

## Pediatric Respiratory Medicine—An International Perspective

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**Summary.** Although Pediatric Respiratory Medicine as a subspecialty has a long tradition and is well established in some countries, there is a wide variation across different regions of the world with regard to e.g. recognition of the discipline, training requirements, training facilities and clinical needs. This review summarizes the situation in North America (US and Canada), South America, Asia, Australia, Israel and Europe with the aim to highlight commonalities and differences and, ultimately, to further support continuous development of paediatric Respiratory Medicine Worldwide. *Pediatr Pulmonol.* 2010; 45:14–24. © 2009 Wiley-Liss, Inc.

**Key words:** education; curriculum; pediatric pulmonology.

### INTRODUCTION

Worldwide, morbidity and mortality from respiratory diseases in children continue to pose a challenge to practicing physicians and healthcare systems. The prevalence and incidence of different disease entities varies greatly from country to country and from region to region. While the specific requirements for adequate care will vary accordingly, common standards for clinical management and for training of Paediatric Respiratory Specialists are desirable in order to provide the best possible care for children with respiratory diseases. Moreover, it is desirable that future pediatric respiratory specialists have insight and knowledge into the global issues in child lung health. Currently, a Task Force from the Paediatric Assembly of the European Respiratory Society is developing an updated curriculum for training in Paediatric Respiratory Medicine (PRM) in Europe. As a result of the work of this Task Force, an updated syllabus which describes the content of specialist training in PRM in Europe has been published recently<sup>1</sup> and the next steps towards a full curriculum are being taken. Similar developments are taking place in other regions internationally, and these efforts to improve training in pediatric respiratory medicine may benefit from exchange between those involved in this task. Those in the process of developing standards and setting up formal training structures may learn from others, who practice in countries where PRM has already a long tradition as a

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recognized subspecialty. There is a longstanding tradition of exchange of research fellows and clinical trainees globally among some, but not all parts of the world. In order to further facilitate development of PRM it appears desirable to understand the current conception of PRM in different parts of the world. To increase awareness and transparency, for this review members of the international pediatric respiratory community have been invited to provide information about the status of PRM locally and to describe current standards of training and potential future developments.

### **Pediatric Respiratory Medicine in Australia and New Zealand (Louis Landau)**

PRM has evolved as a distinct discipline in Australia and New Zealand already from the early 1970s. Experts in PRM provide expertise to professional colleagues and the community in addressing the “new” pediatric pulmonary morbidity including asthma, cystic fibrosis, congenital abnormalities, sleep-related disorders, management of the acute and long-term respiratory illnesses in the extremely preterm baby and management of pulmonary complications of the immuno-compromised child. The discipline must continuously adopt useful new technologies related to endoscopy, ventilation, lung function measurements particularly in the younger child and sleep physiology. Guidelines have been developed for the management of common pediatric pulmonary conditions such as asthma, cough, cystic fibrosis, home oxygen, and bronchiolitis.

The specialty of pediatric respiratory medicine began to emerge in Australia and New Zealand from the 1950s following reports of retrolental fibroplasia with high oxygen levels in preterm babies by Kate Campbell, of measuring lung function in neonates by Eric Burnard and descriptions of childhood tuberculosis, aspiration, bronchomalacia, childhood wheezing and endoscopy by Howard Williams. By the 1970s Peter Phelan, having been trained by H. Williams and J. Mead actively contributed to the establishment of an infrastructure to train the next generation of pediatric respiratory physicians. In the late 1980s, the Australian Paediatric Respiratory Group was finally established across Australia and New Zealand which now includes approximately 60 members. This number of members provides an acceptable service across all sites, but needs some growth to cope with attrition and increased needs of the community. Most services are based in the capital cities with long distances from many rural sites to access these services and workforce programs must address the needs of these dispersed communities.

Training in PRM as a discipline in Australia and New Zealand is managed through a Specialist Advisory Committee in respiratory and sleep medicine of the

Paediatric Division of the Royal Australasian College of Physicians and the Thoracic Society of Australia and New Zealand. Those interested in a career in the discipline have to complete a 3-year basic pediatric physician training program in general pediatrics first with continuing assessment and a final multiple choice written and a clinical examination. On successful completion, they commence 3 years of advance training in pediatric respiratory medicine. This training must be undertaken in an accredited training site during which there will be continuing workplace-based assessment with no requirement for an exit examination.

There are accredited training facilities in pediatric respiratory medicine in seven capital cities across Australia and New Zealand. A major concern is that most placements for training in pediatric respiratory medicine are funded as registrar or fellow posts but many do not have ongoing budgetary commitment so that availability is dependent on access to the resources each year. These places are utilized for training by local graduates and international trainees who have come mostly from Europe, North and South America, and Asia.

Advanced training sites for pediatric respiratory medicine must be accredited to ensure that they provide high-quality clinical training against predetermined standards for facilities, supervision, case-mix, educational opportunities and infrastructure. These factors determine the length of training approved at that site and the numbers of trainees that can be trained.

These standards include:

- Adequate supervision for core advanced training. This usually requires a pediatric respiratory physician on-site most of the time and particularly when trainees are undertaking invasive procedures. The supervisor must provide both formative and summative assessments to the college.
- Sufficient workload of clinical material encompassing a broad range of respiratory diseases.
- Access to appropriate clinical services for pediatric respiratory medicine such as pathology, microbiology and radiology, clinical immunology and pharmacology, thoracic surgery, pediatric and neonatal intensive care, nuclear medicine, multidisciplinary clinics with allergy, gastroenterology and infectious diseases. It is desirable to have access to specialized clinics such as those for tuberculosis, cystic fibrosis, chronic neonatal lung disease, neuromuscular diseases, tracheostomy, and outreach services.
- Sufficient workload to train in procedures such as fiberoptic bronchoscopy.
- A respiratory function laboratory with adequate workload and a full range of testing procedures in infants and children. The trainee shall report studies under supervision. The laboratory must also be accredited.

- An accredited facility for the investigation and management of respiratory sleep disorders.
- Suitable infrastructure for learning including scheduled regular interdisciplinary meetings, teaching and access to texts and on-line information.
- Suitable facilities for research with regular research meetings. Trainees need to be actively involved in at least one research project and present at a national or international scientific meeting.
- A program of quality assurance activities including audit and quality improvement meetings.

Sites are usually accredited every 5 years.

The pediatric respiratory medicine community in Australia and New Zealand has had the pleasure of working collaboratively in clinical medicine and research with colleagues from most continents, the opportunity to assist with training of trainees from all over the world and to collaborate in the development of the text on Pediatric Respiratory Medicine. This collaboration, communication, and consistency in standards should clearly benefit to all children with respiratory disease around the world.

Relevant Websites: The Royal Australasian College of Physicians—[www.racp.edu.au](http://www.racp.edu.au); Thoracic Society of Australia and New Zealand—[www.thoracic.org.au](http://www.thoracic.org.au); Pediatric Respiratory Medicine—[www.pedrespmedtext.org](http://www.pedrespmedtext.org); [www.elsevier.com/wps/find/bookdescription.cws\\_home/714165/description#description](http://www.elsevier.com/wps/find/bookdescription.cws_home/714165/description#description).

### **Pediatric Pulmonology in the United States (Thomas Ferkol and Susanna McColley)**

Pediatric pulmonology advances knowledge of acute and chronic respiratory diseases afflicting infants, children, and adolescents. Pediatric pulmonology fellowship training in the US focuses on clinical care, scholarly activity, and teaching as an advanced, 3-year, subspecialty program beyond general pediatric or medicine-pediatric residency training. Candidates are eligible for the Pediatric Pulmonology Subboard Examination of the American Board of Pediatrics following successful completion of the program. Clinical care is provided for children with a remarkable variety of lung diseases and breathing disorders, such as asthma, sleep-disordered breathing, apnea, central hypoventilation, cystic fibrosis, ciliopathies, bronchiectasis, interstitial lung diseases, bronchopulmonary dysplasia, bronchiolitis, pneumonia, chronic respiratory insufficiency, thoracic tumors, and congenital lung anomalies. Fellows have the opportunity to learn and perform bronchoscopic techniques, including bronchoalveolar lavage and biopsies, and gain understanding of pulmonary function studies and in some programs, polysomnography. A significant portion of

training consists of scholarly activity, during which fellows develop and hone skills necessary to be successful as effective subspecialists, advocates, clinical investigators, and pulmonary scientists.

The need for standardized, subspecialty training and a certifying examination in pediatric pulmonology was increasingly recognized in the 1970s.<sup>2</sup> After several years of negotiation with the American Board of Pediatrics, the American Board of Medical Subspecialties recognized Pediatric Pulmonology in 1984. The first certifying examination was given in 1985, and since then almost 1,200 individuals have taken the examination, with 821 pediatric pulmonologists certified. Initial fellowship guidelines required 16 months of research, the first pediatric sub-board that placed an emphasis on research training.

Since 1992, the American Board of Pediatrics required that all pediatric pulmonology candidates must complete three years of full-time, broad-based fellowship training at a center accredited in pediatric pulmonology by the Residency Review Committee for Pediatrics. There are currently 49 Accreditation Council for Graduate Medical Education (ACGME)-accredited pediatric pulmonology training programs, though six programs are currently inactive. The number of fellows trained at each programs varies. By the end of their training, the fellows must satisfactorily complete all required training, demonstrate clinical competence, and confirm evidence of scholarly activity. Historically, that meant basic, clinical, or translational biomedical research. More recently, the American Board of Pediatrics has broadened the definition of scholarly activity, and work in health services delivery, quality improvement, bioethics, education, and public policy will now fulfill this requirement. All pediatric pulmonology fellows trained in the United States must be assisted by a Scholarship Oversight Committee that will determine whether a specific activity is appropriate to meet the guidelines for scholarly activities. The fellow must prepare and submit a written “work product” describing their work in considerable detail; the work product must be formally accepted by the Scholarship Oversight Committee. Once all criteria are met, the fellow is eligible to sit for the pediatric pulmonology subspecialty certifying examination, the final step in initial board certification. The American Board of Pediatrics and American Board of Allergy and Immunology permit a combined 4-year program training pediatric pulmonology and allergy-immunology. Fellows may choose to complete a fourth year of sleep medicine training in an accredited program, which may or may not be formally affiliated with their pediatric pulmonology training program. Other combined training, such as pediatric pulmonology and critical care, are allowed on a case-by-case basis with prior approval of both relevant sub-boards ([www.abp.org](http://www.abp.org)).

### Challenges to the Subspecialty

In the United States, pediatric pulmonology has reached a crossroad. The American Board of Pediatrics had certified over 800 individuals in pediatric pulmonology, but the number of candidates who enter into fellowship training programs has remained consistently small over the years ([www.abp.org](http://www.abp.org)). During the years 1992–2008, between 20% and 32% of pediatric residents in the United States entered subspecialty fellowships. Between 2002 and 2008, only 30–40 individuals per year completed pediatric pulmonology fellowships, which compares to 90–100 per year in cardiology and 80–100 per year in pediatric critical care. Recently, the first pediatric pulmonology fellowship match was held for the academic year 2010. Several programs did not match a single applicant and 24% of positions were not filled ([www.nrmp.org/fellow/match\\_name/pssm/stats.html](http://www.nrmp.org/fellow/match_name/pssm/stats.html)). The growing shortage of well-trained pediatric pulmonologists in the United States potentially threatens the viability of the subspecialty and our ability to provide care for increasing numbers of children with acute and chronic lung disease. Even fewer young pediatric pulmonologists are choosing research careers,<sup>3,4</sup> which is ironic since the creation of the subspecialty was driven by the need for pulmonary scientists<sup>2</sup> and many opportunities still exist.<sup>5</sup> Each year, only a handful of physician–scientists enter the workforce. Indeed, the proportion of sub-board diplomates who are actively engaged in scholarly pursuits is low, even though the majority of pediatric pulmonologists work in academic settings. Based on a survey organized by the American Academy of Pediatrics, completed a decade ago, research activities occupied less than 15% of their professional time.<sup>6</sup> The shortage impacts training, and reduces the number of potential mentors in pulmonary research and clinical care. Recruiting, training, and fostering early careers of the next generation of academic pediatric pulmonologists, who can become leaders in the field, must become a priority. It may be time to re-examine how we train pediatric pulmonology fellows, particularly those interested in pursuing a research career. Recognizing this, the National Heart Lung and Blood Institute (NHLBI) recently held a workshop, Respiratory Medicine Related Research Training for Adult and Pediatric Fellows, to address these issues. Its recommendations are forthcoming.

### The State of Pediatric Respiri-ology Training in Canada (Tom Kovesl)

The prevalence of pediatric respiratory disease in Canada generally parallels other highly industrialized nations. Asthma is the single most common reason for admission to every pediatric hospital in Canada. Cystic fibrosis, bronchopulmonary dysplasia, neuromuscular

disease, acute lower respiratory tract infection, aspiration syndromes, and technology-dependent patients are also major concerns for the Canadian pediatric respiratory physician. In addition, the prevalence of pediatric sleep disordered breathing is rising rapidly amongst Canadian children. First Nations (aboriginal) and Inuit children represent a population with a particularly high incidence of severe respiratory infections early in life, as well as chronic complications such as *bronchiolitis obliterans* and bronchiectasis.

Pediatric respiratory training programs are well established in Canada, with training programs existing in Montreal, Toronto, and Winnipeg for over 30 years. Additional programs have been established in Calgary and Edmonton. These centers have both made, and are continuing to make, important research contributions, particularly in cystic fibrosis and asthma. Canadian pediatric respirologists have also helped develop the standard reference text in Pediatric Respiri-ology, “Kendig’s Disorders of the Respiratory Tract in Children” (Saunders Elsevier, Philadelphia PA). National Cross-Canada teaching rounds are held monthly during the academic year, and link specialists in every Canadian city that has a pediatric respirologist, using video conferencing. The rounds include case presentations and a journal club (available at: <http://www.crosscanadarounds.ca/index.html>), presented by pediatric respiratory trainees. This resource has been operational since 1997. Canadian programs graduate about two Canadian and two international candidates per year.

The Royal College of Physicians and Surgeons of Canada provides certification. In the province of Quebec, certification is also provided by the Collège des Médecins du Québec. This was previously based on a parallel examination process, but now uses the Royal College’s exams. A certificate of Special Competence in Pediatric Respiratory Medicine requires a minimum three-to-four year residency in Pediatrics, followed by a 2-year fellowship program in Pediatric Respiri-ology. Many fellows complete a third, research year, although research is also strongly encouraged during the core training period. The examination is mandatory for certification, which it is comprised of a written exam that uses short-answer questions, and a structured oral examination. A Respiri-ology Specialty Committee sets out the objectives and accredits training programs in Pediatric Respiri-ology. In addition, it recommends an examination board for Pediatric Respiri-ology to the Evaluation Committee. There is not currently a separate Pediatric Respiri-ology Specialty Committee. The objectives are broadly similar to the European HERMES syllabus.<sup>1</sup> In addition, candidates must be prepared in all key competency CanMEDS roles set out by the Royal College: medical expert, communicator, collaborator, manager, health advocate, scholar and professional ([http://rcpsc.medical.org/canmeds/about\\_e.php](http://rcpsc.medical.org/canmeds/about_e.php)). All programs provide training in

flexible bronchoscopy. Some programs also provide training in exercise testing, sleep medicine, and cross-training in pediatric critical care.

At present, there are approximately 50 pediatric respirologists in Canada. A published Canadian survey estimated that approximately one pediatric Respirologist is needed for every 360,000 population. This represents an overall shortage of at least 40%. While the number of pediatric respirologists has been growing significantly, there is still considerable regional disparity, as well as a major shortage of subspecialists in many Canadian cities. Academic positions may be limited by funding restrictions, which restricts global funding for academic specialty positions in many Canadian healthcare jurisdictions. Traditionally, nearly all Canadian pediatric respirologists have entered academic hospital-based practice. However, it is possible that an increasing number will enter community-based, private practice. The Canadian Respiratory Manpower Survey noted that the average waiting time for a routine outpatient adult respiratory consultation was unacceptably long at 4–8 weeks.<sup>7</sup> While comparable pediatric data is unavailable, it is likely that waiting times for routine pediatric respiratory consultations are much longer than that. This further supports the need to increase the number of pediatric respirologists in Canada. Manpower requirements also depend on the proportion of time academic respirologists spend performing research,<sup>6</sup> and will increasingly be influenced by the time needed to treat pediatric sleep-disordered breathing, particularly in view of North America's obesity epidemic.

In summary, Canadian pediatric respirologists have an established role in the management of Canadian children with acute and chronic respiratory disease, and nationally recognized training programs have been in place for decades. A Canadian Internet Listserv group, Ped-Lung (available at: <http://www.ped-lung.org/>), has also linked Canadian and other pediatric respirologists around the world for over 10 years. The recent establishment of the Pediatric Assembly of the Canadian Thoracic Society will further facilitate academic, clinical, and research collaborations within the Canadian pediatric respiratory community. Canada still has significant regional disparities in availability of pediatric respirologists. Care is further limited by long travel times for patients in smaller communities and rural areas, and by long waiting times throughout Canada. This will hopefully be ameliorated through the efforts of our training programs.

### **Pediatric Pulmonology in Israel (Asher Tal)**

The Israel Association of Pediatric Pulmonology was created in the early 1980s, and several years later Pediatric Pulmonology was recognized as a subspecialty by the Israel Scientific Council of the Israel Medical Association

and the Ministry of Health. Most of the “first generation” pediatric pulmonologists were trained in the USA or Canada. However, while most fellows are currently trained locally, some still spend two to three years in North America. Pediatric pulmonology units are accredited for fellowship programs only if they include at least two full-time board-certified pediatric pulmonologists, and if their service is affiliated with an active pediatric department, pediatric out-patient clinic, neonatal and pediatric intensive care units, a well equipped pediatric lung function laboratory, and flexible bronchoscopy service. Sites are usually accredited every five years after a site-visit by a committee of the Scientific Council. Pediatric pulmonology candidates are board certified pediatricians that must complete two additional years of board-based training in pulmonology that includes active participation in inpatient care in the general pediatric wards, as well as in the neonatal and pediatric intensive care units. Fellows also participate in the various follow-up clinics (asthma, cystic fibrosis (CF), bronchopulmonary dysplasia, chronic lung disease, apnea, ALTE, and SIDS), have to perform a minimum of 25 flexible bronchoscopies, be familiar with and review all lung function and challenge test methods used in children, and be familiar with polysomnography and evaluation of pediatric sleep-disordered breathing. Obligatory rotations include pediatric intensive care, adult pulmonology, and lung function laboratory. Clinical and basic science research is highly recommended but not obligatory. At the completion of the two-year fellowship, in Israel or in North America, all fellows have to pass a two-stage board examination. The first part is a written multiple choice test and, if passed, an oral test. The board examination is prepared by a committee of the Pediatric Pulmonology Association, supervised by the Israel Scientific Council. The syllabus comprises *Kendig's Disorders of the Respiratory Tract in Children* (Saunders Elsevier, Philadelphia, PA), as well as several major journals, especially the *New England Journal of Medicine*, *American Journal of Respiratory and Critical Care Medicine*, *Pediatric Pulmonology*, *Chest*, *European Respiratory Journal*, and *Thorax*.

The Israel Society for Pediatric Pulmonology organizes six one- or two-day conferences each year. One of the two-day meetings is devoted to Cystic Fibrosis, organized by the Israeli Society of Cystic Fibrosis, usually with international guest lecturers. During these meetings, research projects and case presentations are presented and discussed. The members of the Israeli Association for Pediatric Pulmonology are part of a mailing list to share publications, ideas, and opinions.

At present, there are approximately 40 board-certified pediatric pulmonologists in Israel, to serve the general population of about 7.5 million. Most of them work in major university-affiliated medical centers, while some

work in pediatric community centers. Of the 40 pulmonologists, a few are also board certified in another subspecialty such as Neonatology, Pediatric Intensive Care Medicine, and Radiology. Many Israeli pediatric pulmonologists are involved in hospital-related general pediatric clinical and teaching activities, because not all medical centers have a dedicated full time position for pediatric sub-specialists; about 50% of pulmonologists need to spend 25 to 50% of their time in general pediatrics. Unfortunately, this leaves a very small percentage of their time free for research activities. The public medical system in Israel enables easy access to sub-specialists, many of whom, including pediatric pulmonologists, also maintain a small private practice, paid partially by insurance. Hence, only a few Israeli pediatric pulmonologists do basic research, while most are indeed involved in clinical research.

Research funding in general is less available in Israel than in North America. The government grants are smaller in scale than most NIH grants. Some private foundations fund research, but most research done in pediatric pulmonology is unfunded.

The “bread and butter” for a pediatric pulmonologist in Israel is asthma, recurrent wheezing in infancy, and respiratory infections. There are six CF centers in Israel, with multi-disciplinary staff, looking after about 400 patients. The six CF centers cooperate in a wide range of both clinical and basic science and genetic research producing many high quality publications.

In summary, pediatric pulmonology is a well-established pediatric sub-specialty in Israel. Most units are run by graduates of North American fellowship programs, and provide an excellent and available clinical service to the Israeli population. Most members of the Israel Association of Pediatric Pulmonology are actively involved in clinical research, and publish in major international journals. Unfortunately, it is difficult to have enough “free time” for basic research, with only a few pediatric pulmonologists involved, mainly in CF and sleep medicine.

### **The State of Pediatric Pulmonology Training in South Africa—A Resource For Africa (Heather J. Zar)**

Respiratory disease is a major cause of healthcare utilization, morbidity and mortality in children in South Africa and other African countries. Infectious respiratory diseases such as pneumonia and tuberculosis predominate. Pneumonia is a major cause of death in African children under 5 years of age. The HIV epidemic has led to an exponential increase in pulmonary infectious diseases and more severe illness, with an increase in the prevalence of chronic lung diseases. In addition, the burden of childhood asthma has been reported to be increasing

especially in the developing countries. Rates of childhood asthma in African countries participating in the International Study of Asthma and Allergies in Childhood studies (ISAAC) are similar or higher than the reported global average, with an increasing prevalence in both urban and rural areas. However, despite the great burden of childhood respiratory disease, there are very few trained pediatric pulmonologists in South Africa and Africa. Moreover, very limited opportunities for training in pediatric pulmonology exist in African countries.

Despite the large burden of pediatric respiratory illnesses in South Africa and Africa and the dire shortage of trained specialists, prior to 2006 there were no formal programs for pediatric pulmonology training in Pediatric Respiratory Medicine in South Africa. However, as a result of advocacy by South African pediatric pulmonologists and with the support of the South African Thoracic Society, training programs have recently been established in four of the major academic centers—University of Cape Town, Stellenbosch University, University of Pretoria and University of Kwazulu Natal. Currently, there are nine trainees in these programs. Funding for these training posts comes largely from the Department of Health; in addition, an annual fellowship, administered by the South African Thoracic Society, has been funded by a pharmaceutical company. In addition to these posts which are assigned nationally, the center at the University of Cape Town has a funded an African Fellowship Program training program for pediatricians from African countries other than South Africa who wish to specialize in Pediatric Respiratory Medicine. This program enables pediatricians from Kenya, Uganda, Malawi, Zimbabwe, and Zambia to subspecialize in PRM. Potential trainees are identified by their own academic institutions, who ensure that there will be a post available to return to once training is completed. To date, there have been three trainees from Kenya, two of whom successfully completed the training, while a 3rd is currently in training.

Pediatric pulmonology is recognized as a subspecialty by the Health Professions Council of South Africa. To register as a pediatric pulmonologist, candidates must complete 2 years of specialist training and successfully pass an exam. The training program encompasses 2 years of clinical training and includes a compulsory research component. Standard training requirements, a curriculum and log book have been developed. Academic centers must apply for accreditation as a training center to the Health Professions Council of South Africa and must fulfill specific requirements in order to receive accreditation (e.g., ratio of registered fulltime pediatric pulmonologists to trainees at the center must be not less than 2:1, the facility must meet specific requirements, etc.). The pediatric pulmonology exam includes a written and an oral component; the first exam was successfully held in 2008.

This recent establishment of accredited South African training programs in pediatric pulmonology is a real advance in developing local and African capacity in this specialty. Ongoing development, expansion, and evaluation of the programs are needed to meet the need for pediatric pulmonary specialists in South Africa and Africa. Such training programs must strive to address the large burden of childhood respiratory illness, to improve the current standard of clinical care and to create new knowledge through research. These training programs should be at the forefront of developing new leaders and research with the potential to impact on child lung health in South Africa, in Africa, and globally.

### **Pediatric Pulmonology Training Across Asia (Gary WK Wong)**

Asia is the most populous continent and a large percentage of the population is in the pediatric age range. As a result, pediatric respiratory diseases are common problems resulting in significant morbidity and mortality in the entire region. With increasing urbanization and economic improvement, the prevalence of asthma is increasing rapidly across different countries in Asia.<sup>8</sup> Furthermore, with the increasing prevalence of childhood obesity, there is a great demand for assessment of obstructive sleep apnea syndrome in children across different Asian countries.<sup>9</sup>

In most countries in Asia, formal training programs for general pediatrics have been established for many years but there is still a lack of standardized training for pediatric pulmonology. Since the early 1980s, many pediatricians with an interest in pediatric respiratory diseases have gone overseas to acquire further subspecialty training. The duration of such training varies widely from 6 months to a few years depending on the funding available in their countries of origin. Interested pediatricians may also have attended short training courses in specific areas such as pediatric bronchoscopy and pediatric sleep medicine. The United States, United Kingdom, Canada, and Australia are the countries that pediatricians most commonly undergo their subspecialty training.

It has only been in the 1990s, that several countries in Asia have established formal training programs with a defined syllabus for pediatric pulmonology. Thailand, Singapore and Taiwan have led this development. The duration of the subspecialty training program is 2 years and trainees are required to pass an exit examination in Taiwan and Thailand in order to obtain certification of subspecialty in the field. In addition to a component of research during the 2 years of training in Thailand, the exit examination includes an oral examination as well as a multiple-choice examination. Furthermore, recertification in Taiwan is necessary every 6 years with appropriate documentation of continuous medical educa-

tion (CME) in the related discipline. In large academic centers across mainland China, there are also formal training programs which last for 2–3 years. However, there is no formal or national exit examination when the trainees complete the program. Currently in South Korea, there is a 1-year training program for pediatric pulmonology and allergy, and trainees are required to pass an exit examination at the end of their training. In the countries with formal training programs, pediatric critical care medicine is usually part of the syllabus and pediatricians are expected to provide services in the field of critical care after completion of their pulmonology training.

As compared to the long history of subspecialty development in the United States or European countries, many training programs of pediatric pulmonology in Asia are still in their infancy. In order to provide quality services to children with respiratory diseases and to facilitate quality research in the field, there is an urgent need for establishing formal training program of pediatric pulmonology across different countries in Asia. National pediatric societies should evaluate the current work load of all the cases related to pediatric pulmonology within their own countries in order to estimate the number of specialists required to provide an adequate service for the specialty. Evaluation of the case load in large academic centers is needed in order to establish the accredited sites for the future training programs. This process is currently underway and is facilitated by the establishment of the children's hospital in Hong Kong. Ideally, a common syllabus, training program, and evaluation system for Asia would be desirable for facilitating the development of the specialty in the region. However, given the diversity of cultures, languages, and epidemiology of respiratory conditions in different countries, a common syllabus may be difficult to develop. Nevertheless, different centers may have different expertise in providing different modules of training in this important subspecialty of pediatric pulmonology. Collaboration in both training and research programs among large centers across Asia will most likely lead to sustained development and maturation of the training programs for many Asian countries.

### **Pediatric Respiratory Medicine in South America (Ignacio Sánchez)**

In South America, pediatric respiratory disorders are a major cause of morbidity. Along with viral and bacterial infections of the upper airways, pneumonia and obstructive diseases of the lower airway in infants are the most frequent reasons for pediatric outpatient visits and hospital admission. Countries participating in this overview of Pediatric Respiratory Medicine Programs in South America were Argentina, Brazil, Chile, and Peru, who have developed training programs since 1985, establish-

ing one to eight programs per country and yielding a varying group of 10–35 fellows per center since the beginning of each Program. The main motivation for starting these training programs has been to spread the knowledge that fellows had acquired while training abroad in renowned academic centers in North America, Europe, or Australia. After completion of their fellowship they came back to work at public and university hospitals locally and have started to develop individual training programs. These were subsequently developed with clear objectives and university certification to be officially recognized. To be eligible for any of these pediatric pulmonology training program, candidates must complete a 3-year period of pediatric training before applying for a fellowship. In most cases, the training program lasts 2 years with an optional 3rd year, which is focused on research in pediatric respiratory topics.

The objectives and contents of all existing programs include an extensive and detailed review of basic sciences (anatomy, physiology, physiopathology, biochemistry, and molecular genetics), a thorough revision of the different respiratory illnesses affecting the upper and lower airway, restrictive pathologies, bronchial and lung malformations, obstructive diseases, and genetic-related illnesses. Additionally, fellows have to measure and review lung function in children of all ages and learn about their potential research applications. The entire range of techniques and methods is available including spirometry, body plethysmography and lung volume measurements, bronchial provocation challenge tests with metacholine, histamine, cold air and exercise, measurement of diffusion capacity as well as measurement of exhaled nitric oxide, as well as sweat testing and assessment of ciliary function. In some centers, infant lung function testing including assessment of lung mechanics, lung volume, airway function using the rapid thoraco-abdominal compression technique is performed. Rotations during the subspecialty training include basic hospital admission service, intermediate and intensive care unit, neonatology, ambulatory care facilities, lung function laboratory, bronchoscopy unit, and specialty rotation units such as pathological anatomy, immunology, radiology, otho-rhino-laryngology. Research facilities are usually offered in an early optional rotation allowing fellows to participate in a wide range of research projects and to develop a particular research interest during their training period. This is particularly helpful for those who voluntarily do a 3rd year of training. This part of the subspecialty training appears crucial for defining specific interests in pediatric respiratory medicine knowing that the chosen research project may provide the basis for future academic activities.

Teachers at these training programs are university faculty, most of whom have traveled abroad for training and who have significant experience in the development

of basic, clinical, and epidemiological research. Discussing medical evidence is generally considered very important and regular journal clubs are held to critically discuss recent scientific publications. At the end of the Program, fellows have to undergo a written exam with multiple-choice questions as well as an oral exam in front of an Examination Committee. Most of the centers ask their fellows to publish a scientific paper before finishing the program, which may summarize a research project conducted during the fellowship and may have been presented previously at a scientific meeting.

Research from South America has been published in international journals, topics being asthma, lung function in infants, cystic fibrosis, bronchopulmonary dysplasia and infectious respiratory diseases, particularly infection with respiratory syncytial virus and bronchiolitis obliterans caused by adenovirus infection. In the last years, non-invasive ventilation has become a focus of interest in patients with chronic respiratory disease. Though regional publications on these topics account for a rather small percentage of those internationally published, they are the result of a significant effort from the different training centers in South America and the work of different university programs.

Specialists in the region have historically grouped in societies, such as the Adult Respiratory Medicine Society of each country with the corresponding Pediatric section. More recently, local Societies of Paediatric Pulmonology have been formed, as well as the Latin American Pediatric Pulmonology Society. This organization holds a meeting every 3 years, for the last 20 years, which regularly gathers more than 1,000 pediatricians and specialists from the region. This meeting has increasingly fostered the discussion of clinical cases, their treatment and the planning of multidisciplinary and multicenter basic and clinical research protocols.

The development of pediatric respiratory medicine in South America is based on the international ties and agreements between faculty and former fellows from training programs in North America, Europe, and Australia. These contacts and international exchange have been very important in achieving a harmonic development. Furthermore, constant training enables faculty to stay updated both, with regard to research projects and medical issues. A permanent challenge is to strengthen collaborative research projects and academic exchange in order to allow continuous update and training. South American centers can offer interesting areas of research and educational exchange to centers in North America and Europe, because they have well trained specialists, excellent students and a wide range of patients presenting with a variety of interesting disease entities. The ongoing challenge for South American Pediatric Respiratory Specialists is to keep improving our Programs, to cover



the variety of pediatric respiratory Medicine. Their aim is to involve current and future fellows in innovative and creative basic and clinical research to allow translation of knowledge “from bench to bedside” with the overall goal to continuously improve patient care.

## ADDENDUM

The following specialists have contributed to the regional overview of South American Pediatric Respiratory Medicine on behalf of their representing countries: Argentina: Alejandro Teper Carlos Kofman; Brazil: Gilberto Fisher, Renato Stein MD; Peru: Pascual; Chile: Eliana Ceruti, Ricardo Pinto, Guido Girardi, Ricardo Kogan, María Angélica Pérez, Pablo Bertrand, Jose Antonio Castro-Rodriguez, Ignacio Sánchez, Javier Mallol, María Lina Boza.

### Pediatric Respiratory Medicine in Europe (Monika Gappa\*)

\*on behalf of the Paediatric HERMES Task Force: J. Paton, E. Baraldi, A. Bush, K-H. Carlsen, J. de Jongste, E. Eber, B. Fauroux, S. McKenzie, J-L. Noël, P. Pohunek, K. Priftis, T. Séverin, J. Wildhaber, Z. Zivkovic and M. Zach.

The political situation in Europe is unique as the European Union (EU) comprises an economic and political union of 27 member states with a wide variety of healthcare systems, a range of issues related to respiratory diseases as well as differences in medical education and specialty practice. The EU has released directives which allow free access for European Medical Specialists on the European job market. However, medical training is organized under the national authorities and varies significantly from country to country.<sup>10</sup> Some degree of standardization appears therefore mandatory to consider the free access to the job market acceptable. In order to harmonize training in PRM, a first European syllabus for Training in PRM as a tertiary care subspecialty has been developed more than 10 years ago.<sup>11</sup> This first syllabus has been invaluable to help increase the recognition of and to establish and strengthen PRM as a subspecialty within Europe.

Despite this, PRM is still developing as a subspecialty in Europe with widely different approaches in countries within the EU, where the spectrum reaches from PRM as a recognized subspecialty with formal training (UK, the Netherlands, Germany, Austria, and Switzerland), to countries where PRM is not recognized at all, may be organized by adult respiratory specialists and where no formal training has been constituted. Because of this situation, there are no validated numbers as to how many trained Pediatric Respiratory Specialists practice within Europe, how many training programs are available and, on a

European level, centers are self-accredited and no objective data regarding content and quality of training are available.

One particular issue with regard to harmonization of training on the European Level is the EU principle of subsidiarity, that is, that a European body may propose a concept for, but implementation of remains under the auspices of the national authorities. Therefore, at present, any curriculum that is being developed has to be considered a recommendation rather than an obligatory requirement. General requirements for Paediatric Training in Europe are proposed by the European Academy of Paediatrics (EAP), the Paediatric Section of the Union of European Medical Specialists. Training in Tertiary Care subspecialties such as PRM should follow a 3-year Common Trunk Training in General Paediatrics, should be competency based where competence relates to knowledge, skills, and behavior, leaving behind a solely time-based framework for medical training.

In response to current curriculum recommendations of the EAP, and following a survey amongst the members of the ERS Paediatric Assembly, the Paediatric Harmonised Education in Respiratory Medicine for European Specialists (HERMES) Task Force was approved by the ERS and has started its work toward an updated the European Training syllabus in PRM 2 years ago. The first part of this curriculum development, an updated syllabus, has just been published.<sup>1,12</sup> Briefly, following at least 3-year training in General Paediatrics, a 3-year subspecialty training is proposed which should cover 21 areas (mandatory modules) including Respiratory symptoms and Signs, Pulmonary Function Testing, Airway Endoscopy, Imaging, Acute and Chronic Lung Infection, Tuberculosis, Cystic Fibrosis, Bronchial Asthma, Allergic Disorders, Congenital Malformations, Bronchopulmonary Dysplasia, Rare Diseases, Sleep Medicine, Rehabilitation, Inhalation Therapy, Technology Dependent Children, Epidemiology and Environmental Health, Management and Leadership, Teaching, and Communication and Research; these are supplemented by three optional modules which may or may not be covered during the training including Rigid and Interventional Endoscopy, Post Lung Transplant Management and Additional Diagnostic Tests. The new syllabus describes the content of training and defines levels of competence to be achieved for each item listed in this syllabus ([http://hermes.ersnet.org/uploads/Document/de/WEB\\_CHEMIN\\_4260\\_1237469392.pdf](http://hermes.ersnet.org/uploads/Document/de/WEB_CHEMIN_4260_1237469392.pdf)). Based on this syllabus as the first step towards a new European Training Curriculum, the Task Force is currently developing the second of a series of documents which defines training requirements: For each item listed in the syllabus, minimum requirements are proposed, knowledge, skills and attitude and behavior to define the competence to be achieved is detailed. To facilitate practical implementation of the proposed content, summative clinical situations to reflect the

syllabus content, as well as potential assessment tools will be included. Along with the curriculum development, assessment tools will be proposed that are acceptable and applicable for all countries aiming to implement the new curriculum. At the same time, a (voluntary) exit examination is being prepared which will be purely knowledge based and composed of MCQs. To support teaching and availability of knowledge, the European Respiratory School is developing teaching materials including e-learning tracks for each of the modules listed in the curriculum. The real challenge, however, will be to define training center standards, implement center visitation programs for accreditation of training centers and establish training networks of smaller centers which do not have the facilities to provide full training in PRM. How this new syllabus is accepted and implemented will differ from country to country. Flexibility has to be important, or parts of Europe may be unable to offer training in PRM. The harmonized training concept should aim to achieve the highest possible standard but remain realistic at the same time. The aim within Europe is that PRM will be recognized as a separate subspecialty in all member countries; and that the curriculum currently developed by the ERS Task Force is the basis for national training programs across Europe. Until now, only a curriculum for tertiary care PRM is being developed. However, depending on the national healthcare systems, concepts for training in PRM on the secondary or primary care level need to be developed.

It is hoped that the wide representation of countries in the Task Force developing the curriculum will increase acceptability and thus allow continuing development of PRM as a recognized subspecialty. To complicate issues, there are European countries who are not member of the EU and where even less information regarding specialist training in PRM is available (e.g., Russia). The Paediatric HERMES curriculum, however, will hopefully be acknowledged by these countries as well and may serve as a guideline even if a different legal and political framework applies. There are no validated numbers as to how many pediatric respiratory specialists practice in the EU and other European countries, nor how many will have to be trained to meet the needs of children with respiratory problems. However, with this new pediatric HERMES project and further development of accredited training programs hopefully, an increasing number of well trained Paediatric Respiratory Specialists will be available so that ultimately all children with respiratory illnesses will benefit from the very best of the specialist knowledge and expertise available.

## CONCLUSION AND FUTURE PERSPECTIVE

In the present review, views on Training in Pediatric Respiratory Medicine from seven different regions across

the world are presented. Clearly, the longest traditions with a formal training program for more than 30 years exist in Australia and the US. However, despite this long-standing experience with training and the excellent reputation of a large number of centers in the US both for their clinical expertise as well as for their research activities, there is great concern that there is an increasing lack of fellows interested in taking up this specialty training, which may threaten the future of Pediatric Respiratory Medicine in this region. Similarly, in Canada, where a formal training program has long been established, there is still a lack of experts. In Australia, some of the training posts are not funded on a regular basis limiting prospective development of the subspecialty. However, because there is “only” one body of National authorities involved both in the US and in Canada, it may be easier to respond to the recognized shortcomings of the respective programs and the changing needs of the society. In all other regions covered in the current review, although with a wide variety of economic situations within and between regions, the main challenge remains to find a consensus to harmonize training across countries, to allow flexibility both, during the training period as well as following completion of training. All colleagues who contributed to this review are internationally well known experts in pediatric respiratory Medicine who have continuous exchange with colleagues from all over the world. It may be easier to establish research networks than to consent on the best possible and appropriate training while accommodating the special (medical) needs within each of the regions. However, the continued exchange between colleagues is essential to support further development of the subspecialty on the regional (and national) level. It is hoped, that a successful initiative in one region of the world will facilitate the development of harmonized training concepts in the others. Therefore, the European Paediatric HERMES project may serve as a positive example how to develop PRM in a region where national societies remain the responsible authorities for developing subspecialties.

Respiratory diseases remain a major challenge for practicing pediatricians as well as for healthcare systems and the societies in general, irrespective whether the focus is on infectious diseases as in developing countries, on allergic respiratory disorders or respiratory problems secondary to increasing pollution. It is in the interest of the young patients and their families that the international pediatric respiratory community collaborates and continues to exchange fellows and knowledge. Trainee exchange programs between fellows from low, middle, and high income countries could enhance training and skills transfer and promote greater awareness of childhood respiratory illnesses globally.<sup>13</sup> The positive attitude of individual pediatric respiratory specialists and the respective societies towards this overall goal of

improving pediatric respiratory care is reflected in this review that demonstrates worldwide support for further increasing harmonization of Training content and programs worldwide.

## REFERENCES

- Gappa M, Noel JL, Severin T, Baraldi E, Bush A, Carlsen KH, de Jongste JC, Eber E, Fauroux B, McKenzie S, Noel JL, Palange P, Pohunek P, Priftis K, Severin T, Wildhaber JH, Zivkovic Z, Zach M, Paton J. Paediatric HERMES: a European Syllabus in Paediatric Respiratory Medicine. *Breathe* 2009;5:237–247.
- Taussig L. Pediatric pulmonology. In: Pearson H, editor. *History of the American Board of Pediatrics*. Chapel Hill: American Board of Pediatrics; 2008. pp 163–167.
- Chernick V, Mellins RB. Pediatric pulmonology: a developmental history in North America. *Pediatr Res* 2004;55:514–520.
- Freed GL, Dunham KM, Switalski KE, Jones MD, Jr., McGuinness GA. Pediatric fellows: perspectives on training and future scope of practice. *Pediatrics* 2009;123:S31–S37.
- Abman S, Jobe A, Chernick V, Blaisdell C, Castro M, Ramirez MI, Gern JE, Cutting G, Redding G, Hagood JS, Whitsett J, Abman S, Raj JU, Barst R, Kato GJ, Gozal D, Haddad GG, Prabhakar NR, Gauda E, Martinez FD, Tepper R, Wood RE, Accurso F, Teague WG, Venegas J, Cole FS, Wright RJ, Gail D, Hamvas A, Kerckmar C, Kiley J, Weinmann G. Strategic plan for pediatric respiratory diseases research: an NHLBI working group report. *Pediatr Pulmonol* 2009;44:2–13.
- Redding GJ, Cloutier MM, Dorkin HL, Brotherton SE, Mulvey HJ. Practice of pediatric pulmonology: results of the Future of Pediatric Education Project (FOPE). *Pediatr Pulmonol* 2000;30:190–197.
- Cockcroft DW, Wensley D. Respiriology manpower in Canada—a report for the Canadian Thoracic Society Education Committee. *Can Respir J* 2000;7:451–455.
- Fok AO, Wong GW. What have we learnt from ISAAC phase III in the Asia-Pacific rim? *Curr Opin Allergy Clin Immunol* 2009;9:116–122.
- Chay OM, Goh A, Abisheganaden J, Tang J, Lim WH, Chan YH, Wee MK, Johan A, John AB, Cheng HK, Lin M, Chee T, Rajan U, Wang S, Machin D. Obstructive sleep apnea syndrome in obese Singapore children. *Pediatr Pulmonol* 2000;29:284–290.
- Zach M. Paediatric Respiratory Training in Europe: political, educational and historical perspective. *Breathe* 2009;5:374–383.
- Zach MS. Paediatric respiratory training in Europe: syllabus and centres. *Eur Respir J* 2002;203:1587–1593.
- Gappa M, Paton J, Baraldi E, Bush A, Carlsen KH, de Jongste JC, Eber E, Fauroux B, McKenzie S, Noel JL, Palange P, Pohunek P, Priftis K, Severin T, Wildhaber JH, Zivkovic Z, Zach M. Paediatric HERMES: update of the European Training Syllabus for Paediatric Respiratory Medicine. *Eur Respir J* 2009;33:464–465.
- Mellins RB, Zar HJ. Training pediatric pulmonologists for the future: academic is a state of mind not just a location. *Pediatr Pulmonol Suppl* 2004;26:9–11.