Scoring System and Clinical Application of COPD Diagnostic Questionnaires*

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Objectives: **In most primary care settings, spirometric screening of all patients at risk is not practical. In prior work, we developed questionnaires to help identify COPD in two risk groups: (1) persons with a positive smoking history but no history of obstructive lung disease (case finding), and (2) patients with prior evidence of obstructive lung disease (differential diagnosis). For these questionnaires, we now present a scoring system for use in primary care.**

Methods: **Scores for individual questions were based on the regression coefficients from logistic regression models using a spirometry-based diagnosis of obstruction as the reference outcome. Receiver operator characteristic analysis was used to determine performance characteristics for each questionnaire. Several simplified scoring systems were developed and tested.**

Results: **For both scenarios, we created a scoring system with two cut points intended to place subjects within one of three zones: persons with a high likelihood of having obstruction (high predictive value of a positive test result); persons with a low likelihood of obstruction (high predictive value of a negative test result); and an intermediate zone. Using these scoring systems, we achieved sensitivities of 54 to 82%, specificities of 58 to 88%, positive predictive values of 30 to 78%, and negative predictive values of 71 to 93%.**

Conclusions: **These questionnaires can be used to help identify persons likely to have COPD among specific risk groups. The use of a simplified scoring system makes these tools beneficial in the primary care setting. Used in conjunction with spirometry, these tools can help improve the efficiency and accuracy of COPD diagnosis in primary care.**

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Key words: diagnostic techniques; obstructive lung diseases; primary care; questionnaires; sensitivity and specificity

Abbreviations: NPV = negative predictive value; PPV = positive predictive value; ROC = receiver operator characteristic

Underdiagnosis of COPD is a widespread problem.[1] Diagnostic confusion between asthma and COPD, while not as widespread, appears to be an important clinical problem in some patients.[2] The definitive diagnostic maneuver for COPD is spirometry[1]; however, despite frequent advocacy for spirometric screening,[3,4] spirometry is underused.[5] This is especially true in the primary care setting, the usual site of initial presentation.[5,6] There is a perception that spirometric screening of all at-risk persons is impractical in primary care. This has led to efforts to identify a subset of patients for whom such screening is likely to be cost-effective.[7]

In contrast to general population screening programs,[8] efforts to locate persons within a primary care practice are more accurately referred to as *case-finding* programs.[7] These types of programs should be directed toward groups known to have an increased prevalence of the condition to be identified. COPD prevalence is known to be increased in adults >40 years old and in persons exposed to noxious smoke or fumes, especially cigarette smoke.[1] Persons with prior evidence of respiratory problems but in whom a diagnosis has not been definitively established represent another group likely to benefit from closer scrutiny.

Previous work[9] has shown that relatively simple questionnaires can help identify persons with an increased likelihood of fixed obstruction. Most recently, this has been demonstrated in two risk groups: (1) current and former smokers ≥ 40 years old with no prior evidence of obstructive lung dis-

ease (case-finding scenario)[10]; and (2) persons ≥ 40 years old with prior evidence of obstructive lung disease (differential diagnosis scenario).[11] We now describe the development of a scoring system for these questionnaires suitable for use in a primary care setting.

Materials and Methods

Details of the development of the questionnaires have been described elsewhere.[10,11] In brief, two study sites (Aberdeen, Scotland and Denver, CO) were chosen for the evaluation. Subjects ≥ 40 years old were randomly selected from primary care practice rosters in these sites and invited by mail to participate in the study. Eligible respondents were enrolled after providing informed consent. Respondents were eligible if they reported the following: (1) a positive smoking history (current or former smokers), with no prior evidence of respiratory diagnosis (*eg*, no prior respiratory diagnosis and no respiratory medications within the past year); or (2) prior evidence of respiratory diagnosis (*eg*, any prior respiratory diagnosis or any respiratory medications within the past year), regardless of smoking status. Participants completed a questionnaire covering demographics and symptoms and then underwent spirometry with reversibility testing. Study diagnoses were based on guidelines developed by the Global Initiative for Chronic Obstructive Lung Disease[1] and the Global Initiative for Asthma.[12] A study diagnosis of COPD was assigned to persons with postbronchodilator FEV_1/FVC ratio < 0.70. For the differential diagnosis analysis, a diagnosis of asthma was assigned to persons with postbronchodilator FEV_1/FVC ratio ≥ 0.70 and FEV_1 reversibility ≥ 200mL and ≥ 12% of baseline. Persons with no reversibility received a diagnosis of "probable asthma" if they had a prior diagnosis of asthma or were receiving long-term corticosteroids. The study was approved by ethics committees at the two sites. A description of the study populations is provided in Table 1.

In previous reports,[10,11] we described the development and initial performance evaluation of the questionnaires. Prior to analysis, each of the study samples were randomly assigned into two subsamples in order to reduce potential biases introduced by same-sample predictions.[13] For each study sample, a "development subsample" (70%) was used to create the questionnaires, while a "performance subsample" (30%) was used to evaluate the performance characteristics of the questionnaires. Using the development subsamples, item reduction was carried out. Based on the reduced item sets, multivariate logistic regression models were constructed to identify the best performing questions to discriminate between persons with and without COPD in each risk group, again using the development subsamples. All items showing statistical significance at $p < 0.05$ were retained for the final questionnaires, which are provided in Table 2. Using the performance subsamples, receiver operator characteristic (ROC) curves were constructed. Several performance parameters were

Table 1—*Sample Description

Characteristics	Case Finding (Full Sample, n = 818)	Differential Diagnosis (Full Sample, n = 597)
Demographics		
Age, yr	58.2 ± 11.2	58.7 ± 11.4
Age range, %		
40–49	26.0	26.3
50–59	31.2	28.3
60–69	24.2	26.1
70+	18.6	19.3
Male gender	49.3	38.3
Body mass index	28.3 ± 5.7	29.0 ± 6.7
Body mass index categories		
Low tertile	33.5	33.6
Middle tertile	33.3	33.0
High tertile	33.3	33.4
Smoking status		
Current smoker	44.5	24.2
Former smoker	55.5	53.6
Never-smoker	†	22.2
Pack-years	25.6 ± 24.3	19.1 ± 23.9
Pack-year categories, %		
0–14	34.8	55.1
15–24	20.2	12.7
25–49	33.0	19.4
50+	12.0	12.7
Race/ethnicity, %		
Non-Hispanic white	87.0	90.8
Non-Hispanic black	6.8	4.4
Hispanic	0.2	0.2
Asian	0.5	1.0
Other	5.4	3.7
Pulmonary function, % of predicted		
Postbronchodilator FEV_1	94.4 ± 17.0	83.6 ± 23.8
Postbronchodilator FVC	95.8 ± 15.5	91.4 ± 18.9
Postbronchodilator FEV_1/FVC	98.2 ± 9.7	89.9 ± 16.3
Study diagnosis of COPD		
Postbronchodilator FEV_1/FVC < 0.70	155 ± 18.9	235 ± 39.4

*Data are presented as % or mean ± SD.
†Never-smokers were not eligible for this study arm.

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