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Interventional Pulmonology (IP) Training and Competence

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Interventional Pulmonology (IP) is a subspecialty of respiratory medicine focused on minimally invasive diagnostic and therapeutic procedures for thoracic diseases. The complexity and increasing number of procedures highlight the need for standardized training beyond traditional pulmonology fellowships.

KEY POINTS

1. TRAINING AND COMPETENCY

- Current IP training often begins after specialty completion, but lacks standardized methods for learning and competency evaluation.
- The full development of a subspecialty in IP will include the acquisition not only of knowledge and skills, but also of the behaviors and attitudes described in the curriculum, including a high degree of personal and professional maturity, which is based on experience and takes time to acquire.
- There is a need to develop structured training programs, organized in high-volume expert centers in order to improve trainee education, including the development of validated metrics for their competency assessment.
- Targeted training and assessment is essential in cases of high-risk, low-volume procedures in order to obtain comprehensive interventional pulmonology education and patient safety.
- At the moment the certification of competence in IP is not mandatory in Europe but very recommended in many countries as a title of curriculum for a job in Interventional Pulmonology Units.
- Formal recognition of a subspecialty enhances professionalism by creating practice standards and well-defined competencies.
- A recognized field can attract the ‘best and the brightest’ to commit their careers to further developing the field.
- The ultimate goal is to provide standardized, competency-oriented training with objective evaluation methods to improve patient safety and clinical outcomes.
- A consensus document published in 2019 by the Italian group outlines training guidelines, focusing on learner-centered and competency-based education.

2. INNOVATIVE TEACHING METHODS

- Traditional approaches like “see one, do one, teach one” are insufficient and risky for patients.
- Modern techniques, including simulation-based training, flipped classrooms, and problem-based learning, ensure gradual, safer transitions from theoretical to practical knowledge.
- The use of entrustable professional activities (EPAs) could bridge the gap between theoretical knowledge and real-world practice.

3. INTERNATIONAL INITIATIVES

- Organizations such as the American College of Chest Physicians (ACCP) and American Academy of Bronchoscopy and Interventional Pulmonology (AABIP) are standardizing IP training and certification.
- In the US, since 2005, 1-2 year post-specialty fellowship programs have been established with structured curricula, simulation tools, and continuous assessments. At the moment more than 40 Programs are active in US.

- The Association of Interventional Pulmonology Program Directors (AIPPD) in collaboration with the American Academy of Bronchoscopy and Interventional Pulmonology (AABIP) and the American College of Chest Physicians (ACCP) have launched a program aimed at standardizing competencies and training of Interventional Pulmonologists based on the recommendations of the Accreditation Council for Graduate Medical Education (ACGME) (see Mullon JJ).
- The European Respiratory Society (ERS) offers programs like HERMES and certification in EBUS bronchoscopy and Thoracic echography.
- Since 2010, a 1-year academic Master's program in IP has been introduced in Florence-Italy with a standardized core curriculum and structured training with final assessment and academic diploma in interventional pulmonology.

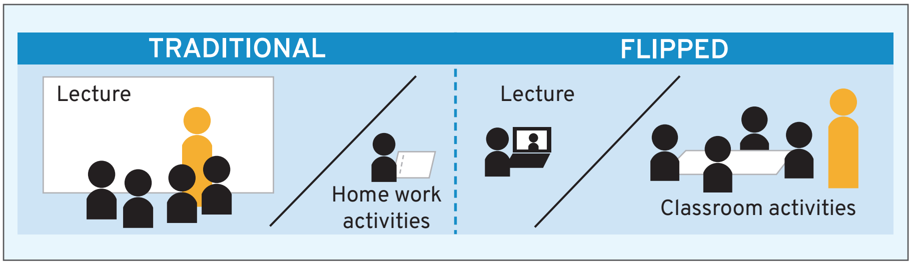

Figure 1.1 Traditional *vs.* Flipped Classroom.

- In Asia some fellowships were launched in the last years.

4. MAJOR CHALLENGES

- A lack of validated tools to objectively assess competency.
- The need for curricula based on measurable metrics instead of procedural volume.

5. SUBSPECIALTY DEVELOPMENT

- Over the past 20 years the number and complexity of interventional procedures has increased considerably, leading to recommendations for additional training after Specialty training.

Hands-On Practical Training in Interventional Pulmonology (IP)

Practical training is a critical component of Interventional Pulmonology (IP) due to its procedure-heavy nature. Modern training emphasizes competency over procedural volume and prioritizes patient safety by replacing outdated approaches like "see one, do one, teach one" with safer, simulation-based methods.

KEY POINTS

1. TRAINING METHODS

- The approach has shifted to "see one, simulate many, do one competently," incorporating simulators and structured learning environments.
- Simulators allow for risk-free practice of complex and invasive procedures.

2. SIMULATION TYPES

- Low-Fidelity Simulators: Basic anatomical models made of silicone or plastic for practicing bronchoscopy and airway management.
- High-Fidelity Simulators: Advanced models replicating anatomy, physiological functions, and real-life scenarios such as respiratory movements and complications.
- Virtual Reality Simulators: Computer-based tools offering realistic procedural simulations, including bronchoscopy and EBUS-TBNA.

3. ANIMAL AND CADAVER MODELS

- Provide increased realism for practicing techniques but face ethical, legal, and logistical challenges.

- Cadaver models help in developing psychomotor skills but lack the complexity of living tissue.

4. NON-TECHNICAL SKILLS (NTS)

- Training programs emphasize teamwork, communication, leadership, and situational awareness to minimize human error.
- Simulation exercises in emergency scenarios (*e.g.*, pneumothorax, bleeding) are crucial for preparing trainees for real-world challenges.

5. ASSESSMENT AND FEEDBACK

- Competency is assessed through simulations and performance metrics.
- Feedback sessions, often using recorded scenarios, focus on improving both technical and non-technical skills.

6. EMERGING TRENDS

- Interdisciplinary emergency simulations mimic high-risk clinical situations to teach leadership and decision-making.
- Continuous advancements in simulation technology are making training more accessible and effective.

This approach ensures comprehensive skill development while maintaining high patient safety standards.

Assessment Tools for Accreditation and Certification in Interventional Pulmonology (IP)

The accreditation and certification process in Interventional Pulmonology (IP) focuses on ensuring practitioners demonstrate competence in both technical and non-technical skills through structured training, evaluation, and continuous professional development.

KEY ELEMENTS

1. COMPETENCY-BASED CERTIFICATION

- Competence combines knowledge, technical skills, and professional behavior.
- Ever since the early 20th century (1933) in the USA there has been a system certifying professional know-how and competence: Board Certification. Since 2001 a time limit has been introduced to the validity of this certification, which now needs to be renewed within 6 to 10 years.
- Certification systems, such as ACGME in US, set standards for training programs and require periodic renewal to maintain quality and patient safety.

2. KNOWLEDGE ASSESSMENT

- Multiple Choice Questionnaires (MCQs) and theoretical tests, like the EBUS/EUS exams, evaluate understanding of clinical knowledge and decision-making.

3. SKILL ASSESSMENT

- Quantitative: Focuses on the number of supervised procedures performed, with recommended minimums for competence.

4. QUALITATIVE

- Tools like Direct Observation of Procedural Skills (DOPS) and Bronchoscopy Skills and Tasks Assessment Tool (BSTAT) assess procedural accuracy and execution. Specific tools include BSET for bronchoscopy maneuvers, OBAT for clinical and technical proficiency, and EBUS-STAT and EBU-SAT for ultrasound-guided TBNA skills. Endoscopic Ultrasonography Assessment Tool (EUSAT): UGSTAT (Ultrasound-Guided Thoracentesis Skills and Tasks Assessment Test) RIGID-TASC; Chest tube-STAT; IBV-STAT.Assessment frameworks often combine simulation and patient-based evaluations.

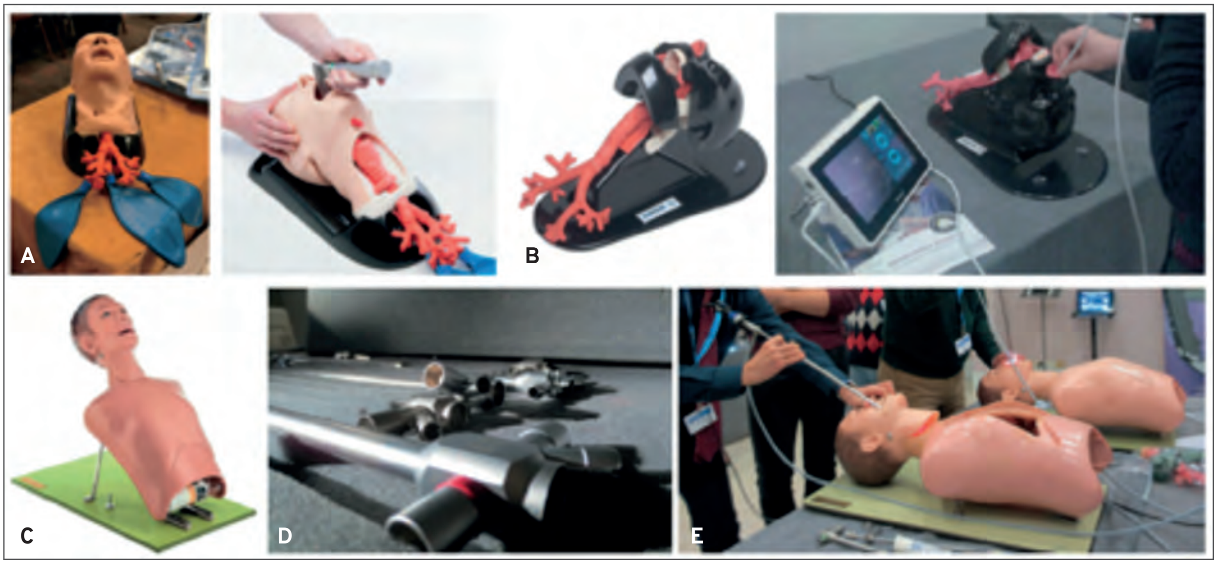

Figure 1.2 Various low-fidelity simulators used for bronchoscopy training. These include anatomical models of the airways made of silicone or plastic, allowing trainees to practice basic bronchoscopic navigation and instrument manipulation. These models can be combined with standard bronchoscopic equipment or disposable bronchoscopes. Examples shown include: (A) Air Sim Advance Bronchi; (B) Air Sim Bronchicona Scope 4 Broncho; (C) Broncho Boy; (D) rigid bronchoscope; and (E) rigid bronchoscope on a manikin.

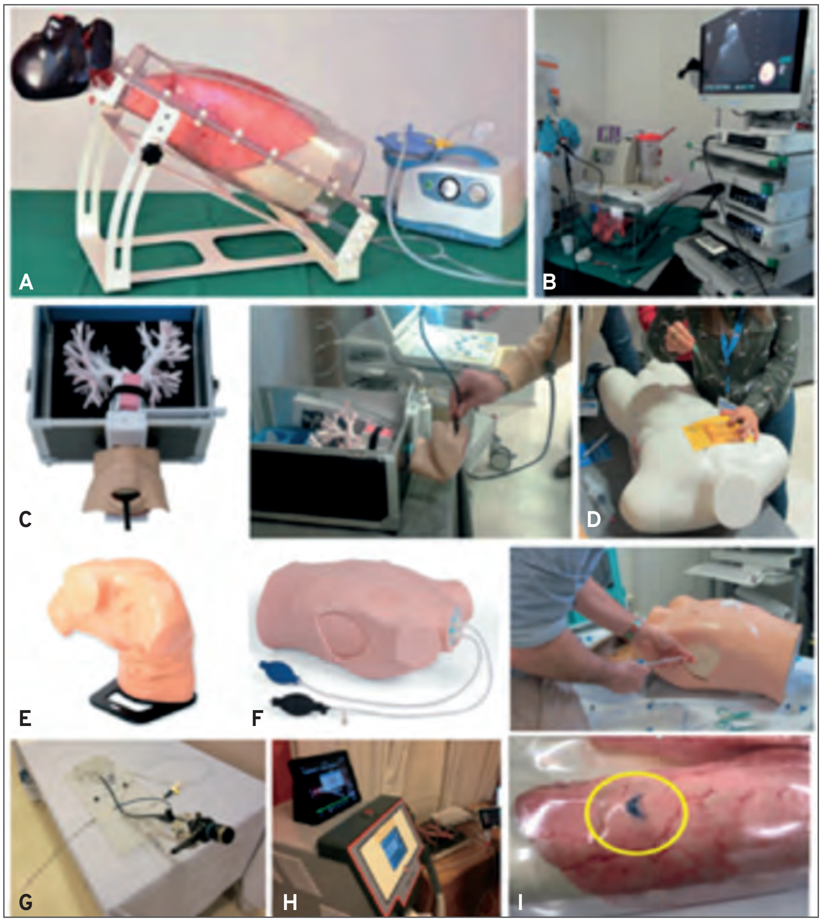

Figure 1.3 Additional low-fidelity simulators used for interventional pulmonology training. It illustrates both physical and animal-based models, and highlights various training scenarios. Examples include (A) ArtiCHEST® trainer; (B) EBUS on pig lung; (C) EBUS bronchoscopy simulator; (D) manikin with thoracic cage window; (E) medial scapular ultrasound-guided thoracentesis simulator; (F) ATLS simulator for thoracic drainage, pneumothorax, and ultrasound techniques; (G) endobronchial valve placement simulator; (H) InterVapor thermal ablation simulator for emphysema; and (I) Artichest with Pig Lung for radial EBUS simulation.

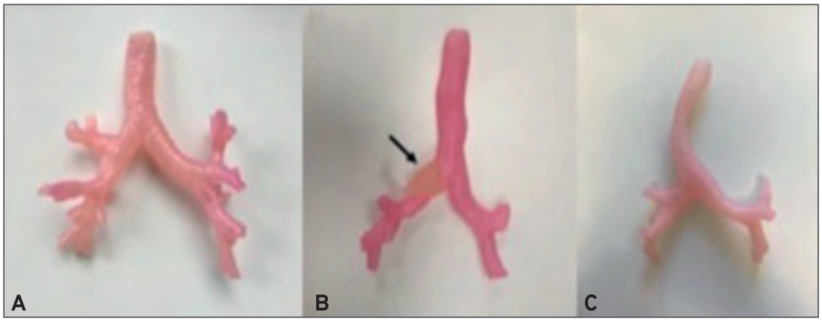

Figure 1.4 3D printing technology to create realistic anatomical models for training. (A) shows a normal tracheobronchial anatomy up to the third generation (segmental bronchi); (B) a 3D model reproducing a bronchial stenosis; and (C) a 3D model reproducing tracheal deformation caused by a retrosternal goiter. These models allow for the simulation of navigation and guided biopsy procedures, particularly with radial EBUS.

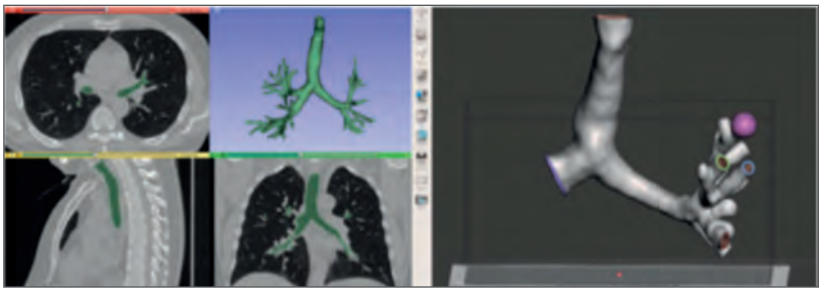

Figure 1.5 3D-printed radial ultrasound model for training radial EBUS techniques. Panels (A) and (B) show a radial EBUS probe being used with a 3D-printed model that simulates the ultrasound imaging and guidance necessary for transbronchial needle aspiration.

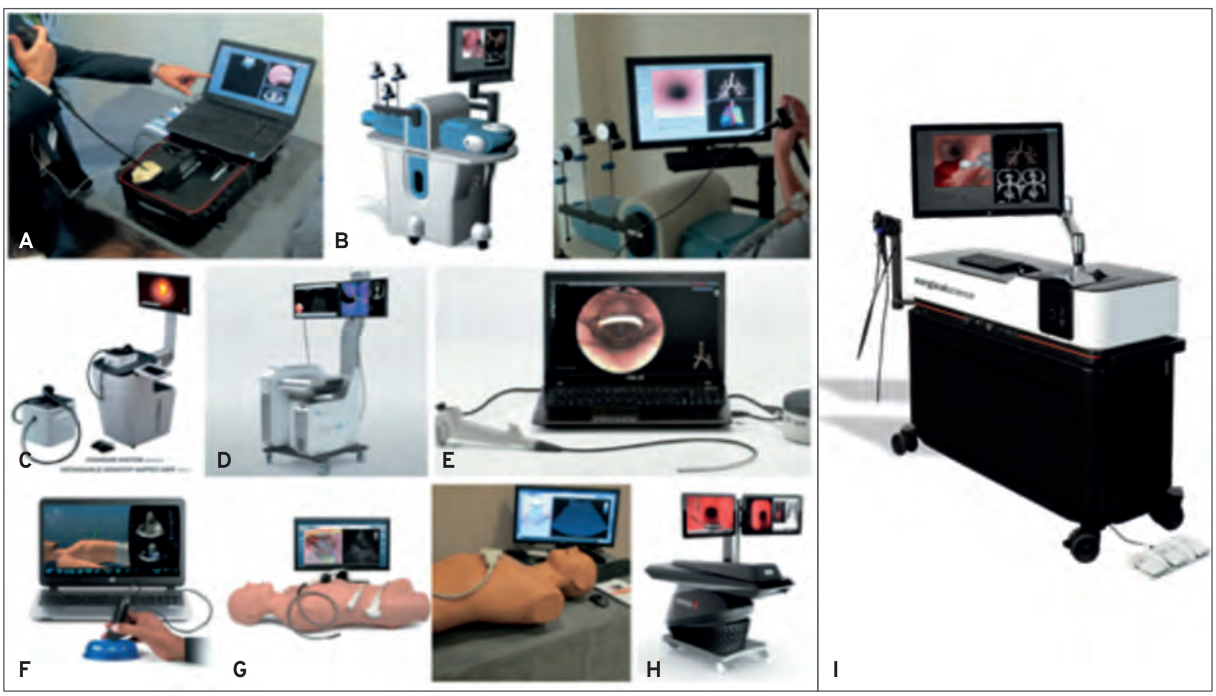

Figure 1.6 Examples of high-fidelity virtual reality simulators used for advanced bronchoscopy training. These simulators offer a realistic experience of navigating the virtual airway, performing biopsies, and managing complications. Examples include (A) Bronch Express; (B) Bronch Mentor; (C) EndoSim®; (D) EndoVR™ Interventional Simulator; (E) ORSIM®; (F) SonoSim®; (G) Vimedix; (H) Broncho-X; and (I) ENDO Mentor Suite.

5. TRANSITION TO PRACTICE

- Transition to Practice (TTP) programs provide a bridge from training to independent clinical practice, emphasizing decision-making, procedural autonomy, and outcome reviews.

6. LIFELONG LEARNING AND CONTINUOUS DEVELOPMENT

- Continuing Professional Development (CPD) focuses on personalized learning, incorporating leadership, teamwork, and advanced technical training.
- Structured approaches like boot camps and simulation centers ensure practical and theoretical knowledge remains up-to-date.

The Integration of AI, AR, and VR in Interventional Pulmonology Training

The integration of artificial intelligence (AI), augmented reality (AR), and virtual reality (VR) into interventional pulmonology training represents a significant shift in medical education. These technological advancements offer novel approaches to procedural learning, allowing for enhanced precision, efficiency, and accessibility. Traditional methods of bronchoscopy training, reliant on patient-based learning and hands-on experience, are increasingly supplemented by AI-driven systems that facilitate more comprehensive skill acquisition.

AI encompasses a broad range of computational tools capable of data aggregation, pattern recognition, and decision-making. Its application in interventional pulmonology extends from real-time navigation support to the automated interpretation of endobronchial ultrasound (EBUS) and radiologic images. AI-driven systems assist in the identification and labelling of bronchial anatomy, thus improving procedural accuracy and reducing reliance on operator experience alone.

AI tools for research and writing

GENERAL RESEARCH ASSISTANCE (in addition to ChatGTP)

	Functionality	Unique features
Perplexity AI https://www.perplexity.ai/	A conversational search engine that provides real-time answers to queries by synthesizing information from multiple sources	- Generates concise summaries with citations for easy verification - Allows follow-up questions to refine search results based on user context
Claude AI https://claude.ai.new	An advance AI chatbot designed for natural language processing tasks, capable of engaging in complex reasoning and generating human-like text responses	- Supports multimodal inputs (text images) for comprehensive analysis - Focused on ethical AI use with safety measures in its responses