Table 1. Spirometric Values With and Without Submaximal Inhalation Error

	Value	% Predicted	Z-score
Submaximal inhalation error			
FVC (L)	3.05	74	−1.93
FEV_1 (L)	1.61	49	−3.86
FEV_1/FVC	0.53		−0.04
Corrected submaximal inhalation error			
FVC (L)	3.26	79	−1.54
FEV_1 (L)	1.76	53	−3.52
FEV_1/FVC	0.54		−0.04

be truncated by suboptimal effort, cough, vocal cord adduction, and other errors (eg, mouth leak).

We are unable to report the prevalence of submaximal inhalation error in clinical practice; however, it is likely to depend on the experience and skill of testing personnel. The clinical impact of submaximal inhalation error may be significant in certain settings, such as identifying a low FVC that may suggest restrictive disease, the correct grading of airway obstruction based on percent-of-predicted FEV_1, or the accurate follow-up of FEV_1 or FVC in patients being treated for obstructive or restrictive disease.

We propose that an unacceptable submaximal inhalation error be defined as an inspired FVC that exceeds the expired FVC by $\geq$ 150 mL in adults. We believe that a $\geq$ 150-mL gap is appropriate because this value is the currently recommended maximum inter-maneuver variance for FVC.[2] Studies are needed to test the ability of patients to satisfy this goal and to determine an appropriate error size for children.

It could be argued that spirometry testing with excessive submaximal inhalation errors may already be identified as low quality by virtue of failure to satisfy repeatability standards; however, it may be possible for this error (like others) to be reproducible, especially if corrective action is not taken by the technologist. In addition, a formal definition of this error is necessary for the training of testing personnel and the development of software to provide computerized technologist feedback regarding submaximal inhalation errors. It is important to realize that a submaximal inhalation error can be the fault of the technologist if a premature command to begin forced exhalation is given (ie, the patient is instructed to exhale before full inhalation is achieved). We therefore encourage manufacturers to include submaximal inhalation error in their quality feedback software with a message such as "the inspired FVC is larger than the expired FVC; ensure that the patient inhales fully before performing forced exhalation."

The addition of submaximal inhalation error to the existing ATS/ERS spirometry acceptability criteria would require a new recommendation that all spirometry tests record a flow-volume loop, including a full inspiratory maneuver following the forced expiratory maneuver. There are some patients who achieve greater lung inflation when inhalation begins from residual volume compared with functional residual capacity.[4,5] For these individuals, submaximal inhalation error may be corrected by the following sequence: tidal breathing, exhale to residual volume, full inhalation, forced exhalation, and rapid and full inhalation.[2,5]

We endorse the comments of Graham[6] published in an editorial in RESPIRATORY CARE: "Pulmonary function standards are not static. They should be questioned. There is always room for improvement in any set of pulmonary function standards."

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The authors have disclosed no conflicts of interest.

DOI: 10.4187/respcare.04061

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The American Thoracic Society/European Respiratory Society Acceptability Criteria for Spirometry: Asking Too Much or Not Enough?

In Reply:

I thank Mr Haynes and Dr Kaminsky for their interest and comments on our study exploring spirometric standards in relation to subject characteristics in routine clinical practice.[1] Regarding the comments about the American Thoracic Society/European Respiratory Society (ATS/ERS) acceptability criteria for spirometry, I share the authors' concerns about the failure to achieve maximal inhalation during the spirometry maneuver; it is also my experience. In addition, I also agree with the proposal to add the term submaximal inhalation error to the ATS/ERS spirometry acceptability criteria.

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Mr Giner has disclosed no conflicts of interest.

DOI: 10.4187/respcare.04161

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