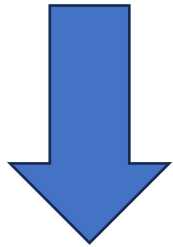


# Disease *Severity* vs. *Activity* in Bronchiectasis

한림의대 호흡기내과  
최하영

# What are disease severity and activity for?

- Accurately identifying patients at high risk of
  - Exacerbations
  - Hospitalizations
  - Mortality



- Proper clinical decision-making

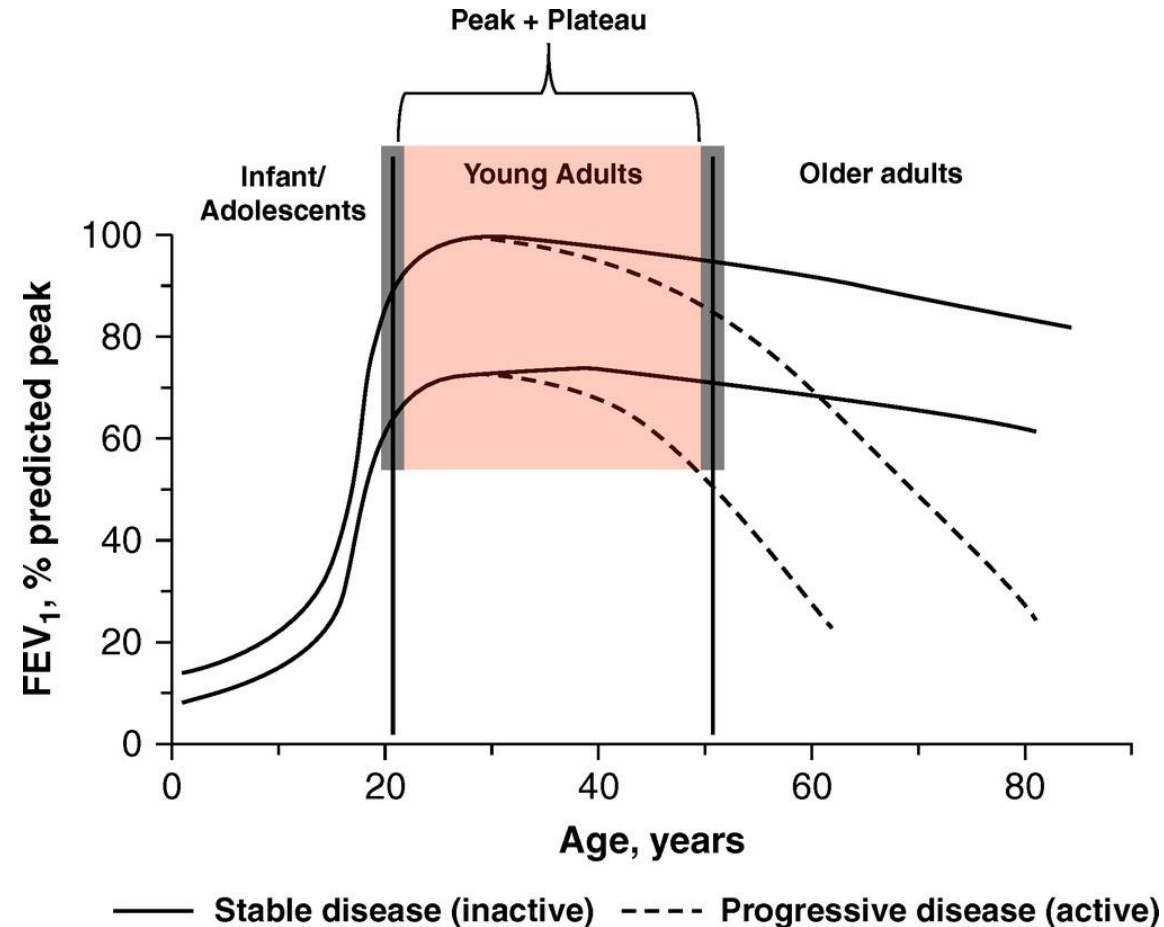


# Definitions

- Disease **severity**
  - **the extent of organ damage or physiologic decompensation for a patient**
  - measured **cross-sectionally** (mild/moderate/severe)
- Disease **activity**
  - **Biologic** term – **activation level of pathobiological processes**
  - ideally identified and quantified by **biomarkers**
- Disease **progression**
  - **Clinical** term – a **deterioration** over time in an **objective marker** of pathology

# Example of COPD

**FEV1**  
Marker of  
disease severity



**1. Disease severity**

**2. Disease progression**  
= change in disease severity

**3. Disease activity**  
= associated with different  
rate of disease progression

# Agenda

1. Disease severity
2. Disease activity
3. How to integrate disease severity and activity in bronchiectasis



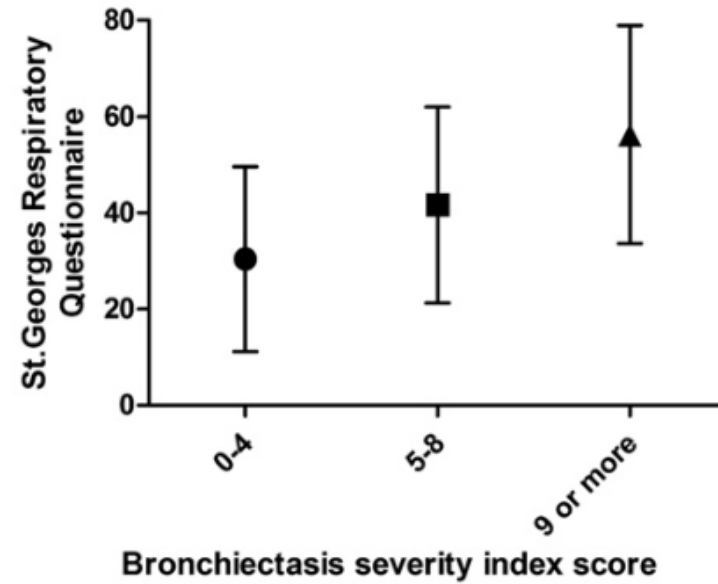
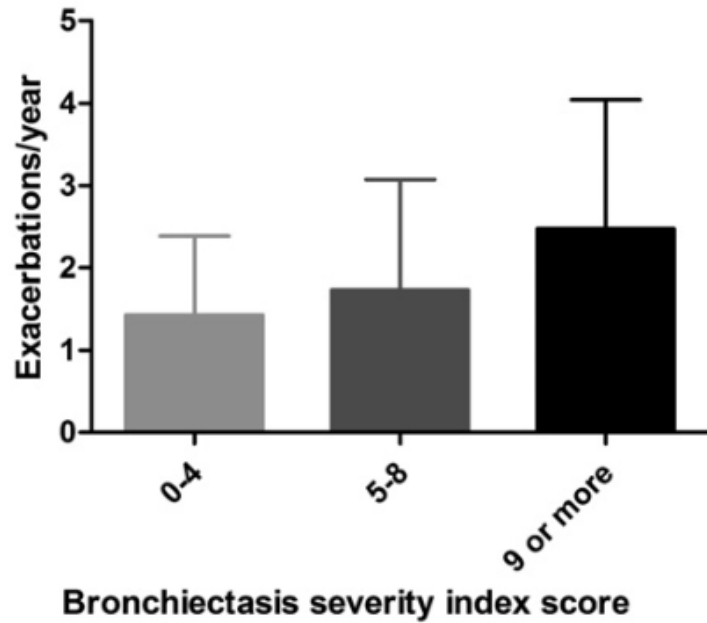
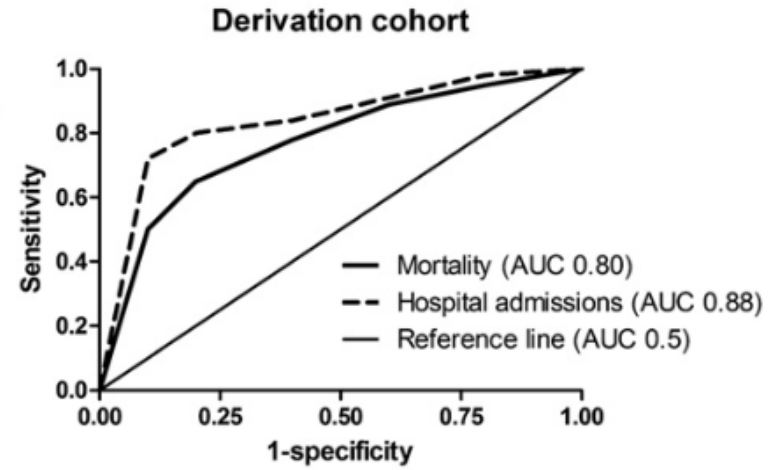
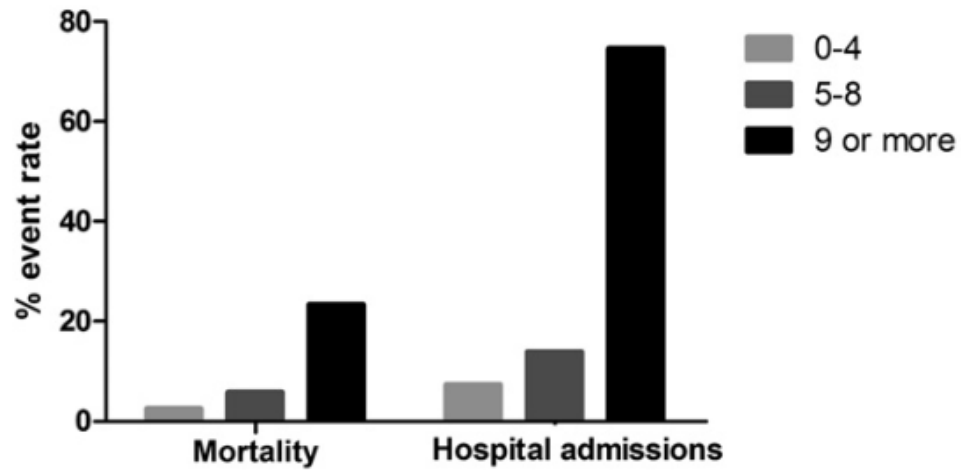
## The Bronchiectasis Severity Index

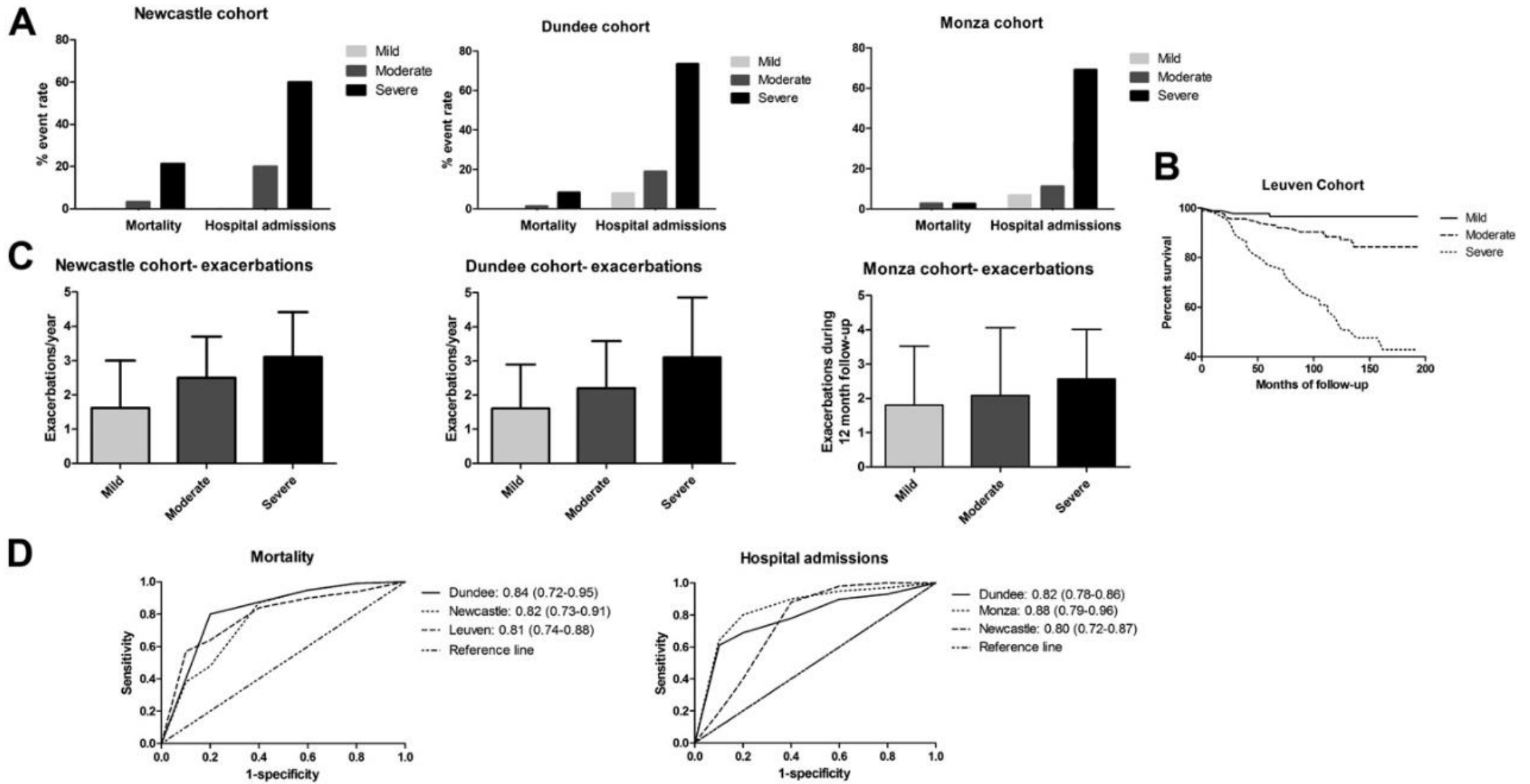
### An International Derivation and Validation Study

James D. Chalmers<sup>1</sup>, Pieter Goeminne<sup>2</sup>, Stefano Aliberti<sup>3</sup>, Melissa J. McDonnell<sup>4,5</sup>, Sara Lonni<sup>3</sup>, John Davidson<sup>4</sup>, Lucy Poppelwell<sup>1</sup>, Waleed Salih<sup>1</sup>, Alberto Pesci<sup>3</sup>, Lieven J. Dupont<sup>2</sup>, Thomas C. Fardon<sup>1</sup>, Anthony De Soya<sup>4,5</sup>, and Adam T. Hill<sup>6</sup>

Severity Marker	HR (95% CI) for Hospital Admissions during Follow-up	HR (95% CI) for Mortality	Score Points
Age, yr			
<50	1.0 (reference)	1.0 (reference)	0
50–69	1.38 (0.73–2.56)	2.21 (0.28–17.5)	2
70–79	1.50 (0.79–2.82)	8.57 (1.15–63.63)	4
80+	1.76 (0.89–3.50)	23.16 (3.09–173.7)	6
BMI			
<18.5	1.23 (0.73–2.08)	2.25 (1.09–4.67)	2
18.5–25	1.0 (reference)	1.0 (reference)	0
26–29	0.90 (0.62–1.30)	0.91 (0.46–1.81)	0
30 or more	1.14 (0.76–1.70)	1.38 (0.68–2.81)	0
FEV <sub>1</sub> % predicted			
>80	1.0 (reference)	1.0 (reference)	0
50–80	1.17 (0.74–1.85)	1.34 (0.67–2.67)	1
30–49	1.40 (0.68–2.85)	1.58 (0.72–3.46)	2
<30	1.52 (1.03–2.25)	4.47 (1.60–12.53)	3
Hospital admission before study			
No	1.0 (reference)	1.0 (reference)	0
Yes	13.5 (9.40–19.46)	2.43 (1.30–4.53)	5
Exacerbations before the study			
0	1.0 (reference)	1.0 (reference)	0
1–2	1.67 (0.78–3.58)	1.78 (0.80–3.98)	0
3 or more	2.25 (0.89–5.70)	2.03 (1.02–4.03)	2
MRC dyspnea score			
1–3	1.0 (reference)	1.0 (reference)	0
4	2.42 (1.66–3.52)	1.05 (0.50–2.20)	2
5	2.69 (1.59–4.53)	1.15 (0.50–2.63)	3
Pseudomonas colonization			
No	1.0 (reference)	1.0 (reference)	0
Yes	2.16 (1.36–3.43)	1.58 (0.75–3.34)	3
Colonization with other organisms			
No	1.0 (reference)	1.0 (reference)	0
Yes	1.66 (1.12–2.44)	1.10 (0.54–2.24)	1
Radiological severity: ≥3 lobes involved or cystic bronchiectasis			
No	1.0 (reference)	1.0 (reference)	0
Yes	1.48 (1.02–2.15)	1.05 (0.57–1.94)	1

- Edinburgh – construction cohort
- Cox proportional hazard regression – used to identify independent predictors of **mortality and hospitalization over 4-yr FU**
- Mild (0–4)  
Moderate (5–8)  
Severe (≥9)





# Multidimensional approach to non-cystic fibrosis bronchiectasis: the FACED score

Miguel Á. Martínez-García<sup>1,2</sup>, Javier de Gracia<sup>2,3,4</sup>, Monserrat Vendrell Relat<sup>2,5</sup>, Rosa-Maria Girón<sup>6</sup>, Luis Máiz Carro<sup>7</sup>, David de la Rosa Carrillo<sup>8</sup> and Casilda Oliveira<sup>9</sup>

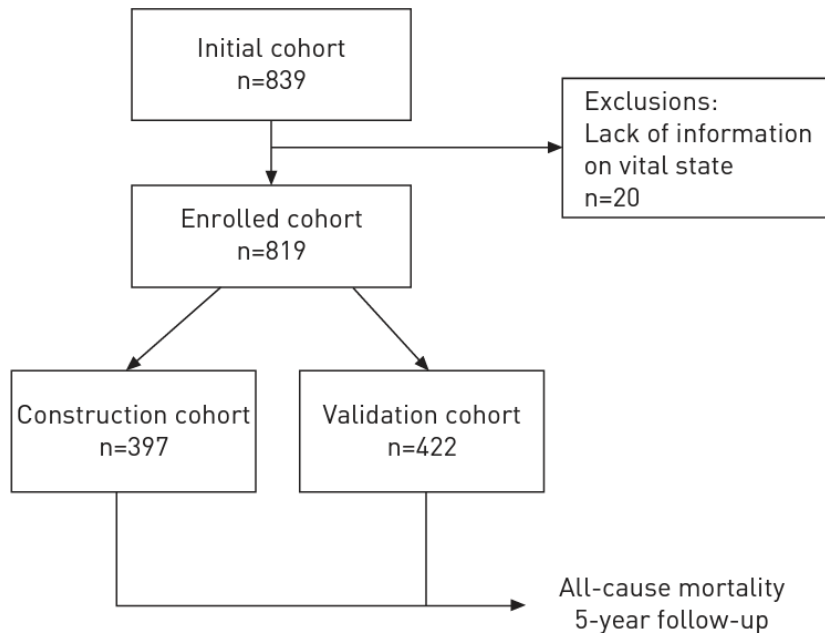


TABLE 4 Predictive capacity for mortality of the 12 initial eligible variables for inclusion in the score

	OR (95% CI)	p-value
<b>Age years</b>	<b>1.08 (1.04–1.11)</b>	<b>0.001</b>
<b>Dyspnoea mMRC score</b>	<b>2.42 (1.23–4.8)</b>	<b>0.01</b>
<b>Post-bronchodilator FEV<sub>1</sub></b>	<b>0.96 (0.94–0.97)</b>	<b>0.0001</b>
<b>Lobes affected</b>	<b>1.41 (1.07–1.86)</b>	<b>0.016</b>
<b>Chronic colonisation by <i>Pseudomonas aeruginosa</i></b>	<b>1.95 (1.01–3.76)</b>	<b>0.045</b>
<b>Body mass index kg·m<sup>-2</sup></b>	0.95 (0.87–1.05)	0.30
<b>Sex</b>	1.64 (0.82–3.25)	0.16
<b>Isolation of fungi</b>	1.22 (0.52–2.86)	0.65
<b>Isolation of atypical mycobacteria</b>	1.9 (0.42–8.72)	0.41
<b>Purulence of sputum</b>	0.8 (0.5–1.15)	0.21
<b>Hospitalisations in previous year</b>	1.18 (0.95–1.45)	0.14
<b>Respiratory insufficiency</b>	1.91 (0.77–4.8)	0.16

Bold indicates statistical significance. mMRC: modified Medical Research Council; FEV<sub>1</sub>: forced expiratory volume in 1 s.

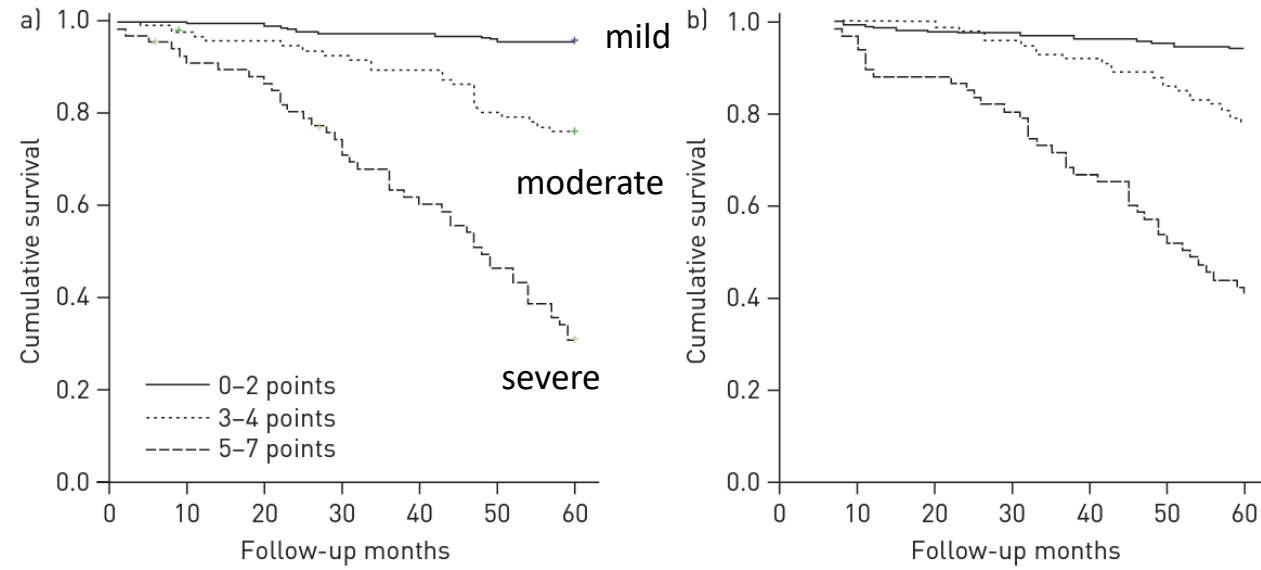
- Multivariate logistic regression analysis

TABLE 6 Final score, cut-off points of the dichotomised variables and scoring of each variable

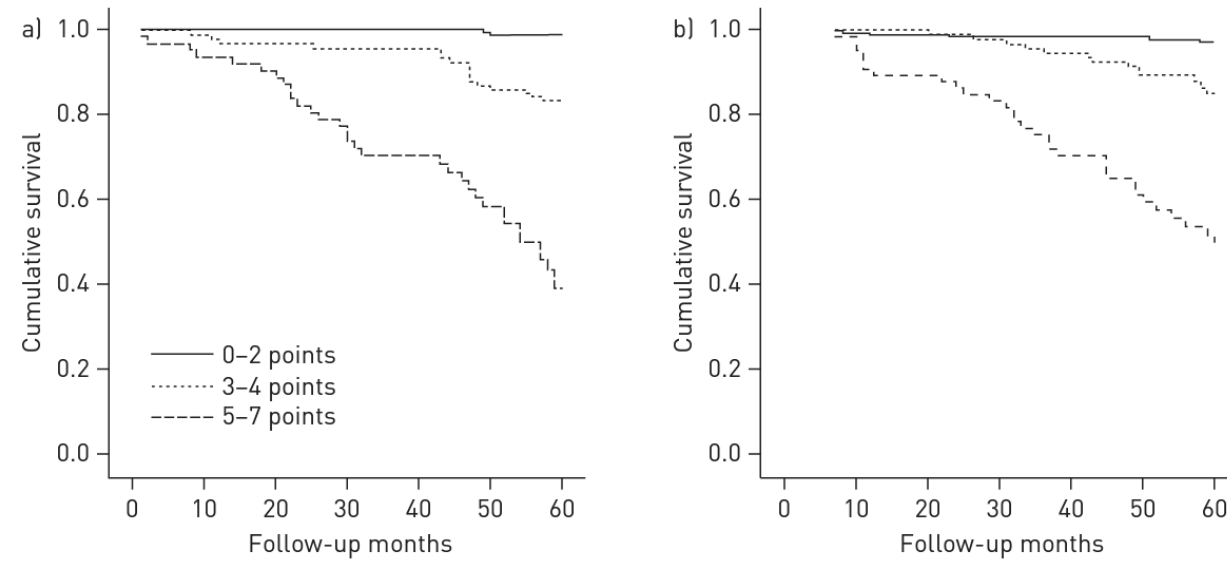
		Points
C	<b>Chronic colonisation by <i>Pseudomonas aeruginosa</i></b>	
	No	0
	Yes	1
D	<b>Dyspnoea mMRC score</b>	
	0–II	0
	III–IV	1
F	<b>FEV1 % predicted</b>	
	≥50%	0
	<50%	2
A	<b>Age</b>	
	<70 years	0
	≥70 years	2
E	<b>Number of lobes</b>	
	1–2	0
	>2	1

Maximum score 7 points. mMRC: modified Medical Research Council; FEV1: forced expiratory volume in 1 s.

## All cause mortality



## Respiratory mortality



## Multidimensional severity assessment in bronchiectasis: an analysis of seven European cohorts

M J McDonnell,<sup>1,2,3</sup> S Aliberti,<sup>4,5</sup> P C Goeminne,<sup>6,7</sup> K Dimakou,<sup>8</sup> S C Zucchetti,<sup>4,5</sup> J Davidson,<sup>2</sup> C Ward,<sup>2</sup> J G Laffey,<sup>3,9</sup> S Finch,<sup>10</sup> A Pesci,<sup>11</sup> L J Dupont,<sup>6</sup> T C Fardon,<sup>10</sup> D Skrbic,<sup>12</sup> D Obradovic,<sup>12</sup> S Cowman,<sup>13</sup> M R Loebinger,<sup>13</sup> R M Rutherford,<sup>1</sup> A De Soyza,<sup>2</sup> J D Chalmers<sup>10</sup>

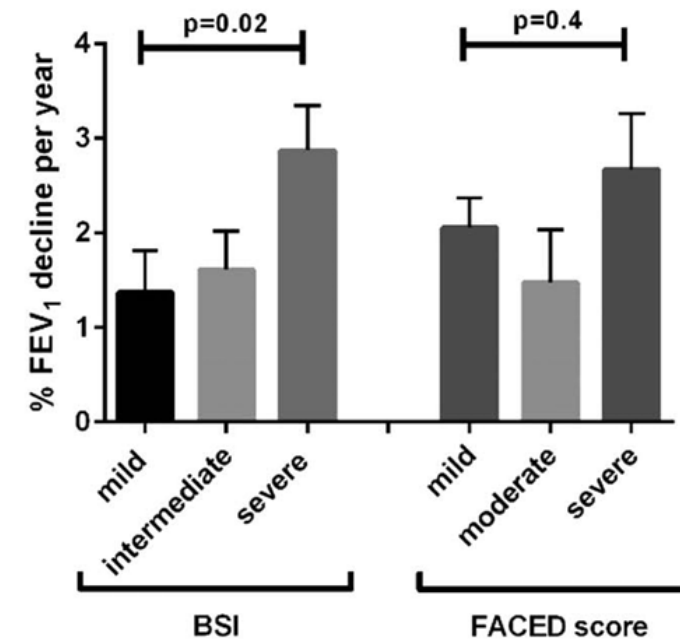
### Mortality and hospitalizations

**Table 3** Area under the receiver operator characteristic curve values for mortality and hospital admissions across seven European cohorts

Cohort	Scores	AUC mortality	AUC hospital admissions
Dundee, Scotland (n=494)	BSI	0.78 (0.71 to 0.85)	0.84 (0.80 to 0.88)*
	FACED	0.76 (0.70 to 0.83)	0.68 (0.63 to 0.73)
Galway, Ireland (n=280)	BSI	0.73 (0.64 to 0.81)	0.87 (0.80 to 0.93)
	FACED	0.71 (0.62 to 0.80)	0.79 (0.73 to 0.86)
Monza, Italy (n=250)	BSI	0.86 (0.75 to 0.96)	0.79 (0.73 to 0.85)*
	FACED	0.77 (0.64 to 0.90)	0.62 (0.55 to 0.70)
Leuven, Belgium (n=190)	BSI	0.73 (0.65 to 0.81)	0.71 (0.63 to 0.78)
	FACED	0.78 (0.70 to 0.86)	0.65 (0.57 to 0.74)
Athens, Greece (n=159)	BSI	0.93 (0.87 to 0.98)	0.76 (0.67 to 0.84)*
	FACED	0.87 (0.80 to 0.94)	0.62 (0.51 to 0.74)
Newcastle, England (n=126)	BSI	0.82 (0.73 to 0.91)*	0.80 (0.72 to 0.87)*
	FACED	0.68 (0.52 to 0.84)	0.56 (0.46 to 0.66)
Vojvodina, Serbia (n=113)	BSI	0.75 (0.65 to 0.85)	0.97 (0.93 to 1.00)*
	FACED	0.74 (0.64 to 0.85)	0.69 (0.58 to 0.81)
Pooled cohort (n=1612)	BSI	0.76 (0.74 to 0.78)	0.82 (0.78 to 0.84)*
	FACED	0.76 (0.74 to 0.78)	0.65 (0.63 to 0.67)

\*Indicates p<0.05 compared with FACED. BSI, Bronchiectasis Severity Index.

### FEV<sub>1</sub> decline



# Predicting mortality in bronchiectasis using bronchiectasis severity index and FACED scores: a 19-year cohort study

74 patients with a median 18.8 years of follow-up

Huw C. Ellis<sup>1,4</sup>, Steven Cowman<sup>1,2,4</sup>, Michele Fernandes<sup>3</sup>, Robert Wilson<sup>1,2</sup> and Michael R. Loebinger<sup>1,2</sup>

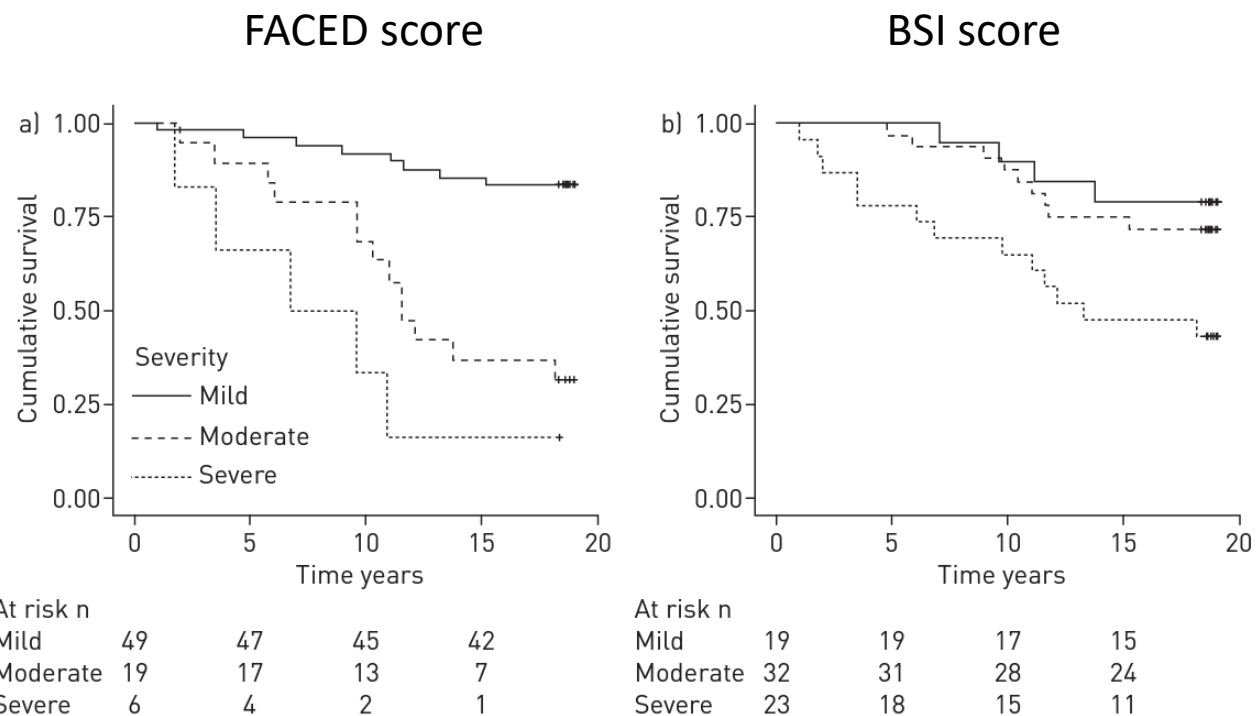
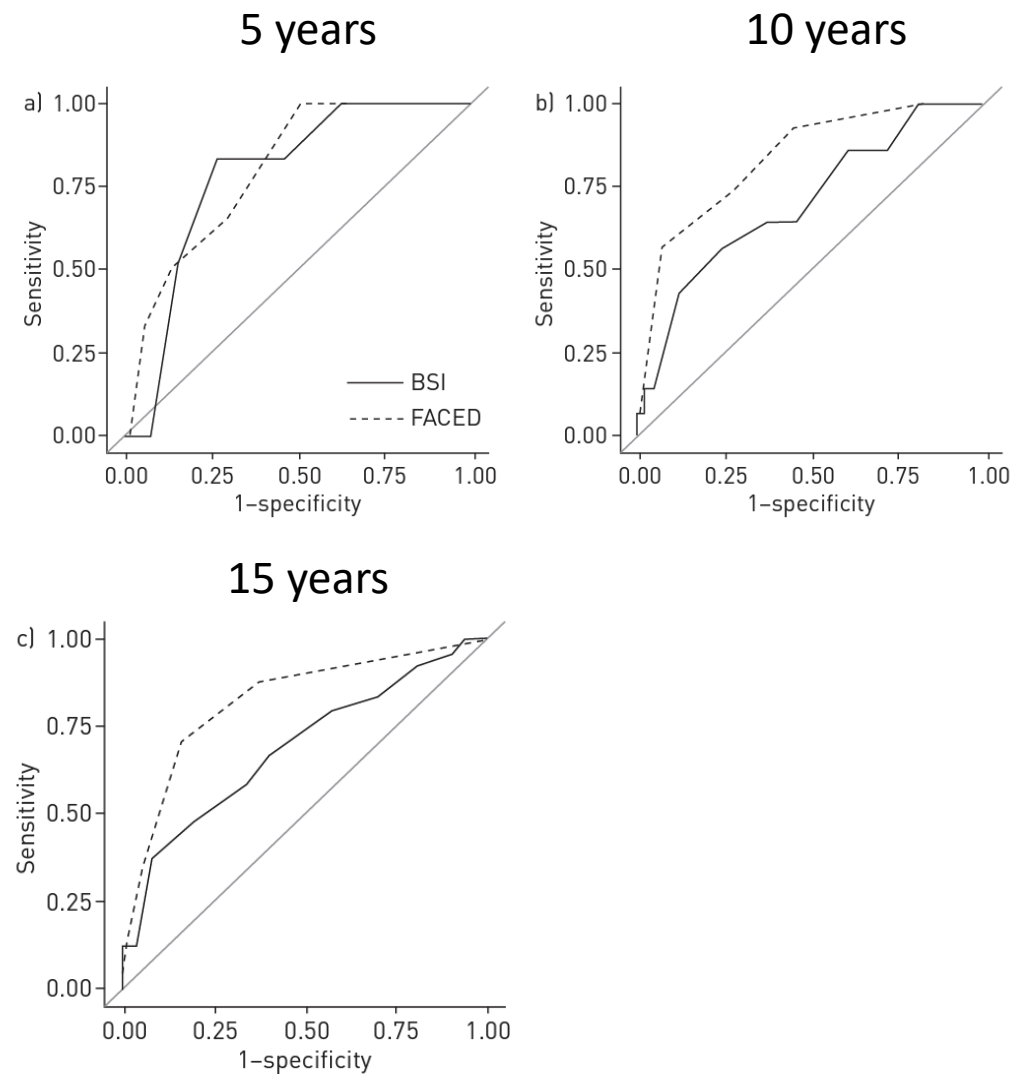


FIGURE 1 Kaplan-Meier curves for mortality during the study period corresponding to a) FACED score and b) bronchiectasis severity index score category.



# Comorbidities and the risk of mortality in patients with bronchiectasis: an international multicentre cohort study

Melissa J McDonnell, Stefano Aliberti, Pieter C Goeminne, Marcos I Restrepo, Simon Finch, Alberto Pesci, Lieven J Dupont, Thomas C Fardon, Robert Wilson, Michael R Loebinger, Dusan Skrbic, Dusanka Obradovic, Anthony De Soyza, Chris Ward, John G Laffey, Robert M Rutherford, James D Chalmers

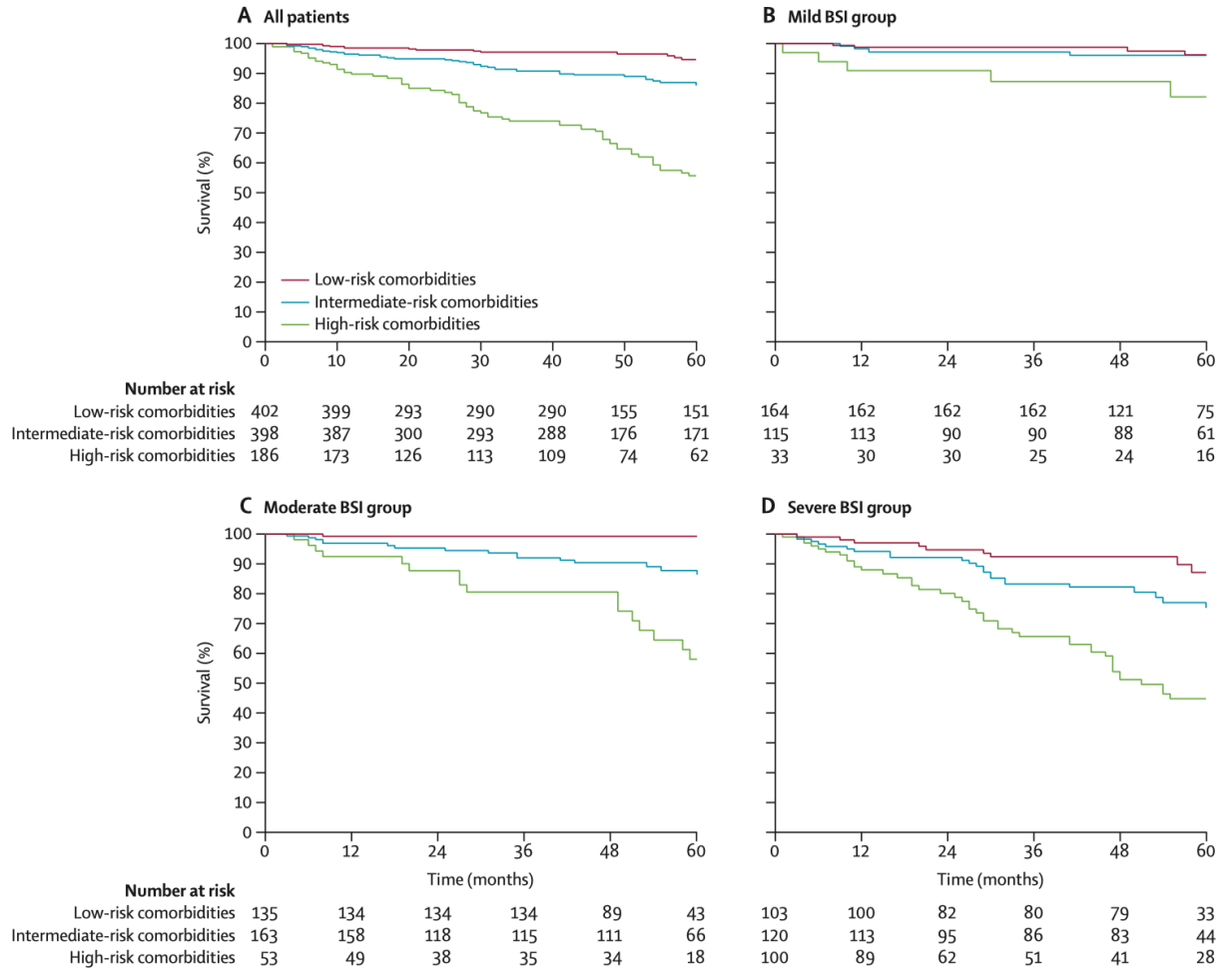
## BSI and BACI: 5-year mortality

### Bronchiectasis Aetiology Comorbidity Index (BACI)

	Hazard ratio (95% CI)	p value	Points
Metastatic malignancy	6.69 (3.53–12.68)	<0.0001	12
Haematological malignancy	2.85 (1.17–6.97)	0.02	6
COPD	2.22 (1.53–3.23)	<0.0001	5
Cognitive impairment	2.21 (0.82–6.01)	0.12	5
Inflammatory bowel disease	2.01 (0.75–5.40)	0.17	4
Liver disease	1.94 (0.80–4.72)	0.14	4
Connective tissue disease	1.78 (1.19–2.68)	0.005	3
Iron deficiency anaemia	1.78 (0.80–2.68)	0.16	3
Diabetes	1.76 (1.10–2.80)	0.02	3
Asthma	1.65 (1.00–2.73)	0.050	3
Pulmonary hypertension	1.58 (0.88–2.84)	0.12	3
Peripheral vascular disease	1.50 (1.00–2.25)	0.052	2
Ischaemic heart disease	1.31 (0.91–1.89)	0.14	2

These variables were then formed into prediction tools using the rounded averaged  $\beta$  coefficient to award points for each variable. The sum of the points intends to capture the effect of an individual disease or a combination of diseases on each patient.

**Table 2: Derivation of the Bronchiectasis Aetiology Comorbidity Index (BACI) and points allocation**



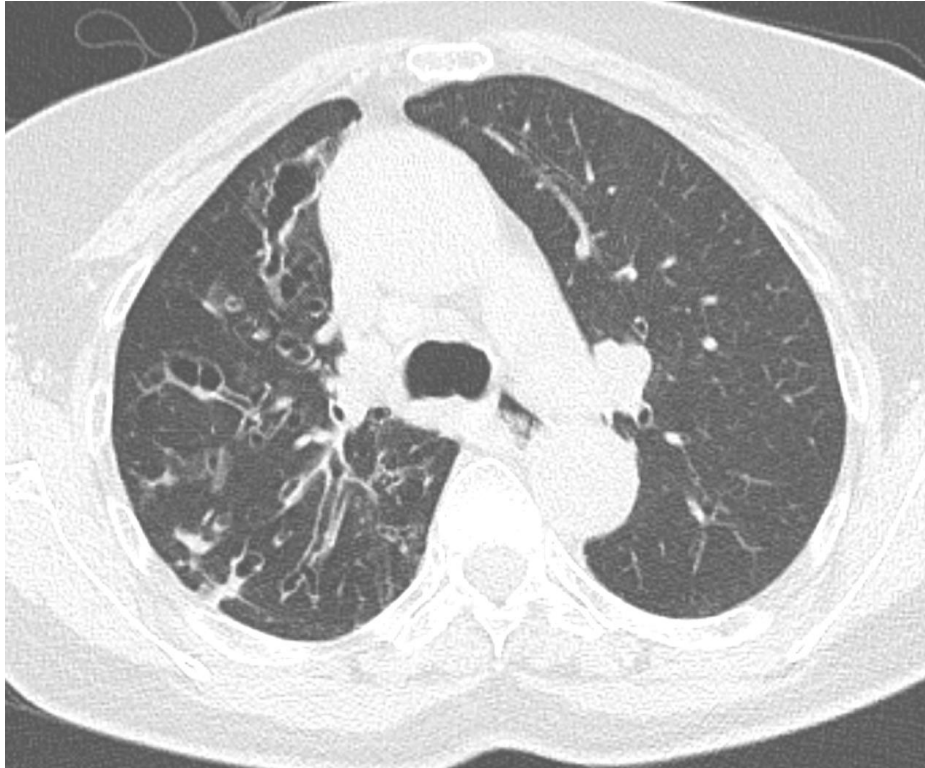
# Limitations of disease severity?

BSI
Age
BMI
FEV1
Hospitalization
Exacerbation
Dyspnea
<i>Pseudomonas</i> colonization
Other bacteria colonization
Radiological severity

FACED
<i>Pseudomonas</i> colonization
Dyspnea
FEV1
Age
Radiological severity

BACI
Metastatic malignancy
Hematologic malignancy
COPD
Cognitive impairment
IBD
Liver disease
Connective tissue disease
Iron deficiency anemia
Diabetes mellitus
Asthma
Pulmonary hypertension
Peripheral vascular disease
Ischemic heart disease

Which bronchiectasis is more **severe**?

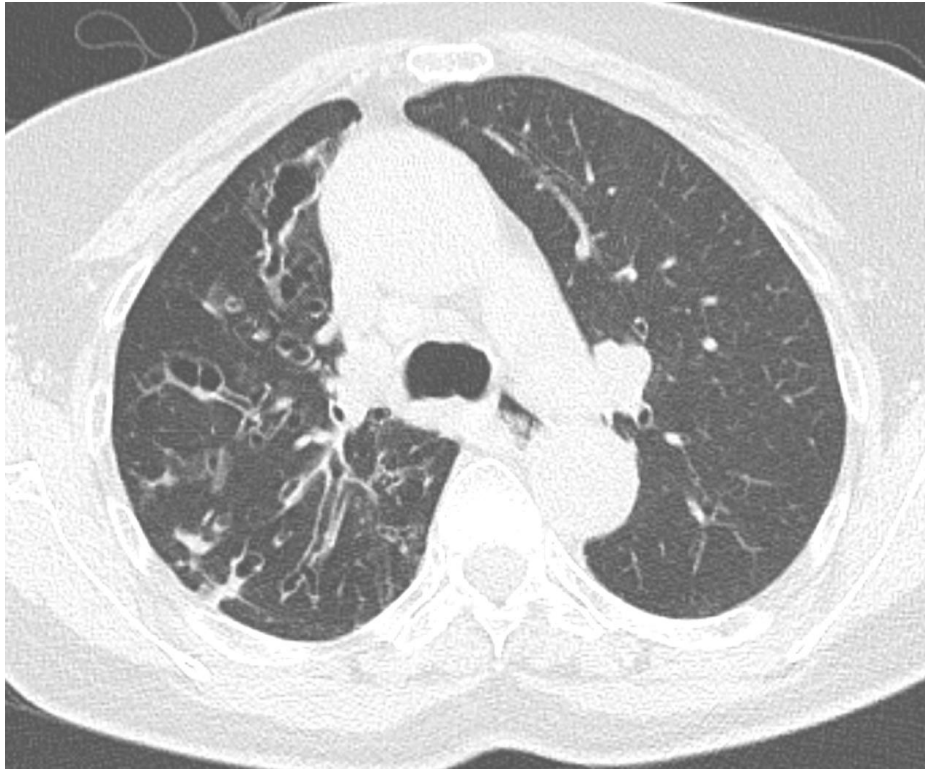


BSI = 9 (**severe** bronchiectasis)



BSI = 4 (**mild** bronchiectasis)

# Which bronchiectasis is more **active**?

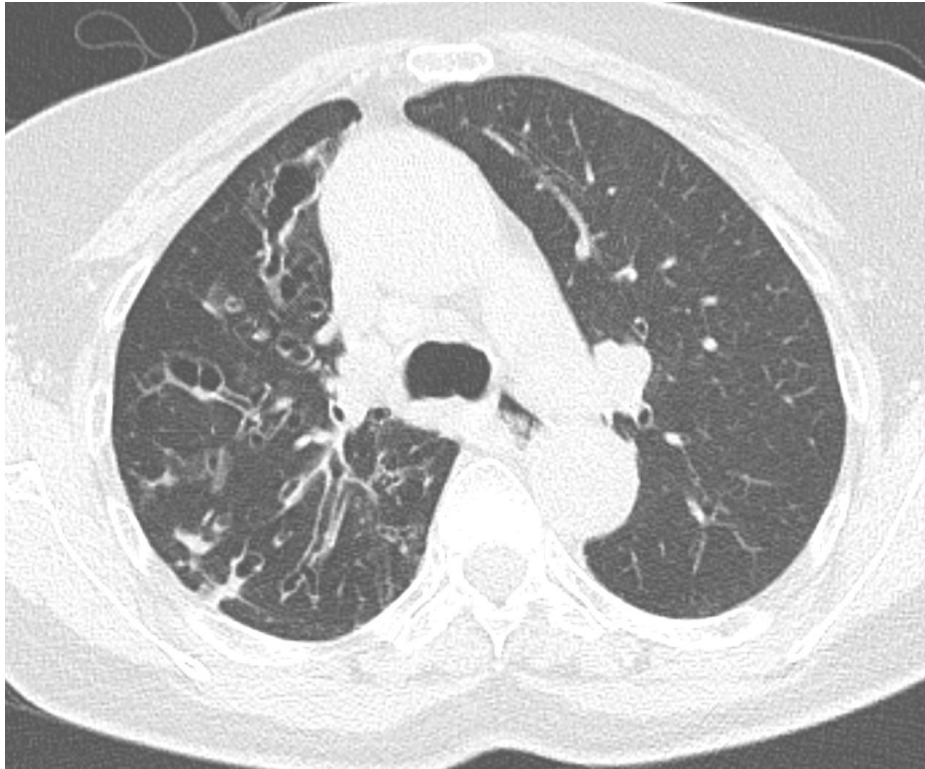


- Airway clearance technique + ICS
- **Low symptom burden**
- **Exacerbation** over the last 1 year = **0**



- **cough** and **purulent sputum**
- **exacerbations** over the 6 months = **3**
- recurred *M. avium* pulmonary disease

# Which should we pay **more attention** to?



severe but Inactive disease



mild but Active disease

# Which should we pay more attention to?



**Active disease**

# Agenda

1. Disease severity
2. Disease activity
  - 1) Symptoms
  - 2) Exacerbations
  - 3) Sputum neutrophil elastase
  - 4) Mucus plugging on chest CT
  - 5) CRP
3. How to integrate disease severity and activity in bronchiectasis

# 1) Symptoms

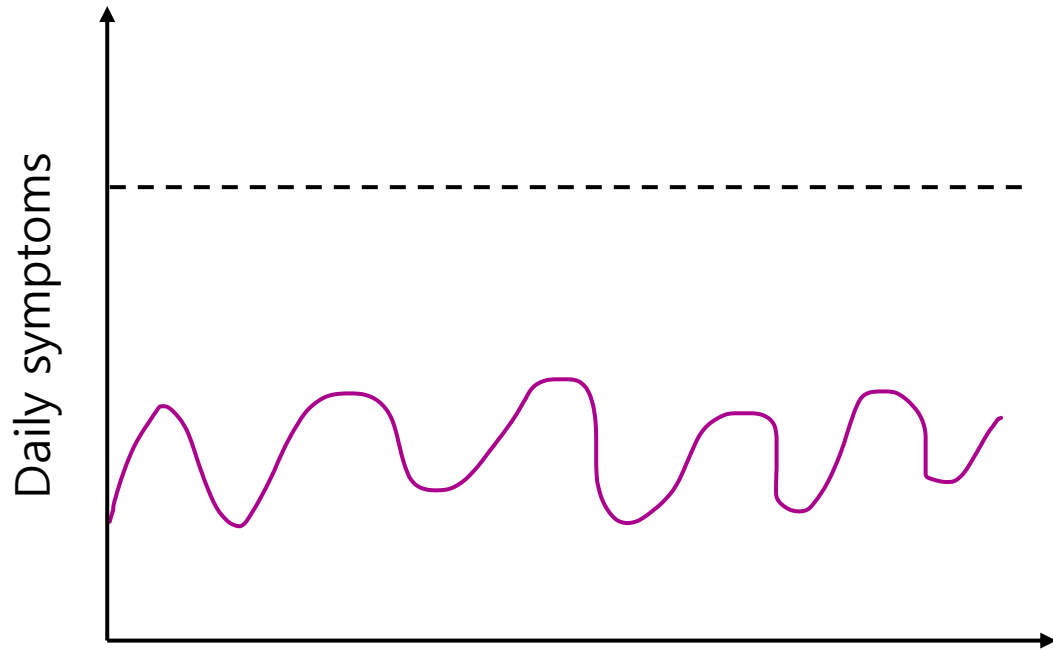
## ORIGINAL ARTICLE

### **Relationship between Symptoms, Exacerbations, and Treatment Response in Bronchiectasis**

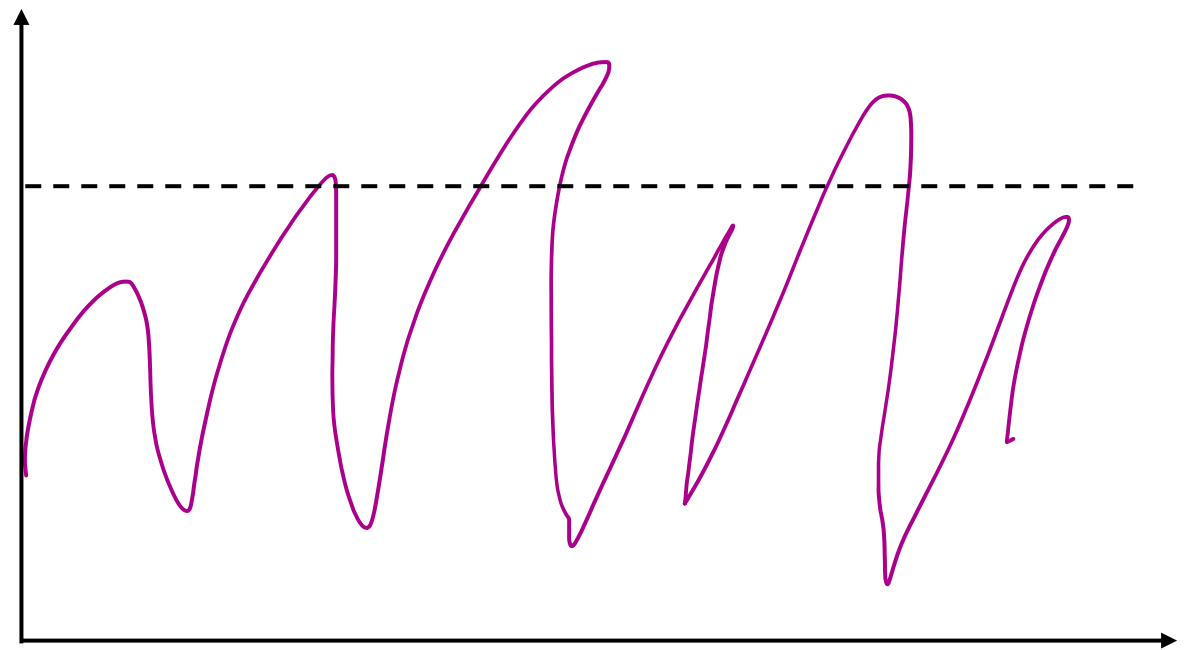
Yong-hua Gao<sup>1,2</sup>, Hani Abo Leyah<sup>2</sup>, Simon Finch<sup>2</sup>, Mike Loneran<sup>2</sup>, Stefano Aliberti<sup>3</sup>, Anthony De Soyza<sup>4</sup>, Thomas C. Fardon<sup>2</sup>, Gregory Tino<sup>5</sup>, and James D. Chalmers<sup>2</sup>

<sup>1</sup>Department of Respiratory and Critical Care Medicine, First Affiliated Hospital of Zhengzhou University, Zhengzhou, Henan, China; <sup>2</sup>Scottish Centre for Respiratory Medicine, University of Dundee, Dundee, United Kingdom; <sup>3</sup>Department of Pathophysiology and Transplantation, University of Milan, Milan, Italy; <sup>4</sup>Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, United Kingdom; and <sup>5</sup>Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania

# Threshold concept of exacerbation



Lower Daily symptoms



Greater Daily symptoms

**Table 2.** Relationship between baseline SGRQ and exacerbations

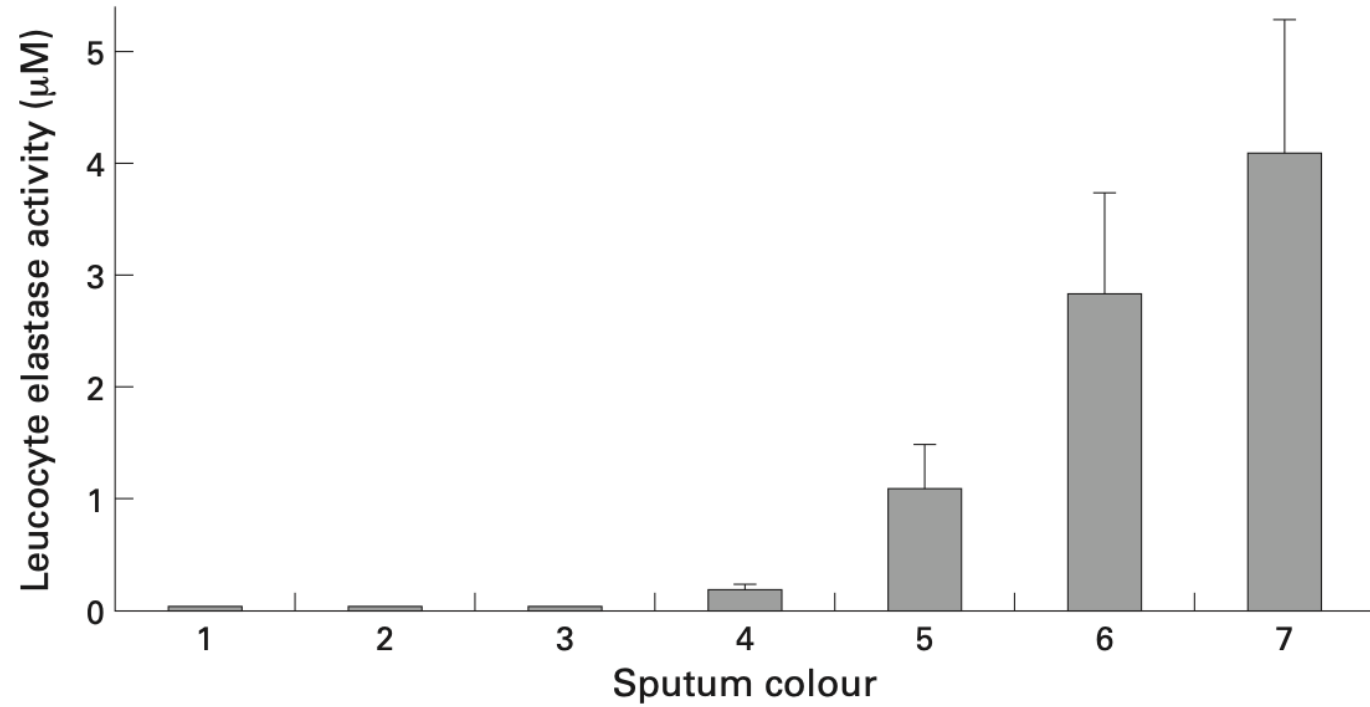
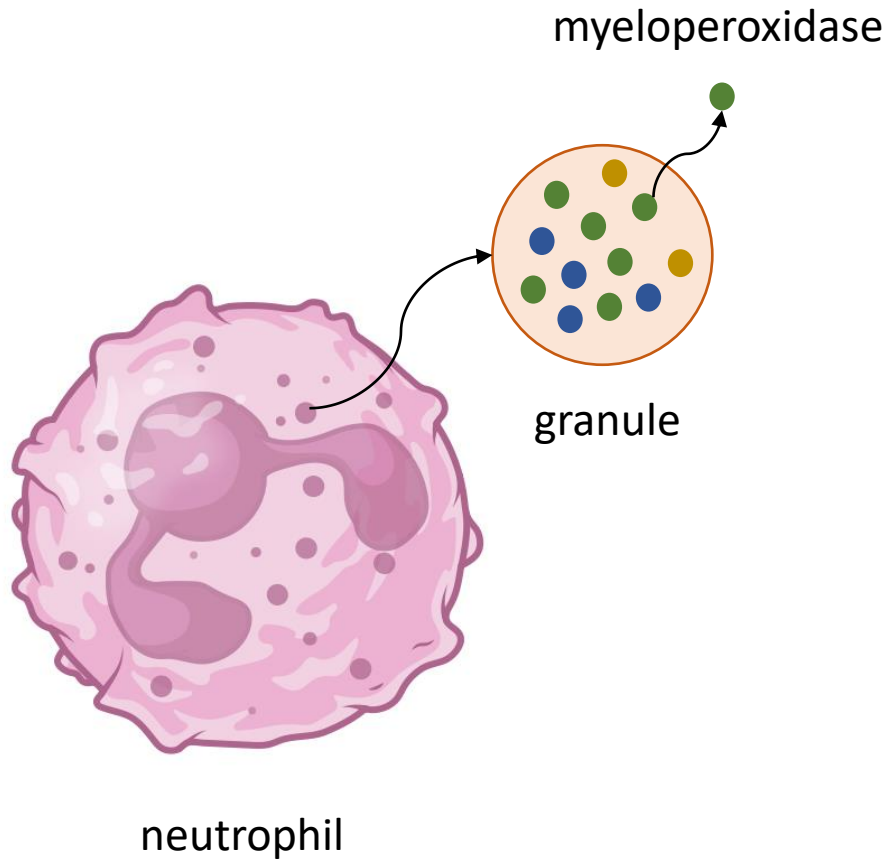
SGRQ Symptom Score	Exacerbations (Any)		Hospitalizations	
	Rate Ratio (95% CI)	P Value	Rate Ratio (95% CI)	P Value
Uncategorized score (unadjusted)	1.15 (1.09–1.21)	<0.001	1.27 (1.15–1.39)	<0.001
Uncategorized score (adjusted)*	1.10 (1.03–1.17)	0.005	1.19 (1.02–1.35)	0.03
Categorized score (unadjusted)				
Low (<40)	1	—	1	—
Moderate (40–70)	1.07 (0.73–1.58)	0.72	3.53 (1.31–9.54)	0.01
High (>70)	2.33 (1.61–3.37)	<0.001	6.88 (2.59–17.73)	<0.001
Categorized score (adjusted)*				
Low (<40)	1	—	1	—
Moderate (40–70)	1.01 (0.66–1.54)	0.96	2.29 (0.77–6.83)	0.14
High (>70)	1.74 (1.12–2.72)	0.01	3.28 (1.09–9.88)	0.04

- Not influenced by disease severity

- BSI ( $P_{\text{interaction}} = 0.25$ )
- FEV1 %pred ( $P_{\text{interaction}} = 0.62$ )

# Assessment of airway neutrophils by sputum colour: correlation with airways inflammation

R A Stockley, D Bayley, S L Hill, A T Hill, S Crooks, E J Campbell



## 2) Exacerbations

### ORIGINAL ARTICLE

#### **Characterization of the “Frequent Exacerbator Phenotype” in Bronchiectasis**

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

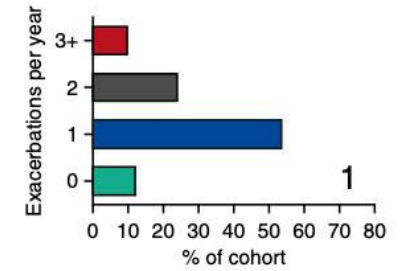
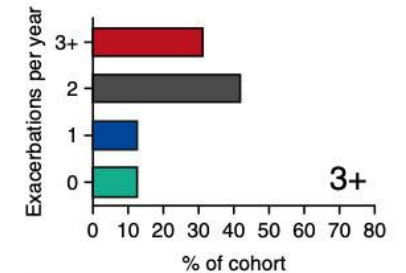
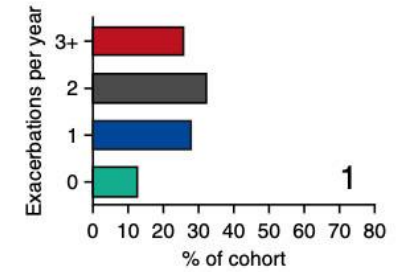
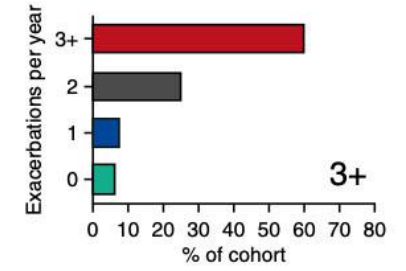
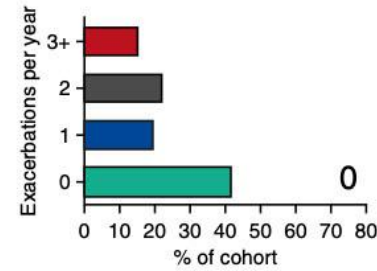
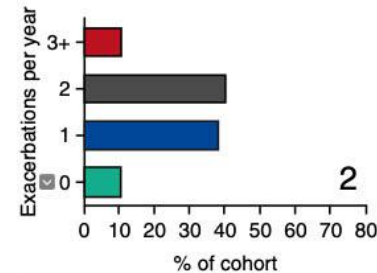
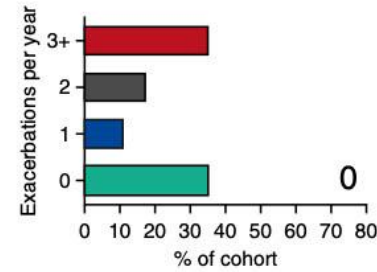
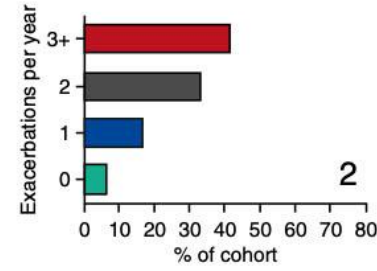
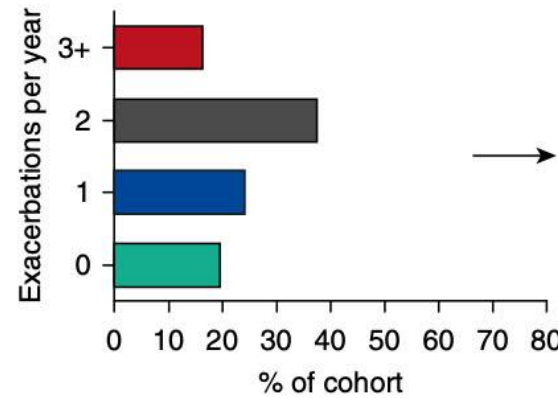
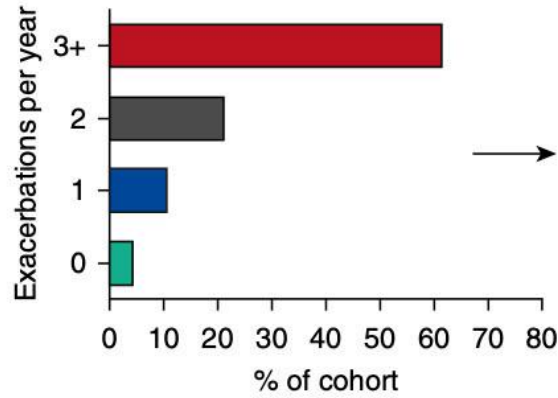
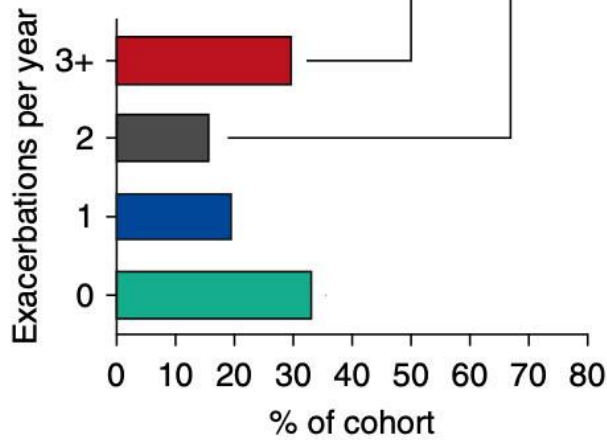
10 centers in Europe and Israel (N = **2,572**)

- up to 5 years of follow-up

Year 1

Year 2

Year 3

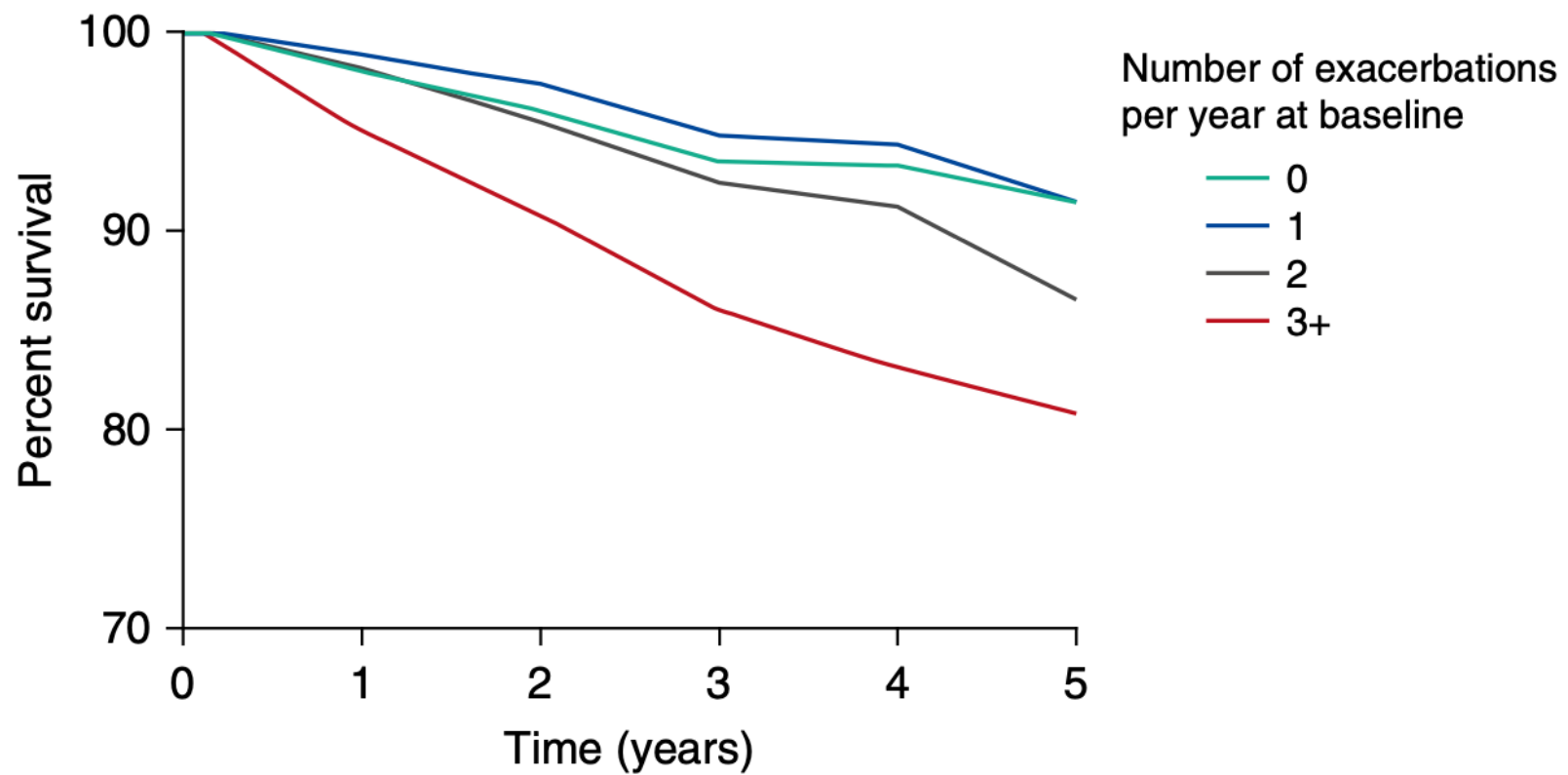


**Table 2.** Adjusted and Unadjusted Incident Rate Ratios for Exacerbation Frequency during Follow-up

	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 <sub>1</sub> % 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
<i>Haemophilus influenzae</i>	1.07	0.96–1.20	0.2	1.13	1.01–1.28	0.04
<i>Moraxella catarrhalis</i>	0.94	0.78–1.14	0.5	0.94	0.77–1.15	0.5
<i>Staphylococcus aureus</i>	1.19	0.97–1.45	0.1	1.08	0.88–1.32	0.5
<i>Enterobacteriaceae</i>	1.30	1.08–1.57	0.006	0.99	0.82–1.20	0.9
<i>Pseudomonas aeruginosa</i>	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.

Baseline exacerbation	Adjusted IRR (95% CI) for future exacerbation
1 per year	<b>1.73</b> (1.47–2.02)
2 per year	<b>3.14</b> (2.70–3.66)
3+ per year	<b>5.97</b> (5.27–6.78)



Numbers at risk

0	657	654	600	554	522	153
1	452	444	402	381	351	134
2	497	490	437	407	376	196
3 or more	966	958	836	771	694	365

# 3) sputum neutrophil elastase

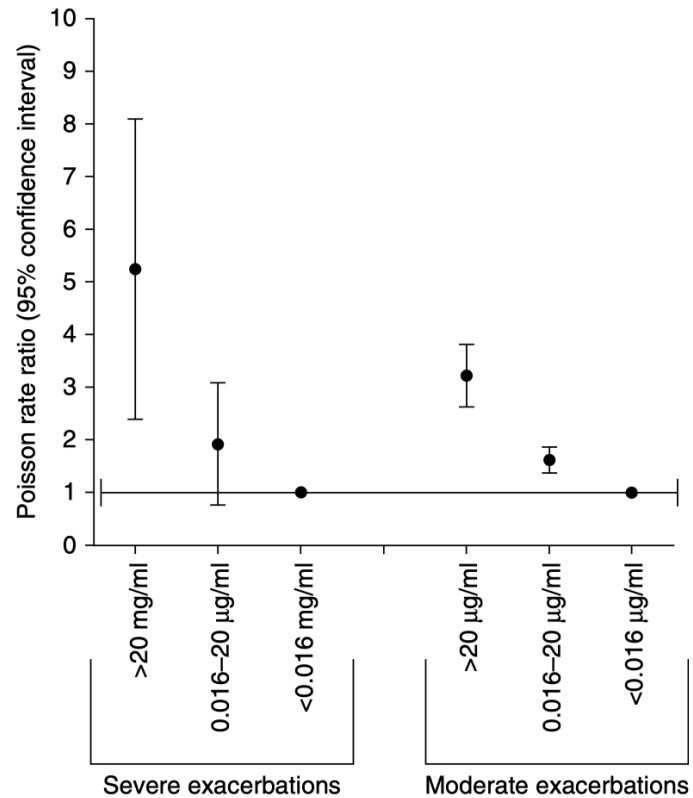
## ORIGINAL ARTICLE

### **Neutrophil Elastase Activity Is Associated with Exacerbations and Lung Function Decline in Bronchiectasis**

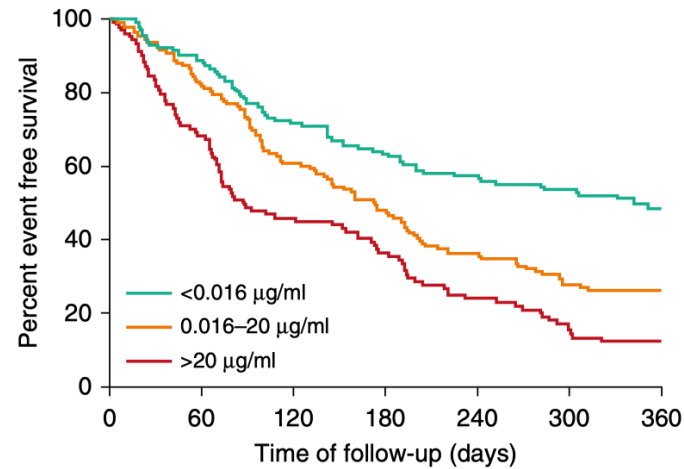
James D. Chalmers<sup>1,2</sup>, Kelly L. Moffitt<sup>3</sup>, Guillermo Suarez-Cuartin<sup>4</sup>, Oriol Sibila<sup>4</sup>, Simon Finch<sup>1</sup>, Elizabeth Furrie<sup>2</sup>, Alison Dicker<sup>1,2</sup>, Karolina Wrobel<sup>2</sup>, J. Stuart Elborn<sup>5,6</sup>, Brian Walker<sup>3</sup>, S. Lorraine Martin<sup>3</sup>, Sara E. Marshall<sup>2</sup>, Jeffrey T.-J. Huang<sup>2\*</sup>, and Thomas C. Fardon<sup>1\*</sup>

# Neutrophil elastase and longitudinal clinical outcomes (3 years)

**A Risk ratio of exacerbation**

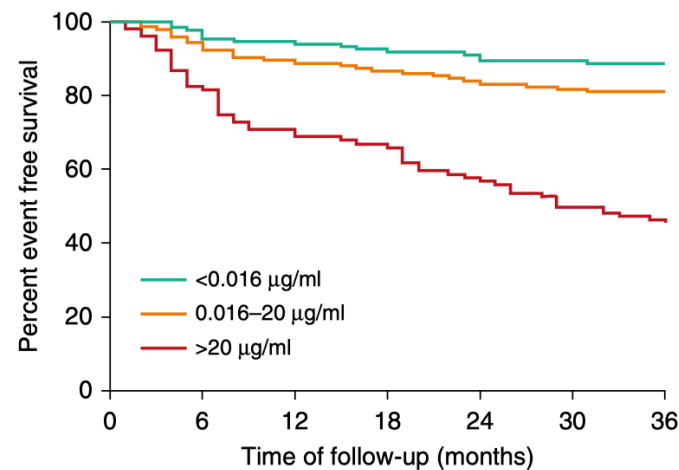


**B Time to next exacerbation**

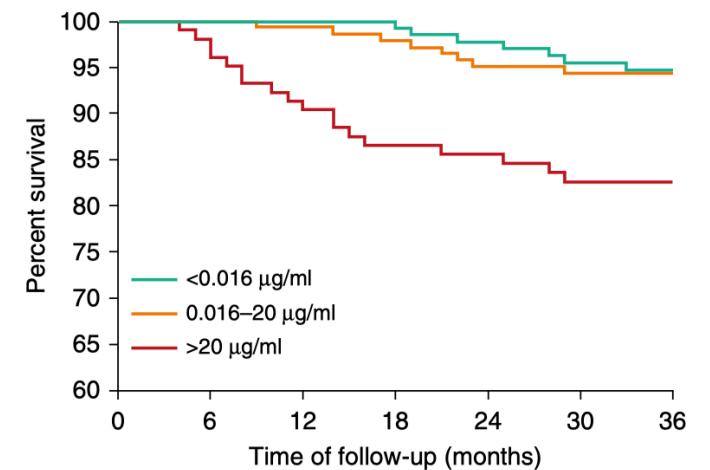


- <0.016 μg/ml
- 0.016–20 μg/ml
- >20 μg/ml

**C Time to severe exacerbation**



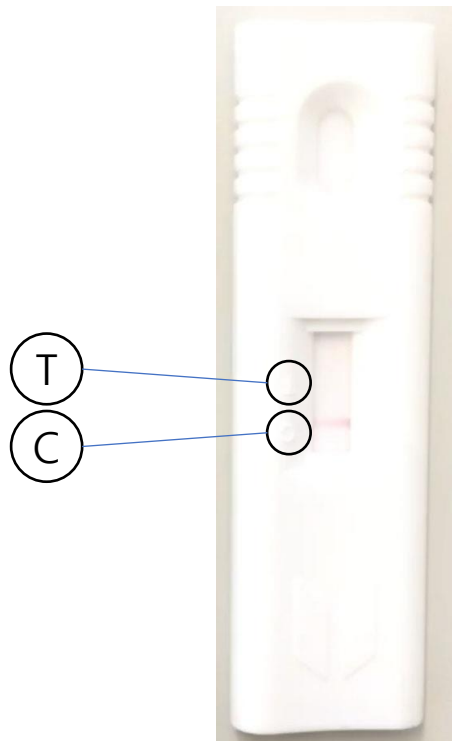
**D All-cause mortality**





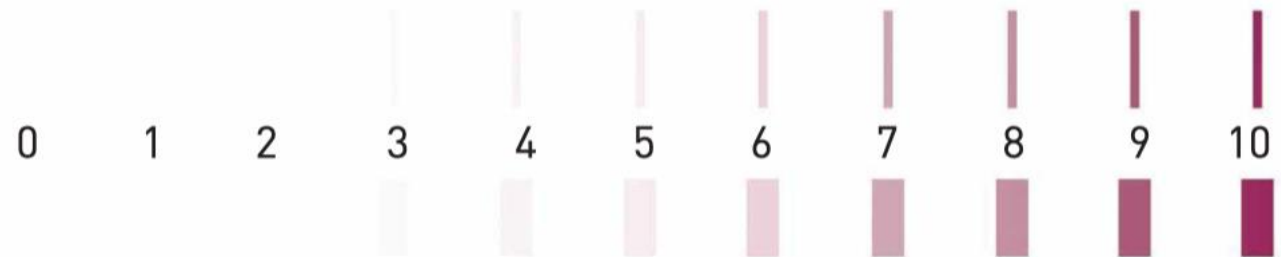
# A point-of-care neutrophil elastase activity assay identifies bronchiectasis severity, airway infection and risk of exacerbation

Amelia Shoemark<sup>1</sup>, Erin Cant<sup>1</sup>, Luis Carreto<sup>2</sup>, Alexandria Smith<sup>3</sup>, Martina Oriano<sup>4</sup>, Holly R. Keir<sup>1</sup>, Lidia Perea<sup>5</sup>, Elisabet Canto<sup>5</sup>, Leonardo Terranova<sup>4</sup>, Silvia Vidal<sup>5</sup>, Kelly Moffitt<sup>6</sup>, Stefano Aliberti <sup>4</sup>, Oriol Sibila <sup>5</sup> and James D. Chalmers<sup>1</sup>



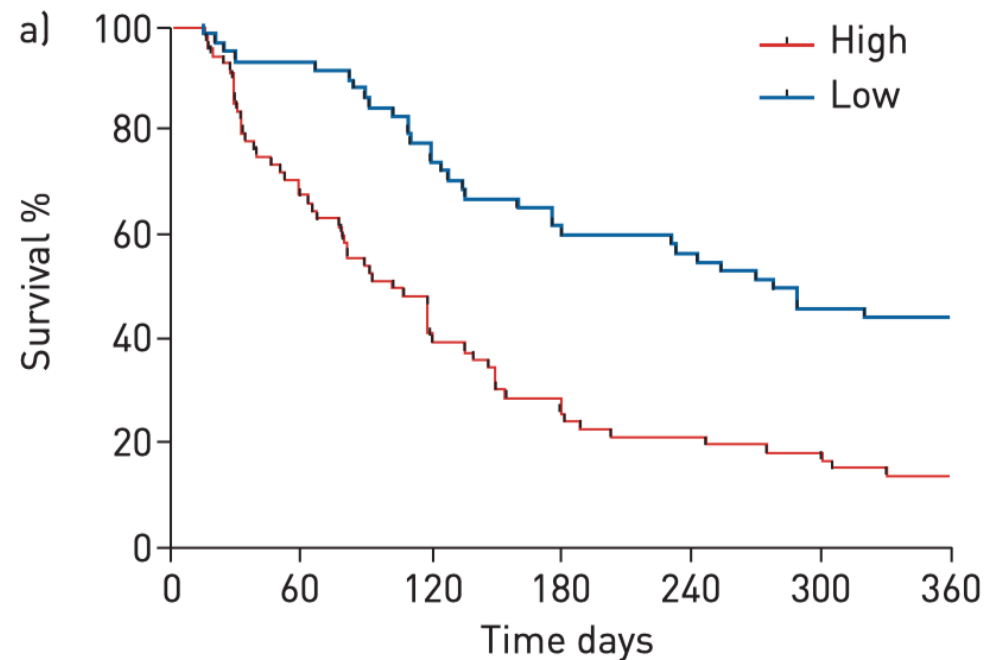
## NEATstik

- point-of-care neutrophil elastase activity assay



# NEATstik grade and future exacerbation

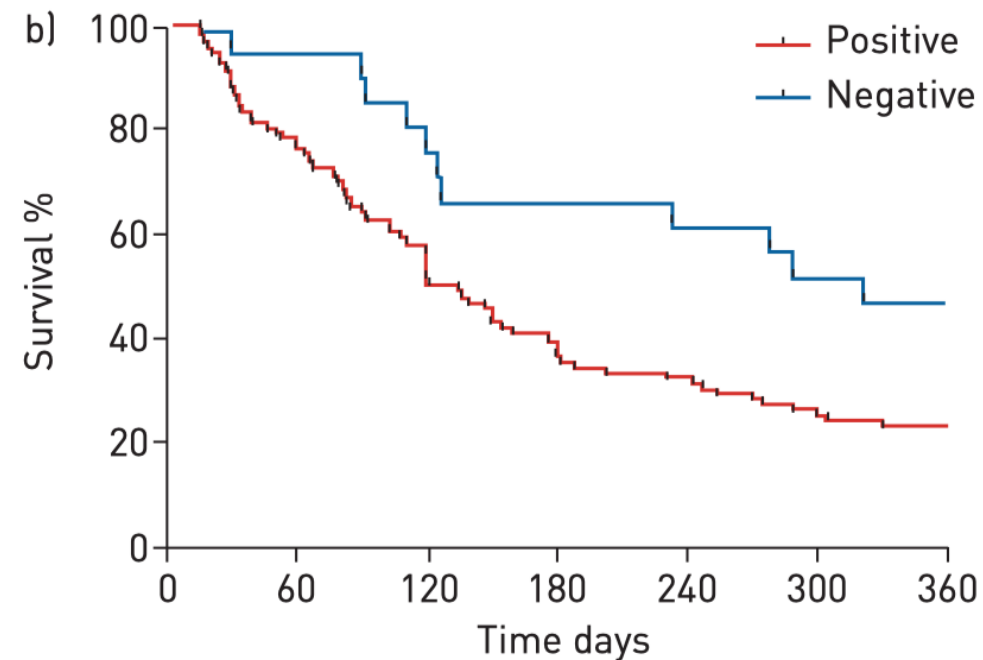
NEATstik grade > 6 (high risk)



At risk n	0	60	120	180	240	300	360
High	64	47	31	19	15	12	0
Low	57	54	44	35	33	28	0

Median time to exacerbation: 103 days vs. 278 days  
 HR, 2.59 (95% CI, 1.71–3.94,  $P < 0.001$ )

NEATstik grade > 0

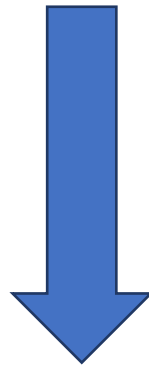


At risk n	0	60	120	180	240	300	360
Positive	103	80	58	40	34	27	0
Negative	21	21	17	15	14	12	0

Median time to exacerbation: 135 days vs. 320 days  
 HR, 2.15 (95% CI, 1.32–3.51,  $P = 0.01$ )

# 4) mucus plugging on chest CT

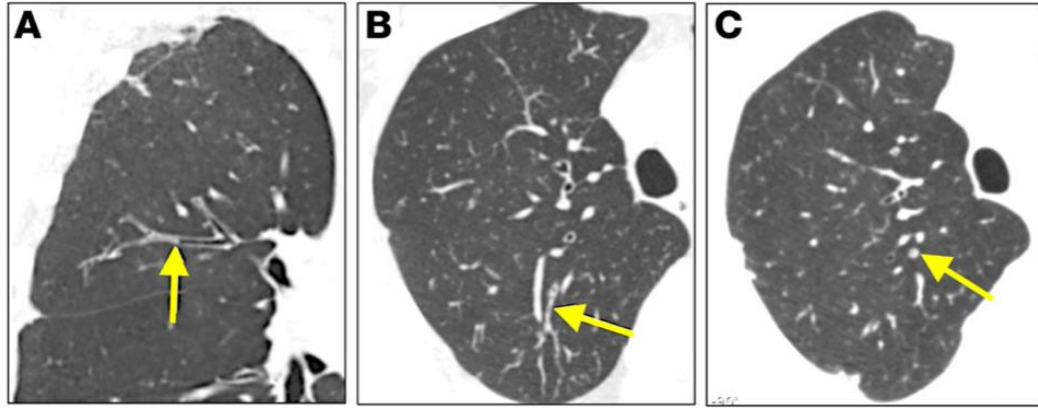
- Chest CT assessment tools in bronchiectasis?
  - Bhalla score
  - BRICS score
  - modified Reiff score (used in KMBARC)



- simple sign? **mucus plugging**

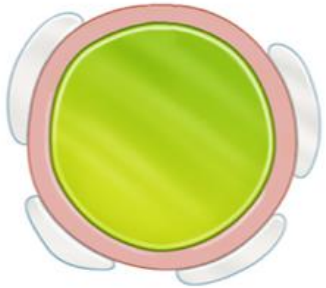
CT상 기관지 확장증이 관찰된 부위를 고르시오 (한 개의 폐엽에서 한가지만 선택)

우상엽	<input checked="" type="radio"/> No Bronchiectasis <input type="radio"/> Cylindrical <input type="radio"/> Varicose <input type="radio"/> Cystic <input type="radio"/> Unknown Severity	좌상엽	<input checked="" type="radio"/> No Bronchiectasis <input type="radio"/> Cylindrical <input type="radio"/> Varicose <input type="radio"/> Cystic <input type="radio"/> Unknown Severity
우중엽	<input checked="" type="radio"/> No Bronchiectasis <input type="radio"/> Cylindrical <input type="radio"/> Varicose <input type="radio"/> Cystic <input type="radio"/> Unknown Severity	설엽	<input checked="" type="radio"/> No Bronchiectasis <input type="radio"/> Cylindrical <input type="radio"/> Varicose <input type="radio"/> Cystic <input type="radio"/> Unknown Severity
우하엽	<input type="radio"/> No Bronchiectasis <input checked="" type="radio"/> Cylindrical <input type="radio"/> Varicose <input type="radio"/> Cystic <input type="radio"/> Unknown Severity	좌하엽	<input type="radio"/> No Bronchiectasis <input type="radio"/> Cylindrical <input type="radio"/> Varicose <input checked="" type="radio"/> Cystic <input type="radio"/> Unknown Severity



Mucus plugging

Identify mucus plugs



Plugged airway in cross-section

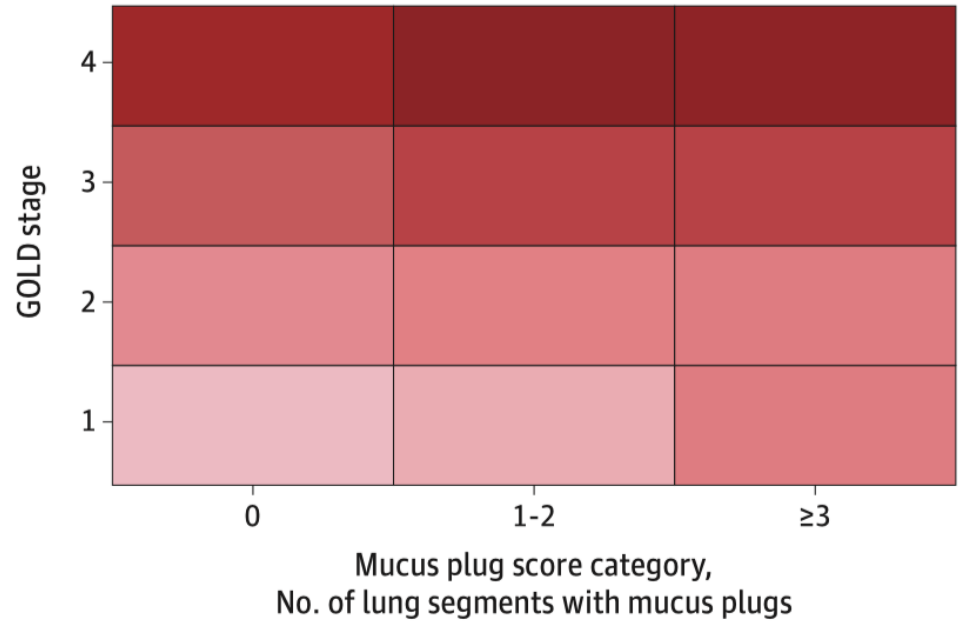
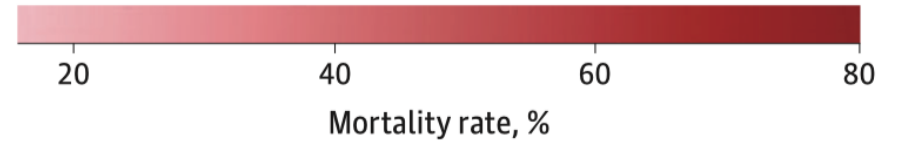
Mucus score

Examine each bronchopulmonary segment for mucus plugs

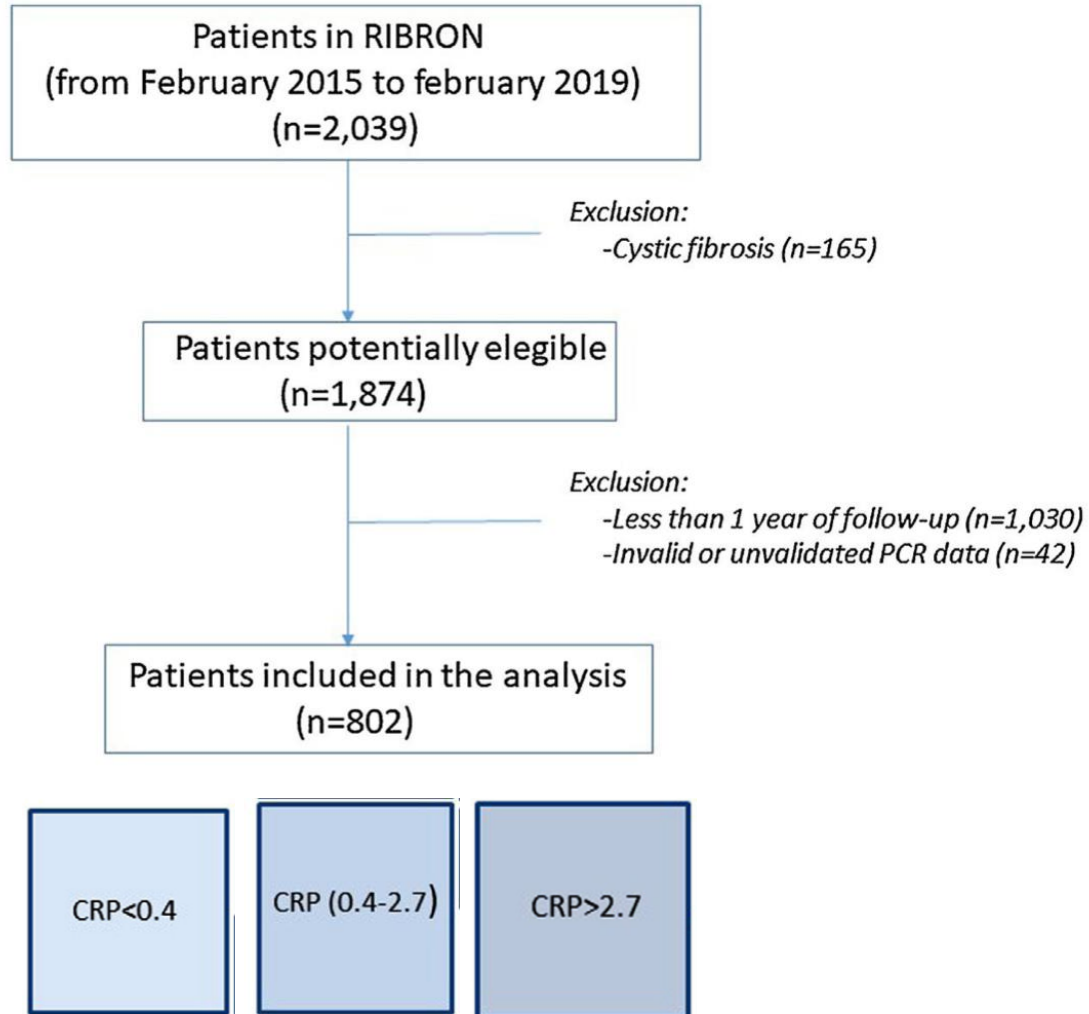


Bronchopulmonary segments

**A** All-cause mortality by GOLD stage and mucus plug score



# 5) serum C-reactive protein (CRP)



**Table 3**

Risk Factors for the Presence of at Least One Severe Exacerbation in the First Year of the Follow-up.

Variable	OR (CI95%)	P Value
Chronic bronchial infection by <i>P. aeruginosa</i>	1.6 (1.1–2.7)	.041
FEV1% predicted	0.97 (0.96–0.99)	.0001
Severe exacerbations (previous year)	1.15 (1.3–1.8)	.0001
Dyspnea (mMRC)	1.23 (1.1–1.6)	.017
CRP (mg/L)		
1st tertile	1	
2nd tertile	2.9 (1.4–5.9)	.0001
3rd tertile	4.2 (2.2–8.2)	.0001

		Referred to the previous year	Nº patients with at least one severe exacerbation / total of patients: Probability of at least one severe exacerbation during the first year of follow-up
CRP<0.4	No CBI by PA	No severe exacerbation	2/192: <b>1%</b>
		At least 1 severe exacerbation	2/56: <b>3.6%</b>
	CBI by PA	No severe exacerbation	4/48: <b>8.3%</b>
		At least 1 severe exacerbation	6/19: <b>31.6%</b>
CRP (0.4-2.7)	No CBI by PA	No severe exacerbation	7/123: <b>5.7%</b>
		At least 1 severe exacerbation	3/17: 17.6%
	CBI by PA	No severe exacerbation	11/49: 22.4%
		At least 1 severe exacerbation	13/37: <b>35.1%</b>
CRP>2.7	No CBI by PA	No severe exacerbation	14/122: 11.5%
		At least 1 severe exacerbation	15/58: <b>25.9%</b>
	CBI by PA	No severe exacerbation	17/59: <b>28.8%</b>
		At least 1 severe exacerbation	8/20: <b>40%</b>

Numbers in green and red in the last column mean: Probability of at least one severe exacerbation during the next year < 10% and >25%, respectively,

# Agenda

1. Disease severity
2. Disease activity
3. How to integrate disease severity and activity in bronchiectasis  
- take home message



**Disease severity (cross-sectional)**

- Bronchiectasis Severity Index
- FACED
- BACI

**Stable disease**

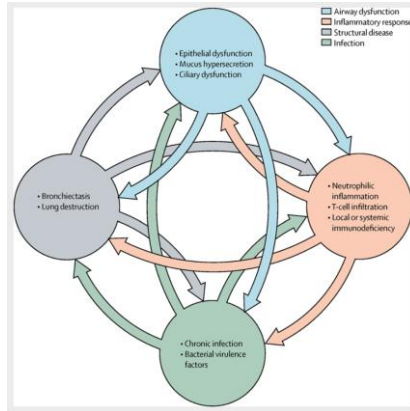
**Progressive disease**



**Disease progression (longitudinal)**



**Inactive disease**



**Active disease**

- Symptom burden (purulent sputum)
- Exacerbations
- Sputum neutrophil elastase
- Mucus plugging on chest CT
- Serum CRP



**Identifying “active” disease and doing something will make differences!**

감사합니다  
Thank you!