

# Tools for Assessing Outcomes in Studies of Chronic Cough

## CHEST Guideline and Expert Panel Report

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**BACKGROUND:** Since the publication of the 2006 American College of Chest Physicians (CHEST) cough guidelines, a variety of tools has been developed or further refined for assessing cough. The purpose of the present committee was to evaluate instruments used by investigators performing clinical research on chronic cough. The specific aims were to (1) assess the performance of tools designed to measure cough frequency, severity, and impact in adults, adolescents, and children with chronic cough and (2) make recommendations or suggestions related to these findings.

**METHODS:** By following the CHEST methodologic guidelines, the CHEST Expert Cough Panel based its recommendations and suggestions on a recently published comparative effectiveness review commissioned by the US Agency for Healthcare Research and Quality, a corresponding summary published in *CHEST*, and an updated systematic review through November 2013. Recommendations or suggestions based on these data were discussed, graded, and voted on during a meeting of the Expert Cough Panel.

**RESULTS:** We recommend for adults, adolescents ( $\geq 14$  years of age), and children complaining of chronic cough that validated and reliable health-related quality-of-life (QoL) questionnaires be used as the measurement of choice to assess the impact of cough, such as the Leicester Cough Questionnaire and the Cough-Specific Quality-of-Life Questionnaire in adult and adolescent patients and the Parent Cough-Specific Quality of Life Questionnaire in children. We recommend acoustic cough counting to assess cough frequency but not cough severity. Limited data exist regarding the performance of visual analog scales, numeric rating scales, and tussigenic challenges.

**CONCLUSIONS:** Validated and reliable cough-specific health-related QoL questionnaires are recommended as the measurement of choice to assess the impact of cough on patients. How they compare is yet to be determined. When used, the reporting of cough severity by visual analog or numeric rating scales should be standardized. Previously validated QoL questionnaires or other cough assessments should not be modified unless the new version has been shown to be reliable and valid. Finally, in research settings, tussigenic challenges play a role in understanding mechanisms of cough. CHEST 2015; 147(3):804-814

**ABBREVIATIONS:** AHRQ = Agency for Healthcare Research and Quality; CB = consensus-based; CER = comparative effectiveness review; CHEST = American College of Chest Physicians; COI = conflict of interest; CQLQ = Cough-Specific Quality-of-Life Questionnaire; LCQ = Leicester Cough Questionnaire; PCQ = Pediatric Cough Questionnaire; PC-QoL = Parent Cough-Specific Quality of Life Questionnaire; PICOTS = population of interest, interventions, comparators, outcomes, timing of outcomes, and settings; QoL = quality of life; VAS = visual analog scale

## Summary of Recommendations

**1. In adult and adolescent patients ( $\geq 14$  years of age) complaining of chronic cough, we recommend that validated and reliable health-related quality of life (QoL) questionnaires be used as the measurement of choice to assess the impact of cough on patients (Grade 1B).**

**2. In adults and adolescents with chronic cough, we recommend the Cough-Specific Quality-of-Life Questionnaire and Leicester Cough Questionnaire, as they are the most extensively studied and commonly used previously validated and reliable cough-specific health-related QoL questionnaires to assess the impact of cough (Grade 1B).**

**3. In children ( $< 14$  years of age) with chronic cough, we recommend that validated and reliable health-related QoL questionnaires be used as the measurement of choice to assess the impact of cough (Grade 1B).**

**4. In children ( $< 14$  years of age) with chronic cough, we recommend the Parent Cough-Specific Quality of Life Questionnaire, the most extensively studied and commonly used previously validated and reliable health-related QoL questionnaire, as the measurement of choice to assess the impact of cough (Grade 1B).**

**5. To standardize the development, utilization, and reporting of cough-specific QoL questionnaires, we suggest that cough counting alone not be used to establish validity of the questionnaires (consensus based [CB]).**

**6. To standardize the development, use, and reporting of cough severity by visual analog scales (VASs) or numeric rating scales, we suggest that they be used in standard fashion (CB).**

**7. To ensure the integrity of health-related QoL questionnaires and other patient-reported outcomes that have been shown to be valid and reliable, we**

**suggest that a modified version should not be used and reported unless the modified version has been shown to be reliable and valid (CB).**

**8. In adult and adolescent patients with cough of any duration, we suggest that tussigenic challenges have a role in research settings to understand mechanisms of cough (CB).**

**9. In patients of all ages, we recommend acoustic cough counting to assess cough frequency but not cough severity (Grade 1B).**

Cough, particularly chronic cough, is a common symptom.<sup>1</sup> Although the possible causes of this symptom are numerous, assessment of its etiologic factors should follow a systematic approach, as stated in previous guidelines.<sup>2-4</sup> Furthermore, it is recognized that the assessment of antitussive medications should follow specific rules and use valid instruments.<sup>5</sup> Research outcomes often measured in studies of cough include one or more of the following concepts: cough severity, cough impact on quality of life (QoL), cough frequency, or cough sensitivity. Most often, measures of frequency and severity of cough and cough impact on QoL have not been based on the use of standardized or valid measures. Therefore, more-precise assessments could help to determine the actual impact of cough on patients and allow for valid evaluation of outcomes, providing reliable measurement of the effect of antitussive therapies.

In this regard, the American College of Chest Physicians (CHEST) Expert Cough Panel initially reviewed the 2006 cough guidelines on this topic to develop the current updated recommendations and suggestions.<sup>2</sup> In the former guideline, recommendations stressed the need for optimally evaluating chronic cough and the efficacy of cough-modifying agents by using both subject self-reporting and objective methods because they have the potential to measure different aspects of

Manuscript received October 9, 2014; revision accepted November 24, 2014; originally published Online First December 18, 2014.

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**FUNDING/SUPPORT:** Funding was provided by ACCP (CHEST).

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DOI: 10.1378/chest.14-2506

the problem. It was proposed to use a valid and reliable cough-specific health-related QoL instrument as well as visual analog scales (VASs). At the time of the 2006 publication,<sup>6</sup> some health-related QoL instruments had been psychometrically tested but VASs had not; thus, the cough-specific health-related QoL instruments were recommended as the primary subjective outcome measure. Regarding objective methods, tussigenic challenges were recommended before and after interventions to assess the effect of therapy on cough sensitivity only in disease states in which cough reflex sensitivity was known to be heightened.<sup>6</sup>

## Methods

The methodology used by the CHEST Guidelines Oversight Committee to select the Expert Cough Panel chair and the international panel of experts and to perform the synthesis of the evidence to develop the recommendations and suggestions has been previously published.<sup>7,8</sup> In addition to the quality of the evidence, the recommendation grading also includes a strength of recommendation dimension. In the context of practice recommendations, a strong recommendation applies to almost all patients, whereas a weak recommendation is conditional and only applies to some patients. In the context of research recommendations, such as the ones in this guideline, we intended for a strong recommendation (grade 1) to imply that we recommend using a particular cough assessment in almost all the cases and instances where such a tool is being considered. The strength of recommendation here is based on consideration of three factors: balance of benefits to harms, patient values and preferences, and resource considerations. Harms incorporate risks and burdens to the patient, which, for example, can include convenience or inconvenience, difficulty of administration, and invasiveness. These in turn affect patient preferences. The resource considerations go beyond economics and should factor in time and other indirect costs. The authors of these recommendations have considered these parameters in determining the strength of the recommendations and associated grades.

Key questions and parameters of eligibility were developed for this topic. Existing guidelines, systematic reviews, and primary studies were assessed for relevance and quality and were used to support the evidence-based graded recommendations or suggestions. A highly structured consensus-based (CB) Delphi approach was used to provide expert advice on all guidance statements. The total number of eligible voters for each guidance statement varied based on the number of managed individuals recused from voting on any particular statements because of their potential conflicts of interest (COIs). For example, C. T. F., A. B. C., S. S. B., and R. S. I. were recused from developing and voting on the recommendations that included mentioning specific QoL instruments. Writing committee member COIs related to the recommendations were identified and are presented in a COI grid (e-Appendix 1). Transparency of process was documented. Further details of the methods have been published elsewhere.<sup>7,8</sup>

The Executive Committee of the CHEST Expert Cough Panel convened a subcommittee to formulate recommendations or suggestions that pertain to the assessment of cough frequency and severity. This subcommittee on assessment of cough based its recommendations on a recently published comparative effectiveness review (CER) commissioned by the US Agency for Healthcare Research and Quality (AHRQ)<sup>9</sup> and a corresponding summary.<sup>5</sup> Various members of the Expert Cough Panel provided the stimulus for the AHRQ CER (R. S. I.) and were invited to participate as key informants, technical expert panelists, and peer reviewers.<sup>9</sup> The CER included a comprehensive search of the literature

Because a large number of studies and analyses have been published on cough assessment in the past decade, the CHEST Expert Cough Panel believed it necessary to review the current status of the previous recommendations and assess the need to develop new ones to advance the field in this area. The purpose of the present committee was to evaluate instruments used by investigators in clinical research on chronic cough. The specific aims were to (1) assess the performance of tools designed to measure cough frequency, severity, and impact in adults, adolescents, and children with chronic cough and (2) make recommendations or suggestions related to these findings.

indexed in MEDLINE, Embase, and the Cochrane Database of Systematic Reviews to identify English-language evaluative studies of instruments used to assess the frequency or impact of acute or chronic cough. Included studies had to (1) compare one cough assessment with another or with clinical assessment of cough or (2) evaluate change in response to treatment over time using a given tool. The literature search began with the inception of these databases; the last literature search date for the CER was June 4, 2012. The literature search was subsequently updated by two authors of the CER (R. R. C., D. C. M.), who are also members of the subcommittee on assessment of cough, using the same selection criteria used for the original CER project. This updated literature search identified 27 eligible studies<sup>10-36</sup> published between June 2012 and November 2013, inclusive, that were not included in the CER.

The CER<sup>9</sup> included an analytic framework constructed by using the general approach of specifying the population of interest, interventions, comparators, outcomes, timing of outcomes, and settings (PICOTS) to address the following key question: In adults and adolescents ( $\geq 14$  years of age) and children ( $< 14$  years of age), what is the comparative diagnostic accuracy, therapeutic efficacy, and patient outcome efficacy of instruments used to assess cough? The criteria used to screen articles for inclusion and exclusion at both the title-and-abstract and the full-text screening stages are detailed in Table 1. Figure 1 depicts this key question within the context of the PICOTS framework. The figure shows that the CER compared the diagnostic accuracy, therapeutic efficacy, and patient outcome efficacy of instruments to assess the severity, frequency, and impact of cough on patient outcomes. Subgroups considered included children aged  $< 14$  years and patients with differing underlying cough etiologies. The subcommittee formulated the additional key clinical research questions presented in the Results section.

The strength of the evidence for the key question was rated using the general approach described in the *Methods Guide for Effectiveness and Comparative Effectiveness Reviews*<sup>37</sup> and the *Methods Guide for Medical Test Reviews*.<sup>38</sup> In brief, the approach required assessment of four domains: risk of bias, consistency, directness, and precision. These domains were considered qualitatively, and a summary rating of high, moderate, or low strength of evidence was assigned after discussion by two reviewers (R. R. C. and D. C. M.) (Table 2).<sup>14,16,19-22,24,29,31,32,34-36,39-100</sup> In some cases, high, moderate, or low ratings were impossible or imprudent to make. For example, when no evidence was available or when evidence on the outcome was too weak, sparse, or inconsistent to permit any conclusion to be drawn, a grade of insufficient was assigned. Two members of the subcommittee on assessment of cough revised the strength of evidence conclusions reported in the AHRQ report to include additional information reported in the studies identified by the updated literature search. Prior to publication, experts reviewed this guideline and addressed all suggestions and criticisms.

**TABLE 1 ]** PICOTS Elements Table With Inclusion and Exclusion Criteria

Study Characteristic	Inclusion Criteria	Exclusion Criteria
Populations	<ul style="list-style-type: none"> <li>• Humans</li> <li>• Patients with cough (any duration)</li> </ul>	None
Interventions	<ul style="list-style-type: none"> <li>• Qualitative and quantitative instruments used to assess cough (eg, general and cough-specific health-related quality of life instruments, visual analog scales, objective cough counting, tussigenic challenge, exhaled nitric oxide)</li> </ul>	None
Comparators	<ul style="list-style-type: none"> <li>• Other instruments</li> <li>• Cough counts as reference standard for cough frequency instruments</li> </ul>	None
Outcomes	<ul style="list-style-type: none"> <li>• Study assesses an outcome of interest:                             <ul style="list-style-type: none"> <li>o Diagnostic accuracy (eg, sensitivity, specificity, positive predictive value, negative predictive value, validity, reliability, responsiveness, feasibility)</li> <li>o Therapeutic efficacy (eg, change in clinical practice, impact on patient or provider decision-making)</li> <li>o Patient outcome efficacy (eg, acceptability, quality of life, chest pain, depression, anxiety)</li> </ul> </li> </ul>	None
Timing	<ul style="list-style-type: none"> <li>• Timing of follow-up not limited</li> </ul>	None
Setting	<ul style="list-style-type: none"> <li>• Inpatient and outpatient</li> </ul>	None
Study design	<ul style="list-style-type: none"> <li>• Evaluation studies</li> </ul>	<ul style="list-style-type: none"> <li>• Not a clinical study (eg, editorial, nonsystematic review, letter to the editor, case series)</li> </ul>
Publications	<ul style="list-style-type: none"> <li>• English-language only</li> <li>• Peer-reviewed articles</li> <li>• Relevant systematic review, meta-analysis, or methods article (used only for background and as potential sources of additional relevant material)</li> </ul>	<ul style="list-style-type: none"> <li>• Non-English-language publications</li> </ul>

PICOTS = population of interest, interventions, comparators, outcomes, timing of outcomes, and settings.

## Results

The original CER report identified 115 articles representing 121 unique studies that underwent full-text review and 78 studies that met inclusion criteria for the review.<sup>5,9</sup> The updated literature search identified an additional 105 studies for full-text review, 27 of which met inclusion criteria, for a total of 105 eligible studies.

The updated search did not change the conclusions of the initial report.

### Evidence and Recommendations

#### Clinical Research Question 1: What Is the Most Important Patient-Related Outcome in Assessing Cough Severity and Treatment in Adult and Adolescent

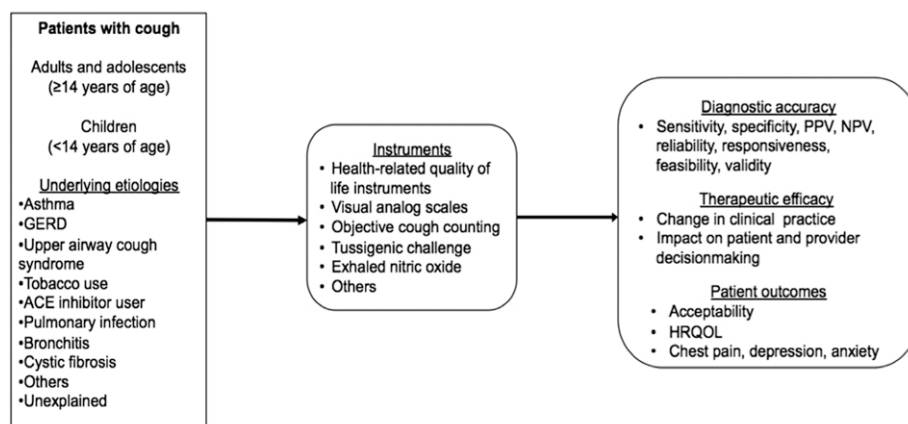


Figure 1 – Analytic framework for comparative effectiveness review. ACE = angiotensin-converting enzyme; GERD = gastroesophageal reflux disease; HRQL = health-related quality of life; NPV = negative predictive value; PPV = positive predictive value.

**TABLE 2 ] Summary of Strength of Evidence and Effect Estimate for Clinical Research Question 1**

Instrument (Dimension Assessed)	Validity (ie, Correlation With Other Measures of Cough)	Reliability			Citations
		Internal Consistency (Cronbach $\alpha$ )	Repeatability	Responsiveness	
LCQ (severity/QoL)	High SOE 17 studies; 1,191 subjects Range of $r = 0.93-0.93$	High SOE 4 studies; 430 subjects Range of $r = 0.77-0.93$	High SOE 2 studies; 256 subjects Range of $r = 0.86-0.92$	High SOE 12 studies; 862 subjects Range of ES = 0.84-19.5	20, 24, 31, 32, 34, 36, 40, 42-56
CQLQ and ACOS <sup>a</sup> (severity/QoL)	High SOE 6 studies; 360 subjects Range of $r = 0.24-0.79$	Low SOE 2 studies; 208 subjects Range of $r = 0.63-0.92$	Low SOE 2 studies; 76 subjects Range of $r = 0.75-0.93$	Moderate SOE 8 studies; 484 subjects Range of MID = 10.6-21.9	28, 39, 41, 53, 56-59
PC-QoL (severity/QoL)	Moderate SOE 4 studies; 593 subjects Range of $r = 0.01-0.70$	Moderate SOE 3 studies; 247 subjects Range of $r = 0.56-0.91$	Insufficient SOE 1 study; 43 subjects Range of $r = 0.40-0.51$	Moderate SOE 4 studies; 519 subjects Range of ES = 0.32-0.41	60-62, 99
Electronic recording devices (frequency)	High SOE 23 studies; 774 subjects Range of $r = 0.89-0.99$	NA	Moderate SOE 6 studies; 239 subjects Range of $r = 0.8-1.0$	Low SOE 2 studies; 129 subjects Detected change with treatment	19, 21, 22, 24, 29, 35, 43-45, 48, 49, 59, 62-92, 100
Visual analog scales (severity/QoL)	Insufficient SOE 13 studies; 638 subjects No summary measure	NA	Insufficient SOE 1 study; 54 subjects Range of $r = 0.71-0.78$	Moderate SOE 6 studies; 250 subjects Detected change with treatment	14, 16, 22, 28, 35, 51, 57, 92-98

ACOS = Adverse Cough Outcome Survey; CQLQ = Cough-Specific Quality of Life Questionnaire; ES = effect size; LCQ = Leicester Cough Questionnaire; MID = minimal important difference; NA = not applicable; PC-QoL = Parent Cough-Specific Quality of Life Questionnaire; QoL = quality of life; SOE = strength of evidence.  
<sup>a</sup> The ACOS has been revised and replaced by the CQLQ.

## **Patients (≥ 14 Years of Age) Complaining of Chronic Cough?**

*Summary of the Evidence and Interpretation:* A variety of tools are available to assess cough, capturing different concepts used to evaluate various aspects of the symptom.<sup>5,9</sup> The choice of instruments in studies is determined by the specific research question and study design. Patient-reported outcomes, such as QoL questionnaires and VASs, reflect the patient's experience of the impact and severity of coughing, whereas cough counting provides objective quantification of the symptom, and cough challenge testing offers mechanistic insights. Cough frequency can be measured using electronic audio and video recording devices. Limited data suggest that audio recordings may be marginally more accurate than video recordings.<sup>75</sup> Although both are reliable compared with other methods of assessing cough frequency, the moderate to poor correlations between cough counting and QoL appear to demonstrate a lack of convergent validity between the two constructs being measured.<sup>5,9</sup> As such, all these tools complement one another and are frequently used in combination. Furthermore, although the majority of studies on cough assessment evaluated various aspects of the comparative diagnostic accuracy of the various cough measurement instruments, they did not evaluate their comparative therapeutic or patient outcome efficacies.<sup>5,9</sup>

Although multidimensional QoL questionnaires describe only one facet of cough consequences, they appear to be the most comprehensive instruments to evaluate the impact of this symptom on the patient.<sup>9</sup> QoL instruments may vary in content and therefore measure different aspects of QoL so that some may be more useful in certain situations. Furthermore, because they provide a personal subjective evaluation of the effects of cough, which may differ greatly from one patient to another, some assessments may be better for subgroups of patients. Because health-related QoL studies have tended to focus on populations with longer durations of cough, we have specified chronic cough in the present recommendation. In this context, health-related QoL questionnaires have been shown to be valid and reliable in adults and adolescents and in pediatric populations.<sup>5,9</sup> In adults and adolescents, QoL questionnaires are based on self-report. In the pediatric population, the questionnaires are completed by the parents, not the child; therefore, the results reflect the parents' perception of the impact of cough on their child's QoL. Older children (generally aged > 7 years) may be able to report their QoL, but self-reported pediatric cough-specific QoL questionnaires are not yet available.

**1. In adult and adolescent patients (≥ 14 years of age) complaining of chronic cough, we recommend that validated and reliable health-related QoL questionnaires be used as the measurement of choice to assess the impact of cough on patients (Grade 1B).**

**Clinical Research Question 2: in Adults and Adolescents (≥ 14 Years of Age), Which Health-Related QoL Questionnaires Are Validated to Assess Cough Severity, and How Do They Compare in Regard to Their Properties?**

*Summary of the Evidence and Interpretation:* The Cough-Specific Quality-of-Life Questionnaire (CQLQ) and Leicester Cough Questionnaire (LCQ) have content validity for assessing how patients perceive the effect of their cough; this is based on both questionnaires being developed with input from patients with chronic cough.<sup>39,40,101,102</sup> Both instruments have been found to be reliable, valid, and responsive measures of the impact of chronic cough on adults and adolescents (Table 2).<sup>5,9</sup> Although there is good responsiveness data for the CQLQ and LCQ, they are limited at this time.<sup>5,9</sup> These two questionnaires have been the most extensively studied, whereas other cough-specific as well as general and disease-focused (eg, cough in patients with lung cancer) health-related QoL instruments have not been extensively studied or used.<sup>9</sup>

**2. In adults and adolescents with chronic cough, we recommend the CQLQ and LCQ, as they are the most extensively studied and commonly used previously validated and reliable cough-specific health-related QoL questionnaires to assess the impact of cough (Grade 1B).**

**Clinical Research Question 3: in Children (< 14 Years of Age) With Chronic Cough, Which Is the Measurement of Choice to Assess the Impact of Cough?**

*Summary of the Evidence and Interpretation:* As for adults, QoL questionnaires have been demonstrated to be valid and reliable instruments to assess the impact of cough in children.<sup>5,9</sup> Because of limited and insufficient evidence to determine the reliability or concurrent validity of the various cough diaries, numeric rating scales, VASs, or tussigenic challenges, these are not recommended as primary outcome measures to assess the impact of cough.<sup>5,9</sup>

Based on studies performed in children, it appears that electronic audio and video recording devices are valid methods of assessing cough frequency.<sup>5,9</sup> Because cough counting does not lend itself to directly measuring the impact of cough as perceived by the patient, establishing

concurrent validity of cough counting may best be assessed by comparing one cough counting method with another cough frequency measure.

**3. In children (< 14 years of age) with chronic cough, we recommend that validated and reliable health-related QoL questionnaires be used as the measurement of choice to assess the impact of cough (Grade 1B).**

**Clinical Research Question 4: in Children (< 14 Years of Age) With Chronic Cough, Which Cough-Specific Health-Related QoL Questionnaire(s) Is/Are Recommended to Assess the Impact of Cough?**

*Summary of the Evidence and Interpretation:* In children, the Parent Cough-Specific Quality of Life Questionnaire (PC-QoL), the most extensively studied QoL instrument in this age-group, has been found to be a reliable and valid instrument of measuring parental perception of the impact of chronic cough on their child (Table 2).<sup>5,9</sup> This questionnaire has content validity based on its development with input from parents of children with chronic cough.<sup>99</sup> Although there is good responsiveness data for the PC-QoL, they are limited at this time (Table 2).<sup>5,9</sup>

**4. In children (< 14 years of age) with chronic cough, we recommend the PC-QoL, the most extensively studied and commonly used previously validated and reliable health-related QoL questionnaire, as the measurement of choice to assess the impact of cough (Grade 1B).**

**Clinical Research Question 5: in Adult and Adolescent Patients (≥ 14 Years of Age) and Children (< 14 Years of Age), Does Cough Frequency Monitoring (Objective Cough Counting) Provide an Added Value to Assess Health-Related QoL or Cough Severity?**

*Summary of the Evidence and Interpretation:* The literature draws moderate to poor correlations between cough counting and health-related QoL, suggesting that these outcomes are measuring different concepts related to the phenomenon of coughing.<sup>5,9</sup> Despite the fact that cough frequency monitoring appears to be measuring data reflecting a concept different from health-related QoL or cough severity, its measurement may still be informative based on study design and outcomes (eg, assessment of drug efficacy).

**5. To standardize the development, utilization, and reporting of cough-specific QoL questionnaires, we suggest that cough counting alone not be used to establish validity of the questionnaires (CB).**

**Clinical Research Question 6: How Should VASs or Numeric Rating Scales Be Used to Assess Cough?**

*Summary of the Evidence and Interpretation:* VASs and patient diaries are widely used in both clinical research and practice. Although they have the potential to assess cough severity, few data exist on their accuracy in doing so, and correlations with other cough measurement tools have been inconsistent.<sup>5,9</sup>

The panel considered that if a VAS is used as an outcome measure, it must be done so in a standardized manner.<sup>103-106</sup> For example, to establish concurrent validity for a cough-specific QoL scale, it is important to ensure that the phenomenon measured by the VAS is that of cough. Therefore, it is important to use the word “cough” in the descriptor at both ends of the scale, and words such as “symptoms” should not be interchanged with the word “cough.” For the purpose of promoting reliability and validity in the use of the VAS, the ends of the scale should be closed by perpendicular lines, and the descriptions on each end should be outside these lines and not within the scale itself (Fig 2).<sup>103</sup> This design will help to avoid confusion on the part of the subject about where to mark the line.

**6. To standardize the development, use, and reporting of cough severity by VASs or numeric rating scales, we suggest that they be used in standard fashion (CB).**

**Clinical Research Question 7: in All Patients, Can We Improve Our Confidence in the Validity of Cough Study Outcomes by Asking That Cough QoL Questionnaires or Other Subjective Rating Instruments Be Copyrighted so That They Cannot Be Altered or Translated Without Going Through Appropriate Steps?**

*Summary of the Evidence and Interpretation:* Because any change in cough-related QoL questionnaires or any QoL questionnaires in general can potentially lead to different results, these questionnaires should not be modified, regardless of whether they have been copyrighted. If they have been modified, permission should be obtained from the developers or from those who hold their copyright. If and when a QoL questionnaire is modified, the modified version should be retested for validity and reliability.<sup>107</sup>

All translations of existing questionnaires into another language should be conducted using an established

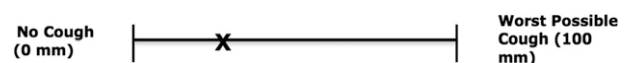


Figure 2 – Representative 100-mm visual analog scale (VAS) for measuring subject self-reported cough severity. Instruct subject to put an X on the line to indicate the severity of his or her cough during the past week or previously identified referent time period. The point of intersection of the crossed lines of the X should be used as the VAS value.

methodology to preserve content validity and other measurement properties (eg, backward and forward translation steps, cognitive interviews, international harmonization meetings).<sup>108</sup> The results of these procedures must be published.

**7. To ensure the integrity of health-related QoL questionnaires and other patient-reported outcomes that have been shown to be valid and reliable, we suggest that a modified version should not be used and reported unless the modified version has been shown to be reliable and valid (CB).**

**Clinical Research Question 8: in Adults and Adolescents, What Is the Clinical Usefulness of Cough Reflex Testing With Inhalation Cough Challenges?**

*Summary of the Evidence and Interpretation:* Because of limited and insufficient evidence to determine the reliability or concurrent validity of the various types of tussigenic challenges,<sup>5,9</sup> these are not recommended as primary outcome measures for determining cough severity or the impact of cough. However, tussigenic challenges may be useful to investigate the mechanisms of cough. At this time, no valid comparisons exist among the various tussigenic challenges regarding their value in clinical or research settings.

**8. In adult and adolescent patients with cough of any duration, we suggest that tussigenic challenges have a role in research settings to understand mechanisms of cough (CB).**

**Clinical Research Question 9: in Patients of All Ages, How Should Cough Counting Be Done to Assess Cough?**

*Summary of the Evidence and Interpretation:* Electronic recording devices appear to be valid assessments of cough frequency compared with human counts. However, correlation between cough counting and other assessments, such as health-related QoL, is moderate to poor,<sup>5,9</sup> suggesting that cough counting is not a reliable way to assess the impact of coughing on patients. If performed, however, it should be done through objective means. Although electronic audio and video recording devices are reliable compared with other methods of assessing cough frequency,<sup>5,9</sup> the moderate to poor correlations between cough counting and QoL appear to demonstrate a lack of convergent validity between the two constructs being measured.

**9. In patients of all ages, we recommend acoustic cough counting to assess cough frequency but not cough severity (Grade 1B).**

## Areas for Future Research

To advance the field, a number of research endeavors should be undertaken, as follows:

- It should not be assumed that QoL questionnaires would perform equally in all studies, across different cultures, and in different populations. Therefore, to assess the performance of QoL questionnaires, their reliability and validity should be reassessed in all studies going forward, including longitudinal studies. Concurrent validity of QoL questionnaires may be assessed by comparing results of cough severity with QoL or QoL of one questionnaire with another.<sup>28,109</sup>
- To standardize the development, use, and reporting of responsiveness of health-related QoL questionnaires, the minimal important difference should be assessed with a prospective (eg, Punum Ladder)<sup>41</sup> as well as a retrospective (eg, global rating of change scale) measure of change to assess whether a consistent difference exists between the two. Based on an empirically supported theory by Streiner and Norman,<sup>110</sup> there is recall bias inherent in retrospective measures.<sup>41</sup> The only study comparing the two types of measures to calculate the minimal important difference found a difference when prospective and retrospective measures of change were used.<sup>41</sup> If future studies confirm this finding and reveal that the difference is consistent, a recommendation should be made about which type of change measure should be routinely used.
- Because there are limited data on the responsiveness of electronic audio and video cough counting devices,<sup>5,9</sup> future research should focus on this gap in knowledge as well as on determining the most useful duration of the monitoring session.
- There is a need to establish reliability and validity of cough-specific VASs and numeric rating scales using appropriate methodology.<sup>5,9</sup>
- There is a need to develop self-reported pediatric cough-specific QoL questionnaires for older children.
- When changing an established questionnaire from a hard copy to an electronic format, measurement properties must be confirmed because the change represents instrument modification.<sup>109</sup>
- Although QoL questionnaires provide important information in the research setting, future research should be directed to transitioning the use of these questionnaires in an appropriate format for the clinical setting.<sup>111</sup>

## Conclusions

Since publication of the 2006 CHEST cough guidelines, it is clear that the field of cough assessment has advanced



based on the results of the systematic review commissioned by AHRQ and performed by methodologists with no conflicts of interest at the Duke Evidence-based Practice Center. By updating the original review through November 2013 and using the updated results as the basis for the present deliberations, the CHEST Expert Cough Panel has made a series of recommendations and suggestions for carrying out clinical research in assessing cough. This article has also identified gaps in our knowledge and areas for future research.

## Acknowledgments

**Author contributions:** L.-P. B. and R. S. I. were the guarantors and topic editors for this article. L.-P. B., R. R. C., D. C. M., C. T. F., A. B. C., S. S. B., J. S., R. L. D., B. R., and R. S. I. contributed to the development of the key questions using the PICOTS format and review of the data and elaboration of recommendations, including their grading; R. L. D. was the methodologist; and R. R. C. and D. C. M. were among the investigators from the Duke Evidence-based Practice Center who conducted the systematic review that formed the basis for the recommendations.

**Financial/nonfinancial disclosures:** The authors have reported to CHEST the following conflicts of interest: Drs Coeytaux and McCrory are authors on the AHRQ evidence report on which this guideline is based, and their efforts on this project were supported by a contract from AHRQ. Dr French is a codeveloper and co-copyright holder of the CQLQ. She has not received any financial compensation for CQLQ in > 3 years. Dr Chang is a codeveloper of the PC-QOL, a member of the advisory panel for the AHRQ systematic review on assessing cough severity, and a reviewer of the final AHRQ document. Dr Birring is a developer of the adult QoL and cough counting tools. Dr Smith has a patent for a cough counting device. Dr Irwin is a codeveloper and co-copyright holder of the CQLQ. He has not received any financial compensation for CQLQ in > 3 years. Dr Irwin was also a member of the advisory panel for the AHRQ systematic review on assessing cough severity and a reviewer of the final AHRQ document. Although Dr Irwin is the Editor in Chief of CHEST, all reviews and decisions made concerning this manuscript were made by others, independent of Dr Irwin. Drs Boulet and Rubin and Ms Diekemper have reported that no potential conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

**Endorsements:** The following organizations have endorsed this document: American Academy of Otolaryngology – Head and Neck Surgery Foundation, American Thoracic Society, Asian Pacific Society of Respiriology, Canadian Thoracic Society, and Irish Thoracic Society.

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MBBS, FCCP; Anne Vertigan, PhD, MBA; Gang Wang, MD, PhD; Miles Weinberger, MD; Kelly Weir, MsPath.

**Role of sponsors:** CHEST was the sole supporter of these guidelines, this article, and the innovations addressed within.

**Other contributions:** The authors thank CHEST for supporting this work.

**Additional information:** The e-Appendix can be found in the Supplemental Materials section of the online article.

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