Pulmonary Function Education for the Novice Learner

We May All Need a Lesson

Michael Keller, M.D.[1,2]

[1]Department of Critical Care Medicine, National Institutes of Health, Bethesda, Maryland; and [2]Division of Pulmonary and Critical Care Medicine, Johns Hopkins Hospital, Baltimore, Maryland

The demands of a busy clinical rotation often pose several unique challenges to providing effective, high-quality teaching (1). Given the time constraints present as a result of the overriding responsibilities of clinical care, educators may find it difficult to strike a balance between a concise approach and one that is comprehensive and clinically useful. Further, the wide variation in levels of training frequently requires the educator to tailor their teaching toward the appropriate training level, especially given the aforementioned time restraints. However, despite these obvious challenges, little framework or guidance exists for effectively providing education in the clinical setting, especially teaching that is rooted in evidence-based methods grounded in cognitive principles of learning. This remains true even for more commonly taught concepts such as pulmonary function testing (PFT).

As part of the How I Teach series in this issue of *ATS Scholar*, Nelson and Richards present their framework for teaching PFT to medical students and residents in the midst of clinical rotations (2). They provide a detailed outline of their succinct, 30-minute didactic workshop aimed to provide novice learners with a foundational understanding of the physiologic basis and interpretation of PFT results. Their approach is rooted within evidence-based principles of cognitive psychology and is composed of two parts: first, an interactive whiteboard minilecture designed to concisely present PFT physiology and interpretation, followed by a worksheet session intended to allow learners to apply these principles to case-based PFT examples. By providing a variety of visual clues and breaking up the lessons into well-partitioned segments, they allow the information to be easily digested. The interactive, visual nature of their approach also promotes active, rather than passive, learning in an effort to continually renew attention and promote long-term retention. The case-based problem set that follows the interactive lecture allows for not only immediate application of their approach to enhance clinical reasoning but also a rapid identification of deficiencies. In this regard, the case-based session allows for almost immediate feedback while also allowing the learner to understand and appreciate the real-world applications of

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their newfound knowledge (i.e., why it is clinically relevant and useful) (3).

Clinicians are often tasked with the responsibility of educating trainees in the clinical setting; however, their level of comfort in delivering this teaching may vary depending on the subject matter and audience. Concepts that may appear straightforward to teach for some may not come as intuitively to others. Many educators acquire their teaching skills mostly through experience, trial and error, and feedback, without formal guidance of faculty development courses (4). The ability to gain insight into how others approach teaching material is vital and may allow even seasoned educators to adapt their methods of teaching and integrate aspects of what they learn into an established curriculum to further shape their educational strategies. This allows for continual refinement of one's teaching skills, a vital process to the development of effective teaching (5).

Despite the relative merits of Nelson and Richards' article, a few limitations exist and are worth considering. Although their methods are grounded in a cognitive psychology framework with a solid theoretical foundation, a multitude of educational approaches exist that may be more effective for learners and teachers alike. The effectiveness of their specific curriculum has not been formally validated in research studies, and the methods and tools of assessing such effectiveness also remain a question. Although the proposed framework does include the option to cover more advanced topics such as the assessment of flow–volume loops, more complex topics relevant to pulmonary fellows or junior faculty are avoided, such as the technical aspects of PFT maneuvers, assessment of test quality, and testing beyond spirometry, lung volumes, and diffusion capacity. Additionally, as the authors note in the manuscript, the use of the fifth percentile of the lower limit of normal of the ratio of forced expiratory volume in 1 second to forced vital capacity to define obstruction (equivalent to a z-score of -1.645) is avoided, along with the corresponding potential for over- or underdiagnosis of obstruction in elderly or younger patients, respectively, with the use of a fixed ratio of forced expiratory volume in 1 second to forced vital capacity of 0.7 (6). However, this does little to detract from the aims and scope of this article, and several of the educational strategies employed (the "how") can certainly be adopted into the framework of curricula revolving around more complex topics in PFT (as well as other concepts entirely). The framework is accessible to not only pulmonary providers but generalists as well. Finally, attention to the use of race and ethnicity in reference equations for PFT interpretation, and their potential contributions to health disparities, remains an important topic of conversation. Given the emphasis placed on adjusted reference equations to calculate expected values for the interpretation and comparison of PFT results, it is crucial to acknowledge the troubling role that race has played as a component of these reference equations. The role of race in the interpretation of spirometry has been perpetuated by justifications rooted in dubious, racially biased assumptions about racial differences in lung function dating back to slavery-based eras in U.S. history (7). Given recent evidence that challenges the notion that race and ethnicity have true biological meaning in the interpretation of PFT results in isolation from their complex interactions with the socioenvironmental determinants of lung function, recent recommendations have been made to replace race- and ethnicity-specific reference equations with race- and ethnicity-neutral ones (8). However, even recommended "race-neutral" reference equations such as

the Global Lung Function Initiative average equation have important limitations, namely representing a weighted average of self-identified (or researcher-allocated) racial groups, making it more of a "race-composite" rather than a truly race-neutral equation. Further, Global Lung Function Initiative reference equations for diffusion capacity and lung volumes are still predicated on values obtained from primarily White populations of European ancestry, with future plans to validate their use in broader populations (9, 10). These concepts provide essential context for effective teaching of PFT interpretation and are important to address with learners.

The concept of lifelong learning is instilled into the essence of medicine; so too does this concept apply to the growth and evolution of the clinical educator. The development of effective educational models is often an iterative process, requiring frequent evaluation of the techniques used in an effort to continually improve our methods of teaching. By openly sharing our teaching strategies and acknowledging the challenges faced in teaching certain topics, the field of medical education will continue to evolve toward the benefit of our learners and, most importantly, our patients.

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