Health status measurement instruments in chronic obstructive pulmonary disease

Yves Lacasse MD MSc, Eric Wong MD MSc, Gordon Guyatt MD MSc, Roger S Goldstein MB ChB,
Centre de Pneumologie, Hôpital Laval, Ste-Foy, Québec; Department of Medicine, University of Alberta, Edmonton, Alberta; Department of Medicine and Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario; Department of Medicine, University of Toronto, Toronto, Ontario

Y Lacasse, E Wong, G Guyatt, RS Goldstein. Health status measurement instruments in chronic obstructive pulmonary disease. Can Respir J 1997;4(3):152-164. Chronic obstructive pulmonary disease (COPD) is associated with primary respiratory impairment, disability and handicap, as well as with secondary impairments not necessarily confined to the respiratory system. Because the primary goals of managing patients with COPD include relief of dyspnea and the improvement of health-related quality of life (HRQL), a direct measurement of HRQL is important. Fourteen disease-specific and nine generic questionnaires (four health profiles and five utility measures) most commonly used to measure health status in patients with COPD were reviewed. The measures were classified according to their domain of interest, and their measurement properties – specifications, validity, reliability, responsiveness and interpretability – were described. This review suggests several findings. Currently used health status instruments usually refer to the patients' perception of performance in three major domains of HRQL – somatic sensation, physical and occupational function, and psychological state. The choice of a questionnaire must be related to its purpose, with a clear distinction being made between its evaluative and discriminative function. In their evaluative function, only a few instruments fulfilled the criteria of responsiveness, and the interpretability of most questionnaires is limited. Generic questionnaires should not be used alone in clinical trials as evaluative instruments because of their inability to detect change over time. Further validation and improved interpretability of existing instruments would be of greater benefit to clinicians and scientists than the development of new questionnaires.

Key Words: *Chronic obstructive pulmonary disease, Dyspnea, Performance status, Quality of life, Questionnaires*

Instruments de mesure de l'état de santé dans la maladie pulmonaire obstructive chronique

La maladie pulmonaire obstructive chronique (MPOC) est non seulement associée à une déficience respiratoire primaire, à une incapacité et à un handicap mais aussi à des déficiences secondaires qui ne sont pas nécessairement limitées au système respiratoire. Parce que les principaux objectifs de la prise en charge des patients atteints de MPOC incluent le soulagement de la dyspnée et l'amélioration de la qualité de vie liée à la santé, une mesure directe de la qualité de vie liée à la santé est importante. Quatorze questionnaires spécifiquement adaptés à une maladie et neuf questionnaires généraux (quatre profils de santé et cinq mesures d'utilité) utilisés le plus couramment pour mesurer l'état de santé des patients atteints de MPOC ont été passés en revue. Les mesures ont été classées selon leur domaine d'intérêt, et leurs propriétés de mesure – spécifications, validité, fiabilité, réponse et interprétation – ont été décrites. La présente revue propose plusieurs résultats. Les instruments de mesure de l'état de santé couramment utilisés se rapportent habituellement à la perception des patients quant à leur performance dans trois domaines principaux de la qualité de vie liée à la santé : la sensation somatique, la fonction physique et liée à l'occupation et l'état psychologique. Le choix du questionnaire doit avoir une relation avec son objectif, en établissant clairement une distinction entre sa fonction évaluative et sa fonction discriminante. Dans leur fonction évaluative, seuls quelques instruments remplissent les critères de sensibilité, et l'interprétation de la plupart des questionnaires est limitée. Les questionnaires généraux ne devraient pas être utilisés isolément dans les essais cliniques comme des instruments évaluatifs car ils ne peuvent déceler les changements dans le temps. Des méthodes de validation plus approfondies et une amélioration de l'interprétation des instruments actuels seraient plus utiles pour les cliniciens et les chercheurs plutôt que le développement de nouveaux questionnaires.

Correspondence and reprints: Dr Yves Lacasse, Centre de Pneumologie, Hôpital Laval, 2725 Chemin Ste-Foy, Ste-Foy, Québec G1V 4G5. Telephone 418-656-4747, fax 418-656-4762, e-mail:lacassey@videotron.ca

Though the focus of treatment of patients with chronic lung diseases often includes physiological measurements of expiratory flows or exercise capacity, growing evidence that symptoms and overall health-related quality of life (HRQL) are poorly related to these physiological outcomes (1-3) has prompted investigators to include measurements of health status as end-points into their clinical trials. Over the past 15 years, investigators have developed a number of instruments to measure health status in patients with chronic obstructive pulmonary disease (COPD). The availability of a variety of questionnaires has led to confusion regarding the most appropriate instrument to use and how to interpret the results. The objectives of this study were to describe and classify currently available health status measurement instruments for patients with COPD.

METHODS

In contrast to the report published in this issue of the *Canadian Respiratory Journal*, reviewing the measurement properties of the Chronic Respiratory Questionnaire (CRQ) (4), this article is not the result of a systematic overview of the literature. This review does not attempt to be comprehensive, but uses the authors' judgement to select the most popular and widely used available instruments, and collect the most salient data on the instrument's measurement properties.

This report will assist interested individuals in identifying the primary articles and recent reviews of the measurement of HRQL in COPD (5-7). To retrieve papers reporting on the measurement properties of the questionnaires included in this review, computer searches of the English-language medical literature were conducted in the Science Citation database using the reference of the original article describing the questionnaire. When information on the measurement properties of a particular questionnaire was limited, the authors of the original report on the instrument were contacted for more detailed information. The basic terminology related to health status measure has been defined in a previous paper (8) and will not be repeated. When commenting on the responsiveness of the instruments on the basis of the results of trials in which the questionnaire was used, priority was given to randomized controlled trials. Such trials usually provide stronger evidence of responsiveness than nonrandomized trials. Throughout this text, in interpreting the coefficients of correlation, the strength of the correlations was qualified as follows: coefficients ranging from 0 to 0.20 denote a negligible correlation; 0.21 to 0.35 a weak correlation; 0.36 to 0.50 a moderate correlation; and greater than 0.50 a strong correlation.

WHY SHOULD HRQL BE MEASURED IN COPD?

End-stage COPD is preceded by years of progressive disability and handicap associated with limited exercise capacity (9,10), and a variety of symptoms not necessarily confined to the respiratory system. For instance, when specifically asked to describe their symptoms, patients most frequently acknowledge breathlessness, fatigue, sleep disturbance, irritability and sense of hopelessness (11,12). Typically, affected patients rapidly enter into the vicious circle of dyspnea, inactivity and physical deconditioning (13), with consequent potentially devastating emotional responses, including depression (14).

Many investigators have found that measures of exercise capacity (either maximal or functional) correlate only weakly or moderately with quality of life instruments in chronic lung diseases (Table 1). Consequently, the measurement of exercise capacity cannot be used as a surrogate outcome for quality of life in respiratory rehabilitation; quality of life should rather be measured directly.

Health status measurement is a growing field. The authors' recent review of the health status measure instruments used in controlled clinical trials of respiratory rehabilitation (15) illustrates the evolution of measurement in pulmonary medicine over the past 20 years. In early trials (16,17) HRQL measurement was assessed by more or less structured interviews; questionnaires related to fixed personality traits; or health status measurement instruments borrowed from the psychosocial sciences which had most often been developed to measure psychological status in psychiatric patients. The most important limitation of these early strategies related to their validity – the capacity of an instrument to measure what it claims to measure (18).

Recognizing that chronic lung diseases may be as an important determinant in the deterioration of quality of life, some investigators have developed their own questionnaire or adapted existing instruments (19). The availability of disease-specific questionnaires has highlighted the limitations of these strategies. For instance, trials of theophylline in stable COPD patients in which health status was measured with nonvalidated diary questionnaires failed to show signifi-

TABLE 1
Correlations between fully validated health-related quality of life (HRQL) measurement instruments and functional exercise capacity

Reference	Study population	HRQL measure instrument	Functional exercise capacity measure	Pearson's coefficients of correlation
Mahler et al (1)	38 patients (32 COPD; 5 asthma; 1 interstitial fibrosis)	Baseline Dyspnea Index	12 min walk test	r=0.60; P<0.05
Guyatt et al (2)	43 patients (25 COPD; 18 chronic heart failure)	Chronic Respiratory Questionnaire (dyspnea)	6 min walk test	r=0.46; P<0.05
Jones et al (3)	141 patients (COPD and asthma; proportion not specified)	St George's Respiratory Questionnaire (symptoms)	6 min walk test	r=–0.26; P<0.01

COPD Chronic obstructive pulmonary disease

TABLE 2
An overview of the health status measurement instruments in chronic obstructive pulmonary disease (COPD)

		Quality of life domains			
Questionnaire	Overall quality of life	Somatic sensation	Physical function	Emotional function	Social interaction
Disease-specific questionnaires					
Medical Research Council Dyspnea Scale (25)		√			
American Thoracic Society Dyspnea Scale (26)		√			
Oxygen Cost Diagram (27)		√			
Additive Activities Profile Test Quality-of-Life Scale (28)			√		
Baseline/Transition Dyspnea Index (1)		√			
Modified Dyspnea Index (29)		√			
Chronic Respiratory Questionnaire (30)		√		Ö	
Pulmonary Function Status scale (31)		√	Ö	Ö	
Chronic Disease Assessment Tool (32)		√	Ö	Ö	
COPD Self-Efficacy scale (33)				√	
Medico-psychological Questionnaire for Lung Patients (34)				√	
St George's Respiratory Questionnaire (3,35)		√	Ö		Ö
Pulmonary Function Status and Dyspnea Questionnaire (36)		√	Ö		
University of California, San Diego Shortness of Breath Scale (37)		√			
Generic questionnaires – Health profiles					
Psychological Adjustment to Illness Scale (38,39)				√	Ö
Nottingham Health Profile (40)		√	Ö	Ö	Ö
Sickness Impact Profile (41)			√	Ö	Ö
Medical Outcome Survey – Short Form (42,43)		√	Ö	Ö	√
Generic questionnaires – Utility measures					
Quality of Well-Being (44)		√	Ö		Ö
Standard Gamble (45)	√				
Time Trade Off (45)	√				
Rating Scale (45)	√				
Health Utilities Index III (46)	√				

** Now called the Human Activity Profile*

cant improvement in subjective effects of the drug (19). Subsequently, several trials in which disease-specific questionnaires were used concluded that theophylline was associated with significant changes in quality of life (20-22).

IMPORTANT DOMAINS OF QUALITY OF LIFE IN COPD

Defining quality of life remains a difficult task. Dimensions assessed by a representative group of quality of life instruments ranged from burden of symptoms to social functioning (23). The term HRQL is often used when widely valued aspects of life not directly related to health, such as income and freedom, are not considered (18). The concept of HRQL usually refers to the patients' perception of performance in at least one of four important domains: somatic sensation, physical function, emotional state and social interaction (24). These domains allow researchers to classify the areas explored by health status measuring instruments currently used in assessing COPD patients (1,25-46) (Table 2).

DISEASE-SPECIFIC QUESTIONNAIRES IN COPD

Disease-specific questionnaires focus on the areas of function that are relevant to a particular condition and, consequently, are likely to detect small changes. Fourteen currently used disease-specific questionnaires in COPD populations (1,25-37) were selected, and their specifications (Table 3) and measurement properties reviewed (Table 4). These questionnaires focus on one or more of the four major domains of HRQL and are presented accordingly (20).

Somatic sensations: Dyspnea is the most frequent symptom presented by patients with COPD and is associated with a wide range of activities (11,12). Accordingly, most questionnaires measuring somatic sensations have focused on the measurement of dyspnea. Other somatic sensations reported by patients with COPD include fatigue and sleep disturbances (11,12).

Defining and measuring dyspnea: Dyspnea may be defined as "an increased sense of respiratory effort" (82). A review of the questionnaires in which dyspnea was measured (1,25-27,29-32,34,37) demonstrated that, most often, the correlations between HRQL scores and indexes of physiological functions were weak to moderate. This observation was thought to reflect the fact that patients with COPD of a similar severity may have different perceptions of the effects of their disease. For most questionnaires, inferences regarding their validity in the measurement of dyspnea would have been strengthened if the investigators had made a priori predictions regarding the magnitude of the correlations and then tested these predictions.

Instruments applied to measure dyspnea are heterogeneous measures examining different components of dyspnea, ranging from the stimuli preceding the development of dyspnea to the consequences of dyspnea (5). For instance, the earliest health status measures used in COPD (those of the British Medical Research Council [25] and the American

TABLE 3
Specifications of selected disease-specific questionnaires in chronic obstructive pulmonary disease (COPD)

Instrument	Measurement purpose	Questionnaire structure	Item scaling and total score	Administration
MRC Dyspnea Scale (25)	Discriminative	From a questionnaire initially designed to be used in epidemiological studies in the general population; measures the stimuli preceding the development of dyspnea Time frame not specified	Dyspnea scale with grades 1 to 5: grade 1 (breathlessness only on strenuous exertion) to grade 5 (too breathless to leave the house or breathless after undressing)	Self-completed or interviewer-administered; completed within 30 s
American Thoracic Society Dyspnea Scale (26)	Discriminative	Initially designed to be used in epidemiological studies in the general population; part of a series of yes-no questions related to: respiratory symptoms (cough, phlegm, breathlessness); past illnesses tobacco smoking; and occupational and family histories Time frame focuses on symptoms that are present or have ever occurred	Series of yes-no questions; no scoring system; the frequency of positive responses to individual questions is usually reported in epidemiological studies (47)	Self-completed or interviewer-administered; telephone interviews possible (47); completed within 20 mins
Oxygen Cost Diagram (27)	Both evaluative and discriminative	Measures only dyspnea; a list of everyday activities is positioned alongside a 100mm vertical scale proportionally to their oxygen cost (48); patients mark the line at a point above which they think their dyspnea would not allow them to go when at their best Time frame not specified	Item scaling: from 0 (sleeping) to 100 (brisk walking uphill)	Self-administered; completed within 1 min
Additive Activities Profile Test Quality-of-Life Scale (28)*	Discriminative	Measures the impact of physical or emotional disorders on lifestyle: 94 activities (numeral against each item) requiring low oxygen consumption (eg, getting in or out of a chair) to high oxygen consumption (eg, running a mile in 10 mins) are ordered Time frame not specified	For each activity, patients are asked to mark whether they are still doing it, have stopped doing it or never did it; scoring is by noting the highest numeral still being performed and then subtracting from it the total number of activities that the patient had quit	Self-administered; completed within 20 mins
Baseline Dyspnea Index (BDI) (1)	Discriminative	Measures three aspects of dyspnea: magnitude of the task that provokes dyspnea; magnitude of the effort needed to evoke dyspnea; and consequent functional impairment	Items: 0 (severe) to 4 (unimpaired); total (baseline focal score) range 0 to 12	Interviewer-administered; completed within 5 mins
Transition Dyspnea Index (TDI) (1)	Evaluative	Measures the same three aspects of dyspnea as the BDI Time frame not specified	Item scaling: –3 (major deterioration), 0 (unchanged), +3 (major improvement); total (transition focal score): range –9 to +9	Same as the BDI
Modified Dyspnea Index (29)	Discriminative	Measures three aspects of dyspnea: magnitude of the task that provokes dyspnea; magnitude of the effort (the vigour with which patients can perform their maximum task); consequent functional impairment at home and at work (forming a composite functional scale) Time frame not specified	Item scaling: 0 (severe) to 4 (unimpaired); total (focal score): range = 0 to 12	Interviewer-administered; completed within 15 mins
Chronic Respiratory Questionnaire (CRQ) (30)	Primarily evaluative	Four domains: dyspnea (five self-generated items); fatigue (four items); emotional function (seven items); mastery (four items) Time frame: two weeks	Item scaling: 7-point Likert scales 0 (no symptoms) to 7 (extreme symptoms); the total score within domain is reported; converting the total score on a 7-point scale is recommended	Interviewer-administered; duration of the first interview: 20 to 30 mins; subsequent interviews, 10 mins
Pulmonary Function Status Scale† (31)	Both evaluative and discriminative	64 items: five demographic and 59 divided into three domains: dyspnea; activities of daily living (subscales: self-care, mobility, household tasks, grocery shopping/meal preparation, daily activities, relationships); psychosocial behaviour (subscales anxiey, depression) Time frame: one month	Item scaling: different item scaling across domains, most often using Likert scales; total score by adding scores for each item and then dividing by the number of items answered with a value greater than 0; low scores indicate greater impact of COPD	Self-administered questionnaire; completed within 30 mins
Chronic Disease Assessment Tool (32)	Evaluative	106 items selected from existing questionnaires and divided into five sections: general health and medical history; environmental risk (air quality and tobacco exposure); Health Impact Measurement Survey (modification of the Arthritis Impact Measurement Survey [49] and of the CRQ [30]); Quality of Life Index (50); demographic data	Item scaling: derived from the original questionnaires	Self-administered; completed within 25 to 30 mins
COPD Self-efficacy Scale (33)	Both evaluative and discriminative	34 items representing situations in which patients are likely to have low confidence in managing breating difficulty; five domains (factors): negative affect; intense emotional arousal; physical exertion; weather/environment; behavioural risk factors Time frame not specified	Item scaling: 5-point Likert scales ("Very confident" to "Not at all confident"); little information currently available on the scoring system	Self-administered; completed within 10 mins

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TABLE 3 (continued)

Instrument	Measurement purpose	Questionnaire structure	Item scaling and total score	Adminstration
Medico-psychological Questionnaire for Lung Patients (34)	Evaluative	52 items divided into four domains: well-being; experienced invalidity; displeasure; social inhibition Time frame "nowadays"	A 3-point scale follows all 52 items written as statements: correct / ? / incorrect; scoring system not provided by the author	Self-administered; completed within 15 mins
St George's Respiratory Questionnaire (3,35)	Both evaluative and discriminative	Three domains: symptoms (eight items); activity (16 items); impact (26 items) Time frame symptoms one year; other domains "these days"	Item scaling – symptom domain: 5-point Likert scales; other domains: yes-no questions; each domain is scored separately (0% to100%); summary score: 0 (perfect health) to 100% (worst); scores calculated using weights attached to each item	Self-completed; completed within 20 mins
Pulmonary Function Status and Dyspnea Questionnaire (36)	Evaluative	164 items; two components: measurement of dyspnea intensity with 79 activities and changes attributed to COPD in functional activities related to 79 activities of daily living; six subscales: self-care; mobility; eating; home management; social; recreational Time frame "now as compared to before you developed breathing problem"	Dyspnea component: a Dyspnea Index is determined from 79 activities rated as causing severe or very severe dyspnea (0 to 79); functional ability component: an Activity Index is determined from the number of activities that have been modified (extreme change or omisson) because of COPD (0 to 79)	Self-completed; completed within 10 to 15 mins
University of California, San Diego Shortness of Breath Questionnaire (37)	Evaluative	24 items: 21 activities of daily living that are associated with varying levels of exertion; three items about limitations caused by shortness of breath, fear of harm from overexertion and fear of shortness of breath	Shortness of breath scale: 6-point Likert scale indicating how frequently patients experience shortness of breath (0 [never] to 5 [not able to do])	Self-completed; completed within 5 mins

**Now called the Human Activity Profile; †Pulmonary Function Status Scale by Weaver, formerly called the 'Pulmonary Impact Profile Scale' (PIPS). MRC Medical Research Council*

TABLE 4
Measurement properties of disease-specific questionnaires used in patients with chronic obstructive pulmonary disease (COPD)

Instrument	Validity	Reliability/internal consistency	Responsiveness	Interpretability
MRC Dyspnea Scale (25)	Poor concordance between the level of dyspnea and maximal voluntary ventilation; coefficient of correlation not reported	No information available	Little potential for responsiveness in a homogeneous population of patients with COPD	Not known
American Thoracic Society Dyspnea Scale (26)	Limited information currently available in COPD; in a general population the frequency of symptoms was correlated to FEV_1 (% pred) (47)	When administered by interviewers, showed good interobserver reliability (47)	Little potential for responsiveness in a homogeneous population of patients with COPD	Not known
Oxygen Cost Diagram (OCD) (27)	No correlations with FEV_1 and FVC (27); weak correlations with P_{Imax} and P_{Emax} (r=0.28 to 0.25) (27); strong correlation with the 12 min walk test (r=0.60) (27) and the 6 min walk test (r=0.50) (2); correlation with the MRC scale: r=–0.53; with the BDI 0.54 (51) to 0.59 (2)	ICC* 0.68 (51)	No ability to detect change compared with the TDI (2,52-55)	Not known
Additive Activities Profile Test Quality-of-Life Scale (28)	Strong correlation with $VO_{2\,max}$ (r=0.83; P<0.01)	Not known	Not known; limited clinical experience with the questionnaire exists	Not known
Baseline Dyspnea Index (BDI) (1)	Moderate to strong correlations with FEV_1, FVC, P_{Imax} and P_{Emax} (r=0.35 to 0.56) (1,51,56); strong correlation with the 12 min walk test (r=0.60) (1) and 6 min walk test (r=0.59) (2); strong correlations with other measures of dyspnea – MRC r=–0.70 (51); OCD r=0.54 (51) and 0.589 (2)	Interobserver reliability (weighted Kappa) BDI 0.65 to 0.72 (1,51)	Does not apply to the BDI (the TDI usually follows the BDI to measure change over time)	Little information available on the significance of difference in scores
Transition Dyspnea Index (TDI) (1)	No correlation with spirometry results (1); weak but significant correlation with the 12 min walk test (r=0.33) (1)	Interobserver reliability (weighted Kappa) TDI 0.63 to 0.65 (1)	Able to detect change over time in an observational longitudinal study (57) and trials of inspiratory muscle training (58,59); theophylline (52,60) and rehabilitation (61,62); as responsive as the dyspnea domain of the CRQ (30,62)	Little information available on the significance of any score
Modified Dyspnea Index (29)	Strong correlations with FEV_1, FVC, P_{Imax} and P_{Emax} (r=0.65 to 0.87); no correlation with the 12 min walk test (r=0.18); strong correlation with the Pneumoconiosis Research Unit Score: Spearman's rho=–0.62 (29); has not been validated against its precursor the BDI	Not measured during the development of the instrument	Not known; limited clinical experience with the questionnaire exists; used in a trial of negative pressure ventilation in severe COPD (54)	No information available on the significance of any difference in scores

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TABLE 4 (continued)

Instrument	Validity	Reliability/internal consistency	Responsiveness	Interpretability
Chronic Respiratory Questionnaire (CRQ) (4,30)	Discriminative function: moderate to strong correlations between the CRQ and corresponding domains of the Symptom Checklist (SCL-90) (63) and the Medical Outcome Survey (MOS-SF-36) (64,65); evaluative function: good agreement between predicted and observed correlations between changes in CRQ scores and changes in physiological measures and changes in patients' health status global ratings (30)	Test-retest reliability demonstrated in three independent studies (63,64,66); internal consistency not applicable for the dyspnea domain; Cronbach's alpha ranges from 0.71 to 0.87 for the other domains (63,65,67)	Ability to detect change demonstrated for all four domains in randomized controlled trials of respiratory rehabilitation in COPD (62,68-70) and in a number of trials of different interventions in COPD (4)	On a 7-point Likert scale, a difference in score of 0.5 represents the minimal clinically important difference; 1.0 represents a moderate change and 1.5 a large change (71)
Pulmonary Function Status Scale (31,72)	Strong correlations with the 12 min walk test (r=0.62; P<0.001); weak correlation with FEV_1/FVC (r=0.29; P<0.01) (72); strong correlation with the Sickness Impact Profile (r=–0.54;P<0.01); moderate correlations with measures of depression (Multiple Affect Adjective Checklist: r=–0.40; P<0.01) and self-esteem (Rosenberg's Self-Esteem Scale: r=–0.41; P<0.01) (72)	Test-retest reliability (one week) r=0.67 (p=0.002) (72); internal consistency Cronbach's alpha=0.81 (72)	Not known; limited clinical experience with the questionnaire exists	Not known
Chronic Disease Assessment Tool (CDAT) (32,73)	Content validity assessed by clinical experts; construct validity assumed on the basis of the validity of the original questionnaires used to develop the CDAT; no correlation with any other health status instrument or physiological measure has been provided to support construct validity of the scale	Internal consistency of the different sections demonstrated	Not known; limited clinical experience with the questionnaire exists	Not known
COPD Self-Efficacy Scale (33)	Validity assumed on the basis of the the apparent validity of the self-efficacy theory; no correlation with any other health status instrument or physiological measure has been provided to support construct validity of the scale	Test-retest reliability r=0.77, P<0.001; internal consistency Cronbach's alpha=0.96	Not known; limited clinical experience with the questionnaire exists	Not known
Medico-psychological Questionnaire for Lung Patients (MPQL) (34)	Weak to moderate correlations between the well-being, experienced invalidity and displeasure domains of the MPQL and the results of 12 min walk test maximal exercise capacity and the number of hospitalization days over a 12-month period (34); no correlation between the social inhibition domain and any of the measured variables (34)	Test-retest reliability (unspecified interval): r=0.36 for the well-being domain; r=0.65 to 0.72 for the other domains; Internal consistency: Cronbach's alpha=0.69 (social inhibition) to 0.93 (well-being) (34)	In a nonrandomized trial of respiratory rehabilitation in COPD, change in MPQL well-being scores weakly correlated with changes in hospital days (r=0.24) and a dyspnea (r=–0.29); change in MPQL-experienced invalidity scores weakly correlated with changes in maximal exercise capacity (r=–0.28) and moderately correlated with change in a measure of leisure activity (74)	Not known
St George's Respiratory Questionnaire (SGRQ) (3,35)	Validated in a heterogeneous population of 141 patients with chronic airways diseases (including asthma and COPD) (3,75,76): SGRQ-symptoms versus MRC-cough, r=0.59; SGRQ-symptoms versus MRC-sputum, r=0.49; SGRQ-symptoms versus MRC-wheeze, r=0.57; SGRQ-activity versus 6 min walk test, r=0.59; SGRQ-impact versus Anxiety/Depression scale, r=0.62; the magnitude of these correlations agreed with a priori predictions	Coefficient of variation† 19%; ICC* 0.92 (3)	Change in SGRQ's total scores correlated with changes in: FEV_1 (% pred), r=0.22; 6 min walk test r=0.36; MRC scale, r=0.47; Depression scale, r=0.35; Anxiety scale, r=0.17 (3); able to detect change (improvement and deterioration) over time in a randomized trial of nasal positive pressure ventilation (77)	Minimal clinically important difference: ~4 units (derived from a mathematical model and then verified in asthmatics [35]); moderate and large treatment effects ~8 and ~12 units, respectively (78)
Pulmonary Function Status and Dyspnea Questionnaire (PSFDQ) (36)	Construct validity tested by dividing subgroups of patients on the basis of their subjective reports of impairment: patients reporting extremes of dyspnea and functional ability (most or least) differed significantly in the following variables: FEV_1, FEV_1/FVC, exercise capacity ($VO_{2\ max}$). Strong correlation between the Dyspnea Index and the Geriatric Depression Scale (r=0.55; P<0.001); moderate correlation between the Activity Index and the Geriatric Depression Scale (r=0.43; P<0.01) (36)	Internal consistency Cronbach's alpha on the six subscales of the dyspnea dimension (36); no data on test-retest reliability	In a 12-week randomized placebo-controlled trial of nortriptyline in depressed patients with COPD using an early version of the PSFDQ, changes in the Activity Index were noted in the treatment group (70)	Not known
University of California, San Diego Shortness of Breath Questionnaire (37)	Moderate correlations with FEV_1 (r=–0.445; P<0.01), ratings of perceived breathlessness (r=0.474; P<0.001), and the CES-D (r=0.418; P<0.001); strong correlation with the 6 min walk test (r=–0.669; P<0.001) (80)	Test-retest reliability (2 days) r=0.94 (37)	Able to detect change over time in a randomized controlled trial of respiratory rehabilitation in COPD (81)	Not known

**An intraclass correlation coefficient (ICC) compares the variability between patients (the signal) with the variability within patients over time (the noise); an ICC of 0.70 is considered to reflect good reliability; †Coefficient of variation: standard deviation/mean; as a reference: coefficient of variation of forced expiratory volume in 1 s (FEV_1)=8%. CES-D Center for Epidemiologic Studies' Depression Scale; FVC Forced vital capacity; MRC Medical Research Council; $P_{I\ max}$ Peak inspiratory pressure; $P_{E max}$ Maximal expiratory pressure; % pred Percentage predicted value; VO_{2max} Maximal expiratory pressure*

Thoracic Society [26]) were developed for discriminative purposes within the frame of epidemiological surveys and focused on predetermined activities provoking dyspnea. They offer little potential for the detection of small changes over time and are only useful to discriminate patients according to the level of activities associated with dyspnea. On the other hand, the Transition Dyspnea Index (1) and the dyspnea domain of the CRQ (30) focus on a set of activities selected during the administration of the questionnaires that are important for individuals. They offer potential for responsiveness but are inappropriate as discriminative instruments because the dyspnea rating among patients is made on different sets of activities. A major limitation of most dyspnea scales (with the exception of the CRQ) is that they are difficult to interpret.

Rest dyspnea versus exercise-induced dyspnea: The Borg dyspnea (83) scale is useful for measuring exercise-induced dyspnea in the laboratory but has not proved useful for obtaining historical reports of dyspnea (37). Because the focus of this review is the measurement of symptoms in day-to-day activities (as opposed to exercise-induced dyspnea), it will not be discussed further.

Measuring other symptoms: The CRQ (30) contains a domain measuring fatigue, a symptom that has been reported as important by patients with COPD (11,12), as opposed to cough, sputum production and wheeze, which are measured by the St George's Respiratory Questionnaire (3,35). Because the latter has been developed for patients with COPD and asthma, the inclusion of cough and wheeze is appropriate.

Physical function: Functional status, defined as the patient's ability to perform activities of daily living (7), often defines the level of autonomy of affected patients and is of crucial importance in the delivery of health services. In a recent review, Lareau et al (7) summarized the psychometric properties of the questionnaires measuring functional status in COPD. Disease-specific questionnaires that measure physical function in COPD include the Additive Activites Profile Test Quality Of Life Scale Now called the Human Activity Profile (28), the Pulmonary Function Status Scale (31), the St George's Respiratory Questionnaire (3,35), and the Pulmonary Functional Status and Dyspnea Questionnaire (36). Both the St George's Respiratory Questionnaire and the Pulmonary Functional Status and Dyspnea Questionnaire have proved able to detect change over time.

Emotional function: Irritability and hopelessness are frequent complaints in patients with COPD (11,12). Depression prevalence rates in patients with moderate to severe COPD are approximately 42% (14,84). Depression prevalence rates as high as 76% have been reported (85). The prevalence of anxiety disorders in COPD is less clear. Investigators have reported anxiety rates ranging from 2% (85) to 34% (86,87). Most clinicians thus consider the measurement of anxiety and depression in clinical trials of COPD relevant (88). The variability of depression and anxiety prevalence rates may stem from the heterogeneity of the populations under study.

Depression has often been measured in COPD with the Center for Epidemiologic Studies' Depression Scale (CES-D) (89), the Beck Depression Inventory (90) and the Zung Self-Rating Depression scale (91). The level of anxiety has often been assessed by the Spielberger's State-Trait Anxiety Inventory (92) and the Zung Self-Rating Anxiety scale (91). Although all these questionnaires are problem-specific (ie, 'depression-specific' and 'anxiety-specific'), they have not been specifically developed for use in patients with COPD. Many have been developed and validated in the context of epidemiological studies in the general population. Their validity with COPD is therefore limited. Their usefulness as evaluative instruments is also unknown because their ability to detect change over time has not been ascertained. A more complete review of these instruments was reported by Lader (93).

Self-efficacy: Negative attitudes and beliefs held by patients with COPD concerning themselves, their illness and its treatment correlate with reduced functional capacity (94). This finding is congruent with Bandura's self-efficacy theory. Self-efficacy refers to the personal conviction people have regarding whether they feel that they can successfully execute particular behaviours to produce certain outcomes (33,95). According to this theory, people who entertain doubts about their capabilities give up; those who have a strong sense of efficacy persist (95). In COPD, self-efficacy represents a mediator between chronic respiratory disease and unnecessary activity restriction (33). The findings by Kaplan et al (96) further support for the validity of this theory. The authors demonstrated that in a group of patients with COPD the efficacy expectations correlated significantly with health status and exercise tolerance.

The COPD Self-efficacy Scale was developed by Wigal and collaborators (33). In the original paper, the authors presented evidence of test-retest reliability, internal consistency and the description of item aggregation of the scale. Validity of the questionnaire was assumed on the basis of the apparent validity of the self-efficacy theory; no correlation with any other health status instrument or physiological measure has supported the construct validity of the COPD Self-efficacy Scale. Also, the psychometric measurement properties of the instrument remain unexplored.

Other disease-specific instruments: Other disease-specific questionnaires include items or even full domains measuring emotional dimensions related to COPD (Table 2). Data regarding the validity and responsiveness of the emotional function and mastery domains of the CRQ (30) exist (Table 4). Items specifically relating to anxiety and depression were not included in the St George's Respiratory Questionnaire (3), the authors arguing that a number of established measures existed for this area of health.

Social function: Social function refers to an individual's capacity to perform activities associated with her or his usual role, including employment, school, work or home-making (7). Occupational function in patients with COPD is often irrelevant (Table 2). Most patients with symptomatic COPD are elderly, retired patients over age 65 years. The St George's Respiratory Questionnaire (3,35) includes work-related items.

TABLE 5
Specifications of selected generic questionnaires in chronic obstructive pulmonary disease (COPD)

Instrument	Measurement approach and purpose	Questionnaire structure	Item scaling and total score	Administration
HEALTH PROFILES				
Psychological Adjustment to Illness Scale (38)	Discriminative and evaluative	46 items in seven domains Time frame past 30 days including today	Item scaling 0 (unimpaired) to 3 (severe) Individual domain score and overall score Score: sum of individual responses	Interviewer-administered; completed within 20 to 30 mins
Self-Reported Psychological Adjustment to Illness Scale (39)	Discriminative and evaluative	46 items in seven domains; Time frame past 30 days including today	Item scaling 0 (unimpaired) to 3 (severe) Individual domain score and overall score Score: sum of individual responses	Self-administered; completed within 20 mins
Nottingham Health Profile (40)	Discriminative and evaluative	Part 1 – 38 items in six domains; Part 2 – seven statements each address an area of daily life most often affected by health Time frame not specified	Item Scaling: Yes/No Predetermined weight for each item Scores calculated individually for each domain and converted to 0 to 100 scale Higher score = worse	Self-administered; completed within 20 mins
Sickness Impact Profile (41)	Discriminative and evaluative	136 items in 12 domains; three domains can be combined to form Physical Global Score; four other domains can be combined into Psycho-social Global Score; total score from all 12 domains Time frame 24 h	Items scaling: Yes/No Preassigned weight for each item Separate score for each domain, physical global score, psychosocial global score and overall score Score: 0 to 100 Lower score = worse	Interviewer-administered, self-administered or over the telephone; completed within 20 mins
Medical Outcome Survey – Short Form 36 (42,43)	Discriminative and evaluative	36 items in 8 domains; number of items per domain vary from two to eight; two summary health concepts; physical component summary and mental health component summary Time frame one week	Item scaling: Yes/No, or 2-, 3-, 5- or 6-point scale Predefined scoring scheme Domain score and overall score Score: 0 to 100 Higher score = better health Summary Concepts require special scoring system	Interviewer-administered, self-administered or over the telephone; completed within 5 to 10 mins
UTILITY MEASURES				
Quality of Well-being (44)	Discriminative and evaluative	Three dimensions each with multiple function levels and 23 symptoms or problem complexes Time frame four consecutive days	Series of questions to determine function levels for each dimension, and Yes/No response to symptoms/problem complexes Items are preference weighted to generate an overall score Score: 0 (death) to 1 (asymptomatic optimal functioning)	Interviewer-administered; completed within 15 to 20 mins
Standard Gamble (45)	Discriminative and evaluative	A gamble between present health state and a combination of probabilities of perfect health and immediate death No time frame Preference patient	Score: 0 (death) to 1 (full health)	Interviewer-administered; completed within 10 mins
Time Trade Off (45)	Discriminative and evaluative	Amount of shortened life span the patient is willing to trade for perfect health No time frame Preference: patient	Score: number of years converted to scale of 0 to 1	Interviewer-administered; completed within 5 mins
Rating Scale (45)	Discriminative and evaluative	Rates current health status on scale No time frame Preference patient	Score: 0 (death) to 100 (perfect health)	Interviewer-administered; completed within 5 mins
Health Utilities Index III (46)	Discriminative and evaluative	15 questions in eight dimensions Time frame four weeks Preference others	Each question has 4 to 6 levels of function Score: 0 to 1	Self-administered; completed within 5 to 10 mins

Disease-specific questionnaires in COPD – Summary: Currently used COPD-specific health status instruments usually focus on patients' perception of performance in three major domains of health-related quality of life: somatic sensation, physical and occupational function and psychological state (Table 2). A limitation of many of the questionnaires is their unproved ability to detect change over time. Furthermore, when differences in scores have been demonstrated in the setting of clinical trials, the clinical relevance of these differences has been uncertain. Information regarding the interpretability of the CRQ (30) and the St George's Respiratory Questionnaire (35) exists. Comparisons of these two questionnaires are under way.

GENERIC MEASURES FOR COPD

Generic measures of quality of life have been used extensively in population research and in clinical research. They can be divided broadly into two groups: health profiles and utility measures. This paper reviews the measurement properties of four health profiles (38-43) and five utility measures (44-46) that are frequently used in research studies (Tables 5,6).

Health profiles: Health profiles are useful because they provide information on many aspects of a patient's life. The first three instruments in Table 5 are multidimensional profiles that cover many health concepts (40-43). Of these three, Psychological Adjustment in Illness Scale (38) and Self-Re-

TABLE 6
Measurement properties of generic questionnaires used in patients with chronic obstructive pulmonary disease (COPD)

Instrument	Validity	Reliability/internal consistency	Responsiveness	Interpretability
HEALTH PROFILES				
Psychological Adjustment to Illness Scale (PAIS) (38)	Discriminative: in nonpulmonary populations good correlations between seven domains and four other psychological test scores (r=0.31 to 0.81) (39)	In nonpulmonary populations, inter-rater reliability = 0.33 to 0.83 for total and domain scores (38)	In patients with duodenal ulcer undergoing therapy for eradication of *Helicobacter pylori* there were significant improvements in PAIS-SR overall scores as well as in three of six domain scores (97)	Little information available on the significance of any difference in score
Self-Reported Psychological Adjustment to Illness Scale (PAIS-SR) (39)	Evaluative: unable to locate any study on validity testing	Internal consistency reliability coefficient 0.47 to 0.87(39)		
Nottingham Health Profile (40)*	Limitation: designed to detect moderate to severe problems only; ceiling effect on mild conditions (98). In COPD and asthmatics: Discriminative: no significant correlation with FEV_1 (99); significant correlations between dyspnea on VAS and all domains (r=0.22 to 0.60) 6MW and S, E and PM (r=–0.24 to –0.52) and PaO_2 and E, P, and PM (r=–0.22 to –0.39) (100); Evaluative: significant correlation between FEV_1 and E (r=–0.46, 0.44) (99); poor correlation with FEV_1 (|r| = 0.03 to 0.16) except between ER and FEV_1 in one group (r=0.32) (101)	In non-COPD patients, test-retest reliability: Part 1 – Spearman's r from 0.75 to 0.88; Part 2 – Cramer's alpha from 0.55 to 0.86 (102)	Able to detect changes in patients before and after combined heart and lung transplantation (103) but unable to detect changes in COPD or asthmatic patients (99,101)	Discriminative: distinct profile of patients with chronic airflow obstruction compared with normal population (101); little information available on the significance of any difference in score
Sickness Impact Profile (SIP) (41)†	Discriminative: in COPD, total SIP versus 6 min walk test r=–0.64; significant correlations between TS, PGS, PSGS and FVC or 6 min walk test and between FEV_1 or PEFR and PGS (104) In nonspecific pulmonary diseases: small but significant correlation between FEV_1 and TS, PGS after adjusted for age (r=–0.29 to –0.26) (105) Evaluative: asthmatics: Correlations with validated disease-specific questionnaire was poor for TS, PGS and PSGS: |r|<0.30 (106)	In nonpulmonary specific populations, reliability by Pearson r value was 0.88 to 0.92 (14)	COPD: significant worsening in FEV_1, FVC and $PaCO_2$ with nonsignificant worsening in TS (107) Asthmatics: significant improvement in night time asthma attacks and daytime bronchodilator use only in treated patients, and significant improvement in TS in treatment and placebo groups but not between groups (108) NPP: PGS and PSGS detect deterioration preferentially but not improvement (109)	Discriminative: distinct profiles for COPD patients (88) and pulomnary patients of different degrees of impairment (105); however, confidence intervals tend to be wide for each group (104) Evaluative: little information is available on the significance of any difference in score
Medical Outcome Survey – Short Form 36 (SF-36) (42,43)	Discriminative: in COPD: good correlations with BDI in six domains (0.42 to 0.91) except RE and MH. Significant correlations with FEV_1 and PI max in five domains (r=0.30 to 0.65) except RE, MH and P (110) Evaluative: in nonpulmonary populations, significant correlations with self-reported scales in all domains and health constructs (111)	In nonpulmonary populations; Cronbach's alpha ranged from 0.73 to 0.96 (112); test-retest reliability r=0.63 to 0.81 (112)	In nonpulmonary populations good correlations with changes in self-reports (111). Hip replacement patients had significant change in scores in the appropriate domains before and after surgery (113)	Discriminative: different profiles between different levels of severity of COPD patients and normal population (114); distinct profiles seen in asthma and other nonpulmonary diseases (115). Evaluative: little information available on the significance of any difference in score
UTILITY MEASURES				
Quality of Well-being (44)	Discriminative: in COPD, moderate to strong correlations with FVC, FEV_1 and exercise tolerance (r=0.34 to 0.54) (116); Evaluative: moderate correlations with exercise tolerance (r=0.40) weak correlations with change in oxygen saturation (r=0.28); poor correlations with FVC, and FEV_1 (r=0.03 to 0.11) (116)	Interday correlations in COPD patients 0.80 to 0.98 (117)	Able to detect changes over time after education with or without exercise in patients before lung transplant (118) but unable to detect improvement after pulmonary rehabiliation (81)	Little information available on the significance of any difference in score
Standard Gamble (45)	Discriminative: asthmatics – poor correlations with FEV_1, FVC and PEFR (0.10) and symptoms (0.17 to 0.21) (119); Evaluative: asthma, weak but significant correlations with PEFR and FVC (0.23 to 0.24) (119); in pulmonary rehabilitation poor correlation with 6MW (unpublished data)	In nonpulmonary populations, internal reliability 0.70 to 0.92; test-retest reliability 0.80 (120)	In asthmatics detected significant differences before and after treatment with salbutamol but not salmeterol and not between groups (119)	Little information available on the significance of any difference in score

Continued on next page

TABLE 6 continued

Instrument	Validity	Reliability/Internal consistency	Responsiveness	Interpretability
Time Trade Off (45)	Little information is available	In nonpulmonary populations; internal reliability 0.77 to 0.88; test-retest reliability 0.63 to 0.80 (120)	Little information is available	Little information available on the significance of any difference in score
Rating Scale (45)	Discriminative: asthmatics – weak correlations with FEV_1 (0.22) and symptoms (0.26 to 0.33) (119) Evaluative: asthmatics – weak but significant correlations with symptoms (0.23 to 0.24) (119);	In nonpulmonary populations: internal reliability 0.86 to 0.94; test-retest reliability 0.77 (44)	In asthmaticss, detected significant differences before and after treatment in salmeterol and salbutamol groups and between groups (119)	Little information available on the significance of any difference in score
Health Utilities Index III (46)	Discriminative: significant difference in utility score between teenagers in control group and group of extremely low-birth-weight infants (121) Evaluative: little information is available	Test-retest reliability in general population: for eight attributes, kappa 0.14 to 0.73. index score (intraclass correlation coefficient) 0.77 (46)	Little information is available	Little information available on the significance of any difference in score

BDI Baselines Dyspnea Index; E Energy; ER Emotional reaction; FEV_1 Forced expiratory volume in 1 s; FVC Forced vital capacity; MH Mental health; MW Minute walk; NPP Nonpulmonary population; P Pain; PEFR Peak expiratory flow rate; PM Physical mobility; PGS Physical Global Score; PSGS Psycho-Social Global Score; RE Role-emotional; S Sleep; TS Total score; VAS Visual Analogue Scale

ported Psychological Adjustment in Illness Scale (39), focus only on the psychological aspects of health.

All of the instruments have proved helpful in distinguishing different populations and examining differences between patients within the same population. The first three instruments in Table 5 have been validated in COPD patients (99,100,104,110). However, the Nottingham Health Profile was designed to discriminate among patients with moderate to severe illness (98). Therefore, it may not be able to discriminate among patients with mild disease.

In an evaluative setting, only the first three instruments in Table 5 have been validated against other measures (99,101,106). Another instrument, the Medical Outcome Survey – Short Form 36 (SF-36), has not been validated in pulmonary patients. The other two instruments showed weak correlations with physiological measures such as the forced expiratory volume in 1 s (FEV_1) (101,106).

The Sickness Impact Profile (SIP) has shown strong evidence of reliability (41). In the remaining questionnaires, there were a few domains in which measures of reliability correlated poorly (38,39,102,112). Trials in COPD patients in which SIP or Nottingham Health Profile was used sometimes identified significant changes in physiological parameters such as FEV_1 without accompanying changes in quality of life assessments (99,101,107). The SF-36 (111,113) and Self-reported Adjustment to Illness Scale (97) are responsive in nonpulmonary patient populations. Whether the instruments are responsive in COPD patients remains to be seen.

The SIP (88,104,115), SF-36 (111,112) and Nottingham Health Profile (103) had distinctive profiles for COPD patients compared with the normal population. The SIP (105) and SF-36 (114) had different profiles for pulmonary patients at different levels of impairment. However, the minimal important difference in the domain scores or the overall scores have not been established, this limitation being most evidence in all five instruments when considering change over time.

In summary, all five health profile instruments listed in Table 5 have similar properties when they are used in a discriminative setting. In an evaluative setting, most of the instruments have not demonstrated good responsiveness in COPD patients. Therefore, in a clinical trial of COPD patients, it is best to use a combination of a generic health profile to reflect quality of life and a disease-specific instrument to detect small changes.

Utility measures: Utility measures use a preference-based or value-based approach to express the HRQL of an individual using a single number. This number incorporates the overall assessment of HRQL and the values attached to it. This number is usually between 0 and 1. The two extreme values are anchored to specific states, most commonly death (0) and full health (1).

There are two different approaches to obtaining the preference weight which can come directly from the patient or from other people. In two common measures, the Standard Gamble (45) and Time Trade Off (45), the preference comes from the patient. In these measures, the patient trades a specific health state for full health by risking death or by shortening his or her life span.

In the second approach, the preference weight is obtained from other people, most commonly through the use of a multi-attribute questionnaire. A series of health states of increasing severity are compiled based on limitations in different dimensions of HRQL. Either the general population or specific population groups are asked to rate these states on a scale. Based on the responses, preference weights are assigned to the different states. During a study, the patient's utility value of a certain state will be determined by the preference weight assigned to the state, made up of the combination of limitations in the dimensions identified by the patient. This is the basis of the Quality of Well-being (44) and the Health Utilities Index III (46). The advantage of the utility measures is that they allow comparison among different diseases. In addition, the single value summarizing the overall health state and its associated values facilitates economic analyses.

In a discriminative setting, only the Quality of Well-being scale has been validated in COPD patients and demonstrated good discriminative power (116). Both the Standard Gamble and the Rating Scale did not demonstrate strong discrimina-

tive ability in asthmatic patients (119). The Health Utilities Index III is a relatively new instrument with only one study showing its discriminative power in adolescents (120). In the evaluative setting, the Standard Gamble (119), Rating Scale (119) and Quality of Well-being (116) have all been validated against other measures. However, only weak correlations were seen compared with physiological measures such as the FEV_1 and forced vital capacity (116,119).

All five measures demonstrated good reliability except for some attributes of the Health Utilities Index III (46,117,119). The responsiveness of Standard Gamble was disappointing; although it could detect changes before and after a treatment in pulmonary patients, it was unable to detect differences among treatment groups though these differences were noted in physiological measures and disease-specific quality of life instruments (119). The Rating Scale (119) and the Quality of Well-being (81,118) showed better responsiveness. Responsiveness data were not available for pulmonary patients in the Time Trade Off and Health Utilities Index III. Little information was available for any of the five instruments regarding the minimally important clinical difference of the instruments in either a discriminative or an evaluative setting.

In summary, information on the measurement properties of the utility measures is limited; these instruments have demonstrated weak discriminative ability and poor responsiveness to change. Although it is very attractive to use these instruments as part of an economic analysis, caution must be exercised in the interpretation of the data. It is recommended that utility measures be used in conjunction with other measures of quality of life in clinical trials.

DISCUSSION

Selection of a questionnaire for clinical research: The most appropriate clinical application of any questionnaire must be in the context of whether it is discriminative, evaluative or both (122). A discriminative instrument is one that can distinguish among groups of patients. Accordingly, the most important properties of a discriminative instrument should be its validity, reliability and interpretability. An evaluative instrument is one that measures changes in individuals or groups over time. Accordingly, the most important properties of a discriminative instrument should be its validity, responsiveness and interpretability. The requirements for maximizing one of the functions (discrimination or evaluation) may influence the choice of questionnaire (122). Because it focuses on specific areas of HRQL, a disease-specific questionnaire is more likely to be responsive to change than a generic instrument designed to measure all important aspects of HRQL (18).

Respiratory rehabilitation has illustrated the application of health status measurement instruments in COPD. In some trials of respiratory rehabilitation, the validity of the health status measurement instruments in a population with chronic lung disease has not been clearly ascertained beforehand. When valid health status measures were used, they sometimes consisted of generic instruments unlikely to detect small but clinically important changes over time. The conclusions from an important, well designed, randomized, controlled trial illustrate this point. Toshima and collaborators (123) reported a trial of comprehensive rehabilitation versus education in patients with COPD. This paper and two other articles (81,124) reported short and long term follow-up results. One hundred and nineteen patients were randomized to either an eight-week comprehensive rehabilitation program (including upper and lower extremity exercise training, chest physiotherapy, psychological support and didactic education) or to a four-session didactic education program. The outcome measures included incremental and steady-state treadmill exercise tests, a self-efficacy scale, the Quality of Well-being Questionnaire (44), the CES-D (89) and the University of California, San Diego, Shortness of Breath Questionnaire (37), all health status instruments that had been proved valid in COPD populations. Immediately after the program, significant changes from baseline, favouring the group that had received exercise therapy, were noted in exercise capacity, self-efficacy for walking and shortness of breath scores. The clinical significance of these changes was uncertain. There were no significant between group differences in the general measures of quality of life or depression. The authors concluded that the Quality of Well-being Questionnaire (a generic instrument) may not have been sensitive enough to detect changes in quality of life attributable to rehabilitation (81). Clearly the choice of questionnaires must match the study objectives; valid questionnaires that are able to detect change over time are essential in clinical evaluative studies of respiratory rehabilitation.

In selecting a questionnaire to be used in clinical research, the investigator should first answer the following questions: Do I want to evaluate an intervention or discriminate among patients? Which of the domains am I most interested in measuring (symptoms, function, emotion, etc)? What is the time frame of the study? These should help the investigator identify the most appropriate questionnaire or questionnaires for the study. In a rehabilitation trial, a generic questionnaire can help to characterize the patients at baseline, whereas one or more selected disease-specific (and responsive) questionnaires can be used to evaluate the effect of the intervention on symptoms (Baseline and Transition Dyspnea Index [1], CRQ [30]) or the impact of the disease (St George's Respiratory Questionnaire [3,35]). When selecting a questionnaire it is also important to also consider the mode, ease and duration of administration (18).

Exercise capacity or health-related quality of life? Our objective was not to discourage the use of exercise testing (or other physiological outcomes such as FEV_1) as end-points in clinical trials in COPD. Exercise capacity testing constitutes an invaluable tool in many respects, but it serves different purposes in measuring different constructs (Table 1). Whereas exercise capacity testing is intended to measure the impairment, ie, the loss or abnormality of physiological function (125,126), and disability, ie, the lack of ability to perform an activity in the manner considered normal for a human being (125), quality of life has more to do with handicap – the disadvantage for a given individual, resulting

from impairment or disability, that limits or prevents fulfilment of a role that is normal for that individual (125).

The use of laboratory exercise testing has been summarized in two broad categories: diagnostic and management (127). An initial exercise test is useful in describing the physiological consequences of the disease and may disclose a coronary or peripheral arterial disease limiting or even contraindicating vigorous training in some patients with COPD. More importantly, exercise testing is useful in the clinical management of patients participating in a respiratory rehabilitation program. For instance, an initial incremental exercise test is helpful in assisting with the prescription of an appropriate level of training (128,129). Also, retesting provides physiological evidence that a training response has occurred and may be useful in the adjustment of intensity levels during the program (127). Exercise testing may be useful in motivating the patient to continue the activities (127). The measurements of health status and exercise capacity are complementary.

Future direction: Health status measurement has become an important part of identifying the impact of a management strategy and is likely to become of increasing interest. Physicians and nonphysician health professionals are likely to continue clinical research aimed at improving the comprehensive and integrative care of patients with COPD. We suggest that future research includes further validation and a better definition of the interpretability of existing instruments rather than the development of new questionnaires.

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