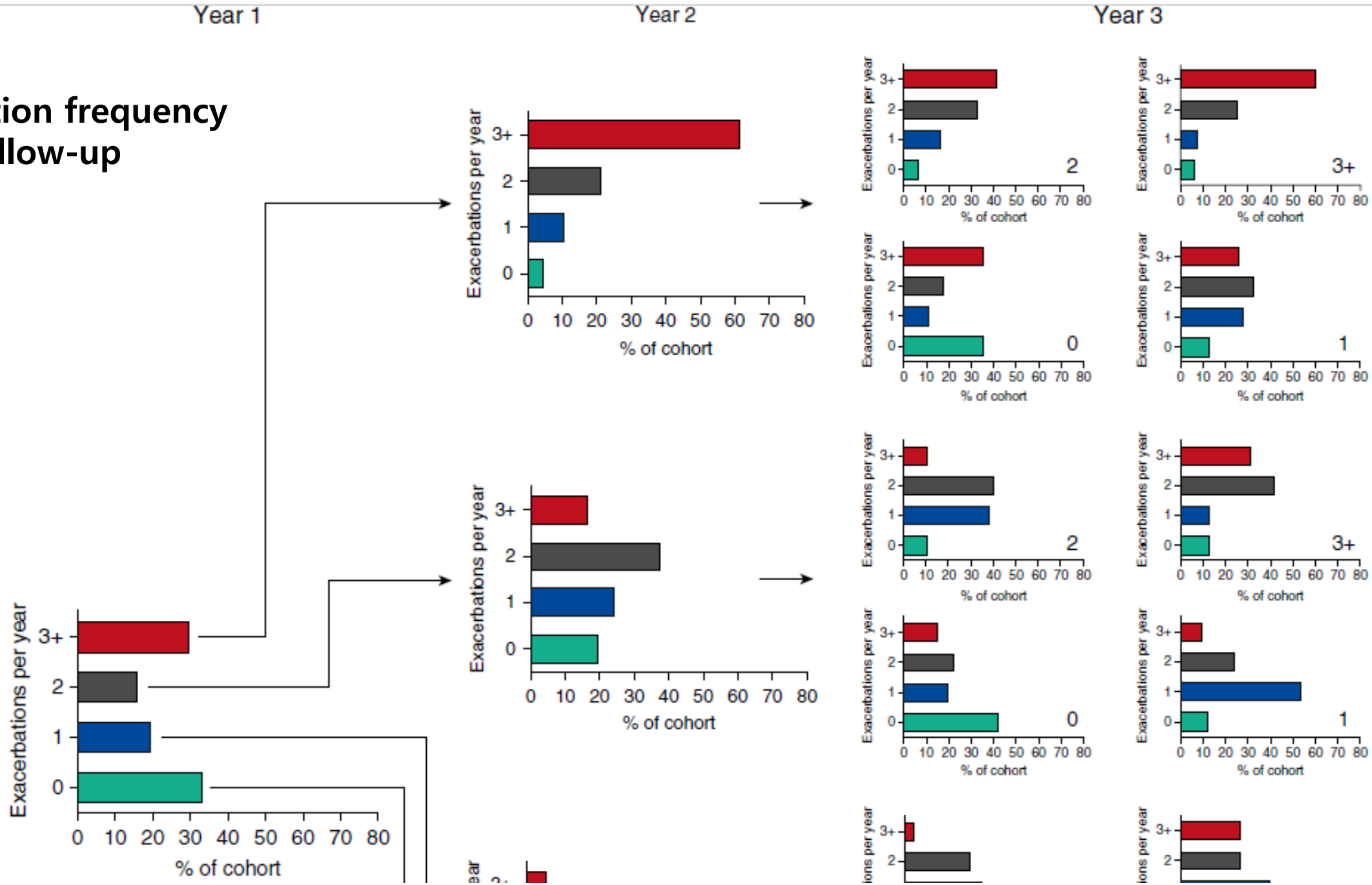


Figure 1. Patient groups and endpoints used in the analysis.

Exacerbation frequency during follow-up



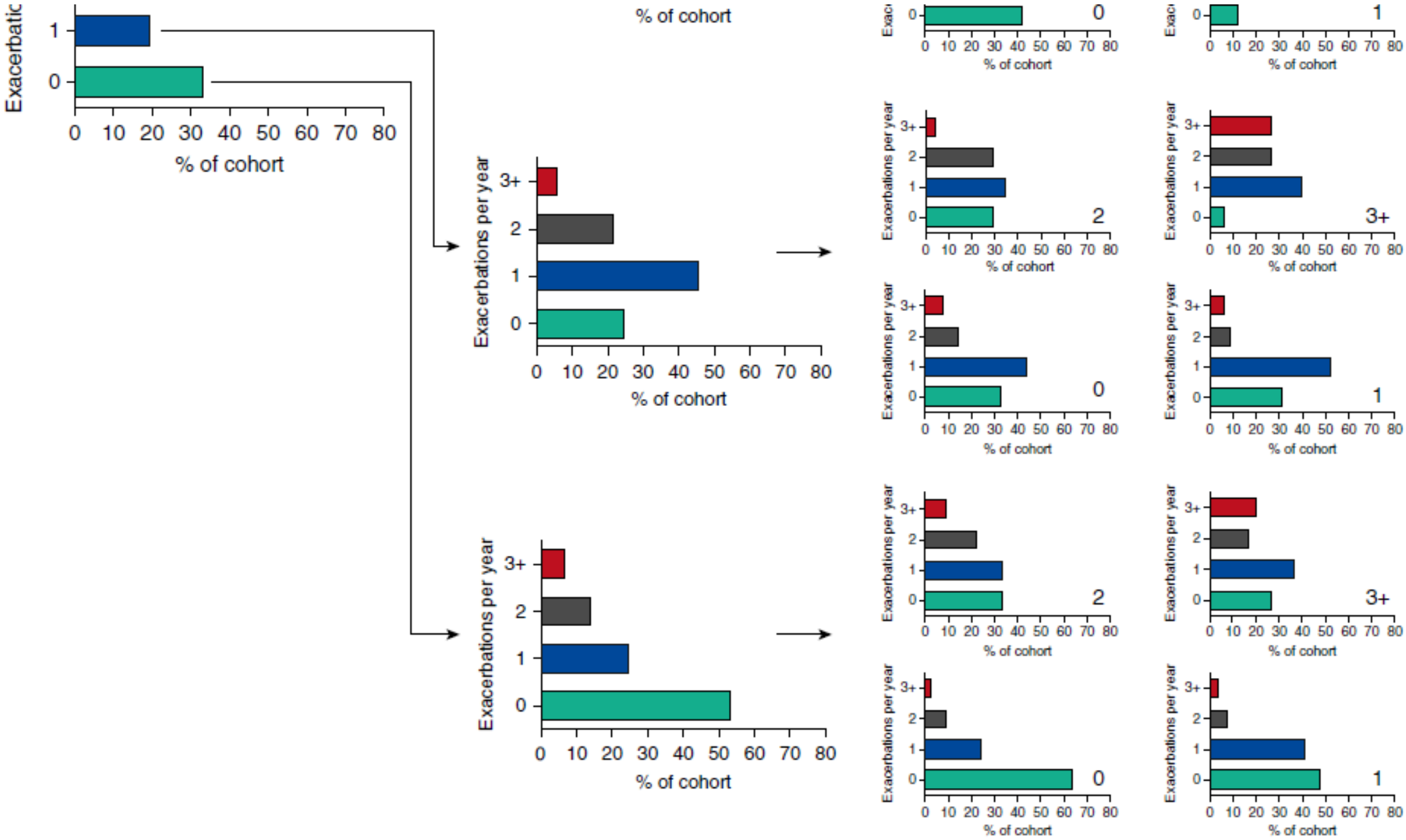


Figure 2. Exacerbation frequency during follow-up and the association with exacerbations in the previous year.

Incident Rate Ratios for Exacerbation Frequency

	Unadjusted			Adjusted		
	IRR	95% CI	*P* Value	IRR	95% CI	*P* Value
0 Exacerbations	1.0 (reference)			1.0 (reference)		
1 Exacerbation	1.73	1.47–2.02	<0.0001	1.81	1.54–2.12	<0.0001
2 Exacerbations	3.14	2.70–3.66	<0.0001	3.07	2.62–3.60	<0.0001
3 Exacerbations	5.97	5.27–6.78	<0.0001	5.18	4.51–5.95	<0.0001
Age (per 10 yr)	1.00	0.96–1.03	0.8	0.96	0.95–1.03	0.6
Sex (M)	1.11	1.00–1.23	0.04	0.95	0.86–1.06	0.4
MRC dyspnea score	1.24	1.19–1.29	<0.0001	1.02	0.97–1.07	0.4

FEV_1% predicted (per 10%)	0.88	0.87–0.90	<0.0001	0.96	0.94–0.98	0.001
Reiff score	1.04	1.03–1.06	<0.0001	1.02	1.00–1.03	0.05
Smoking history	1.22	1.10–1.35	<0.0001	0.95	0.85–1.06	0.3
Haemophilus influenzae	1.07	0.96–1.20	0.2	1.13	1.01–1.28	0.04
Moraxella catarrhalis	0.94	0.78–1.14	0.5	0.94	0.77–1.15	0.5
Staphylococcus aureus	1.19	0.97–1.45	0.1	1.08	0.88–1.32	0.5
Enterobacteriaceae	1.30	1.08–1.57	0.006	0.99	0.82–1.20	0.9
Pseudomonas aeruginosa	1.94	1.69–2.23	<0.0001	1.20	1.04–1.40	0.01
Asthma	1.22	1.03–1.44	0.02	1.16	0.98–1.38	0.09
COPD	1.89	1.66–2.16	<0.0001	1.43	1.22–1.67	<0.0001
Idiopathic	0.72	0.65–0.79	<0.0001	0.92	0.83–1.02	0.1

Definition of abbreviations: CI = confidence interval; COPD = chronic obstructive pulmonary disease; IRR = incident rate ratio; MRC = Medical Research Council.

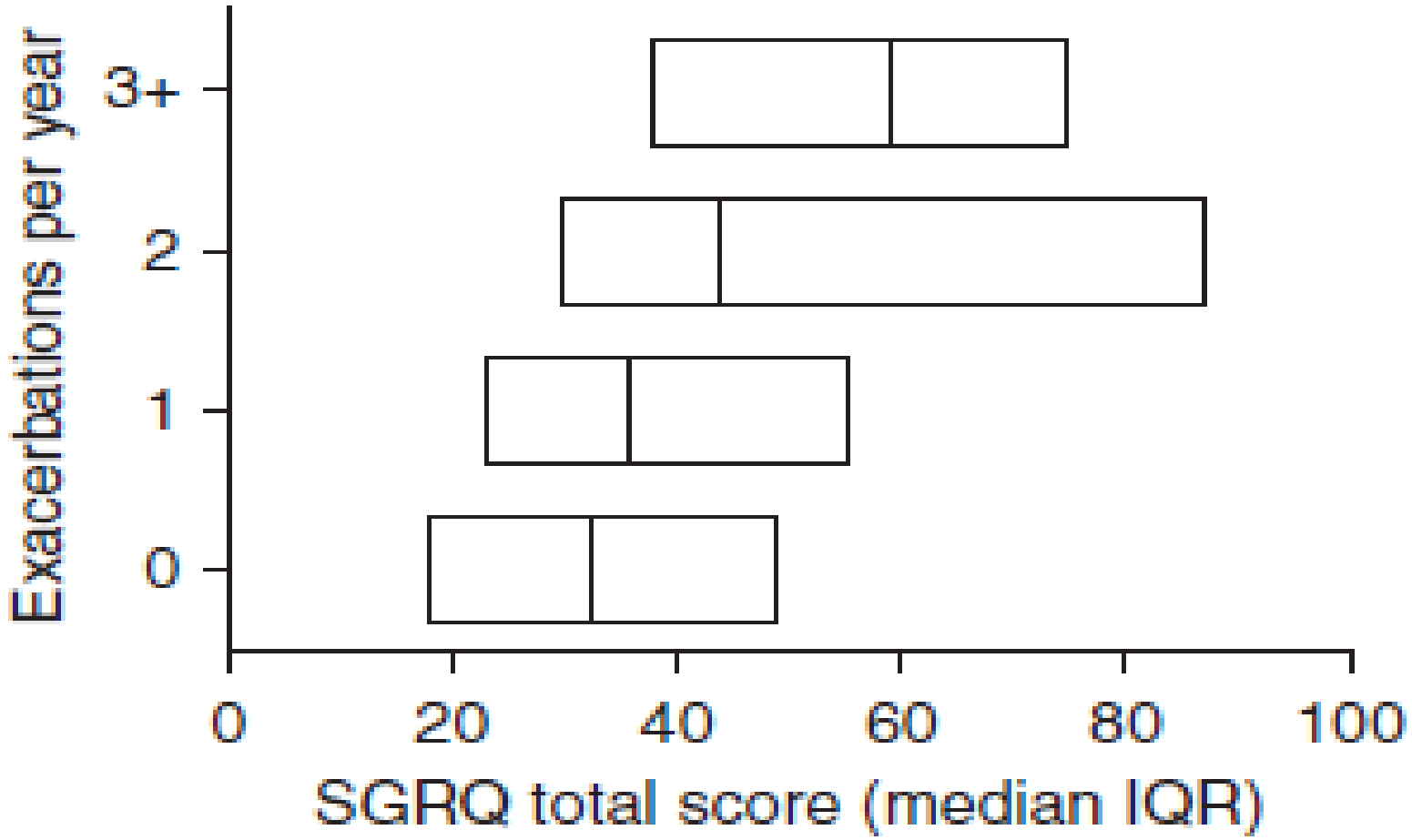
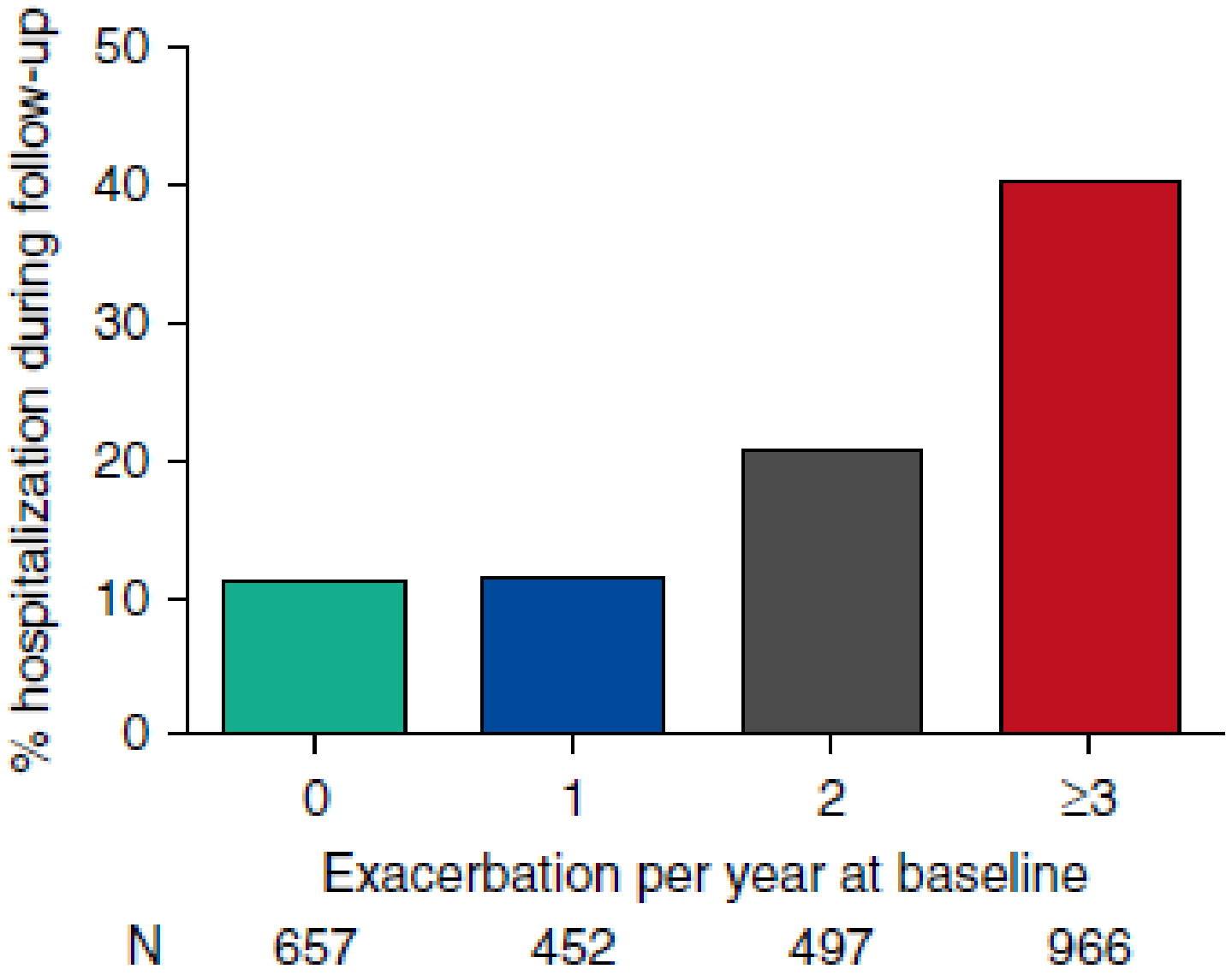


Figure 3. St. George's Respiratory Questionnaire (SGRQ) scores according to baseline exacerbation frequency ($P < 0.0001$ by Kruskal-Wallis test). IQR = interquartile range.


% hospitalization during follow-up
50
40
30
20
10
0
0
1
2
≥3
Exacerbation per year at baseline
N
657
452
497
966

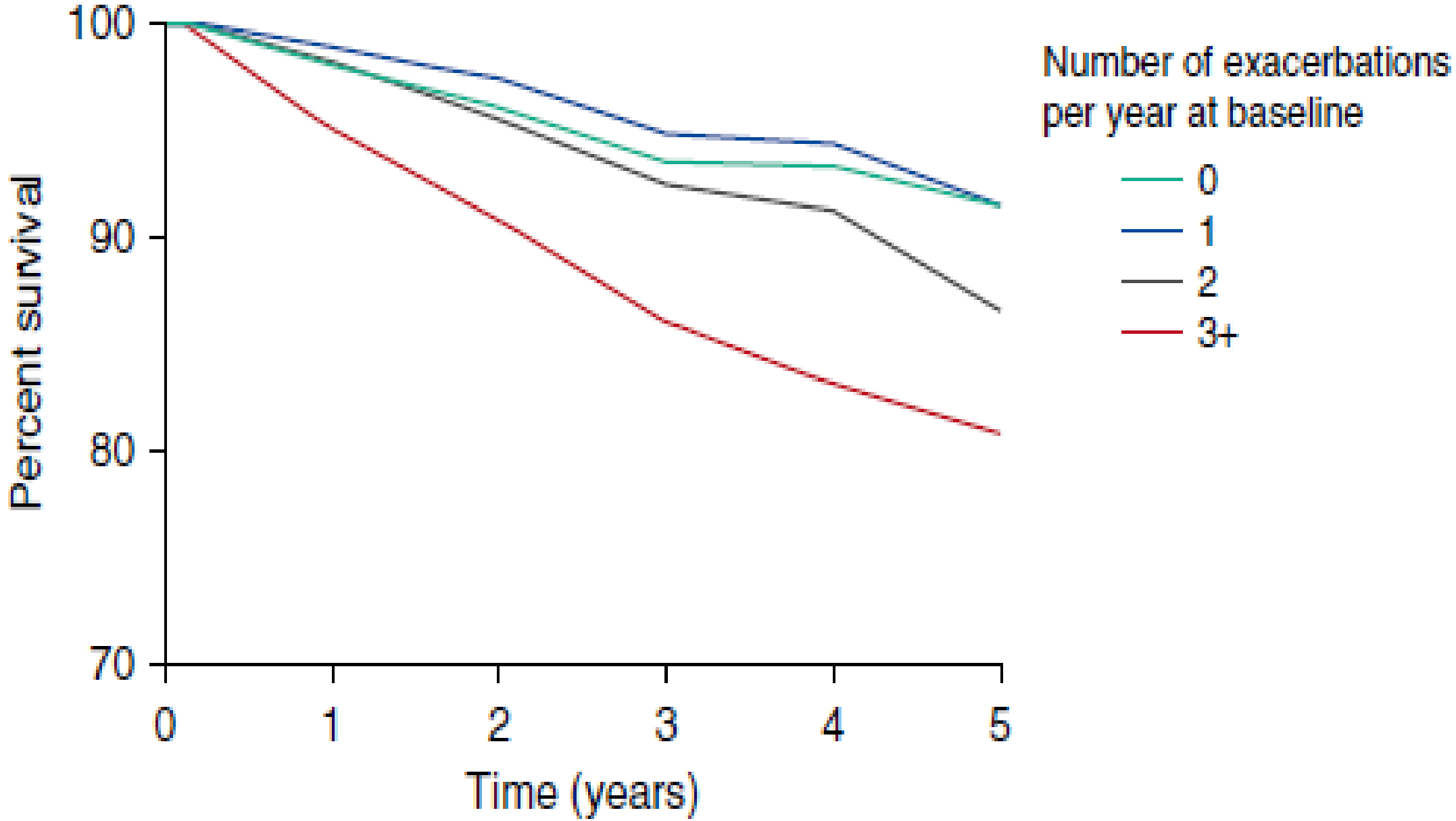

100
90
80
70
Percent survival
0
1
2
3
4
5
Time (years)
Number of exacerbations per year at baseline
0
1
2
3+

Table 3. Sensitivity Analysis of Different Countries and Patient Subgroups Demonstrating the Consistency of the Frequent Exacerbator Phenotype over Time

Subgroup	Incident Rate Ratios from the Poisson Model			Area under the Curve	
	1 Exacerbation	2 Exacerbations	⩾3 Exacerbations	⩾2 Exacerbations	⩾3 Exacerbations
Country					
Belgium	2.92 (1.47–5.82)	4.72 (2.36–9.44)	6.24 (3.32–11.7)	0.78 (0.71–0.84)	0.83 (0.76–0.89)
Greece	0.71 (0.09–5.86)	1.52 (0.20–11.5)	3.57 (0.50–25.6)	0.77 (0.68–0.87)	0.85 (0.76–0.94)
Ireland	0.94 (0.07–12.0)	2.15 (0.19–24.9)	4.16 (0.37–46.2)	0.83 (0.78–0.88)	0.84 (0.78–0.90)
Israel	5.63 (0.62–51.4)	9.47 (1.09–82.1)	13.1 (1.60–106)	0.73 (0.62–0.83)	0.79 (0.70–0.89)
Italy	1.58 (1.08–2.33)	2.26 (1.56–3.29)	3.66 (2.65–5.07)	0.80 (0.76–0.85)	0.81 (0.76–0.87)
Serbia	6.00 (2.17–16.4)	11.0 (4.40–27.5)	20.9 (8.15–53.5)	0.91 (0.83–0.99)	0.93 (0.80–1.00)
Spain	2.72 (1.78–4.15)	5.67 (3.68–8.73)	31.6 (22.3–45.0)	0.89 (0.87–0.91)	0.88 (0.86–0.90)
United Kingdom	1.39 (1.14–1.69)	2.60 (2.12–3.19)	5.49 (4.66–6.47)	0.80 (0.78–0.83)	0.85 (0.83–0.88)

Study limitations

- **Mild exacerbations not receiving antibiotic therapy** but requiring an increase in the use of interventions like chest physiotherapy or inhaled therapies are not yet a widely accepted concept in bronchiectasis

- Exacerbations are poorly defined clinical entities in bronchiectasis. **Variations in antibiotic use** in different countries

In conclusion

- patients with **frequently exacerbating bronchiectasis** represent **a distinct clinical phenotype** with different patient characteristics, a high risk of **hospital admissions, poor QoL, and a higher risk of death** during follow-up.

- This study emphasizes the importance of **prioritizing exacerbation reduction** in the management of bronchiectasis.

The BRICS (Bronchiectasis Radiologically Indexed CT Score)

A Multicenter Study Score for Use in Idiopathic and Postinfective Bronchiectasis

Pallavi Bedi, MD; James D. Chalmers, PhD; Pieter C. Goeminne, PhD; Cindy Mai, MD; Pira Saravanamuthu, MBBS; Prasad Palani Velu, MBChB; Manjit K. Cartlidge, MBChB; Michael R. Loebinger, PhD; Joe Jacob, MD; Faisal Kamal, MBBS; Nicola Schembri, MBChB; Stefano Aliberti, MD; Uta Hill, PhD; Mike Harrison, MBChB BAO; Christopher Johnson, MBChB; Nicholas Screaton, BMBCh; Charles Haworth, PhD; Eva Polverino, PhD; Edmundo Rosales, MD; Antoni Torres; Michael N. Benegas, MD; Adriano G. Rossi, DSc; Dilip Patel, MBBS; and Adam T. Hill, MD

- -CHEST 2018; 153(5):1177-1186

Variable	Values	Points
FEV$_1$	At least 50%	0
	Less than 50%	2
Age	Less than 70 years	0
	At least 70 years	2
Chronic colonization by PA	No	0
	Yes	1
Extension (nº of lobes)	1-2 lobes	0
	More than 2 lobes	1
Dyspnea (mMRC)	0-II	0
	III-IV	1
		Range: 0 – 7 points

The BSI uses the following criteria and is calculated with the assistance of the Online Calculation Tool:

> BMI
>
> %FEV1 Predicted
>
> Previous Hospital Admission
>
> Has the patient been hospitalised with a severe exacerbation in the past 2 years?
>
> Number of exacerbations in previous year
>
> MMRC Breathlessness Score
>
> Pseudomonas colonisation (chronic colonisation is defined by the isolation of Pseudomonas aeriginosa in sputum culture on 2 or more occasions, at least 3 months apart in a 1 year period)
>
> Colonisation with other organisms (chronic colonisation is defined by the isolation of potentially pathogenic bacteria in sputum culture on 2 or more occasions, at least 3 months apart in a 1 year period)
>
> Radiological severity

OBJECTIVES: The goal of this study was to **develop a simplified radiological score** that could assess **clinical disease severity in bronchiectasis**.

TABLE 4 BRICS Derived From Combining Bronchial Dilatation With Number of Bronchopulmonary Segments With Emphysema

Score	0	1	2	3
Bronchial dilatation	Absent	Mild (lumen just > diameter of adjacent vessel)	Moderate (lumen 2-3 times > diameter of adjacent vessel)	Severe (lumen > 3 times diameter of adjacent vessel)
No. of bronchopulmonary segments with emphysema	Absent	1-5	> 5	

BRICS = Bronchiectasis Radiologically Indexed CT Score.

- -CHEST 2018; 153(5):1177-1186

METHODS

Bronchiectasis Radiologically Indexed CT Score (BRICS)

-devised based on a multivariable analysis of the **Bhalla score and its ability in predicting clinical parameters of severity**.
-externally validated in six centers in 302 patients.

-**new score ranges from 0 to 5**
(1 indicates mild disease, 2-3 indicates moderate disease, and > 3 indicates severe disease).

BRICS & Clinical impacts

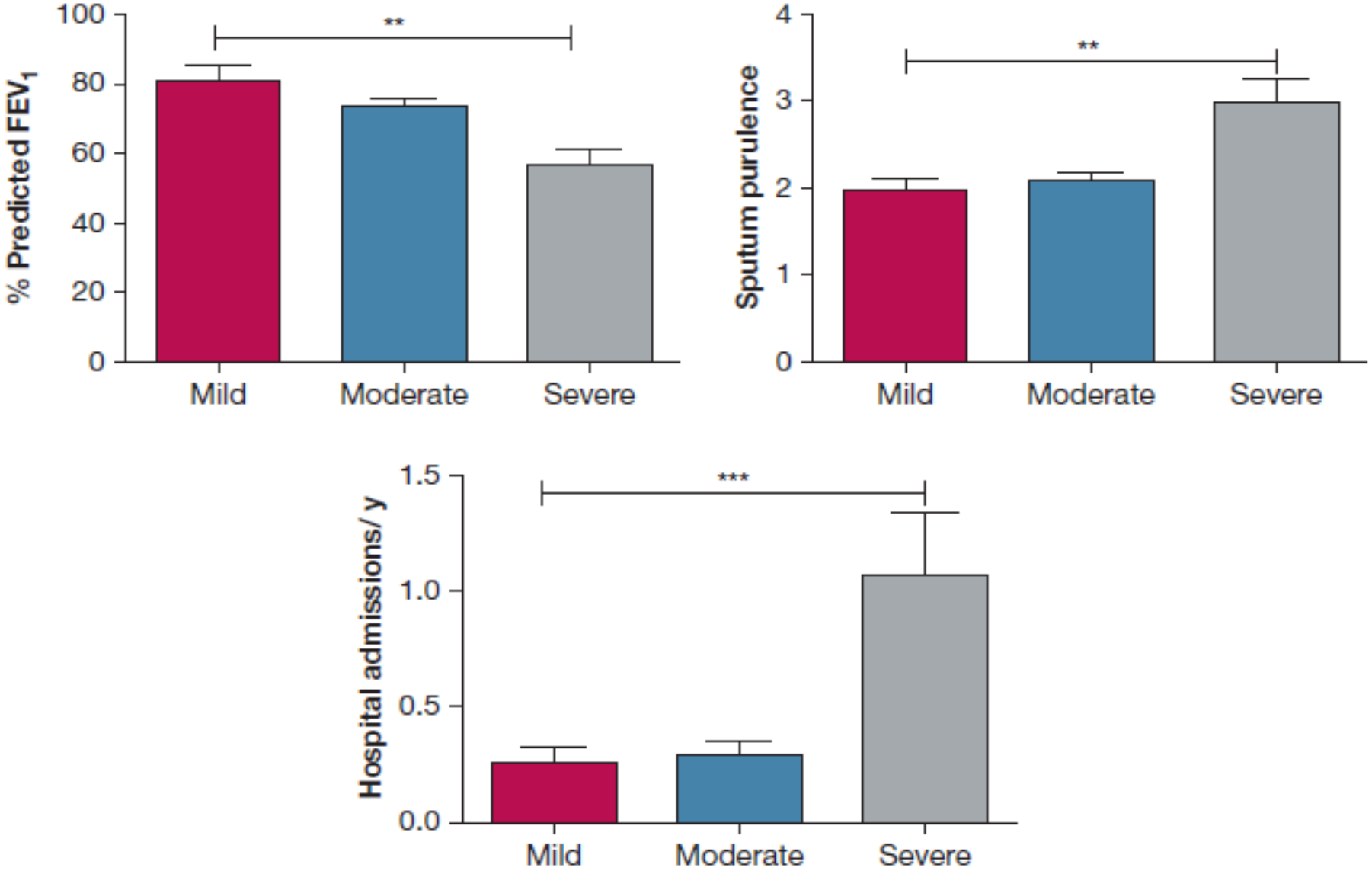


Figure 1 – *Bronchiectasis Radiologically Indexed CT Score correlates significantly with percent predicted FEV_1, sputum purulence, and hospital admission. Sputum purulence (1 = mucoid; 2 = mucopurulent; 3 = purulent). One-way ANOVA with Bonferroni correction for multiple comparisons was performed to assess the Bronchiectasis Radiologically Indexed CT Score in the derivation cohort.* $^{**}P < .01$, $^{***}P < .001$.

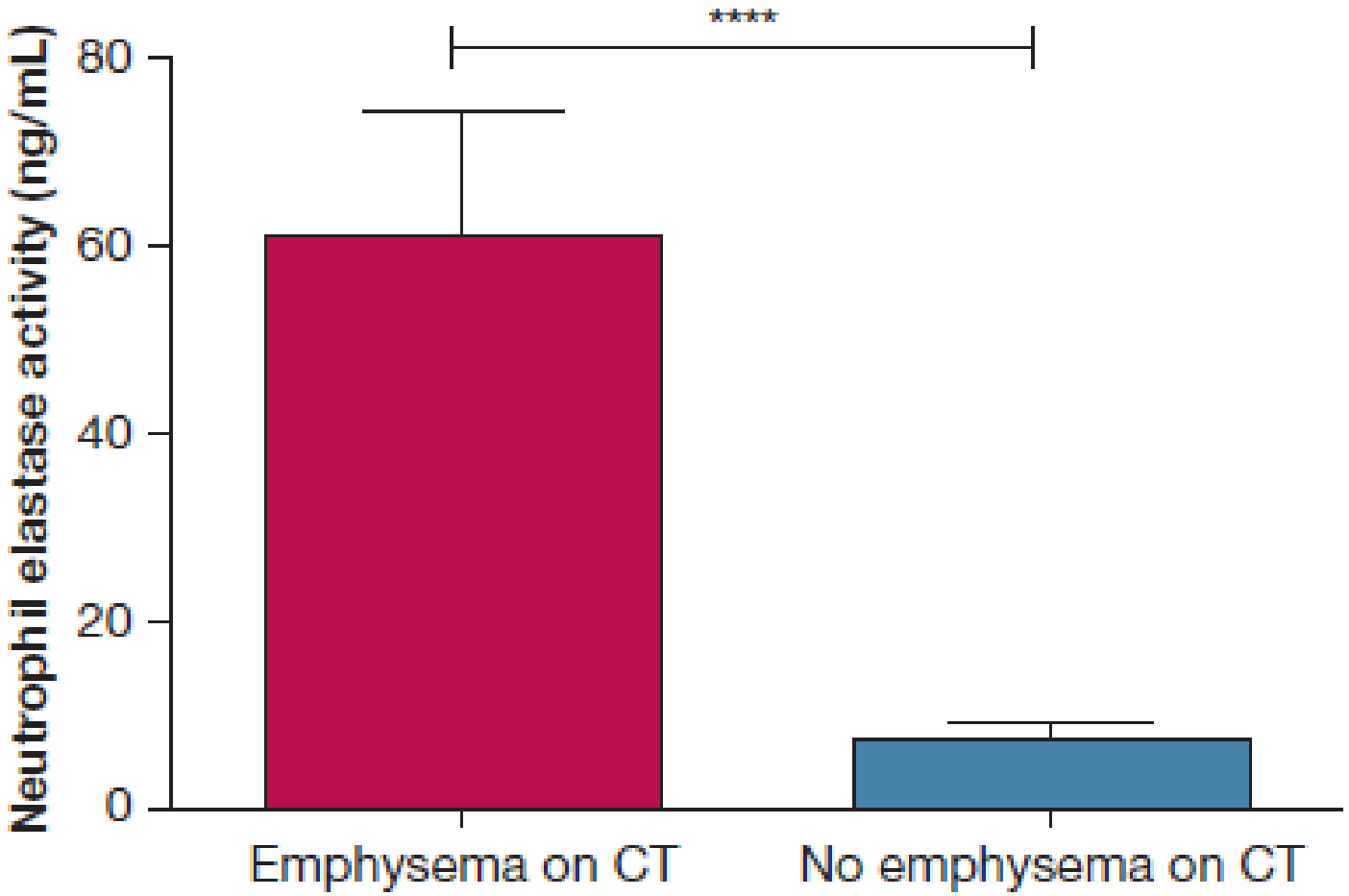


Figure 2 – *Free neutrophil elastase activity was significantly lower in the group that had no emphysema on CT scan. Mann-Whitney U tests were performed on the two groups showing evidence of emphysema or not on the CT scan, in the derivation cohort.* ****$P < .0001$.

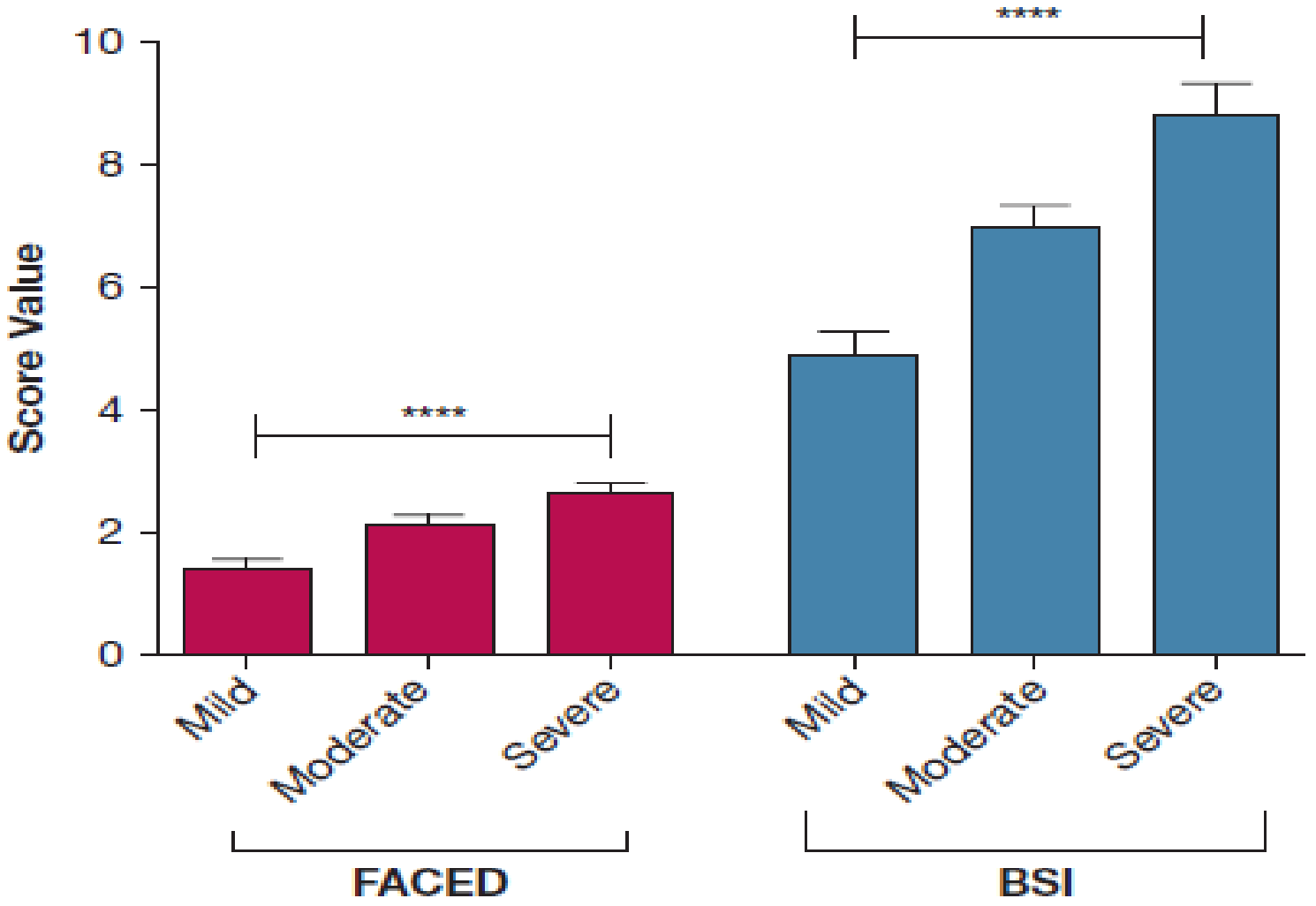


Figure 4 – *Significant association of the Bronchiectasis Radiologically Indexed CT Score severity with that of BSI and FACED in the derivation and validation cohorts combined. One-way ANOVA with Bonferroni correction for multiple comparisons was performed to assess the associations.* **** $P < .0001$. *BSI = Bronchiectasis Severity Index.*

Study limitations

- a cohort in which the patients had idiopathic or postinfective bronchiectasis.

- Bronchiectasis due to other etiologies thus requires further study

CONCLUSIONS

- We developed and validated **a simplified CT scoring** system based on **degree of bronchial dilatation and number of bronchopulmonary segments with emphysema** in patients with idiopathic and postinfective bronchiectasis, with limited smoking history.

- A simplified CT scoring system can be used as an **adjunct to clinical parameters to predict disease severity** in patients with idiopathic and postinfective bronchiectasis

Long-term benefits of airway clearance in bronchiectasis: a randomised placebo-controlled trial

Gerard Muñoz[1,2], Javier de Gracia[3,4,5], Maria Buxó[6], Antonio Alvarez[3,4] and Montserrat Vendrell[1,3]

- -Eur Respir J 2018; 51.

Objectives

- Keeping **airways clear of mucus by airway clearance techniques seems essential** in bronchiectasis treatment, although **no placebo-controlled trials** or any studies lasting longer than 3 months have been conducted.

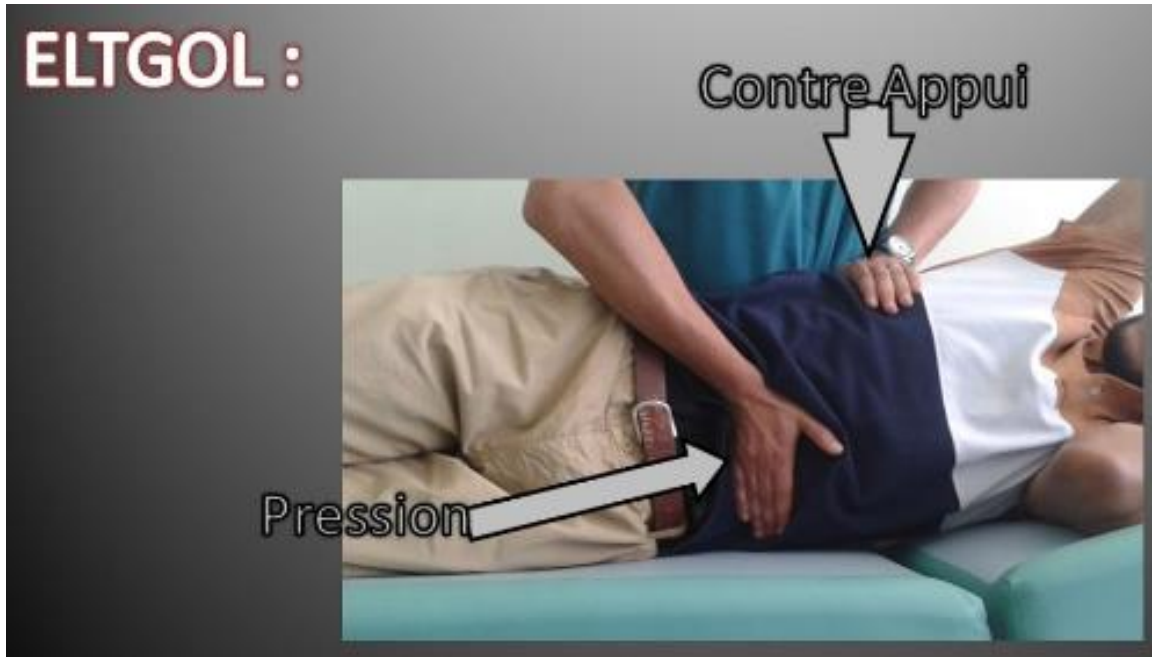
- We evaluate the efficacy of the **ELTGOL (slow expiration with the glottis opened in the lateral posture) technique over a 1-year period** in bronchiectasis patients with chronic expectoration in a randomised placebo-controlled trial.

- -Eur Respir J 2018; 51.

Methods

- Patients were randomised to perform the **ELTGOL technique (n=22) or placebo exercises (n=22) twice daily**

- The primary outcome was **sputum volume** during the first intervention and **24 h later**.
- Secondary outcomes included **sputum volume** during the intervention and 24 h later **at month 12**, **exacerbations, quality of life, sputum analyses, pulmonary function, exercise capacity, systemic inflammation, treatment adherence, and side effects**.



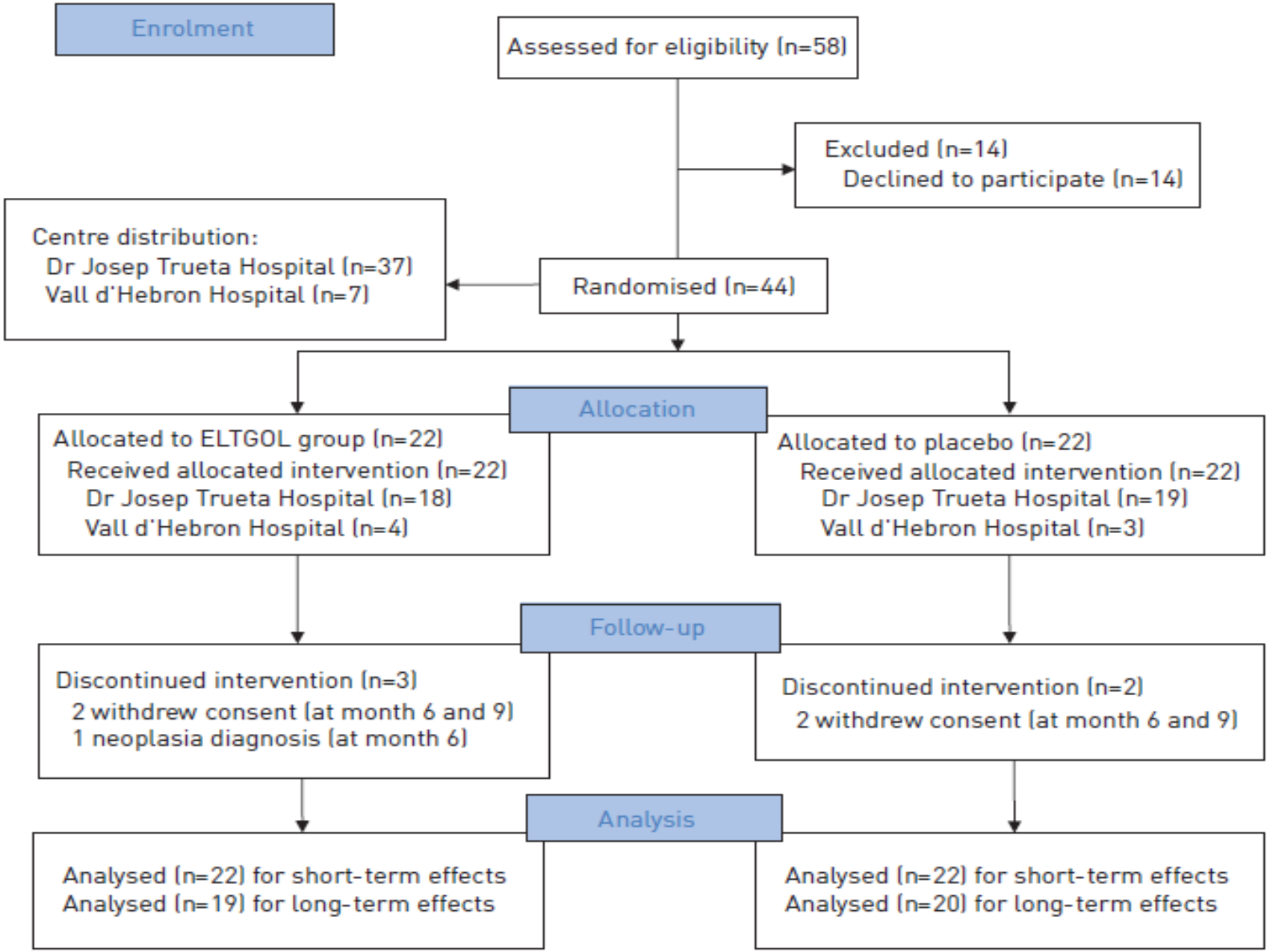


FIGURE 1 Trial profile.

TABLE 2 Sputum volume obtained during the study

	Sputum volume mL		p-value
	ELTGOL group	Placebo group	
Baseline 24-h	20 (15–40)	15 (15–20)	0.061
Visit 2 overall 24-h	40 (23.75–60)	12.5 (0–20)	<0.001
During intervention	12.27±11.93	0	
24 h later	30 (20–45)	12.5 (0–20)	<0.001
Difference between visit 2 and baseline[+]	17.5 (10–26.25)	−5 (−11.25–0)	<0.001
Month 12 overall 24-h	35 (30–50)	15 (10–20)	<0.001
During intervention	10.83±5.21	0	
24 h later	25 (20–40)	15 (10–20)	0.001
Difference between month 12 and baseline[#]	10 (−5–25)	0 (−10–3.75)	0.015
Difference between month 12 and visit 2[¶]	−5 (−30–5)	5 (5–10)	0.019

TABLE 3 Quality of life, pulmonary function, dyspnoea scale, exercise capacity and inflammatory markers between the groups at the beginning and the end of the study

	ELTGOL			Placebo			p-value[#]
	Baseline	Month 12	Between-group differences	Baseline	Month 12	Between-group differences	
SGRQ total score	40.2±13.7	33.7±15.7	−6.8 (−15.1–1.5)[+]	35.0±9.9	47.6±12.8	11.4 (6.9–15.9)[+]	<0.001
LCQ total score	14.5±3.4	16.2±3.2	1.96 (0.2–3.8)[+]	15.7±2	13.7±2.1	−2 (−2.8– −1.2)[+]	<0.001
Exacerbations	2 (1–3.25)	1 (0–2)	−0.8 (−1.5– −0.1)[¶]	1(0.75–2.25)	2 (1–3)	0.35 (−0.5–0.35)[¶]	0.042
FEV_1% predicted	58.1±22.9	57.9±25	−0.4 (−3.5–2.8)[+]	64.6±21.1	61.3±21	−2.5 (−4.7– −0.2)[+]	0.262
FEV_1 L	1.6±0.8	1.6±0.8	−0.004 (−0.1–0.03)[+]	1.5±0.4	1.5±0.4	−0.1 (−0.2–0.004)[+]	0.407
mMRC	1 (0–1.25)	1 (0–1)	0 (−0.5–0)[¶]	1 (1–1.25)	1 (1–2)	0.5 (0–0.5)[¶]	0.127
6MWT m	417.8±67	423.5±84.9	2.3 (−16.7–21.2)[+]	382.9±76.9	377.8±57.3	−2.6 (−29.3–24.1)[+]	0.746
ESR mm	22.3±26.5	17.1±17.5	9 (7–23)[+]	25.5±22.3	23.9±17.6	24 (7.3–34.5)[+]	0.863
Leukocytes $\times 10^3\ \mu L^{-1}$	6.9±2	7.5±2	0.03 (−0.8–0.9)[+]	7.5±2.2	7.7±2.7	0.6 (−0.2–1.3)[+]	0.641
Neutrophils %	59.7±8.7	60±8.9	−1.6 (−6.6–3.3)[+]	58.5±8.4	57.9±12.1	−1.4 (−6–3.2)[+]	0.945
CRP $mg \cdot dL^{-1}$	0.7±0.9	1.7±2.7	0.7 (−0.7–2.2)[+]	0.6±0.5	0.7±0.6	0.06 (−0.3–0.4)[+]	0.619
Fibrinogen $mg \cdot dL^{-1}$	425.5±69	468.6±1000.5	43.9 (−31.3–119)[+]	449.6±930.5	492.6±125.2	59.3 (−13.8–132.3)[+]	0.756

Conclusion

- Twice-daily ELTGOL technique over 1 year in bronchiectasis

→facilitated secretion removal

→associated with fewer exacerbations, improved quality of life, and reduced cough impact

Treatable traits in bronchiectasis

Rita Boaventura[1], Oriol Sibila [2], Alvar Agusti[3] and James D. Chalmers[4]

-Eur Respir J 2018; 52

Proposed treatable traits of bronchiectasis separated into aetiological, pulmonary, non-pulmonary and environment/lifestyle categories

	Diagnostic criteria	Treatment	Expected benefits of treatment
Pulmonary			
Infection[#]	Clinical features Sputum characteristics Inflammatory markers Sputum culture	Airway clearance [33, 34] Prompt treatment of exacerbations Long term oral or inhaled antibiotics	Reduce exacerbations Improve quality of life
Chronic *Pseudomonas* infection	Two or more culture isolates at least 3 months apart in 1 year [35]	Long term inhaled antibiotics Long term macrolides Airway clearance Eradication at first isolation [8]	Reduce exacerbations Improve quality of life [36] Slow lung function decline Prevent chronic infection [37]
Mucus hypersecretion	Volume Colour of sputum	Airway clearance Airway adjunct devices [27, 28] Mucoactive drugs Anti-inflammatories	Reduce sputum volume Reduce viscosity/increase ease of expectoration
Mucus plugging	Clinical features CT scan	Airway clearance Mucoactive drugs Nebulised saline Anti-inflammatories	Reduce sputum volume Reduce viscosity/increase ease of expectoration
Airflow obstruction	$FEV_1/FVC<LLN$ Fixed ratio spirometry GLI equations	Bronchodilators Smoking cessation Exercise	Improved exercise capacity and functional status [8]
Asthma	Bronchodilator reversibility Peak expiratory flow variability Elevated sputum or blood eosinophils	ICS Systemic corticosteroids Bronchodilator Leukotriene receptor antagonists Monoclonal antibody anti-IL-5, anti-IgE [38]	Reduce exacerbations
Eosinophilia	Elevated sputum or blood eosinophils Exclude other causes of eosinophilia	ICS Systemic corticosteroids Treatment for underlying cause	Improve QoL and treatment response
NTM infection[¶]	Positive culture and clinical/radiological findings	Long term antibiotic [39]	Improve QoL and achieve remission [40, 41]
Aspergillus sensitisation	Elevated specific IgE/prick test positive	ICS Systemic corticosteroids Antifungals	Reduce exacerbations Reduce sputum production Improved QoL [21]
Bronchial hyperreactivity	Challenge tests	ICS	Reduce exacerbations
Cough hypersensitivity	Clinical features Search other potential extrapulmonary causes Capsaicin cough challenge	Antitussive Chest physiotherapy	Improve QoL

Aetiological			
Primary immunodeficiencies	Serum immunoglobulins levels Specific antibody levels	Reference to immunology specialist Immunoglobulin replacement	Improve outcome Improve QoL Prevent lung damage
Cystic fibrosis	Clinical features Sweat chloride testing, CFTR genetic analysis and/or CFTR physiological testing	Reference to cystic fibrosis clinic CFTR modulators DNAse	Improve outcome Improve QoL Prevent lung damage
Primary ciliary dyskinesia	Clinical features[+] Nasal NO assay Electron microscopy ciliary structure analysis or video recording ciliary function analysis Genetic testing [42, 43]	Genetic counselling Intensive airway clearance Management of upper airway symptoms	Improve outcome Improve QoL Prevent lung damage
ABPA[¶]	Raised specific IgE and/or positive prick skin test to fungi, raised total IgE Other: eosinophilia, radiological features, raised specific IgG/precipitating antibodies against fungi [8]	Systemic corticosteroids and/or antifungals Monoclonal antibody anti-IgE ICS	Improve outcome Improve QoL Prevent lung damage
CTD	Clinical features Serum antibodies	Reference to rheumatologist Immunosuppressors	Improve outcome Improve QoL Prevent lung damage

Extrapulmonary (comorbidities)			
Depression/anxiety	Questionnaires Psychologist/liaison Psychiatrist assessment	Anxiety management Breathing retraining Cognitive behavioural therapy Pharmacotherapy Support groups	Improve QoL
Obesity/underweight	Body mass index	Nutritional evaluation Regular physical activity	Improve QoL and outcome
GORD	Clinical features Gastric endoscopy pH monitoring	Proton pump inhibitor H2-antagonist Surgery (fundoplication)	Improve QoL
Cardiovascular disease	Clinical features Electrocardiogram Echocardiogram BNP Stress testing	ACE inhibitors Diuretics β-blockers Revascularisation Reference to cardiologist	Improve QoL and outcome
Rhinosinusitis	Clinical features Imaging	Nasal steroids Leukotriene receptor antagonists Antihistamines Immunotherapy Surgery	Improve QoL
Iron deficiency anaemia	Full blood count Reticulocyte count Serum iron tests Exclude other causes	Oral iron supplements Treatment of underlying cause	Improve QoL and exercise capacity
Environment and lifestyle			
Smoking	Patient reported Exhaled carbon monoxide	Tobacco cessation support Nicotine replacement Antidepressants	Improve QoL, lung function, exercise capacity, response to treatment
Lack of exercise/ sedentarism	Cardiopulmonary exercise testing 6-min walk test	Exercise regularly Pulmonary rehabilitation Prescribed exercise programmes	Improve QoL and outcome
Adherence	Prescription refill rate Patient feedback	Education Written instructions Self-management	Improve outcome
Exposure to air pollution	PM_{10} and NO_2 concentrations	Reduce exposure	Reduce exacerbations [44]

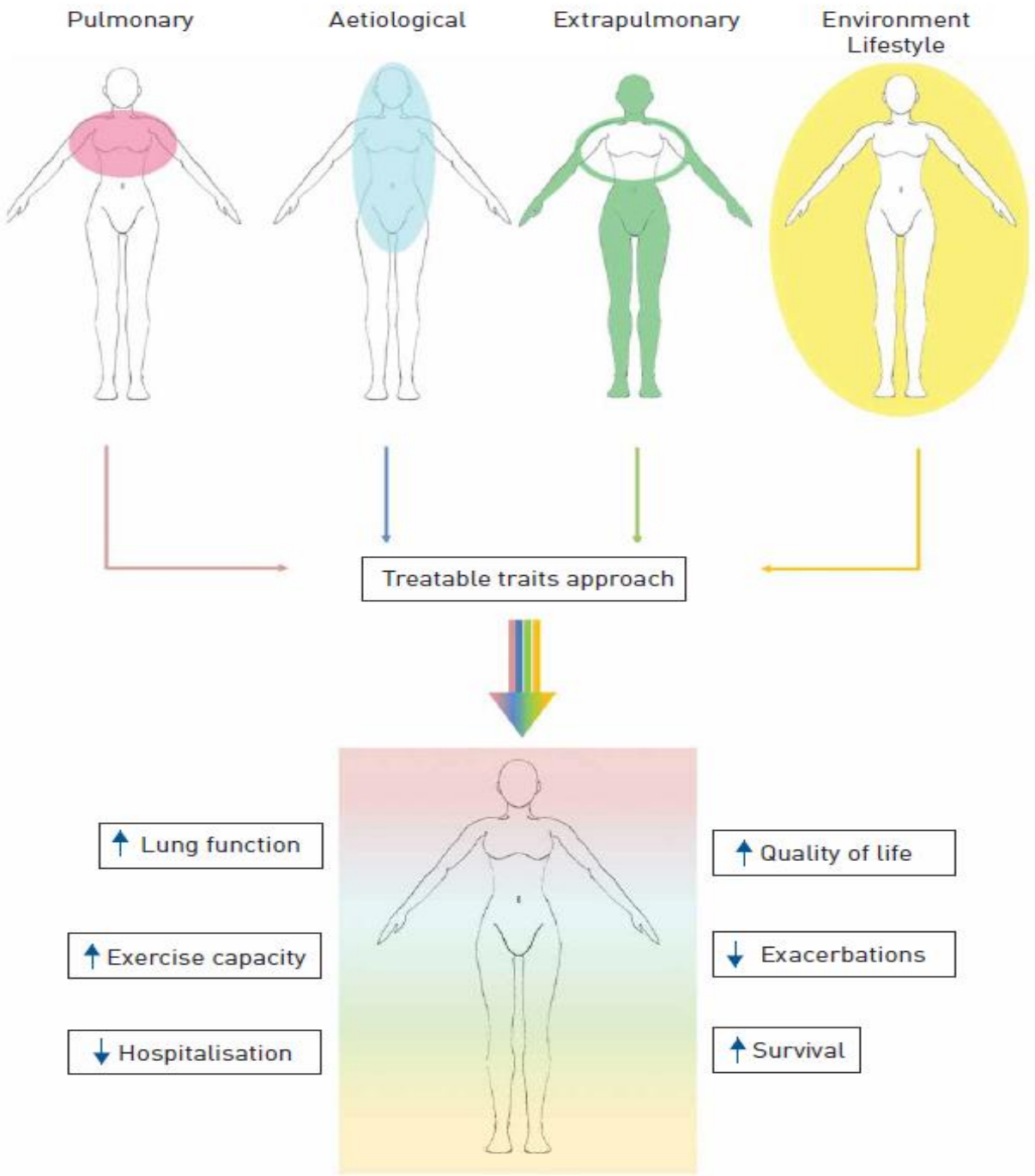


FIGURE 1.

Using the treatable traits concept to improve treatment outcomes in bronchiectasis. Recognition and treatment of multiple pulmonary, aetiological, extrapulmonary and environmental/lifestyle associated traits should lead to more holistic treatment and a greater impact on relevant clinical outcomes.

-Eur Respir J 2018; 52

US Patient-Centered Research Priorities and Roadmap for Bronchiectasis

Emily Henkle, PhD, MPH; Timothy R. Aksamit, MD; Charles L. Daley, MD; David E. Griffith, MD,

Priority	Objectives	
1. Improve treatment of bronchiectasis and prevent exacerbations	2. Improve treatment of exacerbations and associated infections	2.1. Update treatment guidelines for chronic co-infections with pathogens including NTM. 2.2. Establish a standardized definition of exacerbation of bronchiectasis. 2.3. Evaluate the optimal duration of antibiotics for the treatment of acute infectious exacerbations of bronchiectasis. 2.4. Establish updated and more broadly applicable guidelines to the approach of acute exacerbations of bronchiectasis. 2.5. Evaluate the role of culture of respiratory secretions at baseline and during exacerbations on the impact of response to antibiotics and clinical outcomes. 2.6. Explore the impact of specific elements of symptoms and signs of exacerbations on the sensitivity and specificity of exacerbation definition. 2.7. Evaluate the utility of *in vitro*/*in vivo* antibiotic susceptibility testing for guiding antibiotic treatment regimens.

- CHEST 2018; 154(5):1016-1023

Summary

- **Epidemiology**
  - *Characteristics and Health-care Utilization History of Patients With Bronchiectasis in US Medicare Enrollees With Prescription Drug Plans, 2006 to 2014. Chest 2018; 154:1311.*
- **Clinical features**
  - *Characterization of the "Frequent Exacerbator Phenotype" in Bronchiectasis. AJRCCM 2018; 197:1410.*
- **Imaging study**
  - *The BRICS (Bronchiectasis Radiologically Indexed CT Score): A Multicenter Study Score for Use in Idiopathic and Postinfective Bronchiectasis. Chest 2018; 153:1177.*
- **Treatment**
  - *Long-term benefits of airway clearance in bronchiectasis: a randomised placebo-controlled trial. ERJ 2018; 51.*
  - *Treatable traits in bronchiectasis. ERJ 2018; 52*
- **Future research**
  - *US Patient-Centered Research Priorities and Roadmap for Bronchiectasis. Chest 2018; 154:1016.*