Pediatric flexible airway endoscopy training during a pandemic and beyond: Bending the curve.

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Commentary

Flexible airway endoscopy, for diagnostic and therapeutic purposes, is a vital aspect of pediatric pulmonology practice, and has become an integral aspect of formal training in pediatric pulmonology. Achieving competency in flexible airway endoscopy requires mastery of several skills, including cognitive (learning anatomy, recognition of pathology, etc.) and manual (manipulating the instrument safely and effectively, etc.). To acquire the cognitive and manual skills of flexible airway endoscopy, there has been no adequate substitute for direct procedural experience in patients. In pediatric pulmonology, the opportunities for such experience vary widely among training programs, many of which can offer only limited experience.

The pandemic COVID-19 caused by SARS-CoV-2 has resulted in significant disruption to healthcare, including medical training[1, 2]. Because this virus is primarily transmitted by respiratory droplets, aerosol-generating procedures, especially bronchoscopy, pose a special danger to health care workers. Multiple adult bronchology societies have issued guidelines about the role of bronchoscopy and protection of health care workers during the COVID-19 pandemic. All the guidelines recommend limiting personnel present during the procedure, including on patients not suspected of COVID-19, as well as prioritizing and limiting elective bronchoscopies. These guidelines do acknowledge relying on consensus due to limited evidence of studies during this new pandemic[3-5]. The consequences of the pandemic include potentially dramatic reduction in the opportunities of hands-on learning for pediatric pulmonology training, As a result, this could cause a significant educational lacuna for current fellows.

In the setting of caution on scheduling aerosol-generating procedures and consequently restricted opportunities for hands-on experience, how can trainees develop proficiency in performing bronchoscopy? For surgical resident training, several alternative approaches have been proposed, including remote training platforms with

pre-recorded lectures, online practice questions, teleconferencing and telemedicine, procedural simulation, surgical videos, and developing competency tests[6-8].

A survey of training in pediatric flexible bronchoscopy in the US published in 2014 revealed that the apprentice model, with volume-based ascertainment of competency, was the primary method utilized by pediatric pulmonology training directors[9]. There are currently no evidence-based competency guidelines for pediatric flexible bronchoscopy. A suggested list of core competencies for pediatric flexible airway endoscopy is published in the Official ATS Technical Standards document[10]. In addition, the Supplement to the Technical Standards lists some tools for online learning of clinical assessment and performance from the American Thoracic Society, Bronchoscopy International, and a series on YouTube by Dr. Henri Colt, though these tools are primarily on adult flexible bronchoscopy[11-13].

Studies in adult bronchoscopy training have shown variability in performance, and that procedure numbers are not a sufficient tool to assess competency. An Expert Panel on adult bronchoscopy training has suggested "professional societies and certifying agencies move from a volume-based certification system to a standardized skill acquisition and knowledge-based competency assessment for pulmonary and thoracic trainees[14]."

Computerized bronchoscopy simulators have been studied as a method to develop competency (learning anatomy as well as manipulation of the bronchoscope). Several groups have reported that simulation can result in the development of significant skills, and simulators can also provide a mechanism for assessing those skills, including the attainment and maintenance of proficiency[15-18]. There are online virtual bronchoscopy simulation tools available as well as commercial products[19-21]. Currently available virtual simulators, however, are not designed for pediatrics and are thus inadequate for pediatric training.

Simulation training in adult bronchoscopy has evolved. The American College of Chest Physicians (ACCP) has an innovative Bronchoscopy Certificate of Completion (COC) program designed for adult bronchoscopy including cognitive as well as psychomotor skills for basic and advanced bronchoscopy involving transbronchial needle aspiration and endobronchial ultrasound utilizing simulation technology. The ACCP, with its Advanced Clinical Training Program, was the first society to receive accreditation from the Society for Simulation in Healthcare[22].

In addition to virtual simulators, cheaper alternatives with simple inanimate models have been used. Recently, more sophisticated and realistic models for adult bronchoscopy training have been developed utilizing 3D-printed airways. There is also the potential of using a 3D model of a specific patient case for pre-procedural training and planning[17, 23, 24].

Before the pandemic, many pediatric pulmonary physicians have taken a formal course, which has been offered in the US since 1981 by Wood and colleagues. Similar courses have been offered in Europe and Asia. These courses have included lectures, video presentations of anatomy and pathologies, and demonstrations as well as hands-on experience in various non-human models, and have been a vital aspect of initial training. However, the pandemic has resulted in classroom and hands-on training opportunities being currently prohibited; it is unclear when traditional training can resume. The didactic material from the Cincinnati Children's Hospital Medical Center (CCHMC) course is now available online, by subscription, but hands-on training will remain a significant problem for the immediate future.

Traditionally, animal models have been used for initial training[25]. However, due to societal pressure and other factors, despite their many advantages, the use of live animals for training purposes has fallen out of favor. The development of inanimate models for medical training has been a quantum leap forward, but models currently

available commercially have serious limitations. Other models, appropriate for pediatric training, have been reported, but also have significant limitations[26,27].

At CCHMC, we have recently developed a high-fidelity model based on an 18-month-old child, using a combination of CT scan data and artistic enhancement, guided by video recordings of pediatric bronchoscopy procedures and detailed iterative feedback from experienced bronchoscopists. This model includes the entire airway accessible to flexible bronchoscopes, from nostrils to 6th generation bronchi, and is highly accurate. There are realistic haptic qualities, and the model can be used for experience with BAL and clearing of secretions, as well as other interventional procedures. The first generation of this model was introduced for the 2019 Pediatric Flexible Bronchoscopy Course at CCHMC and is now in further development for commercial distribution.

Teaching with a model should involve more than the development of manual skills in driving the instrument. The addition of clinically relevant scenarios to challenge students can be not only stimulating, but vital to establishing an approach for performance of bronchoscopy in patients. Teaching is an art...

The education of current and future trainees for pediatric flexible airway endoscopy is presently unsettled. The challenges of procedural medical training during the pandemic have necessitated different approaches to the traditional method of primarily apprentice training. In the relative absence of clinical experience, trainees will need more formalized didactic instruction regarding anatomy and pathology, as well as the basic psychomotor aspects of endoscopy. During this and any future pandemic or when a training program can offer only limited bronchoscopy experience, it is incumbent upon training directors to utilize all available opportunities for learning. These would specifically include models or simulators from our adult colleagues in order to give pediatric fellows the best possible training, even if this training is not specifically pediatric. This is a time of opportunity to capitalize on innovative solutions to adapt and

improve future training, maintenance of cognitive knowledge and psychomotor skills, and their assessment. Despite the pandemic, we must learn to bend the curve of training to adapt and progress.

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