



State of Practice: Using a Treatable Traits Approach to Predicting the Incidence and Severity of COPD Exacerbation

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Introduction

In the United States, approximately 16.4 million people have been diagnosed with chronic obstructive pulmonary disease (COPD), and it is one of the leading causes of morbidity and mortality worldwide.¹ As COPD progresses and severity worsens, the risk and severity of exacerbations increase.² Exacerbations speed the decline of lung function and often lead to hospitalizations. An increased frequency of severe exacerbations that require hospitalization is associated with higher mortality.³ Successful COPD management would effectively reduce exacerbations and manage symptoms in affected individuals.⁴

Clinical management of COPD is challenging due to the heterogeneity of the disease and the presence of comorbidities. Effective disease management depends on an appropriate assessment of disease severity. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) strategy document categorizes patients according to a patient's level of airflow limitation, symptoms, and comorbidities, and disease stages are often used as a guidance for determining optimal treatment.⁴ However, patients grouped in the same stage of the disease often have variation in symptoms, exacerbations, and risk of mortality.^{5,6} Common conditions that accompany COPD include pulmonary comorbidities, gastrointestinal comorbidities, metabolic factors, and mental health disorders.^{7,8} Individuals with COPD are also more likely to have cardiovascular diseases and cardiovascular risk factors.⁹

Although causation has not been established, the presence of comorbidities may independently increase the risk of death in individuals with COPD.⁸ As such, GOLD recommends routinely evaluating and treating comorbidities in individuals with COPD as they can independently affect mortality and hospitalizations.⁴

A personalized management approach to chronic airway diseases may circumvent some of the difficulties posed by disease heterogeneity and comorbidities. More recently, there has been a push to view COPD as a compilation of symptoms and exacerbations disease characteristics that can affect disease outcome rather than as a homogenous disease.^{10,11} This approach takes into consideration factors such as comorbid conditions, behavioral factors, smoking, and exposures to allergens. Pulmonary disease characteristics affecting disease severity include surrogate markers for airflow limitation, eosinophilic airway inflammation, and infections. These biomarkers or disease characteristics can be diagnosed independently using laboratory tests, imaging tools, or questionnaires, and, consequently, each characteristic can be treated independently. The ultimate goal is to have a customized treatment plan catered to each patient's disease characteristics.

Endeavors are currently being carried out to identify biological biomarkers and disease characteristics to predict and better manage exacerbations. Several studies suggest that a higher baseline eosinophil count is associated with an increased risk of exacerbation.^{12,13} Those with higher eosinophil counts also respond better to systemic corticosteroid treatment.¹³ Other biological biomarkers being investigated in relation to COPD exacerbation include C-reactive protein and procalcitonin.¹⁴ When patients with COPD were subtyped, frequency of exacerbation, impaired health status, white blood counts, and gastroesophageal reflux disease (GERD) were all associated with frequent exacerbation.² However, exacerbation history was the best predictor of future exacerbations. Work in this area is ongoing as researchers aim to identify treatable disease characteristics and biomarkers that can reproducibly predict exacerbations and treatment response.

Community-based pulmonologists play a key role in COPD management, and many have the ability to influence treatment protocols. Their knowledge of treatable disease characteristics and their willingness to adopt a management approach based on these characteristics can significantly affect patient morbidity and mortality. In the present study, we will focus on community-based pulmonologists, the traits they view as being predictive of COPD exacerbation and recovery time, and their likelihood of evaluating treatable traits.

BACKGROUND AND PURPOSE

COPD-related exacerbations adversely impact the health and quality of life of patients with COPD. Frequent exacerbations and resulting hospitalizations lead to greater impairment in daily living, decreased ability to remain in the workplace, and an increased burden on family caregivers. Frequent exacerbations experience worsening lung function along with faster rates of lung function decline.² These individuals are also more likely to have longer hospital stays.¹⁵ Readmissions within 30 days of discharge and repeated acute exacerbations have both been shown to increase mortality risk in patients with COPD.

In this study, CHEST is undertaking primary research with community-based pulmonologists to understand which traits they use to predict the risk and severity of exacerbations, particularly in patients who have never had any exacerbations. More specifically, the objectives of this research are to:

- Assess the frequency with which pulmonary, extrapulmonary, and behavioral traits are evaluated in community-based pulmonology practices.
- Assess which treatable disease characteristics community-based pulmonologists use to predict the occurrence of exacerbations in patients with COPD in general and in patients who have no history of exacerbation in particular.
- Assess which treatable disease characteristics are used to predict the severity of an acute exacerbation as evidenced by length of hospital stay.
- Identify barriers to assessing these disease characteristics in community-based pulmonology practices.
- Assess the extent to which community-based pulmonologists are actively involved in advancing the knowledge and importance of assessing and managing treatable traits among primary care physicians.

METHODOLOGY

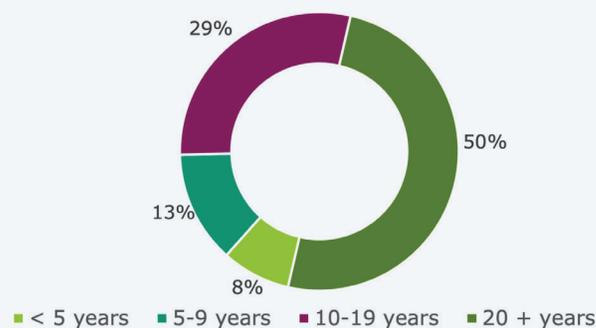
CHEST conducted an online survey with a sample of $n=406$ community-based general pulmonologists randomly sampled from the CHEST member database. Respondents were screened to ensure that they are in active clinical practice in a community-based setting and that they see patients with COPD. Respondents were sent a link to the survey from CHEST, and data were collected during May 28-June 19, 2020.

Data were analyzed in aggregate and by cross-sections, including tenure in practice post-fellowship, by monthly COPD patient volume, by type of practice (single vs multispecialty), by number of physicians in practice, by employment status (health system-employed vs other), and by approach to managing patients diagnosed with COPD (guidelines-based vs symptom-driven). Descriptive statistics were used to assess distributions of the data across study variables. Inferential statistics were used to assess differences in response within the cross-sections identified above. Depending on data type, a two-tailed independent samples t-test and a chi-square test were used to test for statistical significance ($P \leq 0.05$ considered statistically significant).

RESPONDENT PROFILE

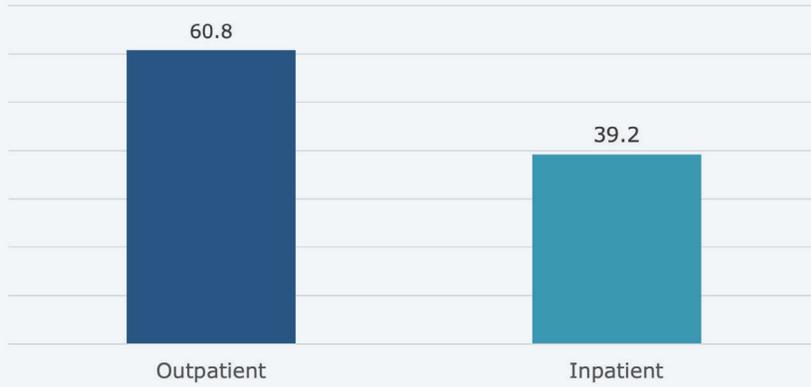
Half of respondents (50%) have been in practice for 20 years or longer, and fewer than a fourth (21%) have been in practice for less than 10 years. On average, respondents report spending 61% of their clinical time working in an outpatient setting. Respondents represent a mix by US region, and the majority practice in suburban settings (59%).

Figure 1. Years in Practice



Q: How many years have you been in practice since you completed your fellowship? $n=406$

Figure 2. Mean Percentage of Clinical Time by Setting



Q: Approximately what percentage of your clinical time is spent in the following settings? n=406

Figure 3. Distribution of Respondents by US Census Region

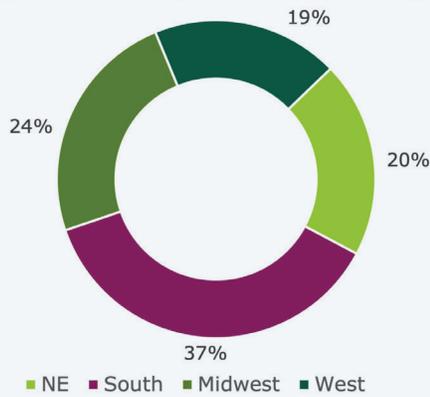
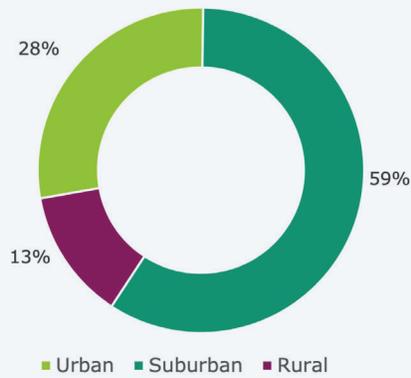


Figure 4. Practice Setting



Q: Does your practice primarily serve...? n=406

PRACTICE PROFILE

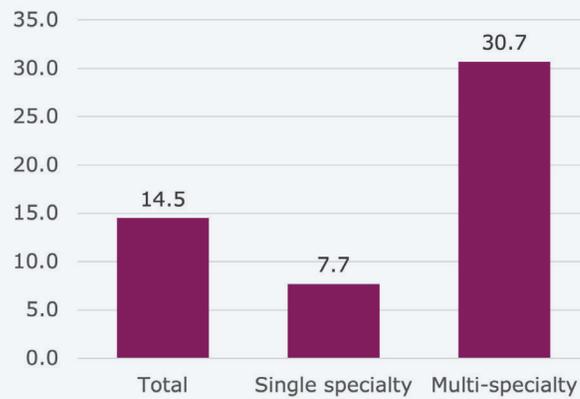
The majority of respondents (68%) are in single specialty practices and report fewer physician colleagues in comparison to their counterparts in multispecialty practices.

Figure 5. Type of Practice



Q: Which of the following best describes the structure of your practice? n=406

Figure 6. Mean Physicians by Practice Type



Q: How many physicians are there in your group? n=341

Respondents are evenly split between those who are employed by a health system (50%) and those who work or are a partner in a privately owned practice (50%). Physicians in multispecialty practices are more likely to be employed by a health system (68% vs 41% among their single-specialty practice colleagues).

Figure 7. Health System Employment by Type of Practice

	Total	Practice	
		Single	Multispecialty
Employed by a health system	50%	41%	68%
Not employed by a health system	50%	59%	32%



Which of the following best describes the structure of your practice? n=406

Are you employed by or is your group owned by a health system or integrated delivery network? n=406

On average, respondents report seeing 60 COPD patients per month, of which 24 are experiencing symptoms of exacerbation. Reported COPD patient volumes are slightly lower in multispecialty practices.

Figure 8. Mean Monthly COPD Patient Volumes and Exacerbation Volumes by Practice Type



Approximately how many COPD patients do you see per month? n=406

Approximately how many COPD patients, who are experiencing exacerbations, do you see per month? n=406

PRESENTATION OF DETAILED FINDINGS

Approach to COPD management

Nearly three respondents in four (71%) say they used a guidelines-based approach (GOLD or some other methodology) to guide management of their patients with COPD, while the remainder develop treatment plans based on the patient's mix of symptoms. Respondents who have been in practice for less than 20 years are much more likely to say they use GOLD strategy document (80%) in comparison to their longer-tenured colleagues (61%).

Figure 9. Approach to COPD Management by Tenure

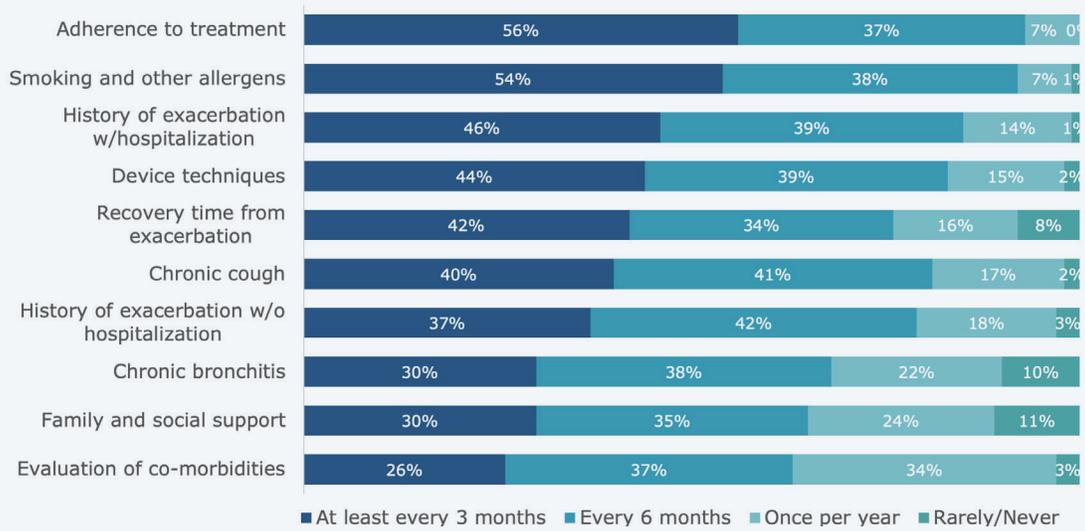
	Total	Tenure	
		<20 years	20+ years
Guidelines based approach (GOLD)	71%	80%	61%
Patient's symptom approach	29%	20%	39%

Q: Which of the following best describes your approach to managing patients that have been diagnosed with COPD? n=406

Frequency of evaluating patient traits

Respondents were exposed to a series of pulmonary, extrapulmonary, and behavioral traits and were asked to indicate how frequently they evaluate each trait in their patients with COPD. The traits respondents say they most frequently evaluate are those that can be reviewed during the course of an office/telehealth encounter that do not require any sort of testing: behavioral traits (tobacco use, treatment adherence, and device issues) and reported experience with exacerbations (history of exacerbation and reported recovery time).

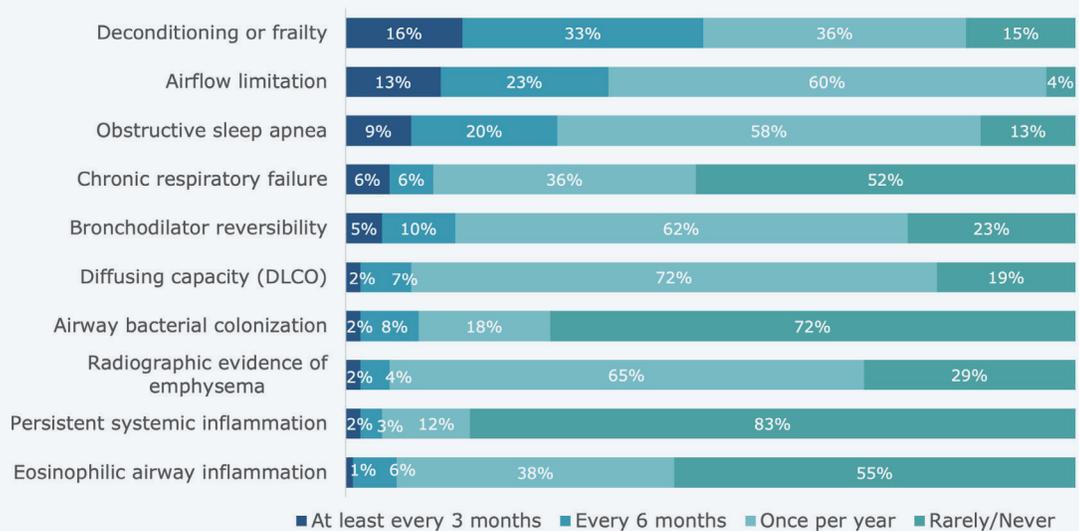
Figure 10. Traits More Frequently Evaluated in Patients with COPD



Q: How frequently do you evaluate the following factors in your patients who have been diagnosed with COPD? n=406

A number of pulmonary and extrapulmonary factors are evaluated somewhat less frequently, including deconditioning/frailty, airflow limitation/lung function, obstructive sleep apnea, chronic respiratory failure, and bronchodilator reversibility.

Figure 11. Traits Less Frequently Evaluated in Patients with COPD



Q: How frequently do you evaluate the following factors in your patients who have been diagnosed with COPD? n=406

Variations in evaluation practice are observed when examining cross-sections of respondents by practice tenure and COPD patient volume. Respondents with longer practice tenure, as well as those who report treating higher volumes of patients with COPD, are more apt to evaluate select pulmonary (airflow limitation, chronic cough, chronic bronchitis, exacerbation recovery), extrapulmonary (deconditioning, OSA, presence of comorbidities, persistent inflammation), and behavioral factors (device technique, treatment adherence and family support).

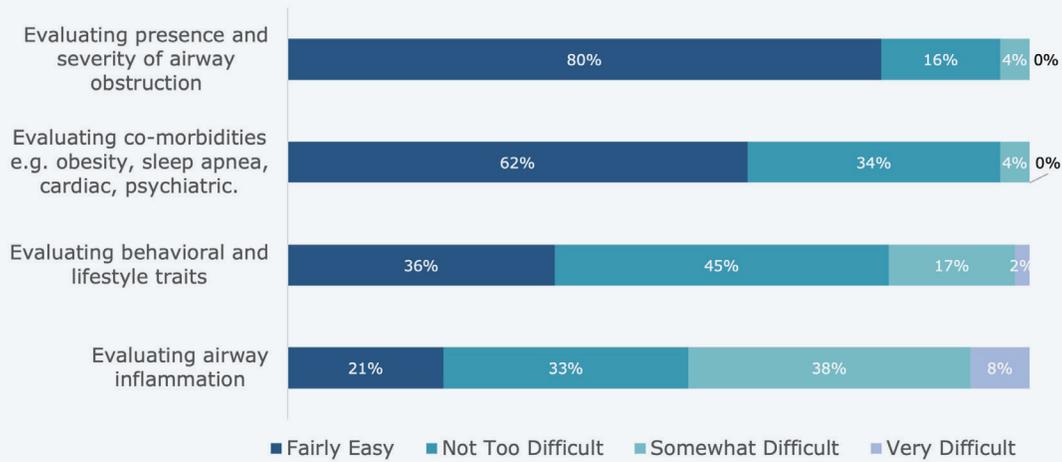
Figure 12.
Frequency of Evaluation of Selected Traits by Tenure and Patient Volume
 (Mean score where 4=At least every 3 months and 1=rarely/never)

	Total	Tenure		Monthly Patient Volume		
		<20	20+	1-50	51-100	101+
Adherence to treatment	3.48	3.46	3.50	3.39	3.52	3.53
Device techniques	3.25	3.19	3.31	3.11	3.29	3.34
Chronic cough	3.18	3.09	3.27	3.08	3.20	3.25
Recovery time from X	3.09	2.97	3.22	3.05	3.09	3.14
Chronic bronchitis	2.87	2.84	2.91	2.72	2.90	2.99
Co-morbidities	2.85	2.76	2.94	2.81	2.78	2.94
Family and social support	2.83	2.68	2.99	2.80	2.79	2.90
Deconditioning	2.50	2.40	2.60	2.32	2.55	2.63
Airflow limitation	2.44	2.42	2.45	2.25	2.45	2.59
Obstructive sleep apnea	2.26	2.20	2.31	2.18	2.22	2.37

Q: How frequently do you evaluate the following factors in your patients who have been diagnosed with COPD? n=406
 Highlighted statistics are significantly different compared with other cross sections using two-sample t-test.

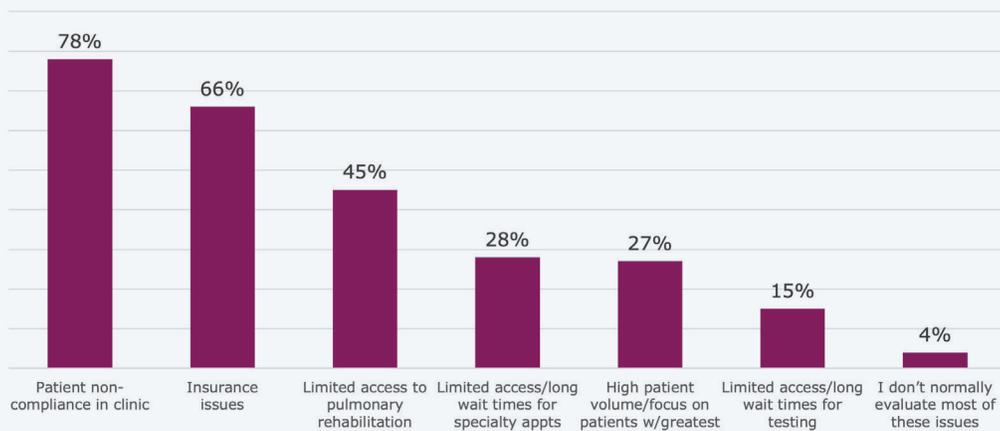
Barriers to evaluation of traits and characteristics

Respondents were asked to rate the extent to which evaluation of pulmonary, extrapulmonary, and behavioral traits are a challenge in their current practice environment. A majority agree that it is fairly easy to evaluate presence and severity of airway obstruction (80%) and comorbidities (62%). However, they are somewhat less likely to indicate that evaluating behavioral characteristics is fairly easy (36%). Evaluation of airway inflammation is challenging (46% say it is somewhat or very difficult to do). No variations are observed regarding perception of barriers by cross-sections of respondents.

Figure 13. Ease of Evaluating Patient Characteristics

Thinking about the resources available to you where you practice, please rate the ease of evaluating the following categories of characteristics in your patients with COPD. n=406

In citing barriers to evaluation, most say that patient noncompliance/lack of follow-up in clinic (78%) and insurance issues (66%) are the main barriers to evaluating key traits and characteristics in patients with COPD. A minority cite limited access/long wait times for appointments as barriers to effective evaluation, eg, pulmonary rehab (45%), specialists for evaluation of comorbidities (28%), and testing (15%). A fourth (27%) say that they have to focus resources on patients with the greatest need due to having a busy practice. Again, no variations are observed by cross-sections of respondents.

Figure 14. Barriers to Evaluation of Patient Characteristics

Which of the following factors make it more difficult for you to evaluate characteristics affecting COPD in your patients? n=406

Predictors of COPD exacerbation

To assess which traits and characteristics respondents consider to be predictors of COPD exacerbation, in general, they were once again exposed to the battery of items reviewed earlier. They were asked to rate how strongly they considered the item to be a predictor of exacerbation, using a 5-point scale where a rating of “5” indicates the item is considered a strong predictor and a rating of “1” indicates it is a weak predictor.

Several items are strongly identified as predictors (mean score of 4.5 or higher): history of exacerbation, tobacco use, and treatment adherence. Several factors are identified as more moderate predictors (mean score between 3.5 and 4.5), prior history of exacerbation not leading to hospitalization, including airflow limitations, chronic respiratory failure, evaluation of comorbidities, family support, length of recovery time from a past exacerbation, deconditioning, device techniques eosinophilic airway inflammation, and chronic bronchitis.

Figure 15. Strong and Moderate Predictors of Future COPD Exacerbation
(Mean score where 5=Strong Predictor and 1=Weak Predictor)

	Total
Prior history of exacerbation resulting in hospitalization	4.72
Smoking and exposure to other allergens	4.54
Adherence to treatment	4.49
Deconditioning or frailty	4.21
Prior history of exacerbation NOT leading to hospitalization	4.10
Recovery time during prior exacerbations	4.08
Airflow limitation	3.85
Device techniques	3.85
Chronic bronchitis	3.83
Presence of co-morbidities	3.68
Chronic respiratory failure	3.61
Family and social support	3.55



Thinking about your COPD patients in general, please rate the extent to which you think each of the following behavior-related characteristics are predictors of future COPD exacerbation. n=406

Radiographic evidence of emphysema, obstructive sleep apnea (OSA), persistent systemic inflammation, chronic cough, diffusing capacity, and airway bacterial colonization lag as predictors as weak predictors (mean score less than 3.5).

**Figure 16. Weak Predictors of Future COPD Exacerbation
(Mean score where 5=Strong Predictor and 1=Weak Predictor)**

	Total
Eosinophilic airway inflammation	3.19
Bronchodilator reversibility on spirometry	3.04
Chronic cough	2.94
Airway bacterial colonization	2.88
Obstructive sleep apnea	2.88
Diffusing capacity (DLCO)	2.77
Persistent systemic inflammation	2.73
Radiographic evidence of emphysema	2.29



Thinking about your COPD patients in general, please rate the extent to which you think each of the following behavior-related characteristics are predictors of future COPD exacerbation. n=406

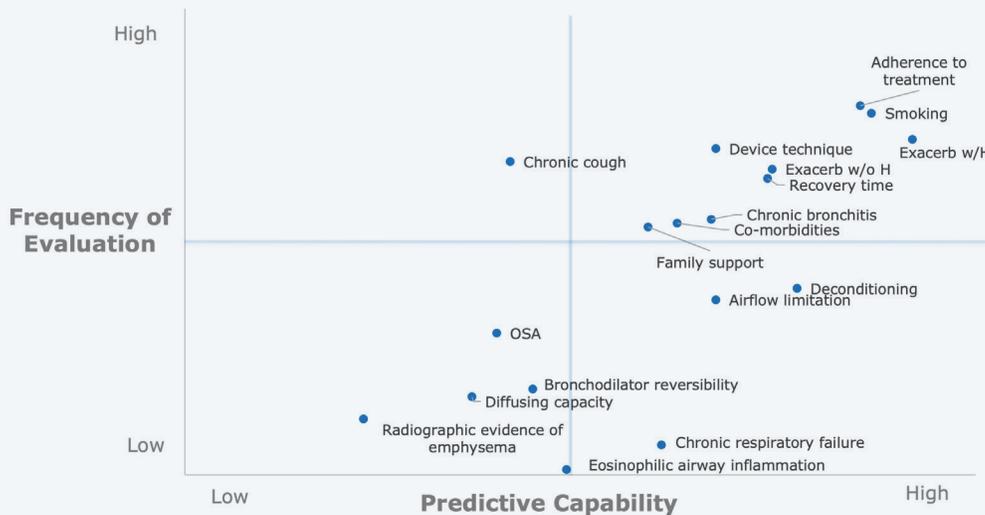
Assessment of predictive capacity of specific traits varies to a degree by reported patient volume. Respondents who report higher COPD patient panels are more likely to identify eosinophilic airway inflammation, chronic bronchitis, airway bacterial colonization, chronic cough, chronic respiratory failure, and persistent systemic inflammation as predictors.

Evaluative practice vs perceived predictive value

Utilizing the mean scores for frequency of evaluation and predictive capability of the traits studied, Figure 17 below was constructed to compare belief (prediction) and behavior (frequency of use). Respondents demonstrate some consistency between selected reported behaviors (frequency of evaluating specific traits) and attitudes toward strength of predictive capacity for exacerbation history and recovery time, treatment adherence, tobacco use, device issues, assessment of chronic bronchitis, assessment of comorbidities, and family support. However, a number of traits that respondents say are

moderate to above average predictors of exacerbation are not being evaluated as frequently. Assessment of deconditioning/frailty and airflow limitation (FEV₁) are slightly less likely to be evaluated, though the need for FEV₁ may vary based on frequency of encounter and the severity of the patient’s COPD. Chronic respiratory failure, eosinophilic airway inflammation, and bronchodilator reversibility are much less likely to be evaluated.

Figure 17. Gap Analysis: Strength of Predictive Capacity vs. Frequency of Evaluation



How frequently do you evaluate the following factors in your patients who have been diagnosed with COPD? n=406
 Rate the extent to which you think the following traits are predictors of future COPD exacerbation. n=406

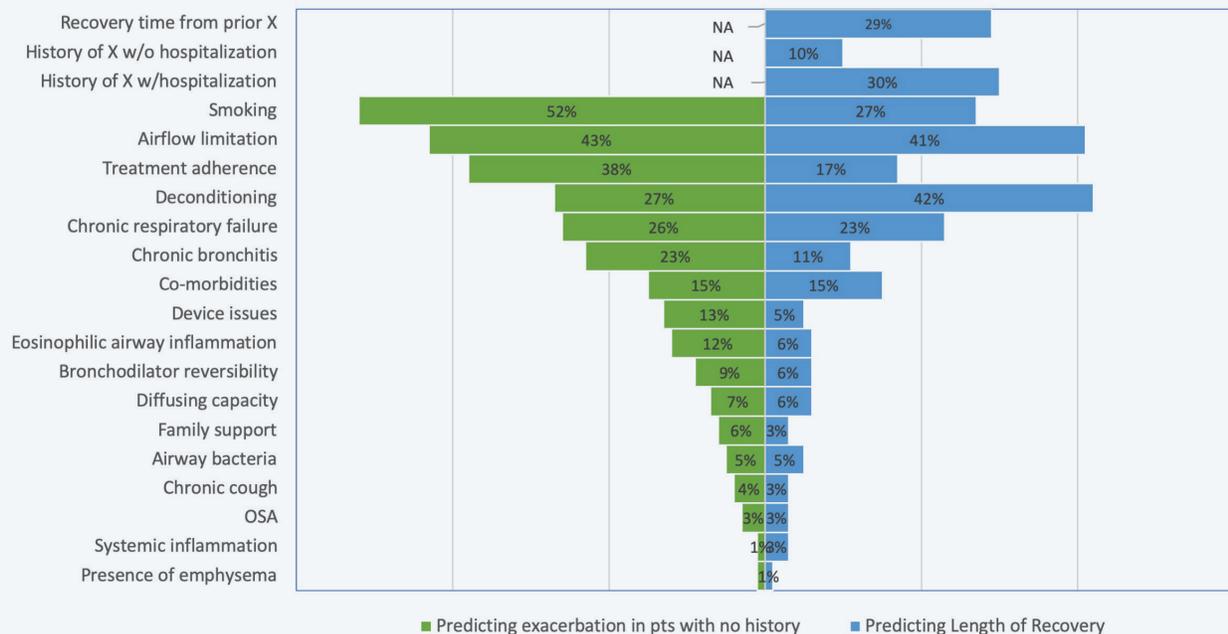
Predicting recovery time and exacerbation in patients with no history of exacerbation

Using the same list of traits examined previously for frequency of evaluation and predictive capability for exacerbation in general, respondents were asked to rank the top five traits they considered to be predictors for each of the following: risk of exacerbation in patients who have no history of exacerbation and length of recovery time from a future exacerbation. For the question regarding prediction of risk among patients with no history, response items related to prior history of exacerbation and recovery time were not included as options.

As shown in Figure 18 below, in predicting exacerbation risk among patients with COPD who have not had an exacerbation, respondents tend to look at the same factors (other than exacerbation history) as they do for risk assessment in general: smoking, airflow limitation, treatment adherence, deconditioning/frailty, chronic respiratory failure, and to a lesser extent, comorbidities. Evaluation of airflow limitation is a more significant predictor for this patient group compared with evaluation of exacerbation risk in general.

In predicting length of recovery time, respondents are more apt to emphasize deconditioning/frailty in the patient and airflow limitation, followed by past history with severe exacerbation requiring hospitalization and recovery time from those experiences.

Figure 18: Predictive Capability of Traits: Exacerbation (No History) and Recovery Time
(% Ranked as Top 3 Predictor)



Please rank the top five predictors of future COPD exacerbation in patients who have limited or no history of COPD exacerbation.
Please rank the top five predictors of a patient's length of recovery time when experiencing an exacerbation. n=406

Medical management and leadership roles

Roughly a third of respondents say they are in a position to influence COPD treatment protocols at their institution because of their formal role in medical management (38%) or informal influence with colleagues in leadership (39%). Similarly, a third (37%) say they are involved in educational activities, including departmental presentations or grand rounds (27%) that reach practicing physicians in their area. Interestingly, when comparing cross sections, respondents who follow GOLD suggested strategies in their approach to treating patients with COPD are somewhat more likely to be in leadership or other roles of influence regarding COPD management.

Figure 19. Medical Management and Peer Leadership Influence

	Total	Approach to Treatment	
		GOLD	Symptoms
Influence COPD treatment protocols even if you are not involved in decisions about guidelines	39%	42%	33%
Part of a team that makes decisions about COPD management	38%	42%	29%
Educate local physicians about COPD	37%	40%	29%
Establish guidelines regarding COPD management	27%	32%	15%
Do departmental presentations on best practices in COPD management	27%	28%	25%
Participate in regional outreach on COPD patient management to other hospitals/medical groups that are part of your system	17%	20%	8%
Publish/speak nationally on best practices in COPD patient management	5%	6%	3%
I don't participate in any educational activities	42%	39%	50%
I don't participate in any medical management activities	37%	32%	48%



Do you participate in any of the following medical management roles?

Are you involved in any of the following educational activities at your affiliated health systems? n=406

Communicating with referring physicians about COPD management

Less than a fifth of respondents (16%) say they make a routine practice of engaging or informally educating referring physicians on how to best evaluate and manage patients with COPD. A majority say they will do this when engagement is triggered by a question from a referring physician. Physicians with larger COPD patient panels are somewhat more likely to take advantage of these teachable moments.

Figure 20. Communicating with Referring Physicians on COPD Patient Management

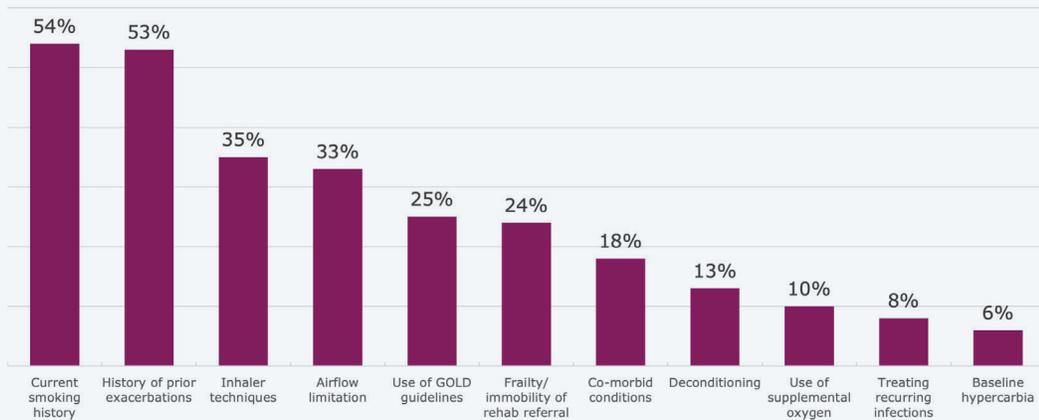
	Total	Monthly Patient Volume		
		1-50	51-100	101+
I routinely do this with all referring PCPs	16%	12%	15%	21%
I will do this when the PCP has a question or asks for my guidance	58%	52%	63%	58%
I rarely/never do this. I mostly focus on sending consult notes back to the PCP	23%	31%	22%	17%



How frequently do you evaluate the following factors in your patients who have been diagnosed with COPD? n=406

When communicating with referring physicians about reducing the risk of COPD exacerbation, respondents are most likely to emphasize tobacco cessation (54%) and importance of understanding exacerbation (53%). To a lesser extent, they also focus on the importance of monitoring frailty/immobility/deconditioning and benefits of pulmonary rehab (37%), assessing device technique (35%), and measuring airflow limitation (FEV₁) (33%). Use of GOLD guidelines (25%) is mentioned less frequently, and comparatively few talk about evaluation and treatment of comorbid conditions (18%), use of supplemental oxygen (10%), and importance of treating recurring infections (8%).

Figure 21. Points of Emphasis to Referring Physicians to Reduce Exacerbation Risk



When you talk to primary care physicians about reducing risk of COPD exacerbations in their patients, what do you tell them to look out for? n=406

**KEY
TAKEAWAYS**

- Community-based pulmonologists play a significant role in the management of patients with COPD who are both stable and experiencing symptoms of exacerbation.
- The majority of community-based pulmonologists use a strategy-based approach to the management of their patients with COPD.
- When evaluating patient disease characteristics, community-based pulmonologists are more likely to evaluate characteristics that do not require testing.
- Characteristics identified as being predictive of exacerbation vary by reported COPD patient volume.
- Some traits identified as being predictive of exacerbations are not frequently evaluated.
- Community-based pulmonologists have the opportunity to influence COPD treatment protocols, but they do not routinely engage or educate referring physicians on how to best manage patients with COPD.

DISCUSSION

Community-based pulmonologists play an important role in COPD management. Here, survey respondents saw an average of 60 patients with COPD per month, and more than a third of these were experiencing symptoms of exacerbation. Most of the surveyed pulmonologists, especially those who had been in practice for less than 20 years, utilized a strategy-based approach for managing their patients with COPD. The GOLD strategy document for COPD management is widely accepted for guiding and optimizing pharmacologic treatment with the ultimate goal of reducing exacerbations and COPD symptoms.⁴ For individuals with one or fewer exacerbations per year, GOLD recommends a bronchodilator (short- or long-acting) may be included in the patient's treatment plan.⁴ However, as exacerbation frequency increases, GOLD recommends long-acting muscarinic receptor antagonists (LAMAs) become the preferred treatment. In the most severe cases, GOLD recommends a combination of long-acting beta-agonist (LABA) in conjunction with inhaled corticosteroids (ICS) or LAMA+LABA may be utilized.⁴ Recent studies, however, suggest that regardless of exacerbation history, triple therapy (LABA+LAMA+ICS) showed the greatest benefit for improving health status and lung function and preventing exacerbations.¹⁶

When evaluating COPD traits, pulmonologists were most likely to evaluate behavioral traits, exacerbation history, and recovery time rather than traits that require testing. Failure to evaluate testing-based traits creates an overdependence on physician-patient communication. Although not

evaluated in the survey, both physicians and patients have previously noted dissatisfaction in communication surrounding COPD, and patient and patient advocates have identified poor communication as a barrier to optimal COPD care.¹⁷⁻¹⁹ However, physician-patient communication is also key to optimizing treatment adherence.²⁰ Patients' and physicians' views around disease severity and chronicity of the disease often differ, and smoking cessation is not always adequately addressed during office visits.²¹ Encouragingly, the majority of respondents in this survey reported discussing smoking and other exposure-related allergens with their patients. This is important as both contribute to exacerbation risk.²² In light of the known issues surrounding physician-patient communication regarding COPD, if testing-based traits are not evaluated regularly, measures must be taken to ensure thorough assessment and effective communication. This study did not specifically identify the assessment tools (if any) used by pulmonologists, but short-structured assessments, such as the COPD Assessment Test and the COPD Control Questionnaire, are suitable for routine use in practice.⁴

Pulmonologists identified 12 strong to moderate predictors of future COPD exacerbations, but some of these traits, such as deconditioning and airflow inflammation, were evaluated less frequently. Airway obstruction and comorbidities were identified as being easy to evaluate. However, almost half of survey respondents said airflow inflammation testing is difficult to perform. This likely explains the low frequency of testing. Similarly, the reduced testing for deconditioning may be related to limited access to pulmonary rehabilitation cited by pulmonologists. While pulmonary rehabilitation is beneficial for COPD patients especially after an exacerbation and as the disease worsens, it is underutilized and insufficiently funded.^{4,23}

The best predictor for exacerbation, regardless of the GOLD stage, is a history of exacerbation.² In the absence of exacerbation history, surveyed pulmonologists were more likely to focus on the same traits that they use to evaluate exacerbation risk with the main focus being on airflow limitation and behavioral elements. While worsening lung function is an important factor in COPD disease progression, some patients are more susceptible to exacerbations regardless of lung function status.² In the absence of exacerbation history, it is also important to evaluate other traits. A focus on behavioral interventions (smoking cessation and environmental toxins) is important since environmental factors along with respiratory infections are important triggers for exacerbation.²² Other biological factors associated with exacerbation frequency that may be important to monitor include

comorbidities (specifically GERD) and elevated white blood cell count.² Current GOLD guidelines do not recommend using eosinophil count as a predictor of exacerbation.⁴ However, several studies suggest that higher baseline eosinophil count is associated with an increased risk of exacerbation, and about a quarter of COPD exacerbations are eosinophilic.^{12,13}

COPD exacerbation recovery time varies, with the average being 7 days to 10 days.²⁴ When recovery is slow, the disease is more likely to progress. Here, airflow limitation and deconditioning were most frequently cited as predictive of recovery time. While these factors are indicative of disease worsening and may contribute to slow exacerbation recovery time, they may also be a result of previous exacerbations. Severe COPD exacerbations require hospitalization and limit exercise capacity and, thus, contribute to deconditioning, which further contributes to disease progression. Up to 25% of patients do not return to baseline lung function 5 weeks after an exacerbation, and without adequate pulmonary rehabilitation, deconditioning and worsening lung function will likely continue.^{23,24}

Community-based pulmonologists play an important role in the management of COPD, and the majority of respondents were also in a position to influence COPD management practices of colleagues. However, the opportunity to educate primary care physicians (PCPs) on COPD management and exacerbation prevention was not utilized by the majority of survey respondents. When this opportunity was utilized, more emphasis was placed on smoking and exacerbation history rather than guideline adherence and comorbidities. COPD is frequently underdiagnosed, and this may be partially due to a lack of adequate knowledge and testing at the primary care level.²⁵ Past studies have highlighted low familiarity and adherence with the GOLD guidelines at the primary care level.^{26,27} More specifically, adherence to spirometry guidelines for diagnosis and management was significantly hindered by PCP's lack of confidence in their ability to administer tests and interpret results.²⁶⁻²⁸ This highlights the need for further education at the PCP level to improve patient care and the need for pulmonologists to engage PCPs in formal or informal educational activities.

EDUCATIONAL OPPORTUNITIES

- Education around the benefits of using an approach to COPD management that is based on disease characteristics.
- Education around the importance of laboratory testing in addition to in-office assessments.
- Education around the need for continuing education at the primary care level on COPD management strategies and exacerbation preventive measures.

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