Evaluation of an electronic daily Diary for measuring symptoms and impact of chronic obstructive pulmonary disease

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Introduction

- Patient-reported outcomes (PRO) are increasingly important in evaluating the severity and impact of chronic conditions such as chronic obstructive pulmonary disease (COPD)
- PROs collected by electronic means may include patient compliance features and allow accurate documentation of when entries were made, unlike the paper based method[1,2]
- Here, we present the psychometric assessment of an electronic diary that includes assessment of COPD symptoms and their impact on patients with COPD from the SHINE study[3] using an exploratory electronic Diary (eDiary)

Methods

- Qualitative interviews were conducted between 2009 and 2010 to elicit concepts from patients in the United States, to identify relevant symptoms and degree of bother due to symptoms
- The present analysis reports the administered exploratory eDiary in a subset of 209 patients from 2144 patients from the SHINE study[3]

Patients

- The SHINE study included patients who:
  - were aged ≥40 years with moderate-to-severe stable COPD (Stage II or III according to GOLD 2008 criteria)
  - had a smoking history of ≥10 pack-years, and
  - exhibited a post-bronchodilator forced expiratory volume in 1 second (FEV_1) ≥30% and <80% of the predicted normal and post-bronchodilator FEV_1 to forced vital capacity ratio <0.70 at screening

Objectives

- The validity, consistency, reliability, and responsiveness of the eDiary was evaluated with following parameters:
  - frequency and severity of symptoms
  - bothersomeness and difficulty in patients with COPD
  - distributional properties and factor structure of the COPD eDiary
  - sensitivity to change
  - interpretation of scores (degrees of change that reflect clinically meaningful difference)
  - responder levels of scores produced by COPD eDiary

Assessments/measures

- The eDiary was completed twice daily, and data were collected for three time periods:
  - Morning assessment 1 (M1): From waking until morning assessment
  - Morning assessment 2 (M2): From last scheduled diary entry (evening before) until the morning assessment
  - Evening assessment (E): From the last scheduled diary entry (morning of current day) until the evening assessment
- Following five symptoms and two impact items were assessed on a 11-point numeric scale (0 none-10 worst possible): shortness of breath, phlegm/mucus, chest tightness, wheeziness, and coughing and bothersomeness (included in all 3 timeframes) and difficulty in activities (in M2 and E)
- Transitional Dyspnea Index (TDI) was measured to compare the responsiveness of the eDiary to an accepted measure of dyspnea. A TDI focal score of +1 was considered to be clinically significant improvement from baseline

Statistical analysis

- Compliance rates for the eDiary were expressed as percentage of scheduled entries at baseline and weeks 1, 12, and 26 post-treatment
- The following descriptive statistics was used for the available data:
  - Each eDiary symptom was rated as 0 for absent or >0 for present, and the frequency (%) of each symptom was plotted for each timeframe (M1, M2, E)
  - An overall mean symptom score was calculated for the five symptom items over baseline and Week 26, which was plotted together with mean scores for bother and difficulty
  - Correlations (Pearson's r) between 5 diary symptoms and 2 impact items scores were calculated for baseline scores, using the mean item scores over the 7-day baseline period
  - Internal consistency of the eDiary was evaluated using Cronbach's coefficient alpha (α) at baseline, weeks 12 and 26
  - Test-retest reliability was assessed using the mean of the baseline 7-day scores as the test and the mean of the 7-day, Week 1 scores as retest, in patients who rated themselves unchanged from baseline in the weekly assessment of change in the eDiary
  - Reliability was calculated using intraclass correlation coefficient (ICC) between these two means
  - Sensitivity to change for eDiary was evaluated using change scores, calculated as the difference between Week 26 and baseline values The analysis was carried out on two groups of patients, those classified as "improved" or "uncertain /no change" based on spirometry analysis and ratings on the global items of the diary on Week 26

Results

Patient demographics

- Baseline demographics of the patients are reported in Table 1

Table 1. Baseline demographics of the eDiary patients

Characteristics	All Diary patients (N=209)
Gender	
Male	140 (67.0%)
Female	69 (33.0%)
Age (years)	
N	209
Mean (SD)	65.3 (8.71)
Age category (years)	
<65	92 (44.0%)
≥65 to <75	80 (38.3%)
≥75	37 (17.7%)

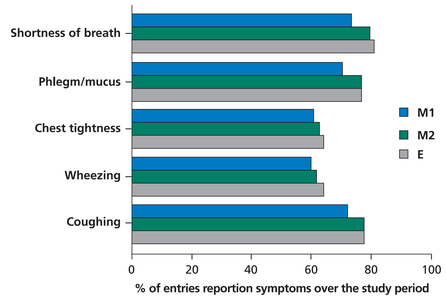
eDiary assessment schedule compliance

- Mean compliance rates over the study period were 90.1% for baseline, 88.9% for Week 1, 84.6% for Week 12, and 80.0% for Week 26

Frequency and severity of reporting of COPD symptoms

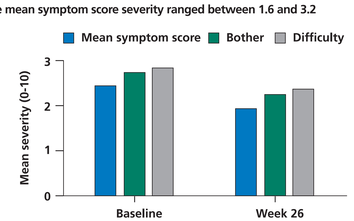
- All five symptoms were reported in ≥50% of entries, and shortness of breath, mucus/phlegm, and cough occurred in over 70% of entries over the study period (Figure 1a)
- The mean severity symptom score ranged between 1.6 and 3.2, indicating that bothersomeness and difficulty are broadly in line with symptom levels experienced (Figure 1b)

Figure 1a. Frequency of COPD symptoms occurrence



M1, waking up to completion of morning assessment; M2, from the last scheduled diary entry until completion of the evening assessment; E, last scheduled diary entry untill completion of evening asessment.

Figure 1b. Mean symptom score severity



Correlations between symptom severity and bother/difficulty with activities scores

- Shortness of breath showed very high correlation with impact items (>0.95 across all assessments; Table 2)

Table 2. Correlations (Pearson's r) between individual symptoms and overall bother/difficulty caused by COPD symptoms at baseline

Symptoms	Assessment point				
	M1	M2		E	
	Bother	Bother	Difficulty	Bother	Difficulty
Shortness of breath	0.957	0.956	0.953	0.958	0.958
Phlegm/mucus	0.763	0.718	0.688	0.675	0.661
Chest tightness	0.856	0.861	0.858	0.844	0.849
Wheezing	0.798	0.782	0.761	0.722	0.706
Coughing	0.733	0.688	0.639	0.656	0.644

Three assessment points are shown: M1, morning diary, symptoms since waking; M2, morning diary, symptoms since last assessment; E, evening diary; COPD, chronic obstructive pulmonary disease.

Internal consistency of eDiary

- Extremely high internal consistency (Cronbach's α >0.95) for all assessment points(M1, M2, and E) at baseline

Test-retest reliability of eDiary

- A high reliability was observed for 7 diary items with ICC between 0.95 and 0.98 for the subgroup of 44 patients who responded "no change" in their condition between baseline and Week 1

Exploratory Factor Analysis

- Exploratory Factor Analysis gave a single factor, including both the symptom items and bother and difficulty (Table 3)

Table 3. Factor loadings for the single factor identified by exploratory factor analysis using baseline data

Item	Assessment points			
	M1	M2	E	Overall
Shortness of breath	0.942	0.947	0.944	0.953
Phlegm/mucus	0.901	0.853	0.839	0.861
Chest tightness	0.921	0.922	0.913	0.921
Wheezing	0.900	0.885	0.845	0.874
Coughing	0.865	0.824	0.812	0.828
Bother	0.942	0.952	0.944	0.954
Difficulty with activities	-	0.939	0.942	0.933

- Cohen's effect size for change over the 26-week study period was large (0.79) in the "improved" patient group compared with a minimal change (0.16) in the "uncertain/no change" patient group showing that the eDiary used was sensitive to change

Meaningful clinical difference

- Change of scores were 0.5-0.6 in all cases, with an improvement of 0.6 points on the eDiary indicating a meaningful clinical difference (Table 4)

Table 4. Reductions in the overall eDiary mean total score with lowest level of improvement on each scale at Week 26

Rating	Items	Change in eDiary Total mean at Week 26
eDiary rating "a little better"	Overall impact	-0.61
	Severity of COPD	-0.58
TDI rating "minor improvement"	Functional impairment	-0.64
	Magnitude of task	-0.52
	Magnitude of effort	-0.55

COPD, chronic obstructive pulmonary disease; TDI, transitional dyspnea index.

Conclusions

- All eDiary items were frequent, being reported in at least half of study entries, thus supporting the appropriateness of the eDairy content
- Good compliance with eDiary procedures
- High correlations between shortness of breath, bothersomeness, and difficulty confirm the importance of shortness of breath in patients with COPD
- The emergence of a single factor indicates that the eDiary is unidimensional so that the mean score may be used as a single summary measure
- Reliability and internal consistency of eDiary scores was extremely high
- The eDiary was sensitive to change
- A change of 0.6 in the mean eDiary score (range 0-10) represented a meaningful change to patients

References

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Disclosure

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