Assessment of Bronchiectasis Severity: The FACED Score versus the Bronchiectasis Severity Index (BSI)

Dr. Jitendrakumar A. Sisodia[1], Dr. Amit R. Dedun[2*], Dr. Priyanka K. Patel[3], Dr. Hardik P. Pandya[4]

[1,2] Associate professor, [3] Assistant professor, [4] Senior resident; Department of Pulmonary Medicine, Medical College Baroda & S.S.G Hospital, Vadodara

ABSTRACT
Background: Bronchiectasis is a multi-dimensional, chronic inflammatory and heterogeneous lung disorder characterized by unpredictable clinical course and progression. Two multivariable score systems, the FACED score and the BSI, which are composites of multiple variables have been used to assess the severity and prognosis of bronchiectasis. **Objectives:** (1) To assess the severity of bronchiectasis in patients using two different validated scores, the FACED score and the Bronchiectasis Severity Index (BSI). (2) To identify microbial profile among bronchiectasis patients and its impact on predicting future exacerbation and hospitalization. **Methods**: A total of 37 patients from June 2019 to November 2019 were enrolled in this prospective study. The FACED score and BSI score of patients were calculated. Severity of bronchiectasis has been defined by both scores and its impact on exacerbation was examined. **Results:** Mean age of patients was 45.8 ± 12.7 years. We found mild, moderate and severe bronchiectasis in 17 (45.95%), 15 (40.54%) and 5 (13.51%) patients as assessed by FACED scores. Low, intermediate and high BSI scores were found in 7 (18.92%), 9 (24.32%) and 21 (56.76 %) patients respectively. Patients with high BSI score demonstrated more exacerbations during the follow up period as compared to those with high FACED score. **Conclusions:** The BSI score is superior to predicting the severity of bronchiectasis as compared to the FACED score. It also helps to identify patients at risk of future exacerbations and hospitalization. Further large-scale studies are recommended to substantiate the findings.
Keywords: Bronchiectasis, FACED, BSI, Pseudomonas, Exacerbations

INTRODUCTION

Bronchiectasis is a chronic inflammatory, heterogeneous, debilitating, structural lung disease characterized by dilatation of the bronchi that predisposes to infection; leading to subsequent inflammation and tissue damage. This cycle results in excess mucus production and impaired mucociliary clearance; which in turn, again predisposes to infection. Bronchiectasis is associated with symptoms like persistent cough with sputum production, dyspnea and hemoptysis. This cyclic event of bronchial tissue damage and recurrent or chronic infection is responsible for recurrent exacerbations and repeated hospitalizationof patients with progressive impairment of lung function.[1]

Clinical course of bronchiectasis is unpredictable as various factors play role in progression. Most patients demonstrate a slow progression but, in few cases, the disease shows rapid progression; requiring modification of treatment frequently. Hence, it is important to identify patients who are at high risk of exacerbations and patients with low risk who can be managed by simpler treatment protocols.Main therapeuticobjectives in patients of bronchiectasis are control of symptoms, avoidance of risk factors, reduction/avoidance of exacerbation and prevention of hospitalization to reduce morbidity and mortality. So,

establishing the severity of bronchiectasis, early in the course of disease can help to improve treatment outcome.

Three multidimensional scoring system composites of various variables have been developed and validated for stratification of bronchiectasis severity and its prognosis: FACED [FEV1% Predicted, Age, Chronic Colonization by Pseudomonas aeruginosa, Extension (radiological extension by the number of lobes affected on HRCT), Dyspnea grading byModified Medical Research Council scale (mMRC)], E-FACED (FACED plus exacerbations in previous years) and Bronchiectasis Severity Index (BSI). The latter includes 9 variables comprising of demographic and clinical characteristics, radiological data and microbiological data.[2] Globally, FACED and BSI scores are widely used by researchers to stratify bronchiectasis severity,prognosis, clinical decision-making and also to evaluate the quality of life. The FACED score is easy to use and provides good prediction value regarding mortality; but it shows low predictability for future exacerbations. The BSI scoring system helps to predict future risk of disease exacerbation and hospitalization.[3] Research in the Indian continent about prediction of future risk of disease exacerbation and frequent hospitalization for bronchiectasis patients is very sparse and limited data is available; which warranted this study to compare the FACED score and the BSI scoring system for the same.

MATERIALS AND METHODS

Study Design: After taking approval from the Institutional Ethics Committee (Approval no. IECBHR/26-2020 Dated - 25.02.2020), a prospective study was conducted in patients of bronchiectasis, who consulted the Dept. of Pulmonary Medicine at Medical College, Baroda between June 2019 to November 2020. Patients were enrolled from June 2019 to November 2019 and followed up till November 2020.

Objectives:

- To assess the severity of bronchiectasis in patients using two different validated scores, the FACED score and the Bronchiectasis Severity Index (BSI) score.
- To identify microbial profile among patients of bronchiectasis and its impact on predicting future exacerbation and hospitalization.

Inclusion criteria: Adult patients with newly diagnosed or previously diagnosed bronchiectasis with no history of antibiotic use in the past month, in whom the diagnosis of bronchiectasis was confirmed by HRCT, according to the British Thoracic Society Guideline for bronchiectasis in adultsand who gave written informed consent for participation.[2]

Exclusion criteria: Patients with a history of antibiotic use in the last 1 month or those with a history of malignancy, acute coronary syndrome, cystic fibrosis, interstitial lung disease, HIV, or other immunosuppressed states were excluded from the study.

Methodology:

Detailed information was collected from all patients including demographic data, clinical data including mMRC (Modified Medical Research Council) and MRC (Modified Medical Research Council) grading of dyspnea, spirometry, gram stain of sputum, sputum culture for *Pseudomonas* and other microbes, HRCT to confirm the diagnosis and to evaluate the number of lobes involved, hospital admissions in preceding 2-years, number of exacerbations in the previous year etc. to assess the severity of bronchiectasis by FACED Score and BSI score. All patients were followed up for 1 year to study the relationship of bronchiectasis severity score with the incidence of exacerbations and microbial colonization. Sputum culture was performed in patients suffering exacerbations during the follow-up period at 3-months interval for 1 year from the date of enrolment in the study.Chronic colonization was defined as isolation of potentially pathogenic bacteria in sputum culture on two or more occasions, at least 3 months apart in 1 year.

Statistical analysis: Data were analyzed using Microsoft Excel to calculate mean, median and SD. The t-test was used to assess statistically significant difference between parametric variables. Continuous variables were expressed as mean ± standard deviation or median (interquartile range) while descriptive analysis was mentioned in numbers and percentages.

The value of K-S test statistic (D) is 0.15409 and the p-value is 0.31089 suggestive of normally distributed data.

RESULTS

Demographic, clinical, radiological and microbiological characteristics of the enrolled patients in the study are described in Table 1.

Type of bronchiectasis: In our study, 25 patients had cystic bronchiectasis, 6 had cylindrical bronchiectasis, and 6 had varicose bronchiectasis. Out of these 25 patients, severe bronchiectasis as per the BSI score and the FACED score were found in 16 and 3 patients respectively.

Co-morbidities: Most common co-morbidity was Cor-pulmonale, present in 14 patients (37.84%). Out of them, 11 patients (78.57%) had cystic, moderate to severe bronchiectasis, as per the BSI score and mild to moderate bronchiectasis as per the FACED score. These patients suffered an average of 3 exacerbations in previous 2 years and, also had exacerbation during follow up.

Spirometry Pattern: In our study, the most common functional impairment on spirometry was obstructive in 24 (64.86%) patients followed by mixed pattern in 8 (21.6%) patients and restrictive pattern in 5 (13.51%) patients. Among 24 patients with the obstructive pattern on spirometry, 13 patients (54.17%) with high BSI score had exacerbations and needed hospitalization during follow-up period, while only 3 (12.5%) patients with high FACED score had exacerbations and needed hospitalization during follow-up.

Table 1: Demographic, clinical, radiological and microbiological variables in patients diagnosed with bronchiectasis (N=37)

Demographic & Clinical characteristics	
Age (years)	48.8 ± 16.7
Sex (M: F)	1.33: 1
Body Mass Index (BMI)	18.6 ± 4.0
Dyspnea mMRC (median)	1.84
Dyspnea MRC (median)	2.84
Age (years)	48.8 ± 16.7
FEV1% predicted	42.5 ± 17.5
No. of exacerbations in the last year	1.1 ± 1.07
No. of hospitalization in previous 2 years	1.48 ± 1.38
Symptoms at enrollment	
Breathlessness	25 (67.56%)
Cough with Sputum production	24 (64.86%)
Fever	13 (35.13%)
Chest Pain	11 (29.74%)
Hemoptysis	10 (27.02%)
Microorganism colonization at enrollment	
Pseudomonas aeruginosa	13 (35.13%)
Colonization with other microorganisms	13 (35.13%)
Radiological involvement at enrollment	
No. of lobes affected	3.27 ± 1.69
Associated Cor Pulmonale	14 (37.84%)
Etiology for bronchiectasis	
Post TB sequelae	21 (56.75%)
Idiopathic	10 (27.02%)
Post-bacterial	4 (10.81%)
COPD	2 (5.41%)

FEV1 –Forced Expiratory Volume in 1st second; MRC: Medical Research Council; mMRC: Modified Medical Research Council

Table 2: Evaluation of variables for determination of FACED score at enrolment in patients diagnosed with bronchiectasis (N=37) as per BTS guideline.[2]

FEV1% predicted	
≤50%	13 (35.1%)
>50%	24 (64.9%)
Age (years)	
>70	7 (18.9%)
≤70	30 (81.1%)
***Pseudomonas aeruginosa* colonization at enrollment**	
Yes	13 (35.13%)
No	24 (64.87%)
Radiological extension of the disease - no. of affected lobes	
>2 lobes involved	23 (62.16%)
≤2 lobes involved	14 (37.84%)
Dyspnea Grade – mMRC scale	
>2 (3 and 4)	15 (40.54%)
≤ 2 (0-2)	22 (59.46%)
Severity According to FACED score (Mean Score: 2.56 ± 1.51)	
Mild Bronchiectasis	17 (45.95%)
Moderate Bronchiectasis	15 (40.54%)
Severe Bronchiectasis	5 (13.51%)

Exacerbations during follow up: In our study, high BSI score was present in 24 patients. Out of these 24 patients, exacerbations were observed in 21 (87.5%) patients with need of hospitalization. From these hospitalized patients 3 (8.1%) had mild bronchiectasis, 13 (35.14%) had moderate bronchiectasis and 5 (13.51%) had severe bronchiectasis as per FACED score. During follow up, 14 out of 16 patients with high BSI and predominant cystic pattern required admission. However, only 3 out of these 16 patients had severe bronchiectasis as per FACED score.

Previous history of exacerbations: 12 out of 15 patients with a history of previous exacerbations and hospitalization before enrollment had exacerbations with hospitalization during follow-up period. Ten out of 13 patients with Ps. Aerugniosa colonization at enrollment demonstrated exacerbation on follow upand out of those 10, 8 patients had cystic bronchiectasis as predominant HRCT pattern.

Involvement of lung lobes: In our study, the median number of lung lobes involved in re-admitted patients due to exacerbation was 3 in comparison to 2 in non-readmitted patients. The average number of lobes involved in our study was 3.27 ± 1.69.

The Mean BSI and mean FACED scores were compared using t test and a significant difference was observed in both scores at enrolment. ($P < 0.0001$). The Correlation coefficient (r) was 0.7262.

Table 3: Evaluation of variables for determination of BSI score at enrolment in patients diagnosed with bronchiectasis (N=37) as per the BTS guideline.[2]

Age (years)	
<50	21 (56.76%)
50-69	9 (24.32%)
70-79	6 (16.22%)
≥80	1 (2.70%)
Body mass index (BMI)	
≥18.5	17 (45.95%)
<18.5	20 (54.05%)
FEV1% predicted	
>80%	0 (0%)
50-80%	13 (35.13%)
30-49%	13 (35.13%)
<30%	11 (29.74%)
Hospital admission in the preceding 2 years	
No	15 (40.54%)
Yes	22 (59.45%)
Exacerbations in the previous year	
0-2	26 (70.27%)
≥3	11 (29.73%)
Dyspnea Grade - MRC scale	
1-3	22 (59.46%)
4	13 (35.13%)
5	2 (5.41%)
***Pseudomonas aeruginosa* colonization at enrollment**	
Yes	13 (35.13%)
No	24 (64.87%)
Colonization with other microorganisms at enrollment	
No	11 (29.73%)
Yes	13 (35.13%)
Radiological extension of the disease - number of affected lobes	
≥3 involved lobes or cystic bronchiectasis in any lobe	25 (67.57%)
<3 involved lobes	12 (32.43%)
BSI Score (Mean Score: 10.86 ± 4.95)	
Low BSI	4 (10.81%)
Intermediate BSI	9 (24.32%)
High BSI	24 (64.87 %)

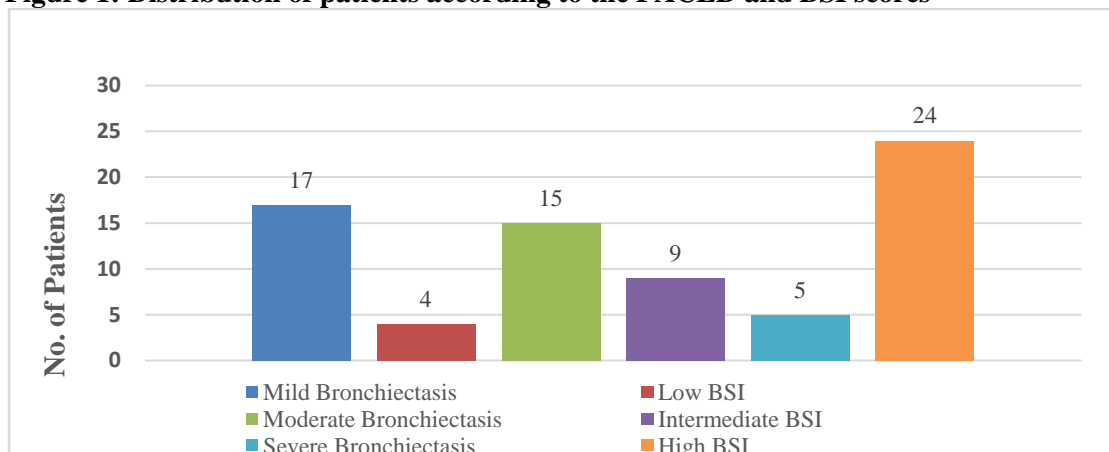**Figure 1: Distribution of patients according to the FACED and BSI scores**

Table 4: Co-relation between FACED and BSI scores in patients diagnosed with bronchiectasis (N=37)

% FACED score conditioned by BSI Score				
		BSI Score		
		Low BSI (n=4)	Intermediate BSI (n =9)	High BSI (n=24)
FACED Score	Mild Bronchiectasis	100% (4)	77.78% (7)	28.58% (6)
	Moderate Bronchiectasis	-	22.22% (2)	61.91% (13)
	Severe Bronchiectasis	-	-	23.81% (5)

Table 5: Microbial colonization in patients diagnosed with bronchiectasis (N=37) at time of enrolment

Type of Bronchiectasis	No. of patients showing growth of an organism in sputum culture at the time of enrollment						Total *
	Pseudomonas colonization	Klebsiella	Acinetobacter	E. coli	H. Influenza	Streptococcus	
Cystic	8	2	-	2	2	1	15
Varicose	4	-	-	-	-	1	5
Cylindrical	1	3	2	-	-	-	6
Total	13	5	2	2	2	2	26

*Eleven patients did not show growth of any microorganism in the sputum culture at enrollment.

DISCUSSION

Among the 37 patients enrolled, 21 (56.76%) were male and 16 (43.24%) were female with a M: F ratio of 1.33: 1. Mean age of the patients was 48.8 ± 16.7 years, similar to studies done by Coban Hikmet.[4]

In our study, we assessed the severity of bronchiectasis by using the FACED and the BSI scoring systems at enrolment. A total of 24 patients (64.86%) had severe bronchiectasis as per the BSI score while 5 patients (13.51%) had severe bronchiectasis as per the FACED

score. In our study, the mean FACED score was 2.56 ± 1.51 and the mean BSI score was 10.86 ± 4.95 which is comparable to the study done by Coban Hikmet[4] (mean FACED score: 2.0 ± 1.9and the mean BSI score was 6.6 ± 4.8).A significant difference was observed in mean BSI and FACED scores of patients at enrolment and suggested significant difference in the assessment of severity of bronchiectasis by both scores.

The % scores of FACED and BSI in enrolled patients were compared (table 4). 41.17% and 35.29% of patients with mild bronchiectasis by the FACED score had intermediate and high BSI scores respectively. About 86.67% of patients with moderate bronchiectasis by the FACED score had a high BSI score. Moreover, 77.78% of patients with intermediate BSI were found to have mild bronchiectasis by the FACED score and 90.49% of patients with high BSI had mild or moderate bronchiectasis by the FACED score. Hence, severity assessment of bronchiectasis showed significant differences when assessed using FACED and BSI system, which can be attributed to difference in the variables used for assessment in both systems. In the study by Coban Hikmet,[4] 55.5% of patients with mild bronchiectasis by FACED had moderate BSI and 56.6% of patients with moderated bronchiectasis by FACED had high BSI. Similarly, in the study by Costa et al.,[5] 40% of patients with mild bronchiectasis by FACED had intermediate BSI and about 46.7% of patients with moderated bronchiectasis by FACED had high BSI.

In our study, 25 (67.56%) patients had cystic bronchiectasis. Among patients with cystic bronchiectasis, 16 (64%) and 3 (12%) patients had severe bronchiectasis as per the BSI score and the FACED score respectively. Studies done by Lynch et al,[6] Singh AK,[7] and Bairwa MK[8] reported that extent of physiologic impairment can be more severe in cases with cystic bronchiectasis, which is predominately associated with the growth of pseudomonas organism.

In our study, Pseudomonas colonization was detected in 13 patients (35.11%), out of whom 10 patients (76.92%) had Pseudomonas colonization during follow-up exacerbations. Pseudomonas aeruginosa colonization was most commonly observed in cystic bronchiectasis (61.53%) followed by varicose bronchiectasis (30.76%), which suggested that severity is likely to be more in patients with cystic bronchiectasis. Ellis HC[1], Singh AK[7], Bairwa MK[8], Athanazio et al.,[9] Miguel et al.,[10] reported pseudomonas colonization in 21.62%, 32.5%, 32.5%, 39.8%, 31.8% and patients respectively.

Our study showed that the median number of lung lobes involved in re-admitted patients due to exacerbation was 3 in comparison to 2 in non-readmitted patients. Number of lobes affected is a criterion for assessment of severity in both scores. In BSI score, 1 point is awarded for at least three lobes involved, while in FACED score, 1 point is awarded for at least two lobes involved. Results of our study suggests that patients with 3 or more lobe involvement are more likely to suffer from exacerbations of bronchiectasis, which favors the use of BSI score for assessment of severity. This is similar to the study by Wang et al.[11] Average number of lobes involved in our study was 3.27 ± 1.69 which was comparable to studies conducted by Ellis HC,[1] Athanazio et al,[9] Costa et al,[5] Coban Hikmet[12] (3.40 ± 1.4, 3.3 ± 1.5, 3.60 ± 1.40, 2.70 ± 1.1 lobes respectively).

In our study, 12 out of 15 patients with a history of previous exacerbations and hospitalization had exacerbations with hospitalization during follow-up. Ellis HC[1] and Wang et al.[11] reported that previous hospitalization and exacerbations are associated with a far higher risk of future hospitalization.

Similar to the findings of Singh AK[7]and Gale et al.[13], Cor-pulmonale, the most common associated co-morbidity, was found in 14 patients (37.83%) in our study. Out of them, 11 patients (78.57%) had cystic and severe bronchiectasis (as assessed by BSI score?) having an average of 3 exacerbations in the previous 2 years and, also had exacerbations and needed hospitalization during follow-up. Cor pulmonale and bronchiectasis both act together rendering patient hypoxic, which worsens the right sided heart failure and increases risk of exacerbation.

Our study suggested that the BSI scoring system is superior to the FACED scoring system to predict the severity of bronchiectasis, exacerbation and hospital admission. Our findings

are similar to those reported by McDonnell et al.[14], Costa et al.[5], Xiao-Yue Wang et al.[11], Huw C. Ellis[1], Chalmers J et al.[15], Minov et al.[16]

CONCLUSION
BSI score provides a more accurate assessment of bronchiectasis severity than the FACED score and helps identify the patients at high risk for future exacerbations and hospitalization, who can benefit from aggressive treatment and also, low-risk patients who can be managed with conservative protocols. Recurrent exacerbation is associated with Pseudomonas Aeruginosa colonization especially among the cystic type of bronchiectasis.

LIMITATIONS
Ours is a prospective study with a limited number of patients. This study does not provide enough data to calculate the capacity of these scores to predict morbidity and mortality. Clinical studies with large sample sizes and longer follow up are required to further confirm the clinical importance of different bronchiectasis severity scoring systems, to modify already existing tools or to develop new strategies.

REFERENCES
1. Ellis HC, Cowman S, Fernandes M, Wilson R and Loebinger MR. Predicting mortality in bronchiectasis using bronchiectasis severity index and FACED scores: a 19-year cohort study. Eur. Respir. J. 47, 482–489 10.1183/13993003.01312-2015
2. Hill AT, Sullivan AL, Chalmers JD, Soyza AD, Elborn JS, et al. British Thoracic Society Guideline for bronchiectasis in adults. Thorax 2019;74(Suppl 1):1–69.
3. Min H, Min Z, Chengdi W, Zuohong W, Feng X, Hongxia W, et al. Prognostic performance of the FACED score and bronchiectasis severity index in bronchiectasis: a systematic review and meta-analysis. Biosci Rep (2020) 40 (10): BSR20194514.
4. Hikmet C. Relationship between FACED and Bronchiectasis Severity Index in the evaluation of bronchiectasis severity Cross-sectional study. Eurasian J Pulmonol2020;22:55-8.
5. Costa JC, Machado JN, Ferreira C, Gama J, Rodrigues C. The Bronchiectasis Severity Index and FACED score for assessment of the severity of bronchiectasis. Pulmonol. 2018;24(3):149---154.
6. Lynch DA, Newell J, Hale V, Dyer D, Corkery K, Fox NL, et al. Correlation of CT findings with clinical evaluations in 261 patients with symptomatic bronchiectasis. AJR Am J Roentgenol. 1999 Jul;173(1):53-8.
7. Singh AK, Bairwa MK, Mangal V, Qureshi MJ, Agnihotri SP. Evaluation of Clinico-Radiological and Functional Profile of Patients with Bronchiectasis According to FACED Score. Indian J Chest Dis Allied Sci 2021; 63:75-80
8. Bairwa MK, Agnihotri S, Qureshi MJ. Characterization of microbiological pattern in bronchiectasis patients. GJRA - Global Journal For Research Analysis, Volume-8, Issue-2, February-2019:168-170
9. Athanazio R, Pereira MC, Gramblicka G, Cavalcanti-Lundgren F, de Figueiredo MF, Arancibia F, Rached S, de la Rosa D, Máiz-Carro L, Girón R, Olveira C. Latin America validation of FACED score in patients with bronchiectasis: an analysis of six cohorts. BMC pulmonary medicine. 2017 Dec;17:1-9.
10. Martínez-García MÁ, De Gracia J, Relat MV, Girón RM, Carro LM, de la Rosa Carrillo D, Olveira C. Multidimensional approach to non-cystic fibrosis bronchiectasis: the FACED score. European Respiratory Journal. 2014 May 1;43(5):1357-67.
11. Wang XY, Li R, Wang WY, Li DS, Zhou YY, Chen XT, Bu XN. Bronchiectasis severity assessment on predicting hospital readmission: a single-center prospective cohort study. Chinese Medical Journal. 2021 Feb 20;134(04):492-4.
12. Coban H, Gungen AC. Is there a correlation between new scoring systems and systemic inflammation in stable bronchiectasis?. Canadian respiratory journal. 2017 Oct;2017.
13. Gale NS, Bolton CE, Duckers JM, Enright S, Cockcroft JR, Shale DJ. Systemic comorbidities in bronchiectasis. Chron Respir Dis 2012;9:231–8
14. McDonnell MJ, Aliberti S, Goeminne PC, Dimakou K, Zucchetti SC, Davidson J et al. Multidimensional severity assessment in bronchiectasis- an analysis of seven European cohorts. Thorax 2016;71:1110–1118.

15. Chalmers J, Goeminne P, Aliberti S, McDonnell MJ, Lonni S, Davidson J et al. The Bronchiectasis Severity Index. An International Derivation and Validation Study.Am J Respir Crit Care Med Vol 189, Iss 5, pp 576–585.

16. Minov J, Karadzinska-Bislimovska J, Vasilevska K, Stoleski S, Mijakoski D. Assessment of the Non-Cystic Fibrosis Bronchiectasis Severity the FACED Score vs the Bronchiectasis Severity Index.The Open Respiratory Medicine Journal, 2015, 9, (Suppl 1: M3) 46-51.