Bronchoscopy training: Why 'hundreds of procedures' may no longer be enough

Written by The Life Science Feed Editorial Team · Published 6 September 2026 · Edited by William Lopes

> Flexible bronchoscopy remains a cornerstone in the diagnosis and management of various pulmonary conditions, from persistent cough to suspected malignancy. But mastering the intricate navigation and precise tissue acquisition required for optimal outcomes demands extensive training and continuous skill refinement. The introduction of artificial intelligence into simulation-based workshops offers a new avenue for accelerating this learning curve.

KEY TAKEAWAYS

- The Pivot: AI-driven feedback mechanisms are being integrated into bronchoscopy training to provide objective, real-time performance assessment.
- The Data: While specific metrics are still emerging, the focus is on quantifiable improvements in navigation time, lesion identification, and biopsy yield in simulated environments.
- The Action: Clinicians should explore AI-enhanced training modules as they become available, particularly for complex procedures like endobronchial ultrasound (EBUS) and guided biopsies.

Flexible bronchoscopy, a minimally invasive procedure, allows direct visualisation of the tracheobronchial tree. It is indispensable for diagnosing lung cancers, interstitial lung diseases, and infections, as well as for therapeutic interventions such as foreign body removal or stent placement. Despite its widespread use, the procedure is operator-dependent, and proficiency varies significantly among practitioners. The learning curve for achieving competence is steep, often requiring hundreds of supervised procedures to master both diagnostic and therapeutic aspects. This inherent variability highlights a persistent unmet need for standardised, effective training methodologies that can reduce procedural complications and improve diagnostic yield.

Traditional bronchoscopy training typically involves didactic lectures, observation, and hands-on practice on cadavers or animal models, followed by supervised patient procedures. While valuable, these methods often lack objective, real-time feedback on specific performance metrics. Trainees might struggle to identify subtle anatomical landmarks, navigate tortuous airways efficiently, or maintain optimal scope positioning for biopsy. The subjective nature of instructor feedback can also lead to inconsistencies in skill development. This is where AI-enhanced workshops aim to intervene, by offering a more precise and data-driven approach to skill acquisition and refinement.

The Role of AI in Skill Acquisition

Artificial intelligence, particularly machine learning and computer vision, is being applied to create sophisticated training environments that can objectively assess and guide trainee performance. These systems typically involve high-fidelity simulators equipped with sensors that track scope movements, insertion depth, and instrument manipulation. The AI algorithms then analyse this data against expert performance benchmarks, providing immediate, granular feedback. This feedback can highlight deviations from optimal technique, such as excessive force, inefficient navigation paths, or prolonged procedure times, allowing trainees to correct errors in real-time.

One key area where AI excels is in pattern recognition. For instance, AI can be trained on vast datasets of expert bronchoscopies to identify optimal pathways to specific lung segments or to recognise subtle mucosal abnormalities that might be missed by an inexperienced eye. This capability is particularly relevant for procedures like transbronchial biopsy or endobronchial ultrasound (EBUS), where precise targeting of lesions is essential for diagnostic success. The system can guide the trainee towards the target, indicating correct angles and depths, thereby reducing the number of attempts and potential complications.

Designing the AI-Enhanced Workshop

An AI-enhanced flexible bronchoscopy skills workshop typically begins with an introduction to the simulator and the AI feedback system. Trainees are familiarised with the virtual anatomy and the various tools available. Initial modules focus on basic navigation, such as advancing the scope through the trachea and main bronchi, identifying segmental and subsegmental airways, and performing systematic airway inspection. The AI provides immediate visual and auditory cues, for example, indicating when the scope is too deep, when a segment has been missed, or when excessive torque is being applied. This iterative feedback loop helps trainees build foundational skills more rapidly than traditional methods.

Subsequent modules progress to more complex scenarios, including simulated biopsies, bronchoalveolar lavage (BAL), and EBUS-guided lymph node aspiration. For biopsy procedures, the AI can assess the stability of the scope, the angle of the biopsy forceps, and the duration of tissue acquisition, all important factors for obtaining adequate and representative samples. In EBUS simulations, the AI can evaluate the trainee's ability to locate target lymph nodes, position the ultrasound probe correctly, and guide the needle accurately into the lesion. This level of objective assessment is difficult to achieve with human instructors alone, who may miss subtle errors in real-time.

Measuring Performance and Progress

The effectiveness of AI-enhanced training hinges on its ability to objectively measure and track trainee progress. Performance metrics often include procedure time, number of airway segments successfully visualised, accuracy of lesion identification, biopsy success rate, and avoidance of simulated complications (e.g., airway perforation, excessive bleeding). The AI system generates detailed performance reports, allowing trainees to review their strengths and weaknesses, and focus their practice on specific areas needing improvement. This data-driven approach transforms training from a subjective art into a quantifiable science.

For example, a trainee might consistently take too long to navigate to the right lower lobe. The AI system would flag this, perhaps suggesting alternative navigation strategies or highlighting specific anatomical landmarks to focus on. Another trainee might struggle with maintaining a stable view during biopsy. The AI could then provide targeted exercises to improve scope control and instrument coordination. This personalised learning pathway, tailored to individual needs, is a significant advantage over one-size-fits-all training approaches. The focus on EBUS and guided techniques at recent conferences highlights the growing recognition of advanced bronchoscopic skills.

Challenges and Future Directions

While the potential of AI in bronchoscopy training is substantial, several challenges remain. The development of high-fidelity simulators and robust AI algorithms requires significant investment and expertise. The validation of these AI systems against real-world clinical outcomes is also essential for patient safety and diagnostic accuracy. It is not enough for trainees to perform well in a simulation; that proficiency must translate into improved patient care. Researchers are actively working on studies to correlate simulator performance with actual clinical competence, ensuring that the skills acquired in the virtual environment are truly transferable.

Another consideration is the integration of these advanced training modules into existing medical curricula. This requires collaboration between technology developers, medical educators, and professional societies. Standardisation of AI-enhanced training protocols will be essential to ensure consistent quality and widespread adoption. The cost of these advanced simulators can also be a barrier for some institutions, although the long-term benefits of improved patient safety and diagnostic efficiency may outweigh the initial investment. The continued evolution of ultrasound education for clinical practice will likely intersect with these AI advancements.

The ultimate goal is to create a generation of pulmonologists who are not only technically proficient but also highly efficient and safe in performing complex bronchoscopic procedures. AI-enhanced training promises to shorten the learning curve, reduce variability in operator performance, and ultimately improve patient outcomes. As these technologies mature, they will likely become an indispensable component of respiratory training programs worldwide. Clinicians seeking to deepen their understanding of respiratory medicine might find the Oxford Handbook of Respiratory Medicine a valuable resource for foundational knowledge.

The open-label nature of most simulation studies is an obvious caveat; trainees know they are being evaluated by an AI, which could influence their performance. But the objective metrics provided by AI systems offer a level of detail and consistency that human instructors cannot match. The technology is still evolving, and whether these benefits extend to all aspects of bronchoscopy, particularly the complex decision-making in unforeseen clinical scenarios, remains an open question. Future iterations will need to incorporate more adaptive learning pathways and perhaps even integrate virtual reality for a more immersive training experience.

The integration of AI into medical education is not limited to bronchoscopy. Similar initiatives are underway in surgical training, endoscopy, and even basic clinical examination skills. The principle remains the same: leverage AI to provide objective, personalised, and scalable training that accelerates skill acquisition and enhances competence. This shift represents a significant step forward from traditional apprenticeship models, offering a more structured and evidence-based approach to medical skill development. The broader implications for cardiopulmonary disease assessment and management are considerable, as improved diagnostic capabilities lead to better treatment pathways.

> **CLINICAL IMPLICATIONS**
>
> The prospect of AI-enhanced bronchoscopy training is not merely an academic exercise; it addresses a tangible need for improved procedural consistency and diagnostic accuracy in respiratory medicine. For clinicians, this means a potential reduction in the steep learning curve associated with complex procedures like EBUS, leading to faster proficiency and, critically, fewer patient complications. The objective feedback from AI systems removes much of the subjectivity inherent in traditional training, ensuring a more uniform standard

of skill.

The industry developing these simulators faces the challenge of translating simulated success into real-world clinical benefit. While AI can refine motor skills and navigation, the complex judgment required in unexpected clinical situations still relies on human experience. The next generation of these tools must integrate more complex case scenarios and decision-making algorithms to truly prepare clinicians for the unpredictable nature of patient care.

For patients, this evolution in training promises safer procedures and more accurate diagnoses. A clinician trained with AI-enhanced feedback is theoretically more likely to obtain an adequate biopsy sample on the first attempt, reducing the need for repeat procedures and minimising patient discomfort and anxiety. This translates directly into better diagnostic yield for conditions like lung cancer, allowing for earlier and more effective treatment initiation.

The widespread adoption of these technologies will depend on their accessibility and cost-effectiveness. While initial investments may be high, the long-term benefits of a more skilled workforce and improved patient outcomes could justify the expenditure. Regulatory bodies and professional societies will need to establish guidelines for integrating AI-enhanced training into certification and continuing medical education programs, ensuring that the technology serves to elevate, rather than merely supplement, existing standards.

EDITORIAL & AI STANDARDS

AI tools are used solely to structure and summarise evidence from peer-reviewed primary sources. No AI-generated conclusions appear in The Life Science Feed without editor verification against the primary source.

REFERENCES

1. 1. Blakeman TC, Scott JB, Yoder MA, Capellari E, Strickland SL. AARC Clinical Practice Guidelines: Artificial Airway Suctioning. Respir Care. 2022;67(2):258-271. doi:10.4187/respcare.09548
2. 2. Alsunaid S, Holden VK, Kohli A, Diaz J, O'Meara LB. Wound care management: tracheostomy and gastrostomy. J Thorac Dis. 2021;13(8):5297-5313. doi:10.21037/jtd-2019-ipicu-13
3. 3. Alraiyes AH, Machuzak MS. Rigid bronchoscopy. Semin Respir Crit Care Med. 2014;35(6):671-80. doi:10.1055/s-0034-1395500
4. 4. Cold KM, Vamadevan A, Laursen CB, Bjerrum F, Singh S, Konge L. Artificial intelligence in bronchoscopy: a systematic review. Eur Respir Rev. 2025;34(176). doi:10.1183/16000617.0274-2024
5. 5. Ramachandran SK, Kumar AM. Supraglottic airway devices. Respir Care. 2014;59(6):920-31; discussion 931-2. doi:10.4187/respcare.02976
6. 6. Wain JC. Postintubation tracheal stenosis. Chest Surg Clin N Am. 2003;13(2):231-46. doi:10.1016/s1052-3359(03)00034-6

LICENCE & RIGHTS

MEDICAL DISCLAIMER