Innovations in Fellowship Education

2022 Highlights Book

ATS 2022

Program Details

The American Thoracic Society greatly values a strong fellowship program as a means of academic and clinical success. To recognize programs that implement exceptional practices, the ATS Training Committee developed the Innovations in Fellowship Education program. All pulmonary, critical care, sleep, and allergy fellowship programs (adult and pediatric) are invited to submit abstracts showcasing a novel and innovative best practice.

Abstracts are reviewed and ranked based on the following criteria:

Innovation: How unique is the educational program? What is new and different?

Implementation/Sustainability: How was the program implemented and how effective was such implementation? Is this program sustainable?

Transferability: How easily might this educational program be adopted by other fellowship programs?

Outcomes: Are there reported outcomes or plans to measure them?

The goal of this program is to recognize fellowship programs that demonstrate educational excellence and to share these best practices with other programs.

There is a focus on fellowship innovations addressing racial/ethnic disparities or improving diversity, equity, or inclusion.

This award focuses on projects related to fellowship education and curricula.

The following program was selected by the ATS Training Committee as the standout program in educational excellence this year. University of Washington submitted the top innovations abstract for 2022.

5 **University of Washington**
Hacking Innovation into Fellowship Education

Contents

The ATS would like to showcase the additional institutions who submitted an abstract to the 2022 Innovations in Fellowship Education program.

Contents

Top Innovation Abstracts of 2022

University of Washington

Hacking Innovation into Fellowship Education

Abstract authors:
Hugo Carmona, MD, Kelli Alderman, Rosemary Adamson, MB BS, Nicholas J. Johnson, MD, Andrew M. Luks, MD, and Başak Çoruh, MD

Program Description

We are a large academic fellowship program within a multi-hospital medical system whose mission is to create academic leaders, scientists, and educators in pulmonary and critical care medicine.

Rationale

Graduate medical education is constantly evolving and requires creative solutions to meet new challenges. We describe a process for complex organizational change that was developed in response to areas for improvement identified in our fellowship program. At its core, the process utilizes a hackathon to generate innovative solutions. Originally described in the design world and used by other GME programs at our institution, hackathons are events where teams compete to come up with a "hack," or innovative solution to a problem.(1) We required the perfect hack to be innovative, integrated into existing workflow, measurable, and cost-neutral.

Method

Figure 1 demonstrates the process map for our fellowship innovation cycle, spanning identification of areas for improvement through evaluation of implemented solutions. Our process started in 2019, when review of fellowship exit surveys and our ACGME self-study revealed quality improvement and patient safety (QI/PS) and wellbeing as areas for programmatic change. We invited fellows, core faculty, and support staff to a fellowship retreat, at which we hosted the hackathon. Thirty-eight fellows, faculty, and staff attended and were randomly assigned to one of five teams. The event started with an explanation of the hackathon process and fifteen-minute didactic overviews of each area of our fellowship with its challenges. Teams had thirty minutes per topic to brainstorm a hack, after which each team had five minutes to pitch their hack to the full group. Participants then voted for their favorite ideas. Following the retreat, separate workgroups comprised of faculty and fellows met on a quarterly basis to implement the hacks as well as other ideas generated at the retreat and in other forums. Once their objectives are accomplished, the working groups are disbanded, although they may reconvene if new issues arise within the scope of their responsibility.

Results

The winning hacks for QI/PS were to provide a curriculum relevant to fellowship and build a system for mentored fellow participation in QI/PS initiatives. The QI/PS Workgroup identified goals and objectives for a QI/PS workshop during the first year of fellowship and created a monthly, fellow-led Outcomes Conference on an ICU rotation, during which fellows partner with ICU service leaders and receive mentorship in root cause analysis. The winning hack for wellbeing focused on fellow schedule flexibility. The Wellbeing Workgroup proposed reworking rotation coverage to provide additional days off on busy rotations, fellow identification of one day each week to leave work early (approximately 5pm), and the addition of opt-out counseling during the first year of fellowship. We continue to measure progress on these initiatives through annual ACGME surveys, Well-Being Index scores (2), fellow exit surveys, and review at our annual program evaluations. Informal feedback has demonstrated that participants appreciated their incorporation into efforts to improve the fellowship program.

Conclusion

The increasing complexity of fellowship training requires innovative solutions. We implemented a unique process involving a hackathon and dedicated working groups to bring together faculty and fellows to improve QI/PS education and wellbeing within our fellowship program. Through this initiative, we built community, engaged diverse participants, and encouraged creativity. Given its success, we have continued to incorporate the process into our annual fellowship retreat to address new challenges. ■

References

1. Brown A, Jauregui J, Chipman AK, Ilgen JS. Using Hackathons to Transform Complex Educational Problems Into Innovative Prototypes. *J Grad Med Educ*. 2018;10(4):465-466.
2. Dyrbye LN, Satele D, Sloan J, Shanafelt TD. Ability of the physician well-being index to identify residents in distress. *J Grad Med Educ*. 2014;6(1):78-84.

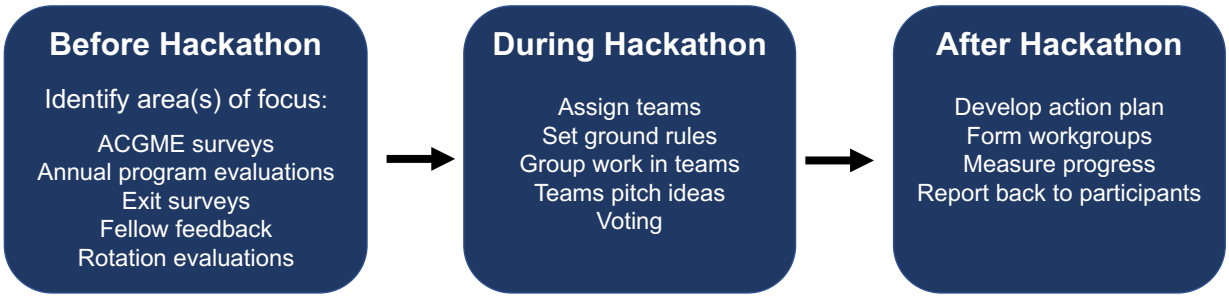

Figure 1: Process map for fellowship innovation cycle.

Baylor College of Medicine

Implementation and Evaluation of an Educational Program for Continuous Renal Replacement Therapy (CRRT) for Pediatric Critical Care (PCCM) Fellows Using a Hybrid of Gamification and Team Based Learning (TBL)

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Background

PCCM fellows are faced with many educational demands within a busy clinical learning environment. Educators must create innovative and efficient education programs. CRRT is commonly used by PCCM physicians. It is critical PCCM fellows understand the principles of CRRT. We aim to create an effective program for accelerated competency development to optimize care for critically ill children receiving CRRT.

Program Design and Methods

Educational Design Research (EDR) was used to guide the development of an evidence-based, theory-informed program. The strengths of EDR lie in its pragmatic and participatory approach to investigating the problem(s) and creating solutions through iterative design within an authentic educational environment.

To analyze the educational problem, we performed a needs assessment of trainees and faculty members, reviewed required content and scanned existing educational programs. On a Likert scale of 1-5, respondents (n=71) reported their confidence in the basics of CRRT, anticoagulation, monitoring and complications as low (mean 2.75, SD 0.14), their motivation was high (mean 4.3, SD 0.11) for learning about each of these objectives and 11% (8/31) received formal CRRT training.

A two-part workshop was created using the blended learning framework. Each workshop is novel with multimodal approach and sequential and synergistic integration of Team Based Learning (TBL) (synchronous) and online gamification (asynchronous) components. TBL shifts the focus from knowledge acquisition in the classroom setting to using class time applying concepts obtained through pre-course work (e.g. reading material) for higher-order thinking. Our design principle is an adaptation of TBL using meaningful gamification in the form of “choose your own adventure (CYOA)” branching scenarios as pre-course work.

Figure 1 depicts the components of each workshop. Participants complete pre-course work containing clinical scenarios created in the commercially available “Survey Monkey” platform in a CYOA format. As the learner progresses through the case, their answers are recorded and provide analytics to course directors. Following the pre-course work, the participants attend a three-hour workshop. During the workshop, there is small group work with reaction and feedback of the participant’s thinking of key concepts introduced during the pre-course work with additional activities of hands on activities and short simulations of common clinical scenarios. The two workshops are sequential. Part two builds on key concepts from part one with more advanced simulations.

Results

To evaluate the program, we used Kirkpatrick’s new world four-level evaluation model shown in Figure 2. Kirkpatrick describes four levels used to evaluate the effectiveness of a program: 1) reaction, 2) learning, 3) behavior and 4) results. We evaluated level one with a survey about the relevance and engagement of the workshop. Level two evaluations included analytics from CYOA to evaluate the skills and knowledge and surveys for the attitude and commitment to learning. We will use

Tand commitment to learning. We will use these evaluative findings to inform program improvement for level three and four outcomes in the future.

Participants include eighteen PCCM fellows. The workshop was evaluated using a Likert Scale 1-5. Results are shown in figure 2. Overall, the participants found the program to be fun, engaging and relevant to their current practice (mean 4.89, SD 0.31). The CYOA format was enjoyable and preferred over the traditional reading method (mean 4.9, SD 0.30). Participants felt well prepared for the workshop (mean 4.63, SD 0.66). The TBL format of the workshop and group activities/simulations were effective ways to learn (mean 4.88, SD 0.32) and met personal expectations (mean 4.96, SD 0.20). ■

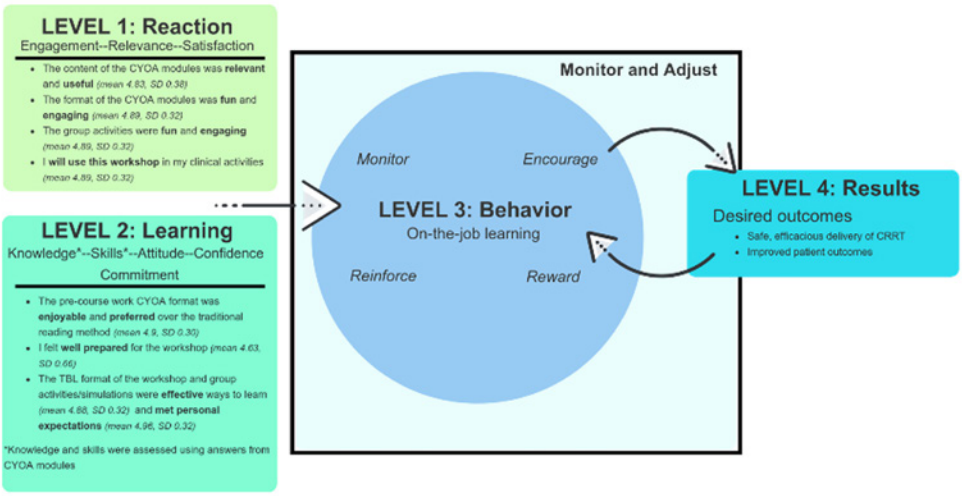

Figure 1: Overview of program showing asynchronous (pre-course work) and synchronous components (TBL workshop).

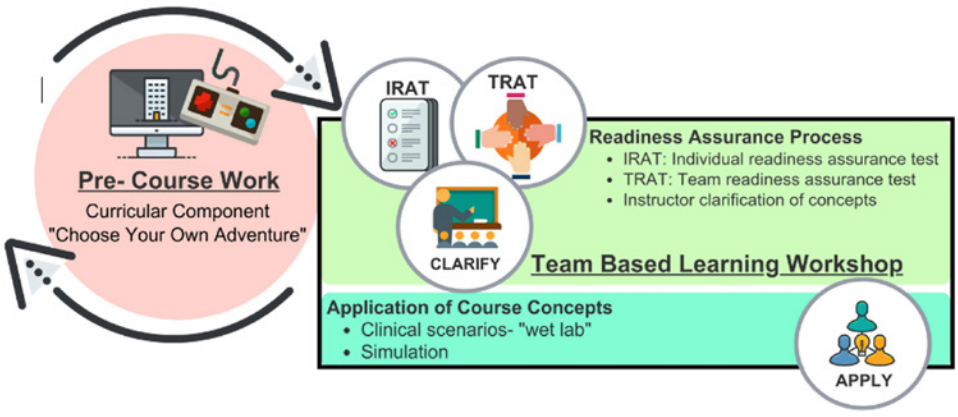

Figure 2: Kirkpatrick's New World Four Level Evaluation Model. This model represents the four levels of evaluation. Results are included for the first two levels after implementation of the first two part workshop. These evaluative results will be used to inform program improvement for level 3 and 4 outcomes.

Icahn School of Medicine at Mount Sinai

Fellows As Educators: Implementation of A Technology Driven Teaching Scholars Curriculum Pilot

Abstract authors:
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Introduction

Trainees who participate in a teaching scholars curriculum (TSC) may improve teaching skills (*Staitieh* 2016) and scholarly productivity, and may jumpstart their clinician educator careers (*Adamson* 2015, *Chen* 2017, *Miloslawsky* 2015). Integration of a TSC into a fellowship training program is feasible, but the few successful models rely on in-person education. Utilizing digital education technologies (*Prober* 2012) may improve instructor efficiency, self-directed learning, and knowledge retention (*Ruffini* 2012). We describe the development and implementation of a technology-driven TSC utilizing a blended learning model to prepare subspecialty fellows for clinician educator careers.

Abstract Presentation

IRB approval was obtained. This work was grant-supported by the Icahn School of Medicine Institute for Medical Education. We designed a 14-month foundational educator TSC including teaching skills, curriculum development, and career advancement. A multidisciplinary faculty was recruited and paired with a 'Tech Mentor' to transform traditional content into asynchronous (75%) and virtual (25%) modules. Asynchronous modules were developed using Storyline 3® (Articulate Global, LLC). Interactive features including knowledge check-ins, in-module reflections, and choose-your-own education pathways were incorporated. Virtual modules were conducted via video conference during afternoons or evenings. Learners followed a monthly timeline for pre-work, module assignments, virtual check-ins, and surveys. Course materials were maintained in the Blackboard® learning management system (LMS) (Blackboard, Inc.). Learners provided batched feedback in semi-structured interviews; subsequent modules were accordingly tailored. Course directors and module faculty were available for virtual mentorship.

Four pulmonary and critical care medicine fellows across three geographically distanced hospitals volunteered as pilot learners. Aggregated post-module survey data was strongly positive (Figure 1). Semi-structured interview data revealed that lower scores for "user-friendliness" were attributed to LMS challenges. Learner impressions from the semi-structured interviews were collated by Kirkpatrick levels (Table 1).

Discussion

Subspecialty fellows educate a wide range of learners across varied clinical topics and education venues. We describe the successful implementation of a novel, technology driven TSC for fellows. The blended learning model allowed for flexible engagement of busy, geographically distanced learners. Learner participation was robust and enhanced by the use of interactive in-module exercises, virtual check-ins, and self-paced completion of modules. The focus of this TSC pilot was on the development and delivery of a novel technology-driven course. The TSC was intentionally not paired with a primary medical education project. As such, the modules on curriculum development centered on theoretical application scenarios were perceived as less authentic by the learners. Learners rated all modules as highly valuable to their careers; however, truncating the course from 14 to 12 months would allow for more convenient delivery in the scope of the academic year. Modules imparting general educator skills may be delivered outside the TSC timeframe. Employing a more

outside the TSC timeframe. Employing a more user-friendly LMS would enhance learner enjoyment. Learners will graduate from the TSC with knowledge, skills, and practical experience to launch their careers. Module faculty were not surveyed on their experience. Informal communications demonstrated their appreciation for the Tech Mentor role. To date, seven TSC faculty have newly-developed, interactive teaching modules suitable for standalone or in-course education. Development of these asynchronous modules will significantly reduce the labor for future TSC rollouts.

Table 1: Learner impressions from semi-structured interviews collated by Kirkpatrick levels.

Kirkpatrick level	Representative learner impressions
Level 1 (participation, reaction)	- 3 out of 4 learners completed 10 modules and associated assignments - 1 learner withdrew after 8 modules (graduated fellowship)
Level 2a (satisfaction)	**General Course** - Feasible and enjoyable - Sufficient time allotted per module, at times stressful during core clinical rotation - Safe space for learning - Assignments relevant and manageable - Assignments requiring engagement of a third-party faculty were more challenging **Tech features** - Interactive features allowed for immediate knowledge application, highly engaging - Ability to return to asynchronous modules and reference links was highly valued - Learners enjoyed working on their own schedule, at their own pace - Adding virtual check-ins to asynchronous modules augmented learning - Strong dislike for clunky LMS interface, difficult to navigate, resorted to email communication with mentors - Virtual modules valued for real-time engagement with expert educators - In-person discussion may benefit certain modules, but logistics considered impractical
Level 2b (knowledge/skill) **Level 3** (behavioral change)	- Gained valuable insights into personal teaching style, areas for growth - Ample opportunities for self-reflection and real-world application - Month by month application and improvements to clinical teaching based on acquired skills - Strongest knowledge acquisition reported when linked to interactive exercises or assignments - Pairing with a medical education project would add valuable opportunity for knowledge application
Level 4a (organizational practice)	- Appreciated variety and quality of sustainable, technology-driven education modules available for future learners - Highly valued exposure to multidisciplinary expert educator faculty

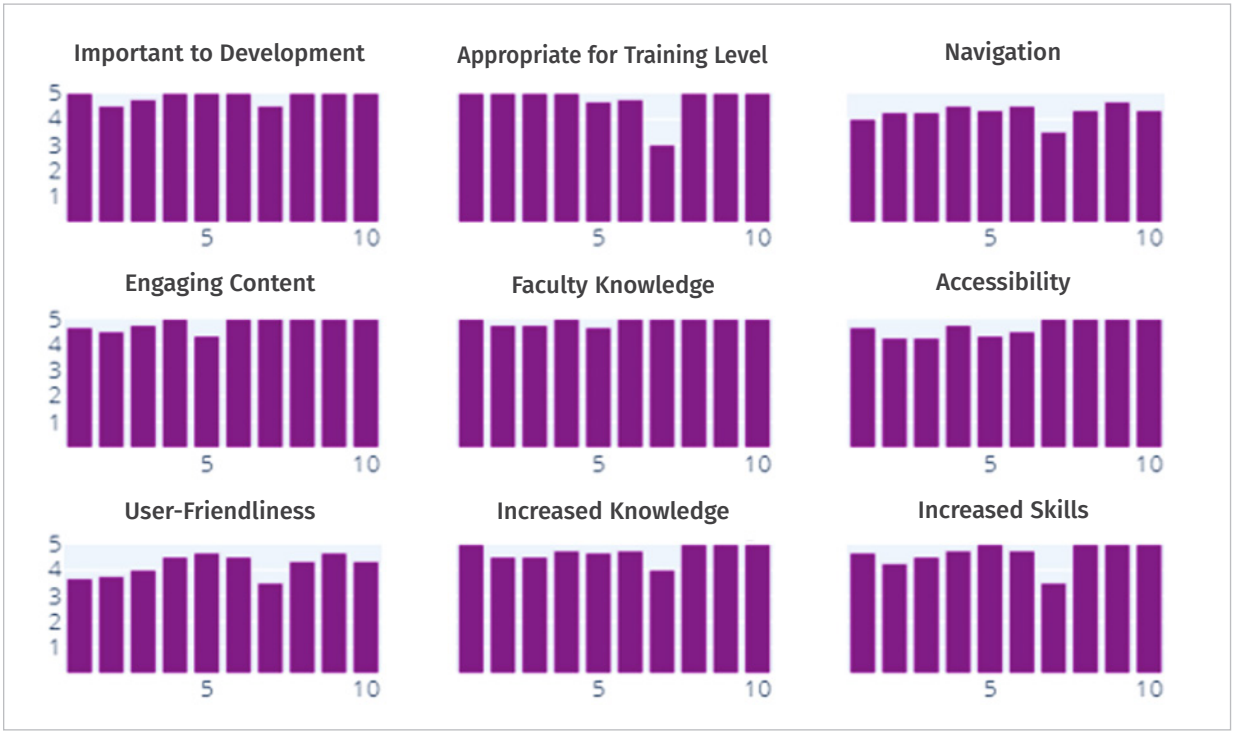

Figure 1: Like data with subplots for each question and a bar for each module: 1 (Self-Directed Learning), 2 (Communication Skills), 3 (Establishing a Positive Learning Climate), 4 (Bedside Teaching), 5 (Adult Learning Theory), 6(Effective Lecturing), 7 (Educational Technology), 8 (Effective Feedback), 9 (Needs Assessments), and 10 (Developing Goals and Objectives).

Mayo Clinic Rochester

Interview Innovations: Creating a Virtual Second Look Day for Applicants

Abstract authors:
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Introduction

The advent of the COVID-19 pandemic brought many unknowns to the field of medicine and the education of trainees. Similarly, the selection process for fellowship candidates was impacted when a working group representing three major medical societies recommended that "all programs commit to online interviews and virtual visits for all applicants, including local students, for the entire [2020-2021] cycle."[1] Additionally, the group recommended that programs "commit to creating a robust digital environment and set of tools to yield the best experiences for programs and applicants."[1] On May 15, 2020, the Association of Pulmonary and Critical Care Program Directors (APCCMPD) released a similar statement recommending an "all-in" approach to virtual interviews.[2]

At the beginning of the 2020 interview cycle, we designed a digital interview experience, the Virtual Second Look Day, to ensure applicants a non-evaluative, multifaceted view of our fellowship program. We report the results of our first and second years piloting this program.

Methods

For the 2020 and 2021 interview cycles, the interview day format included a pre-interview dinner with current fellows the night before and four faculty interviews, one of which was behavioral-based following an information session by the program director on the day of the interview. All interviewees in the combined pulmonary and critical care, pulmonary disease, and critical care medicine programs were offered an invitation to the virtual second look day consisting of various events (Figure 1). Attendance at the optional day had no bearing on applicant rank as the committee had finalized the program's rank list; committee members were not involved in the day's activities. Feedback was provided by an internal review committee consisting of the program leadership during the first year of implementation. Following the second year of implementation, attendees were surveyed to enhance feedback.

Results

During the first implementation year (2020), 28.4% of interviewees attended the Virtual Second Look Day. Feedback themes from our internal review consisted of technical difficulties, specifically in the audio and visual quality of digital rounding.

During the 2021 interview cycle, 37.0% of interviewees attended the Virtual Second Look Day and were surveyed the day after the event. Fourteen applicants responded (51.9% response rate). Most fellowship applicants (71.4%) were not offered optional non-evaluative, virtual open house days or second look opportunities from other programs. All of the aspects of the day were regarded by applicants as being beneficial with greater than 70% positive response, with the exception of the "Tour of the Town" (only 69.2% believed to be beneficial). Forty-three percent of survey respondents did not attend the faculty panel as the last event of the day. Overall, 64.3% of those surveyed said that the experience improved the program's position on the applicant's rank list (Figure 2)

Discussion

The second look experience is beneficial to the applicants by providing a unique view which allows the applicants to assess if they could

thrive in the current culture of the program. Comments provided by those surveyed included that "the ICU rounds were very helpful because it allowed [the applicants] to picture [themselves] actually on rounds at Mayo which made it feel more familiar. Especially in this virtual environment, a feeling of familiarity is very important." A tour of the facilities was suggested as an area of improvement.

Conclusion

The optional, virtual second look day has been a positive addition to our program's interview season. As virtual interviews continue to be recommended by national organizations, fellowship programs will need to continue to build and consider refining digital experiences to produce the best alternative to the in-person interview experience for the applicants.

Figure 1: Schedule/Flow of the Day

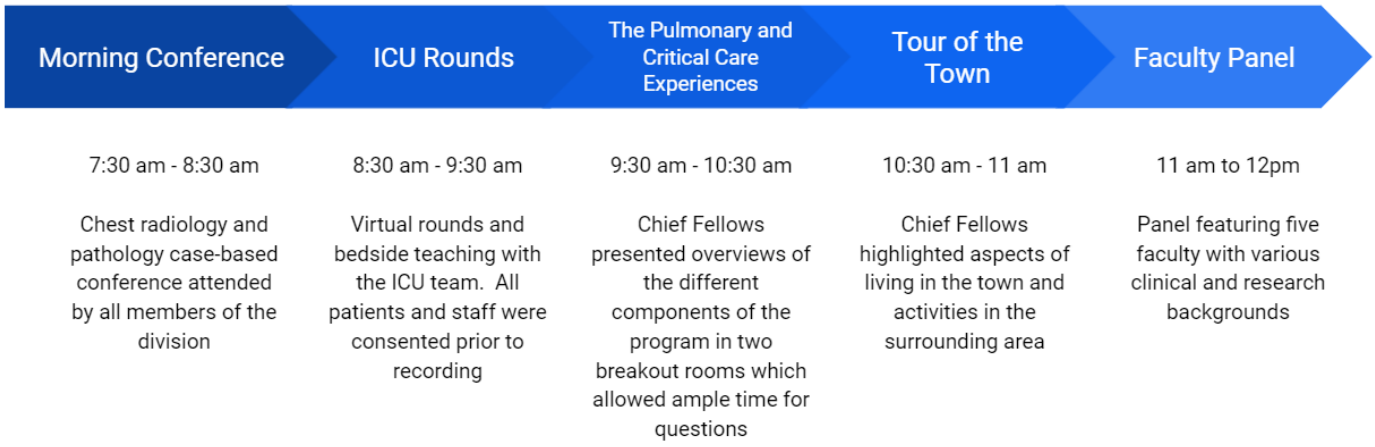
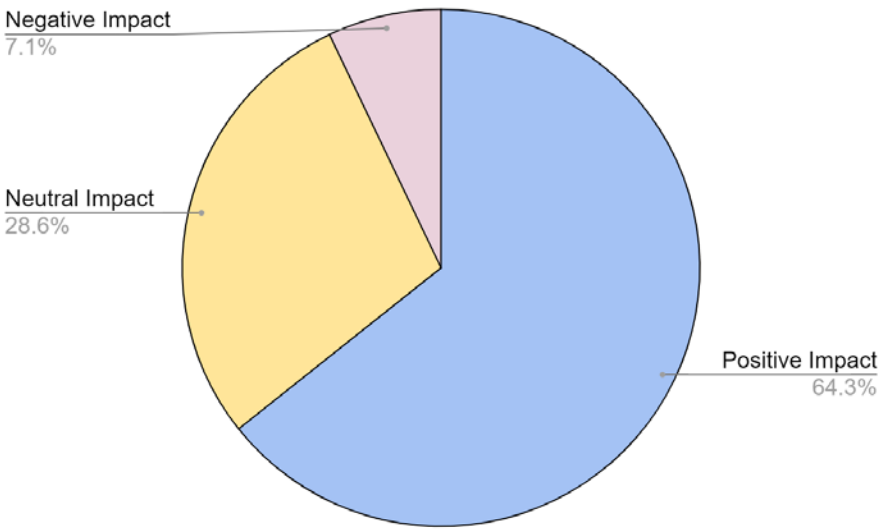


Figure 2: The impact of the Virtual Second Look Day on an applicant's rank list



The Ohio State University

Robotic Assisted Bronchoscopy Training Curriculum for Advanced Fellowship Trainees

Abstract authors:
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Introduction

Following recent FDA approval of two robotic bronchoscopy platforms, training programs struggle to train and certify pulmonary physicians in this novel procedure. In addition, many programs are coupling cone beam computed tomography (CBCT) with robotic bronchoscopy to improve the accuracy of the procedure. While trained in the interpretation of chest CT scans, pulmonary fellows lack training on acquisition of chest CT images. Since not all medical centers provide radiation technologists during bronchoscopy, advanced bronchoscopists also need to be familiar with CBCT use if incorporating it into the procedure. The purpose of this project is to validate a curriculum which may shorten the learning curve and enhance efficiency for robotic bronchoscopy/CBCT.

Methods

New Interventional Pulmonary Fellows will be pre- and post-tested on 15 critical steps of robotic bronchoscopy/CBCT. Four interventional pulmonologists credentialed in robotic bronchoscopy/CBCT also took the test. After a pre-test, fellows are required to complete an online robotic bronchoscopy training module (basic driving, advanced driving, airway driving, advanced airway driving, and touch screen controls), a basic fluoroscopy online module, and hands-on training sessions with a robotic bronchoscopy high fidelity simulator prior to assisting or using the robotic system. The following topics are covered: System Component Overview and Setup, “Shape-Sensing” Technology, Instrument Overview and Docking, Touchscreen and Controller Overview, Workflow demonstration, Emergency Procedures. Cone Beam CT competencies include patient positioning, image acquisition, workstation management, proper team communication, image interpretation and integration with robotic bronchoscopy, and troubleshooting. The trainee will first observe 10 procedure before performing 10 robotic assisted navigation procedures from start to finish with the attending physician’s presence. After completing this entire curriculum, fellows will be post-tested.

Results

The one interventional pulmonary (IP) fellow at OSU was pre-tested on the 15 critical steps and scored 2/15 (13%) correct. All four credentialed IP physicians scored 15/15 (100%) on the test. Following completion of the curriculum, the IP fellow scored 15/15 (100%).

Conclusions

1. After completing a curriculum containing online didactics, simulation training, case observation and participation in 10 cases with real patients, an IP fellow demonstrated competence as measured by a test of key procedural steps.
2. The validity of this test on these key steps should be validated with a larger cohort of physicians with different levels of skill (novice, intermediate, expert) at different centers.
3. Interventional Pulmonology fellowship program should consider a formal curriculum for trainees on robotic bronchoscopy. Robotic bronchoscopy will likely replace older navigational technologies and thus future generations of advanced bronchoscopists and interventional pulmonologists will see the need for adequate training.
4. Reduction in length of procedure is another important outcome that could be measured before and after this training program. ■

PHYSICIAN EVALUATION FOR ROBOTIC ASSISTED BRONCHOSCOPY (RAB)

Complete a form per each case

DATE OF PROCEDURE:
MRN:
CASE DESCRIPTION:
FELLOW:
ATTENDING PHYSICIAN:

Skill	Adequate	More Practice Recommended
Demonstrates understanding of room and system setup		
Docks robot properly		
Understands components, instruments and accessories of the ION system		
Demonstrates safe and efficient registration and navigation		
Demonstrates adequate knowledge of touchscreen		
Demonstrates ability to exchange instruments, accessories and vision probe safely		
Demonstrates the utilization of R-EBUS effectively		
Demonstrates ability to safely biopsy using all instruments. Recognizes tissue response to navigation and biopsy.		
Demonstrates ability to troubleshoot system and manage any unforeseen circumstances.		

Comments:

The fellow demonstrates competency on the robotic system: YES NO

_____ _____

Attending Name Attending Signature

Figure 1: This form will be completed by the attending physician at the end of each robotic bronchoscopy case. R-EBUS (radial endobronchial ultrasound). Instruments include needle, forceps, and brush.

PHYSICIAN EVALUATION FOR CONE BEAM COMPUTED TOMOGRAPHY (CBCT)

Complete a form per each case

DATE OF PROCEDURE:
MRN:
CASE DESCRIPTION:
FELLOW:
ATTENDING PHYSICIAN:

Skill	Adequate	More Practice Recommended
Demonstrates proficiency at patient positioning with image acquisition		
Demonstrate proficiency at managing system touch screen and work station		
Efficiently communicates with team members and coordinates image acquisition in a safe manner		
Demonstrate proficiency at using Emboguide, Segmentation, Guidance and Histogram		
Interpretation of images acquired and integration with RAB and use of different projections		
Demonstrates ability to troubleshoot system		

Comments:

The fellow demonstrates competency on using CBCT: YES NO

_____ _____

Attending Name Attending Signature

Figure 2: This form will be completed by the attending physician at the end of each case if cone beam computed tomography was used. For this curriculum, a Philips Lung Suite software was used. Emboguide, Segmentation, Guidance and Histogram are features specific to the Lung Suite software and are critical steps to localize a desired target lesion for augmented fluoroscopy use intra operatively.

The Ohio State University

Implementing a Novel anti-Racism Curriculum for Pulmonary and Critical Care Medicine Fellows

Abstract authors:
Avneet Singh, MD, Avraham Cooper, MD, Jennifer McCallister, MD

Background

The persistence of health disparities in access and provision of care has led to the recognition of racism as a public health crisis. Awareness of the moral imperative to address effects of structural racism on the health of underserved and socioeconomically disadvantaged communities has emerged. Medical educators must help their trainees become more aware of historical contexts for the status quo, understand the impacts of implicit bias and institutional racism and provide culturally competent care. It is equally important that curricula focus on issues with direct relevance to trainees' clinical practice and learning environment. To address this need, we created and implemented a novel anti-racism curriculum specifically designed for Pulmonary and Critical Care Medicine (PCCM) fellows.

Methods

We administered a needs assessment survey to PCCM fellows and faculty in our division that assessed basic knowledge of structural racism and their experiences with confronting racism in the professional setting. We then created an anti-racism curriculum to address responses to this assessment and incorporated it into the fellowship's core educational conference series for the 2021-2022 academic year (Table 1). The curriculum utilizes current medical, psychological, sociological, and anthropological literature to build a common foundation of the historical legacy of slavery, Jim Crow discrimination, and colorblind racism. Unique to the experience at our institution, we also included a multidisciplinary, panel-based Department of Internal Medicine Grand Rounds discussion on the care of incarcerated patients during the initial surge of the COVID-19 pandemic.

Results: Survey responses were obtained from 18 trainees (sent to 19 trainees, 94.7% response rate) and 32 faculty members (sent to 75 faculty members, 42.6% response rate). Respondents generally shared a belief that structural racism significantly contributes to persistent disparities in delivery of healthcare (94.4% of fellows and 87.5% of faculty either agreed or strongly agreed with this statement). There was a wide variation in personal experiences with racism in professional settings. Sixty-one percent of fellows and 50% of faculty surveyed had personally experienced racism in the professional setting. Seventy-eight percent of fellows and 62% of faculty agreed or strongly agreed that they feel comfortable addressing overt racism from patients and families. Only 31% of faculty and 34% of fellows felt comfortable addressing subtle racism in those same circumstances (Table 2).

Conclusions

The persistence of structural racism reinforces healthcare disparities and must be addressed. Educational interventions represent effective vehicles for both conveying information about structural racism to trainees and for engaging stakeholders in open and honest conversations, all with the goal of equalizing healthcare for our patients. In response to a needs assessment distributed to our division, we implemented a new antiracism curriculum for PCCM trainees. A follow up survey will be distributed to PCCM fellows and faculty, assessing for any changes in knowledge of structural racism and healthcare disparities, after the full implementation of the curriculum at the conclusion of the 2021-2022 academic year. The follow up survey will also assess changes in comfort responding to overt or subtle racism in professional settings. ■

Table 1: Curriculum plan and descriptions of lectures.

Lecture Title	Brief Description
Deconstruction	Provides a foundation of historical context and shared terminology regarding structural racism and healthcare inequities.
Obstructive Lung Disease	Introduces environmental justice and the effects of structural racism on the incidence and severity of obstructive lung disease.
Spirometry	Examines the history of race correction in pulmonary diagnostic testing and ramifications for communities of color.
Person-first Healthcare	Discusses caring for members of the LGBTQIA+ community and other PCCM- specific topics.
Ethical Considerations for Incarcerated Patients	A multidisciplinary, panel-based discussion about the care of critically ill incarcerated patients during the COVID-19 pandemic. Discussants included representatives from PCCM, Palliative Medicine, Bioethics, Legal, and Healthcare Administration.

Abreviations: PCCM = Pulmonary and Critical Care Medicine, ICU = Intensive Care Unit, LGBTQIA+= Lesbian, Gay, Bisexual, Transgender, Queer, Intersex, Asexual[+]

Table 2: Responses to needs assessment survey from Pulmonary and Critical Care Medicine fellows (n=18) and faculty (n=32)

Question		1	2	3	4	5
Race is genetic.	Fellows Faculty	6% 6%	33% 10%	39% 34%	11% 50%	11% 0%
Race is a significant contributor to disparities in healthcare access and equity.	Fellows Faculty	6% 0%	0% 0%	0% 12.5%	22% 25%	72% 62.5%
I have encountered racism in the professional setting.	Fellows Faculty	6% 3%	22% 25%	11% 22%	28% 31%	33% 19%
Racial bias contributes to healthcare inequities specific to Pulmonary and Critical Care Medicine.	Fellows Faculty	6% 0%	0% 9%	6% 25%	50% 38	38% 28%
I feel comfortable addressing racism in the workplace in the following situations: overt racism from patients and families	Fellows Faculty	0% 6%	17% 13%	5% 19%	50% 53%	28% 9%
I feel comfortable addressing racism in the workplace in the following situations: overt racism from colleagues.	Fellows Faculty	17% 9.5%	11% 9.5	0% 28%	50% 50%	22% 3%
I feel comfortable addressing racism in the workplace in the following situations: subtle racism from patients and families.	Fellows Faculty	0% 9%	44% 16%	22% 44%	28% 28%	6% 3%
I feel comfortable addressing racism in the workplace in the following situations: subtle racism from colleagues.	Fellows Faculty	11% 9%	22% 16%	28% 41%	33% 31%	6% 3%

1 = strongly disagree, 5 = strongly agree.

University of Colorado

Use of a Novel "ABCDE Approach" and High-Fidelity Simulator to Teach Cognitive and Procedural Skills for Management of Massive Hemoptysis

Abstract authors:
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Rationale

Massive hemoptysis requires providers to intervene quickly, but given its rare occurrence, fellows may not obtain enough clinical experience to feel equipped to manage this life-threatening presentation. Managing massive hemoptysis requires both a cognitive framework for choosing appropriate interventions, as well as facility with procedural skills to intervene. Cognitive tools can help providers in emergency clinical scenarios to retrieve information and decide steps to take, but no such tool exists for management of massive hemoptysis. For teaching high-risk, low-volume clinical scenarios, simulation-based training is optimal, but no simulator to teach management of massive hemoptysis exists commercially to allow for practice of cognitive and procedural skills. We sought to develop a cognitive tool and high-fidelity simulator to train fellows how to intervene in cases of massive hemoptysis.

Methods

To develop a cognitive tool to assist in the approach to management of massive hemoptysis, we reviewed all recently published expert opinions on this topic. Using these we developed a prioritized, cognitively accessible "ABCDE Approach for Massive Hemoptysis" tool (Table 1). To develop a simulator, we used computed tomography images to develop an anatomically correct 3D-printed airway model that was made of material that was sturdy but somewhat compliant to distending forces. This airway model was inserted into a decommissioned Laerdal SimMan 3G manikin, connecting the airway model to the manikin at the level of the cricoid cartilage; the model was able to "bleed" from one of 3 sources during case-based simulation (Figure 1). During simulations, fellows were provided a case and asked to intervene as they felt appropriate. This model allowed for intubation, bronchoscopy, and placement of an endobronchial blocker, among other interventions. The cognitive material and simulation experience were delivered to Pulmonary/Critical Care fellows in educational workshops. Fellows completed pre- and post-session self-assessments and were surveyed regarding the cognitive tool and simulator following the session; all assessments used a 4- or 5-point Likert scale.

Results

Nineteen fellows from the University of Colorado Pulmonary Critical Care Fellowship program participated in the workshop, which included learning the "ABCDE Approach for Massive Hemoptysis" and subsequently practicing management on the massive hemoptysis simulator. Prior to the session, fewer than half (47%) of the fellows agreed that they could manage massive hemoptysis, with only 21% reporting confidence in their skill; only 5% knew how to place an endobronchial blocker. Following the session there was a statistically significant increase in the percentage of fellows reporting they could perform relevant skills, with 100% of fellows reporting knowledge and confidence in cognitive and procedural skills to manage massive hemoptysis. Survey questions assessing the utility of the cognitive "ABCDE Approach" and of the hemoptysis simulator were overwhelmingly positive, with 94-100% of respondents agreeing that these were beneficial and should be used for teaching in the future. Comments from participants regarding the materials and training session were positive.

Conclusions

We successfully created and implemented a workshop to teach the cognitive and procedural skills needed for management of massive hemoptysis. The "ABCDE Approach for Massive Hemoptysis" is a useful and relevant tool to teach the cognitive component of management of massive hemoptysis. We developed a novel high-fidelity massive hemoptysis simulator which was successful in teaching fellows important procedural skills for intervening in massive hemoptysis. Teaching the "ABCDE Approach" and providing training with a hands-on simulator provided a comprehensive educational experience for fellows that can be replicated by other training programs. ■

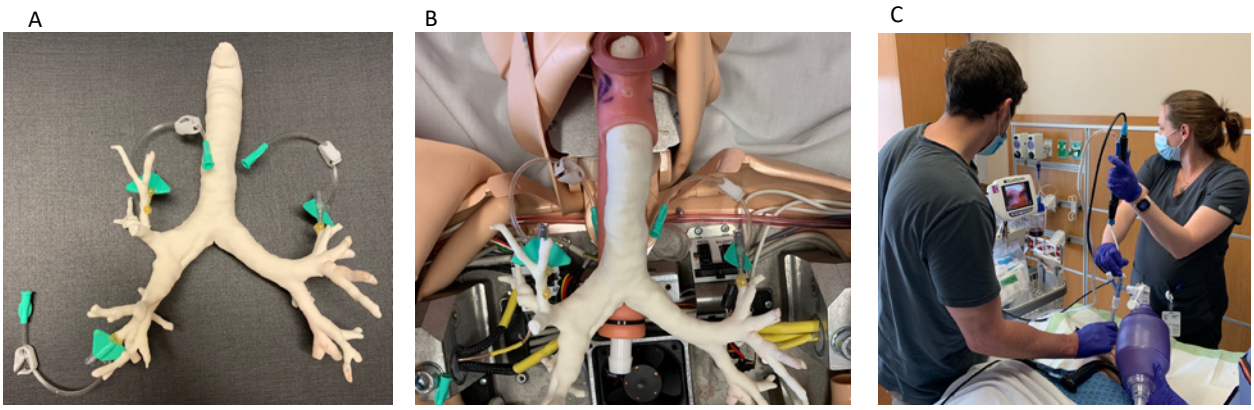


Figure 1: High-Fidelity Hemoptysis Simulator. A. 3-D printed lower airway model with three sites where fake blood could be inserted into the model via intravenous (IV) tubing. B. The lower airway model connected to the SimMan 3G upper airway. C. Fellows practice the management of massive hemoptysis using the simulator, including intubation, bronchoscopy and placement of endobronchial blocker.

Table 1: ABCDE Approach for Massive Hemoptysis

Toolbox Category	Components	Considerations
Assess the AIRWAY	ASPIRATE	Clear the airway
	AIRWAY	Big 0: Large-bore endotracheal intubation 1: Mainstem bronchus intubation 2: Double lumen intubation*
	ANESTHESIA	
BLOCK the Blood	BAD side down	Lateral decubitus positioning
	BRONCH	Lateralize the bleed Clear the airway Direct tube
	Endobronchial BLOCKER	
Cause a CLOT	COMPRESSION	Direct tamponade Wedge
	COLD	Ice-cold saline irrigation
	vasoCONSTRICTION	Epinephrine Vasopressin
	COAGULANTS	Thrombin +/- Fibrin Tranexamic Acid Oxidized Regenerated Cellulose
	CAUTERY	Electrocautery Argon Plasma Coagulation Laser
DEFINITIVE Therapy	IR Consult	Bronchial Artery Embolization
	Surgical Consult	Resection
	Rigid Bronchoscopy	ENT, IP, Surgery
EVERYTHING ELSE	Volume resuscitation	
	Labs	ABG BUN CBC Coags Type & Cross
	Medications	Anticoagulants Antiplatelets
	Correct Coagulopathies	

The components of the “ABCDE Approach”. The first column contains the categories in the toolbox, the second column shows components to consider for each category, and the third column lists relevant data, diagnostic or therapeutic considerations for components. *Double lumen intubation is not recommended for most cases of massive hemoptysis. ABG: arterial blood gas; BUN: blood urea nitrogen; CBC: complete blood count; Coags: coagulation testing including prothrombin time, partial thromboplastin time, and international normalized ratio; ENT: Ear, Nose and Throat surgery; IP: Interventional Pulmonology; IR: Interventional Radiology.

University of Colorado

Breaking it Down: Teaching Endobronchial Ultrasound Transbronchial Needle Aspiration Using Skills-Focused Training

Abstract authors:
Melissa New, MD, Anna Neumeier, MD, Matthew Rustici, MD, Tristan Huie, MD

Background

Endobronchial Ultrasound Transbronchial Needle Aspiration (EBUS-TBNA) is a diagnostic procedure often performed during the evaluation of hilar or mediastinal lymphadenopathy, and for diagnosis and staging of lung cancer. Proper performance of EBUS-TBNA requires various cognitive and procedural skills, including image interpretation; mediastinal vascular anatomy; lymph node location, station, and lung cancer staging approach; bronchoscope manipulation; and TBNA deployment. Simulation is recommended for learners of EBUS-TBNA to improve operator skill and patient procedural outcomes, however commercially available EBUS simulators have limitations, including high cost. To address our pulmonary fellows' identified need of improved EBUS training, we sought to develop and implement a low-cost effective curriculum to teach the components of EBUS-TBNA.

Methods

To teach the various cognitive and procedural skills necessary to perform EBUS-TBNA, we broke down the necessary skills into components and developed curricula and task trainers to teach each component (Figure 1). Lymph node location, station and the approach to lung cancer staging was taught using a schematic mat of the airways and relevant vasculature and an interactive case-based activity where fellows rotated through standing at various lymph node stations and acting as a bronchoscopist approaching a lung cancer staging procedure. Computed tomography (CT) and EBUS image interpretation was taught using CT and ultrasound images, requiring fellows to identify imaging abnormalities, name the correct lymph node station and point out relevant vascular ultrasound landmarks. EBUS scope manipulation and TBNA practice were performed on gelatin/fruit and ballistics gel models that simulated an airway and lymph nodes. EBUS scope manipulation and practice were additionally performed on the Simbionix BRONCH Mentor simulator, where fellows practiced a lymph node survey. This workshop has been provided yearly to our fellows for two years. Pre- and post-session self-assessments were performed using a 4-point Likert scale. Pre- and post-session TBNA training was assessed during the first year of the workshop, using the relevant portion of the validated EBUS Skills and Tasks Assessment Tool (EBUS-STAT). Fellows were assessed using the EBUS-STAT prior to and following the workshop during the 2020/2021 academic year.

Results

Twenty Pulmonary/Critical Care fellows participated in the EBUS-STAT workshop in 2020 and 17 participated in 2021. For each year, there was a statistically significant increase in the fellows' self-assessed knowledge and confidence after the session compared with before the session, with 0-41% of fellows pre-session and 70-100% post-session reporting knowledge/confidence in self-assessed skills. Performance of TBNA was assessed out of 15 points; the pre-session mean score was 5 and post-session this was 15 ($p<0.001$). During patient procedures, five fellows were assessed using the procedural components of the EBUS-STAT prior to the workshop, and 11 were assessed during live or simulated procedures an average of 6 months after the workshop. There was a statistically significant increase in scores for vascular anatomy, lymph node station identification, EBUS processor operation and TBNA performance an average of 6 months after the workshop (Figure 2). Most (78%)

fellows who participated in the workshop in 2020 had applied their learning over the course of the year, but all fellows felt they should repeat the workshop in 2021.

Conclusions

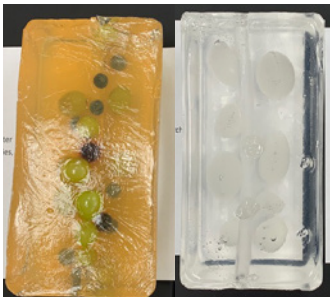
We successfully developed materials and implemented an EBUS-TBNA workshop that broke down cognitive and procedural skills necessary to perform this procedure and demonstrated durability of the skills taught. Each skill was taught using focused training, a hands-on interactive approach, and most utilized low-cost materials. Using this approach can significantly overcome barriers in teaching EBUS-TBNA, including cost of simulators or additional training courses. ■

A

Skill	Materials	Station
TBNA deployment	TBNA task trainers – gelatin/fruit and ballistics gel	TBNA Station: TBNA practice with EBUS scope and task trainer
Lung cancer staging approach and Lymph node station locations	Airway and Vascular Anatomy Schematic Mat	Interactive Lung Cancer Staging: Cases with participants as lymph nodes and bronchoscopist approaching a lung cancer staging EBUS
Lymph node location on imaging	CT images and EBUS images	CT and EBUS image identification station: CT images in axial, coronal, sagittal orientations centered on a single location,
EBUS scope manipulation	EBUS scope; Simbionix BRONCH Mentor Simulator	TBNA practice with EBUS scope station; Simulator station
Approach to finding lymph node stations	Simbionix BRONCH Mentor Simulator	EBUS practice and approach to lymph node survey

B

C



D

Figure 1: EBUS-TBNA Workshop Elements and Materials. A. Skills delivered during the EBUS-TBNA workshop, along with the materials utilized and station at which the skill was learned. B. Airway and vascular anatomy schematic mat being utilized during the Interactive Lung Cancer Staging station. C. Models used for TBNA practice. Model on the left is made out of gelatin with grapes and blueberries serving as lymph nodes. Model on the right is made out of ballistics gel with corn starch used to provide echogenicity to the lymph nodes. D. Fellow participating in TBNA practice station with TBNA needle deployed into a blueberry "lymph node".

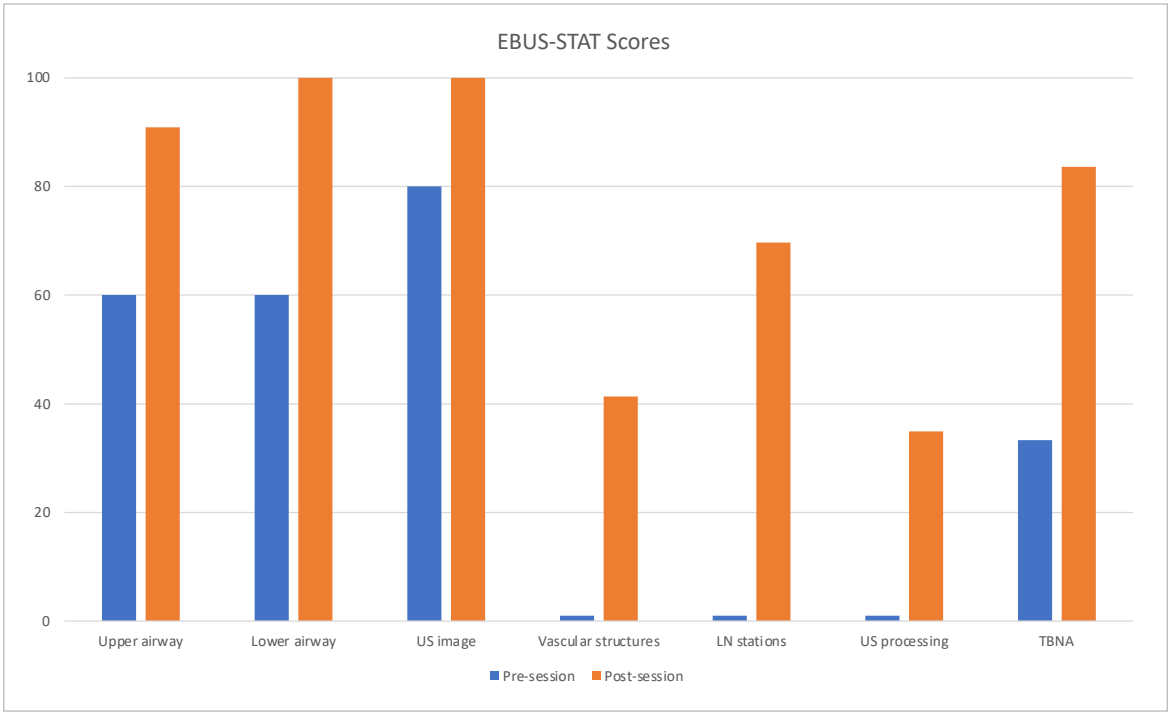


Figure 2: Endobronchial Ultrasound Skills and Tasks Assessment Tool (EBUS-STAT) has 10 domains it assesses. The 7 procedural domains were assessed for 5 fellows prior to the EBUS-TBNA workshop and 11 fellows an average of 6 months after the workshop. There was a statistically significant improvement in Vascular Structures, LN stations, US processing and TBNA on the post-session evaluation ($p<0.05$)

University of Kansas Medical Center

Safe Procedures are a Team Sport: Simulation for Multidisciplinary Performance and Education Improvement in Endotracheal Intubation

Abstract authors:
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Introduction

Nearly half of all patients undergoing endotracheal intubation experience at least 1 major adverse peri-intubation event .[1] Thus, there is a need to both improve the safety of the procedure and to prepare critical care fellows for this essential skill. In our institution, like many, intubation was historically regarded as a procedure for which the success primarily rested on the skills of the physician. Aviation and other industries have seen improved safety by reconceiving of work, such as completing a flight, as a team activity dependent on coordination of the crew. In these settings, simulation has been instrumental in providing opportunities for the team to rehearse together.[2] Our aim was to build on this previous work by first using simulation to engage fellows in the derivation of a multidisciplinary approach to intubation, and then to design a simulation-based curriculum to provide opportunities for the fellows, nurses, and respiratory therapists to practice as a team. This curriculum focuses on deliberate practice and feedback, which leads to the ultimate paradigm shift that intubation not only needs, but more robustly succeeds, via a team-based approach.

Methods

The first step was to reframe intubation as a team activity through a series of facilitated discussions with attendings, fellows, nurses, and respiratory therapists. The multidisciplinary team completed a needs analysis which revealed inconsistent preparatory steps, suboptimal advanced airway equipment, lack of defined roles and intubation workflow, inconsistent communication practices, and variable thresholds to call for assistance (Figure 1).

Each of these identified gaps were addressed through a process of simulation-based problem analysis, draft solution generation, testing, and iteration. Fellows were key stakeholders in this simulation-based design which yielded definition of team roles and responsibilities, procurement of advanced airway supplies and customization of a supply tray, standardization of preparatory and procedural steps, and design of a timeout that structured team conversation about the plan and contingencies. These key elements of the multidisciplinary approach culminated in the ICU Team Airway Checklist (Figure 2).

Categorically, the skills that required cultivation were separated into “Task Training” and “Team Training”. Fellows participated in the “Airway Task Training Course” which provided hands on practice with the checklist as well as specific airway skills including direct and video laryngoscopy, effective bag-valve-mask technique, and utilization of the laryngeal mask airway. Subsequently, first- and second-year fellows joined the full ICU team for a basic and then advanced “Airway Team Training Course” to care for patients requiring urgent intubation, with each case followed by structured debriefing to discuss shared decision making, communication, and team troubleshooting. Surveys were completed to assess the impact of the training on the quality and safety of intubations.

Results

Since simulation-based design launched in 2014, 28 fellows have participated in the three-part simulation-based curriculum alongside 72 ICU nurses and 24 respiratory therapists. The multidisciplinary approach represented by the ICU Team Airway Checklist was rolled out in 2016. Based on the survey data collected,

92% of 41 participants in the simulation-based training "definitely agreed" that the experience would impact the quality of care in endotracheal intubation. 95% of participants were "extremely" or "very" confident in their ability to translate to clinical practice. This initiative provided a platform for similar work with other procedures (implementation of thoracentesis, paracentesis, and central line insertion checklists) as well as development of a difficult airway simulation, which is set to include emergent cricothyrotomy, placement of a bronchial blocker for airway bleeding, and multi-disciplinary troubleshooting with Anesthesia and Otolaryngology teams.

Conclusion

The use of simulation to engage fellows in the design and implementation of a multidisciplinary performance improvement program related to ICU intubations has proven effective and durable. This approach enables simulation-based training for fellows and the ICU team that supports transfer of individual and team skills from the safe learning environment of simulation to the clinical environment.

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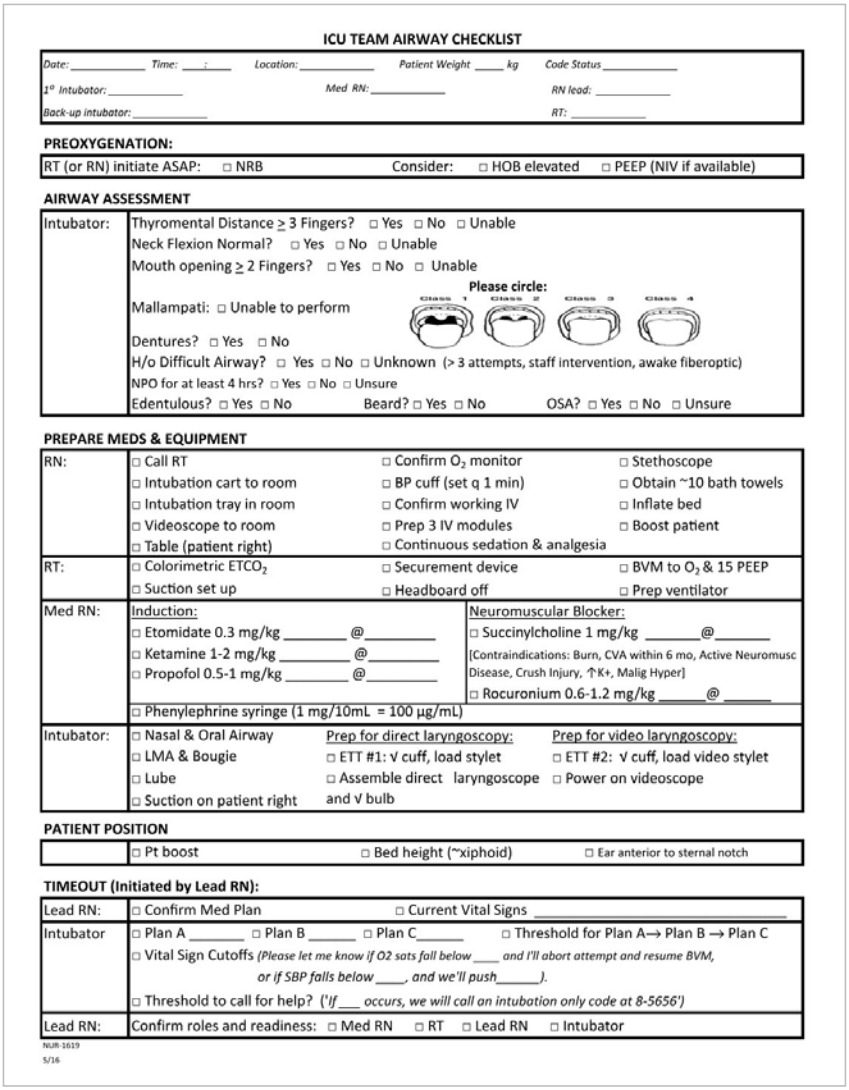
Figure 1



ICU TEAM AIRWAY CHECKLIST

Date: _____ Time: ___:___ Location: _____ Patient Weight ____ kg Code Status _____

1° Intubator: _____ Med RN: _____ RN lead: _____

Back-up intubator: _____ RT: _____

PREOXYGENATION:

RT (or RN) initiate ASAP: □ NRB Consider: □ HOB elevated □ PEEP (NIV if available)

AIRWAY ASSESSMENT

Intubator:
- Thyromental Distance ≥ 3 Fingers? □ Yes □ No □ Unable
- Neck Flexion Normal? □ Yes □ No □ Unable
- Mouth opening ≥ 2 Fingers? □ Yes □ No □ Unable
- Mallampati: □ Unable to perform — Please circle: Class 1 Class 2 Class 3 Class 4
- Dentures? □ Yes □ No
- H/o Difficult Airway? □ Yes □ No □ Unknown (> 3 attempts, staff intervention, awake fiberoptic)
- NPO for at least 4 hrs? □ Yes □ No □ Unsure
- Edentulous? □ Yes □ No Beard? □ Yes □ No OSA? □ Yes □ No □ Unsure

PREPARE MEDS & EQUIPMENT

RN:
- □ Call RT
- □ Intubation cart to room
- □ Intubation tray in room
- □ Videoscope to room
- □ Table (patient right)
- □ Confirm O_2 monitor
- □ BP cuff (set q 1 min)
- □ Confirm working IV
- □ Prep 3 IV modules
- □ Continuous sedation & analgesia
- □ Stethoscope
- □ Obtain ~10 bath towels
- □ Inflate bed
- □ Boost patient

RT:
- □ Colorimetric $ETCO_2$
- □ Suction set up
- □ Securement device
- □ Headboard off
- □ BVM to O_2 & 15 PEEP
- □ Prep ventilator

Med RN:

Induction:
- □ Etomidate 0.3 mg/kg _____ @_____
- □ Ketamine 1-2 mg/kg _____ @_____
- □ Propofol 0.5-1 mg/kg _____ @_____

Neuromuscular Blocker:
- □ Succinylcholine 1 mg/kg _____@_____ [Contraindications: Burn, CVA within 6 mo, Active Neuromusc Disease, Crush Injury, ↑K+, Malig Hyper]
- □ Rocuronium 0.6-1.2 mg/kg _____@ _____

□ Phenylephrine syringe (1 mg/10mL = 100 µg/mL)

Intubator:

□ Nasal & Oral Airway	Prep for direct laryngoscopy:	Prep for video laryngoscopy:
□ LMA & Bougie	□ ETT #1: √ cuff, load stylet	□ ETT #2: √ cuff, load video stylet
□ Lube	□ Assemble direct laryngoscope and √ bulb	□ Power on videoscope
□ Suction on patient right		

PATIENT POSITION

□ Pt boost □ Bed height (~xiphoid) □ Ear anterior to sternal notch

TIMEOUT (Initiated by Lead RN):

Lead RN: □ Confirm Med Plan □ Current Vital Signs _____

Intubator:
- □ Plan A _____ □ Plan B _____ □ Plan C_____ □ Threshold for Plan A→ Plan B → Plan C
- □ Vital Sign Cutoffs *(Please let me know if O2 sats fall below ____ and I'll abort attempt and resume BVM, or if SBP falls below ____, and we'll push_____).*
- □ Threshold to call for help? *('If ___ occurs, we will call an intubation only code at 8-5656')*

Lead RN: Confirm roles and readiness: □ Med RN □ RT □ Lead RN □ Intubator

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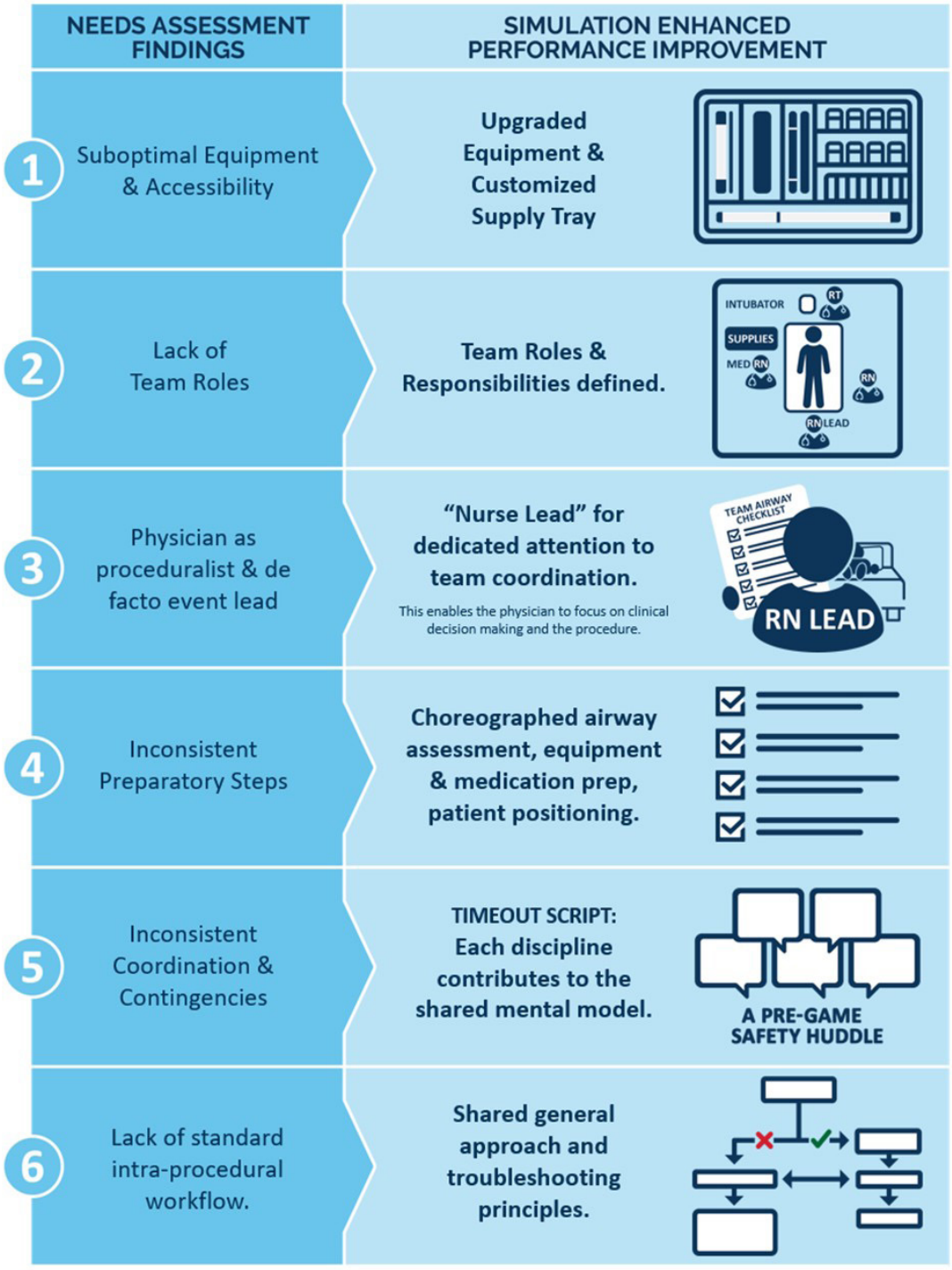
Figure 2


NEEDS ASSESSMENT FINDINGS
SIMULATION ENHANCED PERFORMANCE IMPROVEMENT
1
Suboptimal Equipment & Accessibility
Upgraded Equipment & Customized Supply Tray
2
Lack of Team Roles
Team Roles & Responsibilities defined.
INTUBATOR
RT
SUPPLIES
MED
RN
RN
RN LEAD
3
Physician as proceduralist & de facto event lead
"Nurse Lead" for dedicated attention to team coordination.
This enables the physician to focus on clinical decision making and the procedure.
TEAM AIRWAY CHECKLIST
RN LEAD
4
Inconsistent Preparatory Steps
Choreographed airway assessment, equipment & medication prep, patient positioning.
5
Inconsistent Coordination & Contingencies
TIMEOUT SCRIPT: Each discipline contributes to the shared mental model.
A PRE-GAME SAFETY HUDDLE
6
Lack of standard intra-procedural workflow.
Shared general approach and troubleshooting principles.

University of Maryland Medical Center

The Pulmonary Nodule Curriculum: A Multimodal Learning Strategy for Post-graduate Pulmonary Fellows

Abstract authors:
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Introduction/Rationale

Historically, medical education has focused efforts on teaching content in a lecture format where an expert or authority in the field is passing along information to trainees or students in a passive manner. This method has been shown to be least favored by students or trainees. As technology started to integrate more effectively into medical education, more novel methods of trainee development have been implemented in graduate and post-graduate medical education. Multimodality learning strategies, specifically, VARK, which stands for visual, auditory, reading/writing, and kinesthetic, has been integrated successfully as a learning tool in school and undergraduate education. In this abstract we hope to introduce our multimodal learning curriculum dedicated to teaching post-graduate pulmonary fellows about pulmonary nodules.

Materials and Methods

In this prospective observational study, we looked at a cohort of pulmonary fellows that participated in our pulmonary nodule curriculum aimed at enhancing their education on this challenging topic. The curriculum has a variety of learning activities which includes an introductory didactic session with a pulmonary nodule expert that utilizes a flipped classroom method of teaching where fellows are given the material in advance to self-study and then gathered in class for higher order problem solving and thinking. Moreover, fellows were exposed to short videos on a variety of topics related to pulmonary nodules, lung cancer screening, and pulmonary nodule management to utilize the visual and auditory style of learning. Each fellow is also on a scheduled rotation where they are responsible for seeing patients in a pulmonary nodule clinic on a weekly basis which allows them to apply what they learnt into real life practice. To monitor the effectiveness of this curriculum, our fellows were requested to fill out a survey that gathers information on their demographic data and tests their baseline knowledge prior to and after the implementation of our curriculum.

Results

Twenty fellows have participated in the curriculum. Of those, around 15 fellows (75%) have filled out the pre- and post-curriculum surveys to assess demographic data, test knowledge, and gauge educational value of the pulmonary nodule curriculum. Of those who participated, 58.6% were men. Most of the fellows were between the ages of 31 and 35 (82.8%) and were Caucasian (51.7%). The fellows were from varied levels of training and subspecialty tracks including pulmonary-critical care, pulmonology, and interventional pulmonology. As far as knowledge assessment, all the fellows improved their performance on the knowledge portion of the survey after having participated in the pulmonary nodule curriculum as shown in Table 1. Also, 85.7% of the fellows have agreed that a multimodal approach to teaching pulmonary nodules is helpful.

Conclusions

A multimodal approach to pulmonary fellow education including flipped classroom didactics, educational videos, and immersive clinical experiences maybe a successful strategy at teaching basic concepts of pulmonary nodule evaluation and management. Different fellows may have different methods of learning and thus instituting various strategies of education such as VARK can be an important tool in curriculum development. Future studies and curricula should focus efforts on including other novel strategies and technologies including the development of infographics, twitter polls & threads, simulation experiences as well as mobile applications. ■

Figure 1: Storyboard for one of the pulmonary nodule curriculum videos

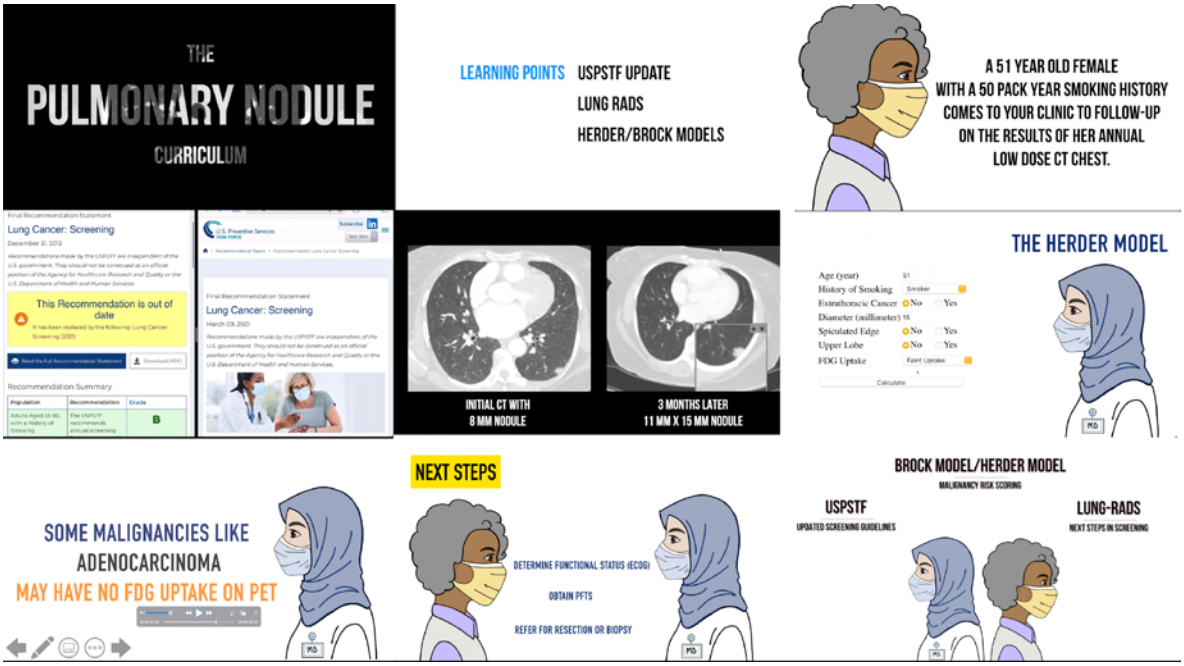

Table 1: Pre- and post- knowledge test for fellows participating in the pulmonary nodule curriculum

Question	Pre-test	Post-test
Q1 - Definition of Solitary Pulmonary Nodule (SPN)	100.00%	100.00%
Q2 - Risk Factors for Malignant Pulmonary Nodules	69.00%	75.70%
Q3 - Management of Incidental Pulmonary Nodule	25.00%	42.80%
Q4 - Cancer Risk Calculators (Brock Model)	69.40%	85.70%
Q5 - Imaging and Histology	68.75%	100.00%
Q6 - Molecular Testing and Lung Cancer	75.00%	78.60%
Q7 - Interventional Management of Pulmonary Nodules	56.00%	57.10%
Q8 - Staging of Lung Cancer	25.00%	57.10%

University of Michigan

Assessment of a Procedural Curriculum Using 3D Printed Airways to Teach Pediatric Flexible Bronchoscopy

Abstract authors:
Thomas Saba, MD, Natalia Painter, MD

Background

Pediatric flexible bronchoscopy is a relatively high-risk procedure usually performed under general anesthesia. The indications are to assess for congenital airway malformations and collect bronchoalveolar lavage fluid for diagnostic purposes. Given the high risk of this procedure, simulation models are required to gain competency. No studies to date have adequately explored the use of 3D printed airways in pediatric flexible bronchoscopy training. The use of 3D printing has provided an opportunity to design realistic and durable surgical models for medical education. Compared to traditional virtual reality (VR) simulators, 3D printed airways have been shown to be more affordable, more realistic, and provide better haptic feedback 1-4. Our aim is to create a sustainable and transferable pediatric flexible bronchoscopy training curriculum using 3D printed pediatric airways to teach pediatric pulmonology, pediatric critical care and pediatric surgery fellows pediatric flexible bronchoscopy skills under simulation. Our hypothesis is that this will be a well-liked curriculum and that 3D printed airways are a satisfactory teaching model. The primary outcome is the overall feasibility and satisfaction of learners. Secondary outcomes include: a) competency of learners at the end of the course and b) comparison of the learner assessment of the traditional VR model and the novel 3D printed airway.

Methods

This curriculum employs three different teaching tools: a didactic instructional video, VR modules on the CAE Endoscopic Simulator (CAE, Sarasota, FL), and a custom 3D printed airways. The 3D printed airway model was produced from a CT scan of a de-identified patient and built by computer aided design.

An airway reconstruction from the larynx to the 4th generation airways was isolated, printed in polylactic acid, and silicone dyed using methods previously described 4, 5. The model was encased in an external box designed to produce airway compression at different locations at the instructor's discretion in order to simulate congenital tracheobronchomalacia (Figure 1). Participants used the two simulation models under expert supervision and guidance. Participants learned technical skills, normal anatomy, how to identify tracheobronchomalacia and how to perform a bronchoalveolar lavage. After course completion, each participant assessed the two simulation models using a modified version of a validated tool using a 5-point Likert scale across 5 domains: physical attributes, realism of experience, ability to perform tasks, value, relevance, and global assessment. Faculty experts used the same assessment tool in the model validation process.

The expert instructors also observed each learner perform a bronchoscopy on a 3D printed model and assessed the learner's competency using a modified version of the validated Bronchoscopy Skills and Tasks Assessment Tool 6.

Results: Four faculty experts participated in validation and four learners participated in the curriculum. Faculty assessments were very favorable but small improvements were suggested. All participants agreed or strongly agreed that it was valuable use of their time. All learners successfully identified right and left sided bronchial anatomy on the 3D printed pediatric airway model under expert observation. Learners provided very favorable assessments of both the VR simulator and 3D printed airway models, although a more comprehensive comparison will be pursued once more learners complete the course (Figure 2).

Conclusion

This course, employing didactic training, a traditional VR simulator and a novel 3D printed pediatric airway was well liked by participants. Participants provided similar assessments of the two simulation models. We present early promising data on a new simulation model with significant potential for growth and development. If this basic model is proven to be an effective training tool with a larger study, this approach can be further developed to simulate various airway pathologies and offer a new and inexpensive model for training programs without virtual reality systems. ■

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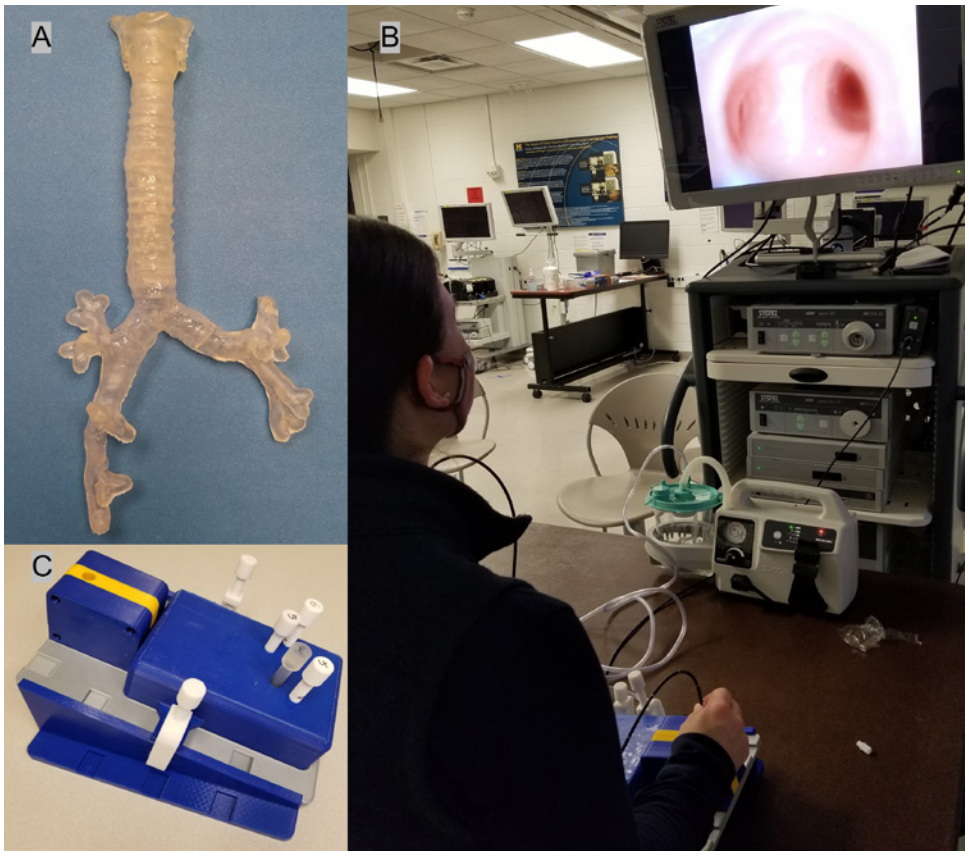

Figure 1: (A) 3D printed pediatric airway model, (B) Representation of fellow using model to learn airway anatomy, (C) Casing housing airway model with external pegs to simulate airway compression.

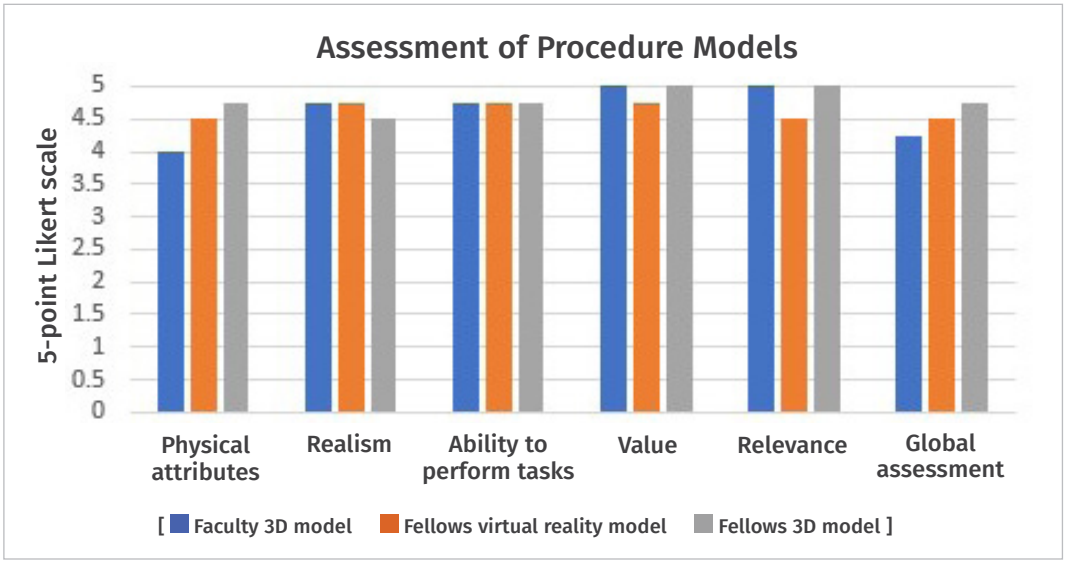

Figure 2: Faculty and fellow assessment of simulation models.

University of North Carolina at Chapel Hill

A Novel Hybrid Online/In-person Thoracic Radiology Curriculum for Pulmonary Diseases and Critical Care Fellows

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Background

Accurate, independent interpretation of thoracic imaging is an essential skill for pulmonary and critical care medicine (PCCM) physicians, as they often have to make clinical decisions based on their interpretation of imaging. Clinical decisions based on improper interpretation leads to delayed or misdiagnoses, and potential patient harm, which is magnified in the intensive care setting.

Although, competency in thoracic imaging is important, training varies widely among PCCM fellowship programs due to lack of national emphasis, standards, and competency framework, including how competencies should be achieved or assessed. Most PCCM fellowship programs rely on clinical exposure for radiographic learning. In a recent national survey, almost half of fellows cited a lack of imaging curricula as a barrier to their education.

Methods

After reviewing the national cardiothoracic curricula and competencies for radiology residents, thoracic radiology resources, PCCM board blueprints, and interdisciplinary collaboration with thoracic radiology and PCCM experts, we developed a syllabus of thoracic radiology competencies with associated goals and objectives for PCCM fellowship.

To achieve these competencies, we developed a systematic, yearlong chest-imaging curriculum comprised of weekly ~30-minute self-paced online didactics (predominantly from the Society of Thoracic Radiologists) and one-hour case-based pulmonary-radiology conferences (Table 1). Self-paced online didactics increased flexibility and provided lectures from nationally renowned experts.

The first two months of self-paced didactics encompassed a foundational phase of chest X-ray and CT interpretation basics. The subsequent ten-months focused on specific disease processes, their clinical and radiologic correlates, and imaging-based quizzes.

Fellows lead and pulmonary and radiology faculty facilitate the weekly case conference, which focuses on fellows working through complex cases with a specific emphasis on integrating thoracic radiology interpretation into clinical reasoning and differential development. The curricular design utilizes evidenced-based techniques to enhance learning and recall, including interactive quizzes, spaced repetition, and interleaving topics.

Fellows were assessed at the beginning and end of the 2020-2021 and 2021-2022 academic years with a 33-question board-style assessment, specifically crafted to require integration of radiographic interpretation with the clinical history provided. The assessment was developed by the lead author and was adjudicated by two content experts: a senior PCCM faculty member and a cardiothoracic radiologist.

The assessment also captured data on the fellows' career goals and comfort level in independently interpreting thoracic imaging modalities and disease processes.

Results

Average pre-test scores (N = 13) were 44% (14.5/33) overall, 38% (12.5/33) in first-year fellows, and 53% (17.6/33) in senior fellows. Average post-test scores (N = 5) increased by 8% overall (52%, 17.2/33), 9% in first-year fellows (47%, 15.3/33), and 8% (61%, 20/33) in senior fellows (Chart 1).

The average and median pre-test confidence of fellows to independently interpret chest x-rays and chest CTs was "somewhat confident." The average and median post-test confidence of the fellows increased to "fairly confident."

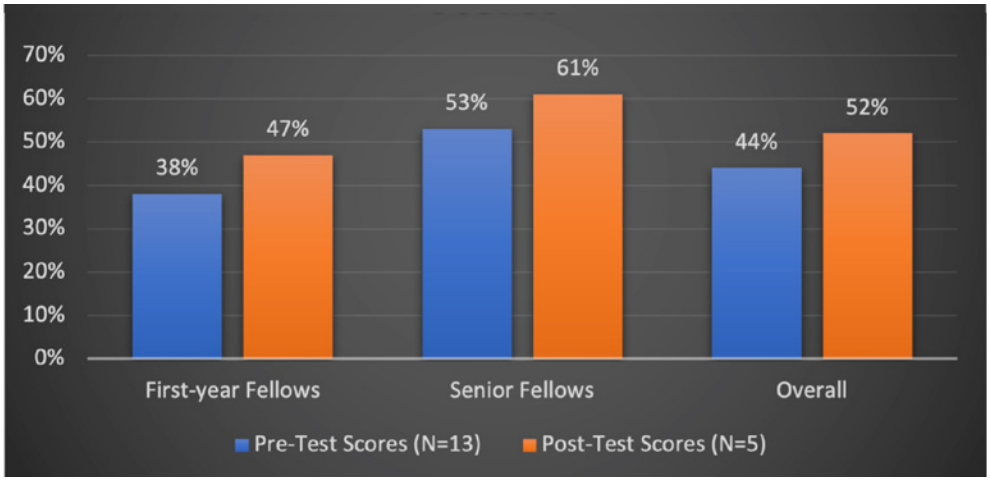
There was no correlation between confidence interpreting a modality of imaging (chest x-ray or CT chest) or disease process and score.

Conclusion

We created a comprehensive, innovative, sustainable, and transferable chest imaging curriculum utilizing evidence-based teaching methods, and we objectively assessed fellows' knowledge and ability to integrate thoracic radiology interpretation with clinical decision-making. Initial assessment showed that fellows have lower than expected proficiency in radiology interpretation, and fellows' confidence and knowledge do not correlate.

With this curriculum, all fellows improved their skills and confidence in independently interpreting chest x-rays and CT chests. Further study will examine how scores change after multiple years of this competency-based curriculum and developing a three-year curriculum and assessing its impact. The curriculum provides standardized thoracic radiology competencies for PCCM fellows and a systematic process to advance and evaluate radiographic knowledge in PCCM fellowships nationally.

Chart 1: Pre-Test and Post-Test Scores



University of Wisconsin School of Medicine and Public Health

Individual Coaching in Response to Burnout Data. How Self-Awareness Can Help?

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Rationale

Burnout rates are rising and professional fulfillment is on the decline among healthcare providers, including those in training. The global pandemic has only exaggerated these trends. Training programs must think outside the box to support their learners in this evolving climate. If the stressors of their medical education are overly burdensome, learners will not have the bandwidth to ask questions, take risks and explore personal interests, all of which are necessary for their growth and professional fulfillment. We theorize that coaching can help combat burnout symptoms by re-aligning the actions of trainees with their values, practicing self-awareness to make deliberate choices and creating a structure to offer personal accountability for goal acquisition. We believe coaching can improve both burnout rates and professional fulfillment for fellows in PCCM.

Method

UW Health providers participate in the Stanford's "Physician Wellness Survey" which has revealed residents and fellows report rates of burnout of 40% in 2017 and 43% in 2019, and increased to 48% in 2020. Similarly, professional fulfillment scores have decreased from 36% in 2019 to 32% in 2020. Even more dramatic was our PCCM Fellowship's program evaluation of burnout, with a self-reported 72% "yes" on burnout questioning in 2020, with 75% of trainees identifying the ICU as the main source of this burnout.

A 2019 JAMA article entitled "Effect of a Professional Coaching Intervention on the Well-being and Distress of Physicians, A Pilot Randomized Clinical Trial"(L.Dyrbye et al) evaluated practicing physicians from Internal Medicine, Pediatrics and Family Medicine in a coaching program. They reported that following three half hour coaching sessions over 6 months, the "coaching group" saw a 19.5% decrease in emotional exhaustion scores and a 17.1% decrease in burnout symptoms. The coaching group also showed a 20% increase in overall quality of life with a 4.2% increase in resilience scores. After our review of the coaching literature, we believe coaching can improve both burnout rates and professional fulfillment for fellows in Pulmonary and Critical Care.

Topics focusing on wellbeing and burnout were allocated to either coaching domains or mentorship domains, ensuring separation of these two distinct roles. It is important for mentors to function in an advisory capacity, modeling best practices in medicine, while coaches partner with each learner to explore opportunities for self-reflection. Our PCCM Fellowship program manager enrolled in the Professional Coach Certificate program offered by the University of Wisconsin. As a student in this program, she offers coaching sessions to residents and fellows as a pilot program. As our coach is a student in this certificate program, it was advised that the first 25 client hours be spent with learners who volunteer for participation, as they have a self-selected interest in this coaching program. Currently three PCCM fellows and five other learners from the Department of Medicine are participating. Each learner has agreed to 3-6 one hour long coaching sessions. Pre- and post-evaluation questions are being obtained from each client reflecting on self-assessments. Phase two of this program will include trainees who identify as having difficulty with self-reflection or are recommended for participation by their mentors or program directors.

Conclusion

Burnout among fellows is at an all-time high. Decreasing professional fulfillment appears connected to high burnout rates as well. Fulfillment should motivate learners to explore personal interests and inspire professional growth. Individualized coaching supports trainees through practicing self-awareness in making more deliberate choices that align with their values, therefore improving their sense of professional fulfillment. The new insights resulting from this program are expected to demonstrate how self-assessment is a tool that can improve professional fulfillment and reduce burnout symptoms during fellowship training. ■

Wayne University School of Medicine

Mechanical Ventilation Training of Pulmonary Critical Care Fellows During The COVID-19 Pandemic

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Introduction

Mechanical ventilation (MV) management is an essential skill expected of Pulmonary and Critical Care Medicine (PCCM) fellows to master during their medical training. However, mastery of the competencies required for proficiency is not standardized or tailored to fellowship trainees. The unprecedented emergence of the SARS-CoV-2 pandemic has highlighted the need for advanced operator competency in MV to improve patients' outcomes; however, there are no standardized MV curricula for rapid mastery. Our objective is to create a standardized MV curriculum using simulation and evidence-based practices for SARS-CoV-2 infection (COVID-19) for PCCM fellows.

Study Design/Methodology

The curriculum targeted new PCCM fellows to assess competency and knowledge in the following key topics: indications for MV, the implementation of rapid sequence intubation for patients with COVID-19, initiating MV and ventilator bundle per best practices, recognizing and directing the management of mucous plugging, ventilator desynchrony, ARDS, auto-PEEP, developing a care plan for proned patients, and adhering to best practices in ventilator liberation. The MV curriculum consisted of the following sequential steps:1) A baseline written knowledge test consisting of fifteen multiple-choice questions (MCQs), including MV topics and the latest evidence-based practices, and discovered pathophysiology of the COVID-19. Discrimination and difficulty indices were used to narrow to the final fifteen MCQs from a pool of fifty tested on five PCCM attendings and eight PCCM fellows. The internal consistency and reliability were calculated using item-total correlation and Cronbach alpha coefficient. 2) A one-on-one 90-minute session using a high-fidelity simulation manikin (SimMan® 3G), a lung simulator (ASL 5000TM Lung Simulator), and a mechanical ventilator to test baseline competencies within clinical scenarios. 3) A 10-minute structured debriefing session tailored per each fellow's knowledge gap as determined by a 50-point competency assessment checklist from the simulation. 4) Accumulated running time of 160 minutes of short didactic video modules with remote tracking for completion. 5) A 60-minute hands-on session in small groups of 1 to 3 fellows for basic knobology, waveforms, and various modes of MV. 6) A 90-minute one-on-one simulation reassessment session. 7) A written knowledge post-test two weeks from the baseline testing. 8) A post-training confidence survey using a 5-point Likert scale.

Results

In July 2021, eight first-year PCCM fellows completed the training. The average MCQ score increased from 7 ± 3 to 10 ± 2 questions (maximum of 15), which equated to a 43% improvement ($P<0.05$), while the simulation scores improved from 16 ± 4 to 31± 4 (maximum of 50 points) or a 93% improvement ($p<0.05$) (as shown in Figure 1). Comparing the simulation reassessment to the baseline session, fellows showed statistically significant improvement in simulation-based skills ($P<0.05$). Specifically, the significant improvement was in ability to assess indications for MV, implementing rapid sequence intubation for patients with COVID-19, initiating MV & ventilator bundle per best practices, recognizing and directing the management of mucous plugging, determining and solving ventilator desynchrony, deploying evidence-based practices for ARDS, and developing a care plan for proned patients. The post-training survey response revealed improved learner confidence in all competencies (see Table 1).

Discussion and Conclusion

Our new MV curriculum using video didactics, hands-on small group sessions, and high-fidelity simulation testing allowed for improvement in knowledge and skills of MV use in PCCM fellows during the pandemic. This was further reinforced by self-reported improvement in confidence in managing MV by first-year PCCM fellows. This new curriculum will need to be validated in another setting with a larger sample size.

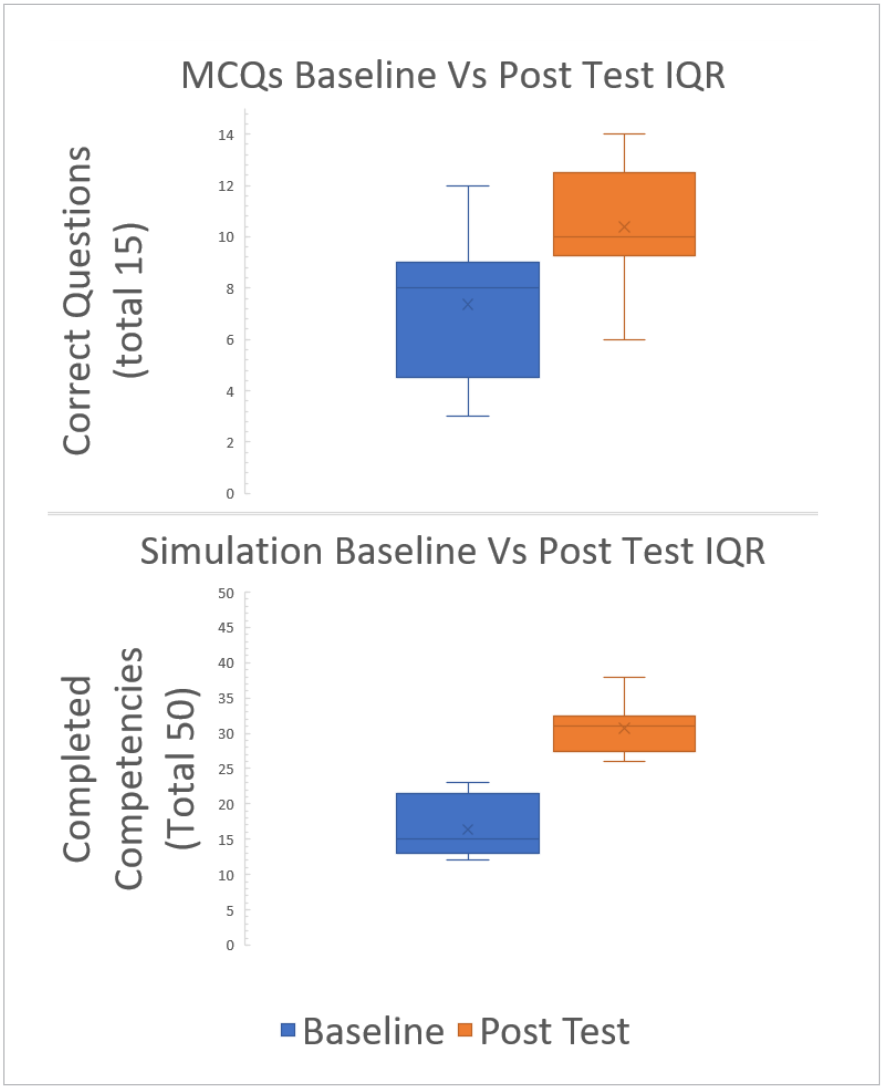

Figure 1: Box and whisker plots depicting improvement of the median scores for the MCQ-based knowledge test and simulation-based competency skill assessment after weeks of training. (MCQ=multiple choice question. IQR=interquartile range.)

MV Competency Subjects	Median (IQR: 25, 75)
Initiation of mechanical ventilation	5 (4.25,5)
Personal protective equipment (PPE) Donning/Doffing	4.5 (3,4)
Rapid sequence intubation during the Covid-19 viral pandemic	4 (4,4)
Sars-Cov-2 clinical trials and medical management	4.5 (5,4)
Auto-PEEP management	5 (4.25,5)
Mucous plug management	4.5 (4,5)
Ventilator desynchrony	4 (4,4)
ARDS management	4 (4,5)
Regractory ARDS	4 (4,5)
Prone ventilation during Covid-19 viral infection	5 (4,5)
Administration/monitoring of parlytics in mechanically	4 (4, 4.75)
Safe and effective prone cardiopulmonary resuscitation in	5 (4.25,5)
Liberation from mechanical ventilation	5 (4,5)

Table 1: Based on a post-training confidence survey using a 5-point Likert scale with 5 as strongly agree, the table of median and interquartile ranges (IQR) show self-reported improvement in competencies related to the menagement of mechanical ventilation or COVID-19.

Yale University School of Medicine

Defining Core Entrustable Professional Activities for Critical Care Ultrasound Competence Assessments of Critical Care Fellows

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Rationale

There is no consensus among Critical Care Ultrasound (CCUS) experts about how to best assess learners and assure competence. An ideal assessment tool is simple and readily integrated into clinical practice, but existing tools are time-intensive to use and interrupt clinical workflow, making assessment of trainees difficult. Herein, we describe the creation of a novel assessment tool by CCUS experts that can be readily integrated into clinical workflow to assess critical care fellows at the bedside.

Methods

We developed a tool for assessing fellow competence in CCUS based on Entrustable Professional Activities (EPAs). An EPA is a complete clinical task that can be entrusted to a trainee once he/she has demonstrated the competence to perform it unsupervised. Assessment of an EPA is done using an ordinal rating scale of the level of supervision a trainee requires. Experts in the field of CCUS were recruited for participation in a consensus meeting to define the core EPAs for CCUS performed by critical care fellows. Recruitment was done via email, and experts were identified through authorship on publications, leadership at conferences, and reputation identified by Yale experts. Participants were eight intensivists who practice throughout the United States and Canada and who have received local, national, and international recognition for their expertise. Participants met online by video conference. A nominal group technique was used with the following steps for reaching consensus: individual idea generation, round-robin recording of ideas, serial discussion of ideas, preliminary voting, discussion of preliminary voting, and final voting. A web-based assessment tool was created based on the EPAs defined by the group. This tool was implemented to assess fellows in the Yale Pulmonary and Critical Care Fellowship program.

Results

The experts defined seven diagnostic and four procedural EPAs that should be considered core EPAs in CCUS for fellows. The diagnostic EPAs are: Use CCUS to evaluate a patient with 1) shortness of breath/respiratory failure, 2) hypotension/shock, 3) cardiac arrest, 4) acute kidney injury/renal failure, 5) a pleural effusion, 6) clinical concern for intraabdominal free fluid, and 7) clinical concern for deep venous thrombosis. The procedural EPAs are: Perform ultrasound-guided 8) thoracentesis, 9) paracentesis, 10) central line placement, and 11) arterial line placement. A web-based tool (Figure 1) was created to record assessments of trainees performing the EPAs and other variables that will be used to evaluate the validity and reliability of the tool.

Conclusion

Experts in CCUS reached consensus to define eleven core EPAs for trainees. A novel tool based on these EPAs was implemented to assess fellows in the Yale Pulmonary and Critical Care Fellowship program. Future work includes ongoing evaluation of our EPA-based tool for reliability and validity. ■

Figure 1: Scan this QR code to access the web-based assessment tool.