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Research Article

CORRELATION OF THE DOSE INDEX AND COPD ASSESSMENT TEST (CAT) SCORE IN PREDICTING RECURRENT EXACERBATIONS IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Abstract

Background: Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality worldwide, with acute exacerbations contributing significantly to disease progression, recurrent hospitalizations, impaired quality of life, and increased healthcare costs. Accurate assessment of disease severity and prediction of future exacerbations are essential for optimizing patient management. This study evaluated the relationship between the DOSE Index and CAT score and their ability to predict clinical outcomes in patients with acute exacerbation of COPD.

Objectives: To determine the correlation between the DOSE Index and CAT score and to assess their utility in predicting future exacerbations among patients with acute exacerbation of COPD.

Materials and Methods: This prospective observational study was conducted in the Departments of General Medicine and Pulmonary Medicine, Government Thiruvarur Medical College and Hospital, Tamil Nadu, from January to December 2025. A total of 100 patients aged ≥40 years admitted with acute exacerbation of COPD were enrolled. Demographic and clinical characteristics, smoking history, spirometry findings, DOSE Index, and CAT scores were recorded at admission, one week after stabilization, and at six months of follow-up. Statistical analysis was performed using SPSS version 25.0. Pearson's correlation coefficient, paired *t*-test, receiver operating characteristic (ROC) curve analysis, and logistic regression were used, with $p<0.05$ considered statistically significant.

Results: The mean DOSE Index and CAT scores showed significant improvement following clinical stabilization and at six months of follow-up (p<0.001). A strong positive correlation was observed between the DOSE Index and CAT score at admission (r=0.74), one week (r=0.79), and six months (r=0.87) (all p<0.001). Patients with a DOSE Index ≥4 had a significantly higher risk of experiencing two or more exacerbations during follow-up (Odds Ratio: 8.9; 95% CI: 3.2–24.7). ROC analysis demonstrated good predictive performance of the DOSE Index for recurrent exacerbations (AUC=0.86).

Conclusion: The DOSE Index correlates strongly with CAT score and is an effective multidimensional tool for assessing disease severity, health status, and predicting future exacerbations in patients with acute COPD exacerbation. Its simplicity and predictive ability support its routine use in clinical practice for risk stratification and individualized patient management.

Keywords: Chronic obstructive pulmonary disease; Acute exacerbation; DOSE Index; COPD Assessment Test; CAT score; Spirometry; Prognosis; Smoking.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable respiratory disorder characterized by persistent airflow limitation resulting from chronic airway and alveolar abnormalities, usually caused by prolonged exposure to noxious particles or gases. It remains one of the leading causes of morbidity and mortality worldwide, accounting for substantial healthcare utilization and economic burden. According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD), COPD is currently the third leading cause of death globally, with acute exacerbations contributing significantly to disease progression, reduced quality of life, and increased mortality rates. (1,2)

India bears a considerable share of the global COPD burden because of the high prevalence of tobacco smoking, biomass fuel exposure, occupational pollutants, and environmental air pollution. The prevalence of COPD among adults aged over 40 years in India is estimated to range from 4% to 10%, with a steadily increasing disease burden owing to population aging and continued exposure to risk factors. (3,4) Acute exacerbations of COPD are characterized by a sudden worsening of respiratory symptoms requiring additional therapy and are the principal cause of emergency department visits, hospital admissions, and repeated healthcare utilization. (5)

Traditionally, the severity of COPD has been assessed using spirometric measurements, particularly the forced expiratory volume in one second (FEV_1). However, pulmonary function alone does not adequately reflect symptom burden, health-related quality of life, or the future risk of exacerbations. Consequently, multidimensional assessment tools have been developed to provide a more comprehensive evaluation of disease severity and prognosis. (1,6)

The Dyspnea, Obstruction, Smoking, Exacerbation (DOSE) Index is a validated multidimensional scoring system that incorporates the modified Medical Research Council dyspnea scale, airflow obstruction, smoking status, and previous exacerbation history. Previous studies have

demonstrated that the DOSE Index predicts future exacerbations, hospitalization, and mortality more effectively than spirometry alone. (7,8) The COPD Assessment Test (CAT) is an eight-item, patient-reported questionnaire that provides a reliable assessment of symptom severity and health status and has been widely adopted in routine clinical practice and research. (9,10)

Although both the DOSE Index and CAT score are recommended for assessing COPD severity, evidence regarding their correlation and combined prognostic value in Indian patients with acute exacerbation of COPD remains limited. Establishing this relationship may facilitate improved risk stratification and individualized disease management. Therefore, the present study was undertaken to evaluate the correlation between the DOSE Index and CAT score and to determine their utility in predicting clinical outcomes among patients admitted with acute exacerbation of COPD at Government Thiruvarur Medical College and Hospital, Tamil Nadu.

MATERIALS AND METHODS

Study Design

This was a prospective observational study designed to evaluate the correlation between the Dyspnea, Obstruction, Smoking, Exacerbation (DOSE) Index and the Chronic Obstructive Pulmonary Disease Assessment Test (CAT) score in predicting clinical outcomes among patients admitted with acute exacerbation of chronic obstructive pulmonary disease (AECOPD).

Study Setting

The study was conducted in the Departments of General Medicine and Pulmonary Medicine, Government Thiruvarur Medical College and Hospital, Thiruvarur, Tamil Nadu, India. The institution is a tertiary care teaching hospital catering to urban and rural populations of the Cauvery delta region.

Study Duration

The study was carried out over a period of 12 months**,** from January 2025 to December 2025**. Each p**articipant was followed for six months after enrolment.

Study Population

The study included adult patients admitted with acute exacerbation of COPD. A total of 100 consecutive eligible patients were enrolled after obtaining written informed consent.

Sample Size

A convenience sample of 100 patients was included during the study period. This sample size was considered adequate to assess the correlation between the DOSE Index and CAT score and to evaluate their predictive value for recurrent COPD exacerbations.

Inclusion Criteria

- Patients aged 40 years and above**.**
- Diagnosed cases of COPD according to the GOLD 2024 criteria.
- Patients admitted with acute exacerbation of COPD requiring hospitalization.
- Patients able to undergo spirometry after clinical stabilization.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Bronchial asthma or asthma-COPD overlap syndrome.
- Bronchiectasis.
- Active pulmonary tuberculosis.
- Interstitial lung disease.
- Lung carcinoma.
- Severe congestive heart failure.

- Connective tissue disorders involving the lungs.
- Patients unable to perform spirometry.
- Patients unwilling to participate or those lost before baseline assessment.

Data Collection

After enrolment, detailed demographic information including age, gender, occupation, smoking history, biomass fuel exposure, duration of COPD, previous exacerbations, hospitalization history, and associated comorbidities were recorded using a structured case record form. A thorough clinical examination was performed for all patients.

Baseline laboratory investigations included complete blood count, renal function tests, liver function tests, blood glucose, serum electrolytes, chest radiography, electrocardiography, and arterial blood gas analysis wherever indicated.

Pulmonary Function Assessment

Spirometry was performed using a calibrated computerized spirometer after stabilization of the acute exacerbation, usually within 48 hours of admission, following the recommendations of the American Thoracic Society/European Respiratory Society (ATS/ERS). Forced expiratory volume in one second (FEV_1) was expressed as a percentage of the predicted value. Patients were categorized into GOLD grades based on the severity of airflow limitation.

Assessment of DOSE Index

The DOSE Index was calculated for every participant using four validated clinical parameters:

- Dyspnea assessed by the Modified Medical Research Council (mMRC) dyspnea scale.
- Airflow obstruction measured by FEV_1 (% predicted).
- Current smoking status.
- Number of COPD exacerbations during the previous 12 months.

The total DOSE score ranged from 0 to 8**,** with higher scores indicating greater disease severity and an increased risk of future exacerbations.

Assessment of CAT Score

Health status was assessed using the COPD Assessment Test (CAT), an eight-item validated questionnaire that evaluates cough, sputum production, chest tightness, breathlessness, activity limitation, confidence, sleep quality, and energy levels. Each item was scored from 0 to 5, producing a total score ranging from 0 to 40, with higher scores indicating greater impairment in health-related quality of life.

Follow-up

The DOSE Index and CAT score were assessed at three time points:

- At admission after clinical stabilization.
- One week after initiation of treatment.
- Six months after enrolment.

During follow-up, information regarding recurrent exacerbations, emergency department visits, hospital admissions, smoking cessation, treatment adherence, and mortality was recorded. Recurrent exacerbations were confirmed using hospital records or documented prescriptions whenever available.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of Government Thiruvarur Medical College and Hospital before commencement of the study. Written informed consent was obtained from all participants. Patient confidentiality was maintained throughout

the study, and all procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 19 Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Comparisons between continuous variables at different follow-up periods were performed using the paired Student's *t*-test. Associations between categorical variables were analysed using the Chi-square test or Fisher's exact test as appropriate. Pearson's correlation coefficient (*r*) was used to determine the relationship between the DOSE Index and CAT score. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the predictive ability of the DOSE Index for recurrent exacerbations. Logistic regression analysis was used to estimate odds ratios (OR) with 95% confidence intervals (CI). A two-sided *p*-value of <0.05 was considered statistically significant.

RESULTS

A total of 100 patients admitted with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) were included in the study. The mean age of the study population was 61.8 ± 8.7 years**.** Male patients constituted 76% of the study population. Most participants had a history of smoking, and the majority belonged to GOLD stage III. The mean DOSE Index and CAT score improved significantly after treatment and during follow-up. A significant positive correlation was observed between the DOSE Index and CAT score at all assessment periods.

A total of 100 patients admitted with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) were included in the study. The mean age of the study population was 61.8 ± 8.7 years, with the majority of patients belonging to the 60–69-year age group (39%). Males constituted 76% of the study population, reflecting the higher prevalence of COPD among men. The mean body mass index was 22.6 ± 3.9 kg/m²**,** and the average duration of COPD was 8.4 ± 3.6 years. The mean number of exacerbations during the previous year was **2.1 ± 1.0**. The baseline demographic and clinical characteristics of the study population are summarized **(Table 1).**

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population (n = 100)

Variable	Frequency (%) / Mean ± SD
Age (years)	61.8 ± 8.7
Age group (years)	
40–49	12 (12.0)
50–59	28 (28.0)
60–69	39 (39.0)
≥70	21 (21.0)
Gender	
Male	76 (76.0)
Female	24 (24.0)
BMI (kg/m²)	22.6 ± 3.9
Duration of COPD (years)	8.4 ± 3.6
Previous exacerbations/year	2.1 ± 1.0

Current smoking was reported by 61% of patients, while 27% were former smokers and 12% had never smoked. Bidi smoking was the predominant form of tobacco exposure (49%), followed by cigarette smoking (22%). Biomass fuel exposure was documented in 18% of the study population, indicating the contribution of environmental risk factors to COPD in this region **(Table 2).**

Table 2. Smoking Characteristics

Smoking Variable	n (%)
Current smokers	61 (61.0)
Former smokers	27 (27.0)
Never smokers	12 (12.0)
Bidi smokers	49 (49.0)
Cigarette smokers	22 (22.0)
Biomass fuel exposure	18 (18.0)

Pulmonary function assessment revealed a mean predicted FEV_1 of 42.8 ± 14.5%**.** Nearly half of the patients **(**47%**)** belonged to GOLD stage III**,** whereas 23% were classified as GOLD stage IV. Only6% of participants had mild airflow limitation (GOLD stage I), indicating that most patients were hospitalized with moderate-to-severe disease**(Table 3).**

Table 3. GOLD Classification Based on Spirometry

GOLD Stage	FEV_1 (% Predicted)	n (%)
GOLD I	≥80	6 (6.0)
GOLD II	50–79	24 (24.0)
GOLD III	30–49	47 (47.0)
GOLD IV	<30	23 (23.0)

The mean DOSE Index at admission was 5.34 ± 1.41. Following treatment, the score decreased significantly to 3.82 ± 1.32 at one week and further to 2.95 ± 1.56 at six months of follow-up (p<0.001), demonstrating progressive clinical improvement after stabilization **(Table 4).**

Table 4. DOSE Index during Follow-up

Assessment	Mean ± SD	p-value
Admission	5.34 ± 1.41	
One week	3.82 ± 1.32	<0.001*
Six months	2.95 ± 1.56	<0.001*

*p value significant using Student T test

Similarly, the mean CAT score showed a significant reduction from 30.96 ± 5.12 at admission to 20.44 ± 4.68 after one week and 12.94 ± 5.71 at six months (p<0.001), reflecting substantial improvement in symptom burden and health-related quality of life following treatment **(Table 5).**

Table 5. CAT Score During Follow-up

Assessment	Mean ± SD	p-value
Admission	30.96 ± 5.12	
One week	20.44 ± 4.68	<0.001*
Six months	12.94 ± 5.71	<0.001*

*p value significant using Student T test

A strong positive correlation was observed between the DOSE Index and CAT score throughout the study period. Pearson's correlation coefficient was 0.74 at admission, 0.78 after one week, and 0.87 at six months, indicating that patients with higher DOSE scores consistently reported greater symptom severity and poorer health status. The correlation was statistically significant at all three time points (p<0.001) **(Table 6).**

Table 6. Correlation Between DOSE Index and CAT Score

Assessment	Pearson's r	p-value
Admission	0.74	<0.001*
One week	0.78	<0.001*
Six months	0.87	<0.001*

*p value significant using Pearson's correlation coefficient test

During the six-month follow-up period, the mean number of exacerbations was 1.71 ± 1.09**.** More than half of the patients **(**54%**)** experienced two or more exacerbations, whereas 15% remained free from exacerbations throughout follow-up. Recurrent exacerbations were more frequent among patients with higher baseline DOSE Index scores **(Table 7).**

Table 7. Frequency of COPD Exacerbations during Six-Month Follow-up (n = 100)

Number of Exacerbations	Number of Patients (n)	Percentage (%)
0	15	15.0
1	31	31.0
2	29	29.0
3	18	18.0
≥4	7	7.0
Total	**100**	**100.0**

Receiver operating characteristic (ROC) curve analysis demonstrated that the DOSE Index had excellent predictive ability for recurrent exacerbations, with an area under the curve (AUC) of 0.868 (95% CI: 0.794–0.941; p<0.001). A DOSE Index cut-off value of ≥4 yielded a sensitivity of 82.4% and specificity of 76.1%**,** indicating good diagnostic performance and superior predictive accuracy compared with GOLD staging alone **(Figure 1).**

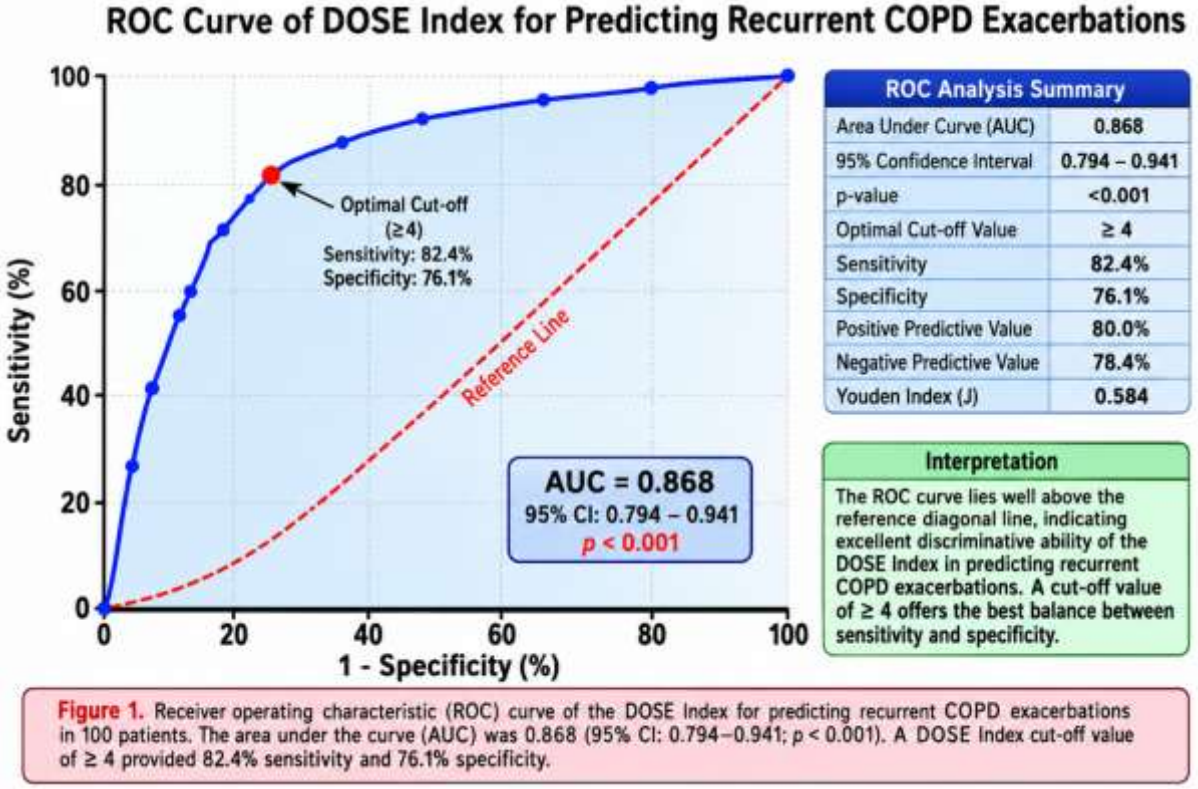

Figure 1. Receiver operating characteristic (ROC) curve of the DOSE Index for predicting recurrent COPD exacerbations in 100 patients. The area under the curve (AUC) was 0.868 (95% CI: 0.794–0.941; p < 0.001). A DOSE Index cut-off value of ≥ 4 provided 82.4% sensitivity and 76.1% specificity.

Multivariable logistic regression analysis identified a DOSE Index of ≥4 as the strongest independent predictor of recurrent COPD exacerbations (adjusted OR: 9.18**,** 95% CI: 3.54–23.82; p<0.001). Current smoking (adjusted OR: 3.12; p=0.012) and advanced GOLD stage (adjusted OR: 2.84; p=0.020) were also significantly associated with recurrent exacerbations. However, age, sex, and biomass fuel exposure did not show statistically significant independent associations after adjustment for confounding variables **(Table 8).**

Table 8. Multivariable Logistic Regression Analysis for Predictors of Recurrent Exacerbations

Variable	Adjusted Odds Ratio (OR)	95% Confidence Interval	p-value
DOSE Index ≥4	9.18	3.54–23.82	<0.001*
Current smoking	3.12	1.28–7.63	0.012*
GOLD Stage III/IV	2.84	1.18–6.82	0.020*
Age ≥60 years	1.54	0.72–3.28	0.262
Male gender	1.29	0.56–2.95	0.551

*p Value <0.05 significant

DISCUSSION

The present prospective observational study evaluated the relationship between the Dyspnea, Obstruction, Smoking, Exacerbation (DOSE) Index and the COPD Assessment Test (CAT) score in predicting clinical outcomes among patients admitted with acute exacerbation of COPD (AECOPD). The findings demonstrated a strong positive correlation between the DOSE Index and CAT score, with both instruments showing significant improvement following treatment and during six months of follow-up. Furthermore, a higher DOSE Index independently predicted recurrent exacerbations, emphasizing its value as a multidimensional prognostic tool.

The study population predominantly consisted of elderly male smokers, reflecting the well-established epidemiology of COPD in developing countries. This observation is consistent with the findings of Motegi et al., who reported that smoking remains the principal risk factor associated with COPD severity and recurrent exacerbations.(11) Similarly, Sundh et al. observed that increasing age and cumulative smoking exposure were associated with worsening airflow limitation and poor long-term outcomes among COPD patients.(12)

The majority of participants belonged to GOLD stage III and IV, indicating advanced airflow obstruction at the time of hospitalization. Similar findings were reported by Gupta et al., who demonstrated that patients admitted with AECOPD commonly presented with severe airflow limitation and impaired pulmonary function.(13) However, spirometric impairment alone does not adequately reflect symptom burden or future risk. Consequently, multidimensional indices such as the DOSE Index provide a more comprehensive assessment by incorporating clinical symptoms, smoking status, and exacerbation history in addition to airflow limitation.

One of the important findings of the present study was the significant reduction in both DOSE Index and CAT scores following treatment. Improvement in these scores reflects better symptom control, enhanced quality of life, and reduced disease severity after optimal medical management. These observations are comparable to those reported by Mackay et al., who demonstrated that multidimensional indices are responsive to clinical improvement following treatment of exacerbations.(14)

A strong positive correlation was observed between the DOSE Index and CAT score throughout follow-up. Patients with higher DOSE scores consistently reported higher CAT scores, indicating greater symptom burden and poorer health-related quality of life. This finding agrees with the work of Jones et al., who validated the CAT questionnaire as an effective measure of disease impact and demonstrated its close relationship with multidimensional COPD severity indices. (15) Likewise, Kon et al. concluded that CAT scores accurately reflect health status impairment and correlate with disease severity in routine clinical practice. (16)

During the six-month follow-up, recurrent exacerbations occurred predominantly among patients with higher baseline DOSE Index scores. ROC analysis demonstrated excellent predictive performance of the DOSE Index (AUC = 0.868), and a score

of ≥4 provided good sensitivity and specificity for predicting future exacerbations. Similar observations were reported by Sundh et al., who found that the DOSE Index effectively predicted hospitalization and mortality among COPD patients managed in primary care settings.(17) Motegi et al. also reported that the DOSE Index performed better than spirometric grading alone in identifying patients at increased risk of recurrent exacerbations. (18)

Multivariable logistic regression analysis identified a DOSE Index ≥4 as the strongest independent predictor of recurrent exacerbations, followed by current smoking and advanced GOLD stage. These findings support previous reports by Chavannes et al., who demonstrated that multidimensional assessment tools improve risk stratification compared with conventional spirometric classification alone.(19) Likewise, Müllerova et al. emphasized that previous exacerbation history and symptom burden are major determinants of future exacerbations and healthcare utilization. (20)

The findings of the present study have important clinical implications. Routine assessment using both the DOSE Index and CAT questionnaire provides a rapid, inexpensive, and reliable method for identifying patients at high risk of recurrent exacerbations. Such patients may benefit from intensified smoking cessation counselling, pulmonary rehabilitation, vaccination, optimized inhaled therapy, and closer follow-up to reduce hospital readmissions. Recent studies by Miravitlles et al., Agustí et al., and Vogelmeier et al. have also highlighted the importance of multidimensional assessment in personalized COPD management. (21–23) Furthermore, the GOLD 2024 report recommends combining symptom scores with exacerbation history to guide treatment decisions and improve long-term outcomes. (24) Collectively, these findings reinforce the usefulness of the DOSE Index as a practical prognostic tool in routine clinical practice. The results are also consistent with the systematic review by van Dijk et al., which concluded that multidimensional prognostic indices outperform single physiological measures in predicting clinically relevant outcomes in COPD. (25)

CONCLUSION

The present study demonstrated a strong positive correlation between the Dyspnea, Obstruction, Smoking, Exacerbation (DOSE) Index and the Chronic Obstructive Pulmonary Disease Assessment Test (CAT) score among patients admitted with acute exacerbation of COPD. Both the DOSE Index and CAT score showed significant improvement following treatment and during six months of follow-up, indicating their usefulness in monitoring disease progression and response to therapy. Patients with higher baseline DOSE Index scores experienced a significantly greater frequency of recurrent exacerbations, and a DOSE Index of ≥4 emerged as the strongest independent predictor of future exacerbations. Receiver operating characteristic analysis further confirmed the excellent predictive performance of the DOSE Index, supporting its role as a reliable multidimensional prognostic tool.

The findings suggest that the DOSE Index complements spirometric assessment by

incorporating symptom severity, smoking status, and exacerbation history, thereby providing a more comprehensive evaluation of COPD severity. When used together with the CAT score, it enables better risk stratification, facilitates individualized treatment planning, and assists clinicians in identifying patients who require closer monitoring and intensive disease management.

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