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Training in interventional pulmonology: What we have learned and a way forward

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ABSTRACT

IP encompasses a complex list of procedures requiring knowledge, technical skills and competence. Modern, learner-centric educational philosophies and an explosion of multidimensional educational tools including manikins, simulators, online resources, social media and formal programs can foster learning in IP, promoting professionalism and a culture of lifelong learning. This paper provides background and guidance to a structured, multidimensional and learner-centric strategy for medical procedural education. Focusing on our experience in IP, we describe how competency-based measures, simulation technology and various teaching modalities contribute to a more uniform learning environment in which patients do not suffer the burdens of procedure-related training.

Key words: bronchoscopy, competency, interventional pulmonology, medical education, professionalism.

> 'What is important is not what can be taught, but rather what is learned'[1] GD Fenstermacher and JF Soltis

INTRODUCTION

Interventional pulmonology (IP) is a subspecialty of thoracic medicine, with an increasing number of procedures available to a growing group of enthusiastic subspecialists. Until a few years ago, training strategies were intrinsically linked to a see one, do one, teach one approach that has its roots in the traditional apprentice-style medical teaching model.

However, the world is changing rapidly, and so is IP-related training. The global population is now 32% Generation Z (2001 onwards) and 31.5% Millennials (1980–2000). By 2030, people aged over 60 years will have increased to 1.4 billion (16.4% of the world's population). According to the Association of American Medical Colleges, medical schools in the United States are increasingly diverse, and women now make up more than 50% of classes, a trend found in many other countries.[2]

Increased familiarity with social media and the internet makes sharing information and experience instantaneous. If predictions about the doubling time of medical knowledge, which in 2010 was 3.5 years and was projected to be a mere 73 days by 2020, are close to correct,[3] our needs for up-to-date information and quality, evidence-based care demand the rapid adoption of information-based technologies, including artificial intelligence. Evolving educational paradigms encourage access to these technologies, as well as to a wealth of new training materials and IP-related learning content regardless of a physician's level of training.

Such radical and transformative changes do not occur without challenges. People and institutions are reluctant to abandon traditional ways of thinking and slow to adapt to new paradigms. This natural resistance may be coupled with the accelerating speed of technological evolution and conflicts faced in teaching environments where optimal patient care must be balanced with cost concerns, time efficiency, expectations for quality, safety and accountability, as well as with an instructor's goal to impart knowledge and the trainee's desire to master essential career skills,.

Now is our chance to embrace changing paradigms in procedural education. We believe, for example, that it is no longer acceptable for patients to bear the burden of procedure-related training; that knowledge can be made more readily accessible through open access to most, if not all teaching materials; and that structured, multidimensional and learner-centric educational programs help attain a globally more uniform quality of care.

In this paper, we describe some of these newer concepts and educational methods which help physicians acquire the knowledge and skills, needed for IP. We discuss how new philosophies and instructional techniques might serve in multidimensional training programs and postgraduate courses. We provide examples of how such programs can help IP physicians develop and maintain competence through a lifelong learning process.

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A FEW MILESTONES IN IP EDUCATION

Milestones in IP education mirror those of key developments in IP applications and are summarized in Figure 1. During the early years of modern bronchoscopy, training was haphazard, with physicians usually learning-by-doing and most rigid bronchoscopes were relegated to hospital basement closets. The American College of Chest Physicians and the journal *CHEST* recognized the potential importance of flexible bronchoscopy. They solicited the help of Donald Zavala at the University of Iowa to organize postgraduate training courses. His iconic *Flexible Bronchoscopy, A Training Handbook*, was published in 1978.[4]

In July that same year, 660 participants from 26 countries gathered in Tokyo for the first biennial World Congress on Bronchoscopy, conducted by the newly created World Association for Bronchology (known today as the World Association for Bronchology and Interventional Pulmonology, WABIP).

The 1980s and 1990s were times for consolidation and expansion. New diagnostic techniques were described, and expected outcomes were better defined.[5] Renewed interest in rigid bronchoscopy was the result of an international group of early adopters who bucked conventional wisdom to conduct courses and demonstrate the benefits of procedures such as laser resection to treat the obstructed central airways. Advances in imaging and recording technologies accompanied the gradual introduction of video-bronchoscopy and made cumbersome teaching attachments, used until then with fibreoptic scopes and rigid telescopes, rapidly obsolete. Meanwhile, in the 1980s, Professor John Nakhosteen developed the SCOPIN CLA-9 practice manikin called Broncho Boy and, in 1994, the first scientific journal dedicated solely to bronchology, *Journal of Bronchology and Interventional Pulmonology*, was published.[6]

By the start of the 21st century, training needs for IP increased as physicians sought to expand their roles in cancer management, palliative care, translational research, medical ethics, technological innovation and procedure-related education. In 2001, a radical shift in training was suggested by advocates of computer-based bronchoscopy simulation,[7,8] and in 2002, Bronchoscopy International (www.bronchoscopy.org) provided free educational materials online and began developing Train-the-Trainer programs to help build a cadre of bronchoscopy educators. The increasing availability of manikins and computer-based simulators continues to empower the growing numbers of bronchoscopy and IP training workshops. Coupled with an expanding array of procedure-related validated assessment tools, structured IP training programs and formal IP fellowships, the fundamentals of training future generations of proceduralists were revolutionized.

CONCEPTS FOR TRAINING IN IP

As well as being skilled proceduralists, modern interventional pulmonologists must expertly interpret imaging data and display leadership skills, management abilities, organizational acumen, political savvy and clinical expertise as well as the human qualities needed

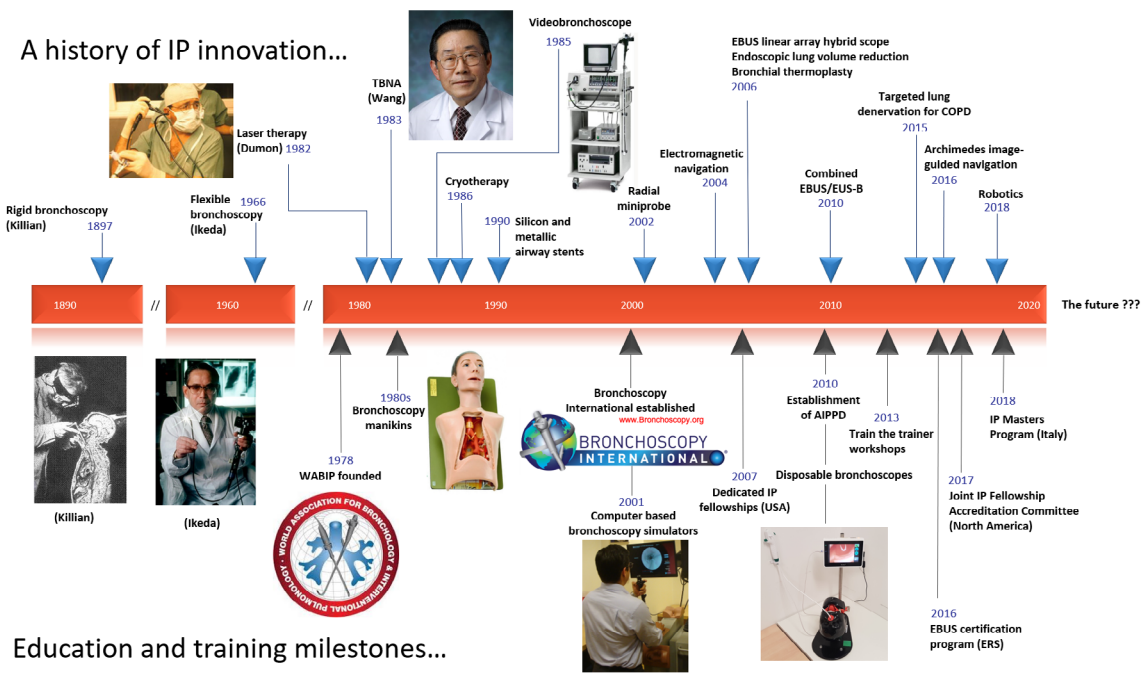

Figure 1 Innovation, educational and training milestones in IP. AIPPD, Association of Interventional Pulmonology Program Directors; COPD, chronic obstructive pulmonary disease; EBUS, endobronchial ultrasound; ERS, European Respiratory Society; EUS, endoscopic ultrasound; IP, interventional pulmonology; TBNA, transbronchial needle aspiration; WABIP, World Association for Bronchology and Interventional Pulmonology.

to care for patients with often complex and potentially fatal disorders. Add the roles of teacher and mentor, and we have a snapshot of challenges for IP educators today.

Comprehensive reviews summarizing the evidence of training concepts in IP have been published and provide an evidence base for the following discussions and theories.[9–11]

The nature of IP suggests that training programs should provide learners with a broad exposure to more than just technical skills. Opportunities to assess many forms of knowledge, including those needed to nurture humanistic qualities and medical expertise, are also desirable. Given the expansion of our profession, the design, development and implementation of a comprehensive IP educational model are daunting.

Similar to other subspecialties, a minimum requirement for practitioners is to commit to learning IP in specialized centres.[12] The increasing number of possible interventions, in addition to decreased durations of hospitalizations, a limited source of patients, overwhelming amounts of information and procedure-related technologies, and rising healthcare costs make it difficult for centres to assure sufficient exposure to all possible interventions in a short time. Furthermore, the expanding role for multidisciplinary care, rather than authoritarian doctor–patient relationships, as well as shifts in care dynamics where informed patients increasingly participate actively in management decisions, is altering medical practice environments.

Traditionally, numbers were a metric upon which attaining competency was based, and many societies have recommendations for a minimum number of procedures (Table 1). Although results from studies show that in already trained physicians, numbers in some interventional fields correlate with clinical outcomes in practice,[13–15] many note that a purely number-based training program does not equate to competency, and is insufficient on its own.[16,17] We believe that numbers have a role because they represent hands-on experience in the patient care setting, but are in and of themselves of little value without oversight. Constructive feedback and two-way instructor–learner communication help address both observed and hypothetical procedure-related issues.

We believe, therefore, that every hospital department should provide bronchoscopists with manikins or affordable (or ideally, free) access to simulation so they and their teams can maintain and improve their skills through repetitive, task-driven practice. The associated use of assessment tools, some validated, others in development, provides opportunities for feedback based on measurable outcomes, particularly technical skills,[18–22] and alters the learning curve so that a degree of competency can be reached before performing procedures on patients.[20,23]

There is still debate regarding how assessment tools might serve as low- and high-stakes measures of competency. Score-based assessments, if conducted serially, can identify weaknesses to be remedied by individualized training, thus establishing a minimum standard of competency that is potentially confirmed using a high-stakes examination with cut-off scores or pass/fail criteria. We believe such an approach helps assure patient safety as well as the ethical and appropriate performance of a particular procedure often required by hospital accreditation committees in credentialing individual practitioners. Other assessments might include multiple-choice style examinations[24] documenting satisfactory participation in a predefined number of workshops, charting observations of a learner's behaviour during interactive small-group exercises, mandating completion of a specified duration of apprentice-style training and reviewing procedure-related experience with videos and procedural logbooks.

Given the above, we caution against learning by doing. Instead, we suggest learners participate in structured, multidimensional educational programs, albeit with a caveat: All learners have varying levels of experience. Some are already competent proceduralists whilst others are beginners, and one may be an expert in one procedure, yet have novice or intermediate abilities in another. Acknowledging that all learners learn differently, adds value to a learner-centric educational approach.[23,25]

On a related note, there has never been a clear distinction between procedures in the domain of the general bronchoscopist or the IP (Fig. 2). We hesitate using the terms *basic* or *advanced* because experience shows that what is often considered new or advanced one year, can rapidly become standard of care and presumably basic the next.

INTERNATIONAL IP TRAINING CURRICULA, CONFERENCES AND POSTGRADUATE COURSES

New training techniques focus on learner-centric philosophies and include maximizing active engagement through interactive learning sessions and using high teacher-to-learner ratios. Individualized training can be based on results from competency-oriented assessment tools, and moderated case-based discussions can be held around the use of checklists and evidence-based clinical algorithms and multidisciplinary care plans. We also believe that dedicated teaching moments are preferable to teaching on-the-job during clinical/service rounds because most learners have facts, figures and much of the published literature at their fingertips using mobile devices. With the above-mentioned strategies, competency-oriented outcomes are pursued in a manner diametrically different from the somewhat antiquated 'see one, do one, teach one' apprenticeship approach.

With regards to structured curricula and implementing a more uniform model for IP education, the United States now has several 12- to 24-month programs with centralized application processes, published standards for program curricula and exit examinations.[24,26,27] From five dedicated IP training programs in 2007, there are now over 35 sites currently accredited for IP training.[26] The Association of Interventional Pulmonology Program Directors (AIPPD) coordinates programs and, together with the American Association of Bronchology and Interventional Pulmonology (AABIP), established a Joint IP Fellowship

Table 1 Summary of international published guidelines for numbers of procedures required in IP training (Reproduced from Corbetta *et al.*,[48] with permission)

Type of procedure	BTS	TSANZ	ERS/ATS	ACCP	AIPO
Flexible bronchoscopy	50[††]	200/12–20	NR	100/25	100/100
Rigid bronchoscopy	—	—	20/10–15	20/10	NR
TBNA		20	25/NR	25/10	NR
AFB	—	20/20	Long learning curve	20/10	NR
EBUS	—	50/20	40/25	50/20	NR
TTNA/B	—	—	10/5–10	10 aspirates, 10 cores/10	NR
LB	—	—	>20/10–15	15/10	NR/30
EES/APC	—	—	10/5–10	15/10	NR
EBCT	—	—	10/5–15	10/5	NR
Airways stents	—	—	10/5–10	20/10	NR
EBBT	—	—	5/5–10	5/5	NR
PDT	—	—	10/5–10	10/5	NR
PT	—	—	5–10/10	20/10	NR
TTOT	—	—	5/5	10/5	NR

Number of supervised procedures needed according to the different societies. The first number represents the minimum training required and the second (when present) the minimum procedures per year required to maintain competency.

[†]The authors suggest at least 50 procedures under direct supervision and 50 under indirect supervision.

ACCP, American College of Chest Physicians; AFB, autofluorescence bronchoscopy; AIPO, Associazione Italiana Pneumologi Ospedalieri; BTS, British Thoracic Society; EBBT, endobronchial brachytherapy; EBCT, endobronchial cryotherapy; EBUS, endobronchial ultrasound; EES/APC, endobronchial electrosurgery/argon–plasma coagulation; ERS/ATS, European Respiratory Society/American Thoracic Society; IP, interventional pulmonology; LB; laser bronchoscopy; NR, Not reported; PDT, photodynamic therapy; PT, percutaneous tracheostomy; TBNA, transbronchial needle aspiration; TSANZ, Thoracic Society of Australia and New Zealand; TTNA/B, transthoracic needle aspiration and biopsy; TTOT, transtracheal oxygen therapy.

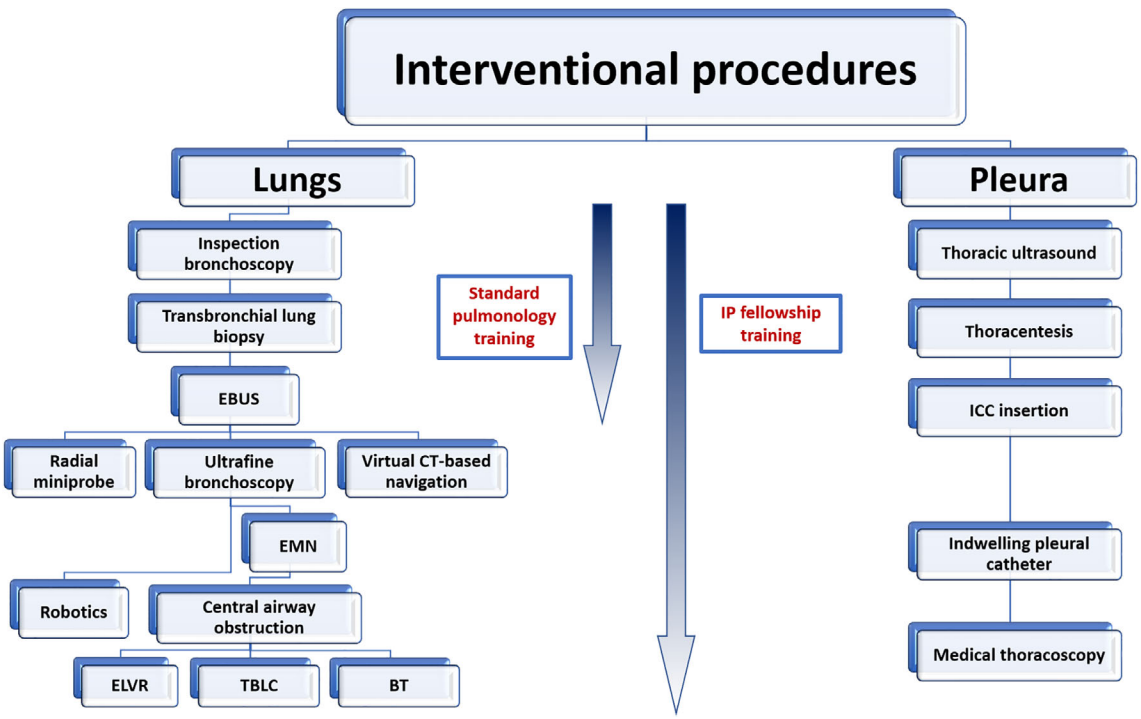

Figure 2 Overlap between what is considered standard thoracic medicine procedural training and that of IP. Defined boundaries between the two will vary considerably depending on local experience, culture and training. BT, bronchial thermoplasty; EBUS, endobronchial ultrasound; ELVR, endoscopic lung volume reduction; EMN, electromagnetic navigation; CT, computed tomography; ICC, intercostal catheter; IP, interventional pulmonology; TBLC, transbronchial lung cryobiopsy.

Accreditation Committee to publish accreditation standards that outline duration of training, learning requirements, educational content, procedural volume and curricular needs, as well as institutional and faculty obligations.[27]

Italy has an extensive curriculum for IP training,[28,29] including a Master's program through the University of Florence, and, more recently Ancona, providing a link between an academic university-based program for didactic and course-oriented studies with affiliated teaching hospitals to provide the necessary hands-on procedural experience.

The European Respiratory Society has an IP accreditation program built around endobronchial ultrasound (EBUS), and a professional certification program utilizing Miller's pyramid model for clinical competency. This encompasses a three-part program covering theory, online self-directed modules, quizzes, webcasts, course and live case attendance, hands-on simulation training, and submission of a logbook and video cases for review.[30,31]

The Thoracic Society of Australia and New Zealand described competency standards for several IP procedures,[32] instituted regional training seminars, procedural log reviews and encourages using a variety of validated assessment tools while actively building a cadre of Bronchoscopy International certified and master instructors. There is not yet a formal accreditation standard or formally described IP fellowship despite the availability of several training positions across the region.

In Argentina, a 1-year certification program in bronchoscopy includes a multidimensional curriculum, objective measures of knowledge and technical skill, procedural log reviews, multiple opportunities for targeted practice using airway models and manikins and supervised hands-on training. Similar programs are being designed elsewhere in South America, as well as in India, Bangladesh, Algeria and several European countries.

Organization of international conferences and workshops is also changing. The largest IP workshop to date was held at the 2019 Asia Pacific Congress of Bronchology conference. More than 200 participants attended four half-day workshops from a selection of eight topics. The philosophy was to keep didactics to a minimum and to provide numerous opportunities for learners to interact with international experts during small-group, instructor-led, task-specific hands-on sessions.

MODERN PARADIGMS FOR TEACHING IP

A comprehensive 1-year fellowship provides, at best, finite theoretical and hands-on experience. This time must be optimized for maximum impact. According to Gentile,[33] 'A good curriculum needs to spiral around the great ideas, principles and values of a field'. Medicine lends itself to a spiral-shaped approach to learning where many pathologies are seen repeatedly, allowing learners to spiral around subjects, viewing a similar process from different angles while building on memory and experience until familiarity, confidence and competency are attained with eventual mastery of the task.

A multidimensional approach to teaching allows different topics to be addressed similarly, and similar topics to be addressed differently, which takes into account the various ways learners assimilate materials. This educational method disrupts the hierarchal and often dogmatic teaching systems that dominated medicine for hundreds of years.

A vital element of this new approach is the assessment tool, which can be used to complement an apprentice-style learning program making use of manikins and computer-based simulation. The value of using assessments and checklists is in the way they help assure patient safety, promote knowledge acquisition and help avoid systems-based errors. As newer generations of medical specialists become accustomed to their use, they will design and implement new tools to objectively document positions on the learning curve for virtually every procedure.[20,23] We believe that training programs that allow individualization through the identification of strengths and weaknesses using such objective measures[23,25] will also help identify a minimum standard of competency that might be accepted regardless of one's country or region of practice.

Technical skills require *muscle memory*. Research shows that neural pathways can be formed and habits developed by combining many small tasks learned incrementally before combining them into more complex procedures. This is similar to the way one learns to play a musical instrument or swing a golf club.[34] The 'Step by Step' method of bronchoscopy training is one example of gradual acquisition of muscle memory whereby trainees acquire skills by deconstructing a complex procedure into numbered steps that are taught individually and combined gradually until the entire procedure is performed.[18,35]

In a multidimensional, structured learning environment, the acquisition of psychomotor skills is ideally accompanied by the acquisition of cognitive (theoretical, metacognitive and factual), affective (growth in how feelings and emotions might affect decision-making) and experiential (as opposed to a priori) knowledge. This can be accomplished through minor alterations to the apprenticeship-style model and lends credence to the use of small group, case-based instruction using real or fabricated case scenarios. Role-playing exercises are beneficial and popular for practising communication skills. At the same time, independent learning is encouraged using social media platforms and programs designed for mobile devices such as BronchAtlas and BronchPilot Anatomy which are available free online.[36]

Because time with an instructor is precious, a 'Flipped Classroom' model[11,37] is also attractive. This differs from a traditional classroom model because materials are usually provided before on-site learning, and students are asked to consider, reflect and explore content often as homework or during interactive small group sessions. Such pre-classroom material can include teaching slides, articles, online lectures and web-based courses. The teacher's role changes from classroom-based lecturer to attentive coach and

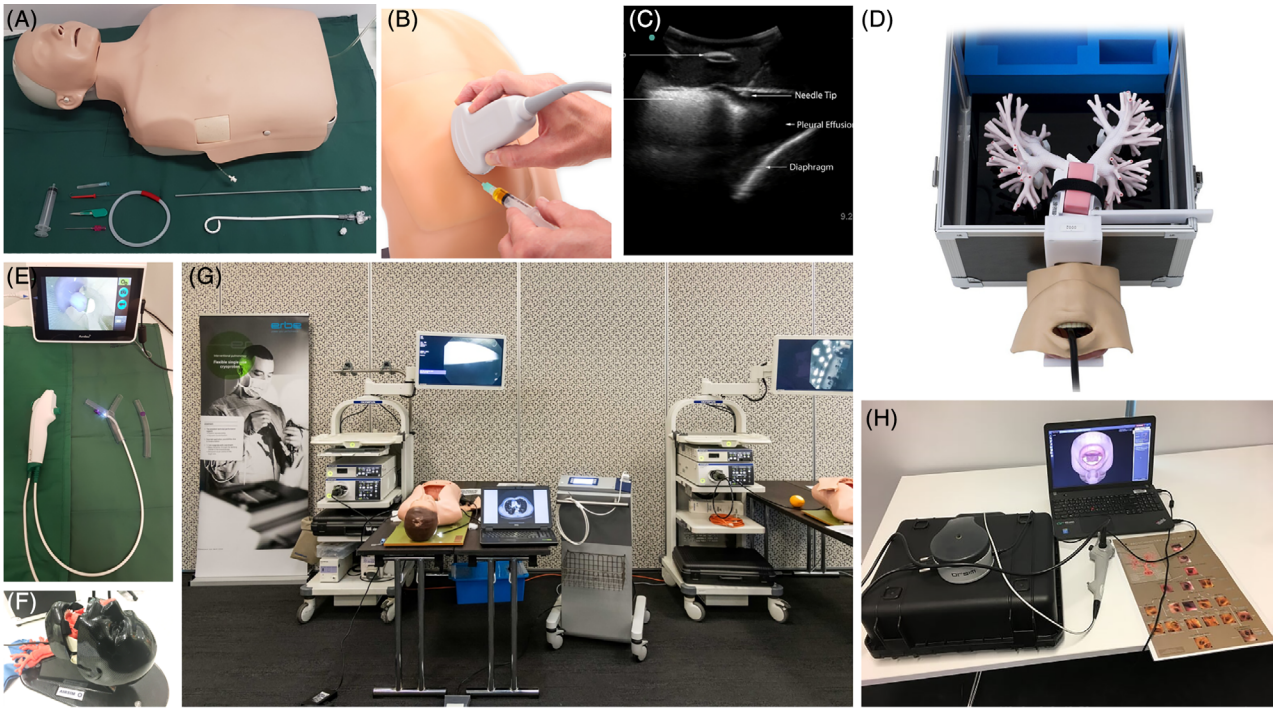

Figure 3 Composite of models and manikins utilized at the 2019 ACPB Interventional Pulmonology workshop. Super Annie (SimCentral, Sydney, Australia) ICC insertion manikin (A). Blue phantom ultrasound and thoracentesis training model (B) and corresponding ultrasound image (C). Koken (Tokyo, Japan) bronchoscopy training model (D). Simulated central airway obstruction constructed from plastic tubes, plasticine and visualized using an Ambu aScope (Ambu, Copenhagen, Denmark) (E). AirSim (TruCorp, Craigavon, UK) Bronchi bronchoscopy training model (F). Bronchoscopy training station set up (G). ORSIM (Auckland, New Zealand) bronchoscopy simulator (H). ACPB, Asia Pacific Congress on Bronchology; ICC, intercostal catheter.

supportive facilitator. The flipped classroom model in various forms leads to improvements in knowledge retention, active learning, student satisfaction and test scores. Such an approach lends itself well to problem-based learning methods such as those used in Case-based, 4-Box Practical Approach exercises.[38] This simple tool may be applied to virtually any procedure-based scenario and facilitates the construction and deconstruction of the task using a uniform approach to facilitate the acquisition of cognitive, technical and experiential knowledge prior to procedures to optimize planning, response to complications and post-procedure care of patients.

Hospital-based teaching is usually not done in a formal setting, and frequently, face-to-face contact between student and teacher occurs at the patient's bedside, in clinical consultation rooms or the procedure suite. These moments are opportunities to impart and reinforce knowledge, involve the trainee in care discussions and management plans, provide career advice and identify a learner's needs.[39] We suggest adding a dedicated moment for teaching, rather than teaching on-the-run, to help distinguish between clinical service and education.

We believe doctors should not be expected to be good teachers just because they have a medical degree, and even those with natural talents can improve. 'Train-the-Trainer workshops' and 'Faculty Development Courses' are modelled on business leadership courses and other types of master classes. Participants hone their skills, practice positive reinforcement and other forms of communication such as learning to give and to receive feedback. A variety of educational philosophies and learning methods are taught, such as how to use checklists and assessment tools, provide step-by-step instruction using manikins, computer-based simulators and during procedures performed in patients.[40]

EXAMPLES OF ONLINE LEARNING RESOURCES

Considering the wealth of educational resources available online, in libraries and on social media, state-of-the-art information is more accessible than ever. One such multidimensional and custom-designed online resource is Bronchoscopy International (www.bronchoscopy.org). Available materials include validated assessment tools, case-based exercises and the Essential Flexible Bronchoscopist series of training manuals. This site also contains an introductory bronchoscopy Step-by-Step approach and 'How to' YouTube videos.

Other examples of online resources include Uptodate in Pulmonary Medicine; Panminerva Medica's comprehensive articles on training needs, competency requirements and state-of-the-art reviews[41–51]; online bronchoscopy simulation; and YouTube instructional

videos.[52,53] There are numerous Facebook pages (such as www.facebook.com/groups/pleural.hub/); Bronchology groups where more than 2000 physicians can communicate in real-time using a WhatsApp platform, with interactions between regions coordinated by WABIP clinician-educators (contact authors for more information); and Massive Open Online Courses (MOOCS) produced by reputable universities and programs such as Coursera, Open Learning, Udacity and Iversity. Using social media platforms requires strict adherence to patient confidentiality and ethical codes of conduct.

MANIKINS AND COMPUTER-BASED SIMULATION

Simulation-related fidelity refers to the recreation of reality, such as using a bronchoscope in an airway with or without pathology, and with a high degree of realism. Simulators vary from a physical airway model through which a real bronchoscope is passed to computer-generated images on a monitor and linked to a handheld probe or proxy bronchoscope (Fig. 3). The benefits of one form of simulation over another are yet to be demonstrated. From a practical viewpoint, each modality has advantages and disadvantages in terms of upfront costs, maintenance, availability, reusability and portability.[27,29,54–58] We caution against using the terms *high* and *low fidelity* to distinguish computer-based from manikin-based simulation, because a manikin might be highly realistic, and sometimes, even a costly computer-based program is less so.

The existence of commercially available airway manikins and newer disposable bronchoscopes provides a relatively low-cost alternative to computer-based simulation whilst maintaining a remarkable degree of anatomical realism with a true to life sense of bronchoscope handling. Manikins are often preferable to computer-based simulation for learning to remove foreign bodies, sample endobronchial masses and suction airway secretions or blood. A single-use disposable bronchoscope costing a few hundred dollars can be reserved for educational purposes and used hundreds of times coupled with an inexpensive display panel. A three-dimensional (3D) custom-printed airway cast is a less expensive device that may provide even more realism than many expensive commercial units[59,60] reliably discriminating between novice, intermediate and expert groups.

Results from simulation studies show increased dexterity skills, improvements in the speed of airway inspection, numbers of segments visualized, reduced airway wall collisions and faster performance on the learning curve early in training. As few as 20 simulated procedures are significantly associated with increased acquisition of bronchoscopy skills on validated assessment tasks.[7,23]

Studies also show superior performance in patients for trainees who learned initially on a simulator compared to those who did not, a finding that is consistent with results from simulator studies in other subspecialties.[61–63] Although Cochrane reviews in endoscopy and otorhinolaryngology conclude there is insufficient evidence to advise for or against replacing the apprenticeship model of training with simulation,[64,65] we believe the ability to differentiate between novices, intermediates and expert bronchoscopists using objective measures is an important step towards documenting competency and adequacy of training.[18,66–68]

Simulator centres are available in hospitals, universities and specialty units. Although skills are readily learned at these places, we believe that permanent access to manikins or computer-based simulation is preferable to one-off sessions, because it allows the establishment and maintenance of procedure-related muscle memory, and opportunities for repeated practice to perfection.

Although the cost of simulators is decreasing, and laptop-sized models are available for carrying to various courses,[69–71] computer-based simulation for procedures such as stent insertion and other interventions is lacking. As an alternative, discarded animal tissues, such as explanted pig or sheep lungs and torsos, offer the advantage of being an inexpensive and readily available alternative to be used as models.[72] When connected via an Endotracheal tube (ETT) to an anaesthetic bag and valve, ventilation too can be simulated, as well as a reliable pleural model (Fig. 4). Limitations include anatomy that is different from that of humans, the need for dedicated equipment (although using disposable materials circumvents this issue), time limitations because of decomposition and a need to dispose of tissue properly. Preserving tissues in plastic lamination overcomes the decomposition issue but adds cost. The ethical issues related to using animals in medical education, particularly when satisfactory and often better alternatives exist, prompt us to caution against using discarded animal tissues unless necessary, and we advise against the use of live animals for any form of medical training.

A PHILOSOPHY OF LIFELONG LEARNING

A philosophy of lifelong learning is enthusiastically embraced by most medical professionals,[73] so IP fellowships and postgraduate programs are ideal for fostering behaviours that may continue until retirement (Fig. 5). Core components of lifelong learning are similar to those outlined earlier in this article. Still, one may further identify an individual's needs (learner-centric) by using assessments, needs-based questionnaires and inquiry as to the learner's perception of areas for improvement. Because simulation-based training is effective for acquiring and maintaining technical skills, it would be particularly beneficial for physicians already in practice who want to learn new procedures or enhance current procedural expertise. It could also benefit faculty working in centres where trainees do the majority of the work, leaving only a small number of cases with which teachers maintain their skills.

Figure 4 Constructing a chest wall manikin for an introductory thoracic ultrasound course is straightforward with components obtained from a local hardware store and butcher as follows: Pork belly rib cage (A). Affixing chest wall with screws, brackets, wingnuts and a tube of clear drying silicone gel to the inside of a domestic garbage bin (e.g. 25 L, 271 × 540 × 330 mm) with a window (250 × 150 mm) cut out with a blade (B and C). Placing a large domestic sponge (approximately 220 × 120 × 70 mm) on the back wall of the bin and filling the airtight unit with water (D). Scanning with option for needle and intercostal catheter insertion (E).

COMPETENCY AND PROFESSIONALISM

Physicians historically learned their craft one patient at a time, with all this entails in terms of human suffering, inefficiency, the risk for complications and other potentially suboptimal outcomes. Competency was usually presumed based on one's attendance at conferences, completion of an apprentice-style training program, participation in a certain number of procedures and performance on written tests that contained few questions that were pertinent to IP.

If competency is defined as a combination of observable and measurable skills, knowledge and behaviours, it follows that an assessment strategy using a collection of specific tools and methodologies is required. Among others, these encompass objective forms for measuring, monitoring and reviewing one's technical skill and knowledge, as well as one's ability to plan a procedure, obtain results similar to one's peers and respond appropriately to procedure-related complications.

The American Board of Medical Specialities defines professionalism as a belief system in which group members declare to each other and the public the shared competency standards and ethical values they promise to uphold in their work and what the public and individual patients can and should expect.[74] We believe competency should also be demonstrated in periprocedural aspects of care such as the ability to obtain informed consent, deliver news of a diagnosis in a culturally sensitive and appropriate manner, communicate effectively with colleagues and patients, perform effectively as a team leader and develop a satisfactory follow-up procedural plan.

THOUGHTS ON THE FUTURE OF IP TRAINING

At the time of writing, there is no globally accepted measure of competency. As agents-of-change, physician-educators around the world are shifting

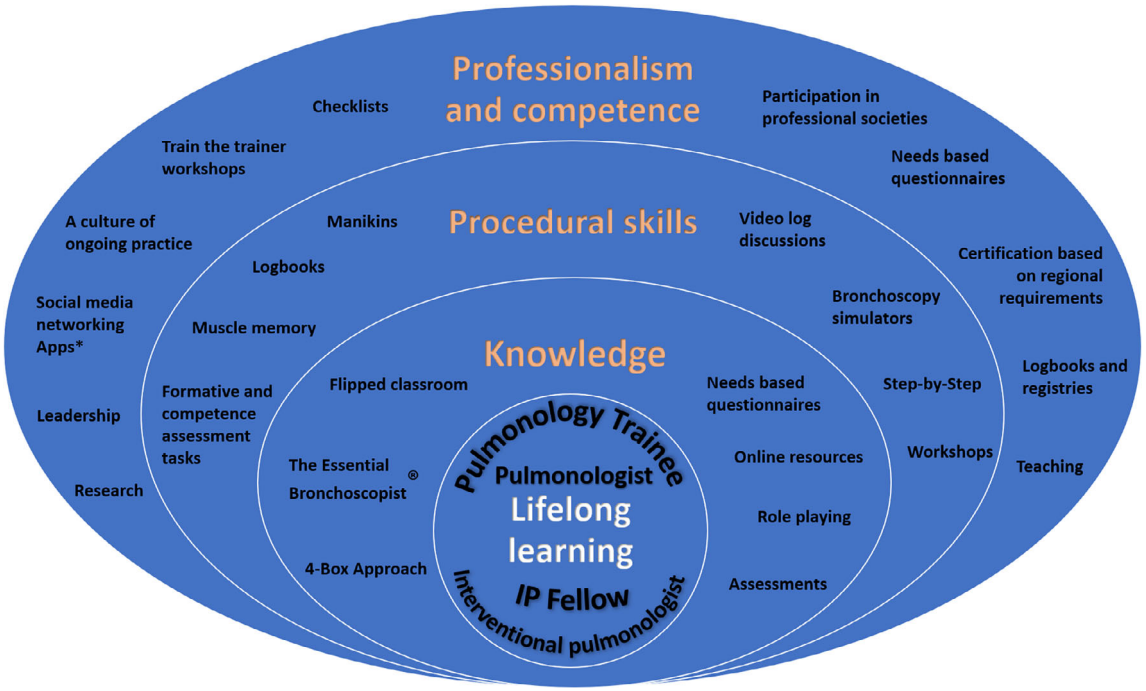

Figure 5 Lifelong IP learning begins as a junior pulmonology trainee and continues throughout a career with learning modalities that are applicable at all times and regardless of one's 'stage' in training or whether IP is a major or minor component of procedural practice. Education spirals around repeated topics and themes utilizing multidimensional, learner-centric tools reinforced by repetition, practice and directed by needs-based learning. *Social media Apps (Applications) such as WhatsApp can be used to readily communicate clinical questions and share information with other IP clinicians in real time with interactions between regions coordinated by WABIP clinician-educators. IP, interventional pulmonology; WABIP, World Association for Bronchology and Interventional Pulmonology.

educational paradigms and introducing competency-oriented materials into their training programs.

Moving forward, we believe that physicians will adopt strategies modelled on established services and modify them according to regional needs and cultural environments. An achievable goal is to develop national curricula and a more uniform approach to training. This might include central allocation schemes, developing guidelines or standards and implementing competency-based learning programs that help train future practitioners and nurture future leaders in the field. IP organizations and national bronchology societies are well positioned to drive such programs and to take maximal advantage of existing developments.

The scope of IP training is probably too broad even for a comprehensive 1-year fellowship program using current constructs. Considering the expansion of technologies and procedures, the need for continuing education and professional development is obvious for physicians at all stages of their careers. Adopting a learning paradigm in which doctors avoid using patients as learning subjects, incorporate learning tools consistent with our rapidly evolving digital age and use strategies for greater self-directed learning provides opportunities for greater efficiency in order to maintain professional standards.

CONCLUSION

Expanding opportunities for competency-based learning benefits patients, spreads enthusiasm for our specialty and provides IP physicians with strong foundational skills that might accelerate the introduction of new technologies into clinical practice. Understanding that modern competency-based teaching approaches have advantages over traditional training styles, coupled with increasing access to manikins and computer-based simulation, an open-access philosophy for distributing learning materials, and changing the role of a dogmatic and authoritarian clinician-educator to that of coach and facilitator will help overcome existing challenges.

We are confident in new paradigms where structured, multidimensional and learner-centric programs are built on the premise that patients should not suffer the burden of procedure-related training. These not only foster the development of specially trained physician-educators, but also honour the philosophies of lifelong learning and professionalism aspired by IP practitioners around the world.

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Abbreviations: AIPPD, Association of Interventional Pulmonology Program Directors; EBUS, endobronchial ultrasound; ERS, European Respiratory Society; ICC, intercostal catheter; IP, interventional pulmonology; WABIP, World Association for Bronchology and Interventional Pulmonology.

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