

## NHLBI Training Workshop Report: The Vanishing Pediatric Pulmonary Investigator and Recommendations for Recovery

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**Summary.** The adequacy of the pipeline of advanced pulmonary fellows to supply appropriately trained and committed researchers to enter academic careers was the major topic of a recently held National Heart Lung and Blood Institute NHLBI Workshop: Respiratory Medicine-Related Research Training for Adult and Pediatric Fellows. The special challenges and opportunities for the academic pediatric pulmonary trainee were discussed as part of this workshop and are discussed as a companion paper to the report by the full workshop. Surveys were conducted of pediatric chairs of academic departments and pediatric pulmonary training directors in the United States to examine the current status and opportunities for the pediatric pulmonary trainee. Strategies for recruitment and retention of talented young trainees and junior faculty are proposed. *Pediatr Pulmonol.* 2010; 45:25–33. © 2009 Wiley-Liss, Inc.

**Key words:** clinician researcher; training pipeline.

### INTRODUCTION

Pediatric pulmonology is a relatively young medical discipline, recognized by the American Board of Pediatrics (ABP) as a subspecialty only a quarter century ago. In 2008, 897 of 18,949 (4.7%) pediatric specialists certified by the ABP were in pediatric pulmonology (<https://www.abp.org/ABPWebStatic>), though 50% of visits to pediatricians are for respiratory symptoms, and respiratory diseases are the most common causes for pediatric emergency department and hospital visits.<sup>1</sup> The number of pediatric pulmonary candidates who have successfully transitioned from training to faculty positions has decreased during the past decade. This shortage is increasing. The first pediatric pulmonary fellowship match occurred in June 2009 for academic year 2010; 24% of positions were not filled and many programs did not match a single applicant ([www.nrmp.org/fellow/match\\_name/pssm/stats.html](http://www.nrmp.org/fellow/match_name/pssm/stats.html)). Because ~40% of the fellowship candidates are non-American medical graduates, these individuals face significant challenges regarding grant eligibility and research support. This shortage of well-trained pediatric pulmonologists who are adequately prepared to seek peer-reviewed funding potentially threatens the viability of the field and the

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ability to provide care for increasing numbers of children with acute and chronic lung disease. It is equally worrisome that the proportion of sub-board diplomates who are actively engaged in scholarly pursuits continues to decline.<sup>2,3</sup> This will impede our ability to develop new approaches to prevent and cure both childhood and adult respiratory disease, and to sustain strong academic programs in the future.

Opportunities for discovery research in childhood lung diseases have expanded with new insights into the human genome, epigenetics, functional genomics, and emerging technologies to examine the complex networks of genes and gene products that influence health and disease.<sup>4</sup> As we document below, there are many job opportunities for those with appropriate research training. The need for a well-trained workforce of clinician–scientists is especially critical for achieving success along the National Institutes of Health (NIH) Roadmap (<http://nihroadmap.nih.gov/>). Without such personnel, the concept of a new transformative approach to translate observations from the bench to the bedside will be difficult, if not impossible. Although an academic career in biomedical research, like any career, has its challenges it is also very rewarding as discoveries from the bench are applied to diagnostic testing or clinical care. These limitless possibilities are being constrained by the shrinking pool of pediatric pulmonary scientists as well as a decreasing number of physicians choosing to pursue a research career at all.<sup>5,6</sup> Recognizing this, the National Heart Lung and Blood Institute (NHLBI), which actively helps to prepare investigators to participate in this research, organized a Respiratory Medicine-Related Research Training for Adult and Pediatric Fellows Workshop to address these issues. Participants included pulmonary training directors, NHLBI T32 training program directors, and representatives from professional societies.

## PEDIATRIC PULMONARY TRAINING

The challenges that confront the pediatric pulmonology pipeline occur well before a trainee selects a career path. Although nearly 2,400 medical students enter pediatric residencies in the United States each year, few are considering additional subspecialty training and even fewer select pediatric pulmonology as a career path. Vanishingly few choose a research career, a phenomenon not unique to our pediatric subspecialty. More than half of respondents to a recent survey of all pediatric fellows in the United States stated that they would prefer shortened training without research or scholarly activity as their priority is skill development for clinical practice.<sup>7</sup> Trainee commitment to the competing demands of clinical service and scholarship appears to be in flux, perhaps in part due to changing generational perspectives. This also reflects the failure to recognize potential benefits from research to

enrich their clinical training and skills in problem solving during fellowship even in trainees who do not choose to pursue a long-term academic career. Increasingly medical trainees are finding that it is difficult to balance career and family demands: competing careers of spouses/partners, concerns over timing of child-bearing, demands of child-rearing, increased medical school debt, and pressure to moonlight to cover these expenses are tipping the balance, as shown in the accompanying manuscript (ref full workshop report).

To examine the status of pediatric pulmonary training programs, two questionnaires were created and distributed to USA-based pediatric department chairs and pediatric pulmonology fellowship training directors, respectively. Both survey questionnaires and the resultant information, as outlined in figures, are available as supplemental documents on line.

## CAREER OPPORTUNITIES IN ACADEMIC PEDIATRIC PULMONOLOGY

To better understand the magnitude and nature of the career opportunities in academic pediatric pulmonology, a survey of the Association of Medical School Pediatric Department Chairs (AMSPDC) was performed between December 2008 and February 2009. Fifty-nine percent ( $n = 75$ ) of the total 128 eligible departments responded. A higher response rate was obtained from the medium (faculty size = 60–150 members) and large (faculty size >150 members) pediatric departments with response rates of 60% ( $n = 37$ ) and 80% ( $n = 24$ ), respectively. The results below only represent the departments who responded to our survey.

At the time of the survey, AMSPDC pediatric departments had few pulmonologists (average, 4.8 faculty members; median, 4 members) with markedly fewer serving as principal investigator (PI) on NIH R01 grants (average department, 0.8 pulmonologists, with ~50% conducting clinical research) or acting as the primary mentor for a K award (average department, 0.1 pulmonologists) (Fig. 1). Not surprisingly, the large departments had the larger pulmonology divisions (average, 8.1 members) and more, albeit inadequate, amount of major NIH-related research activities. As shown in Figure 2, the large departments had on average 1.4 pulmonologists who were a PI on an R01 compared to 0.7 pulmonologists in the medium sized departments, while only one small department reported a faculty member who was a PI on an R01. The large departments had an average of only 0.3 pediatric pulmonology faculty who were serving as the primary mentor for a K awardee. Self-sustaining research programs require a critical mass of anchor investigators and mentors. We suggest that an adequate minimum number is four pediatric pulmonary faculty in an academic department with or without an R01

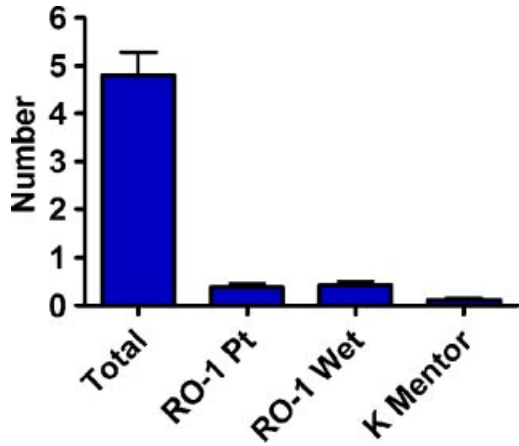


Fig. 1. Average number of pediatric pulmonologists and research status in U.S. academic pediatric departments. The average number is 4.8, with <1 full-time equivalent NIH R01 funded, shown as the mean ± standard error of the mean (SEM). RO-1 Pt, patient-based RO-1 grant as principal investigator; RO-1 Wet, wet laboratory-based RO-1 grant as principal investigator; K mentor, primary mentor for a K awardee.

equivalent. This estimates that faculty would have 25% clinical effort, 25% training/education effort, and as much as 50% to pursue scholarly activities. Junior faculty to be successful in building a research career need protected time of 75–80%.

Pediatric chairs reported that there were a large number of academic job opportunities for pediatric pulmonologists. Those who responded to our survey indicated that they anticipated 145 positions to be available between 2009 and 2014 and 31 retirements expected (Fig. 3). Equally important was their stated goal to allocate 38 of these positions to pulmonology faculty who would commit >80% of their time doing research and 31 of these positions to faculty who would spend 50–80% of their time doing research. Over 70% of medium and large

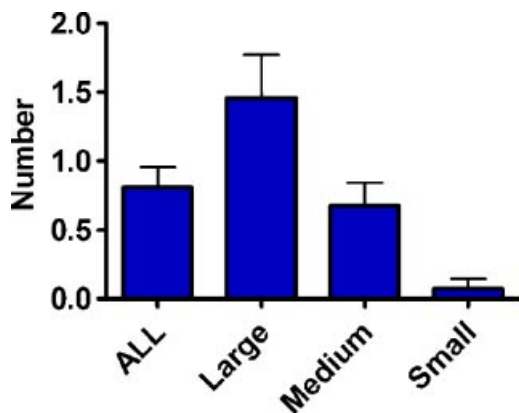


Fig. 2. Effect of department size (see text) on number of R01 grants held by pediatric pulmonologists, depicted as mean ± SEM. On average, larger departments had the higher average number of R01-funded faculty.

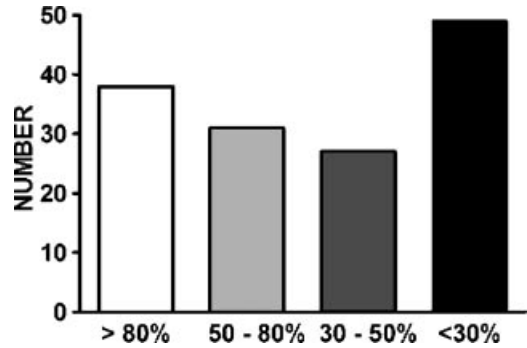


Fig. 3. Anticipated number of pediatric pulmonologists to be hired (2009–2014) by Pediatric Department Chairs and anticipated percent research time, represented as the mean ± SEM. Based on responses, there are 38 anticipated positions for pediatric pulmonology faculty who would have >80% research time.

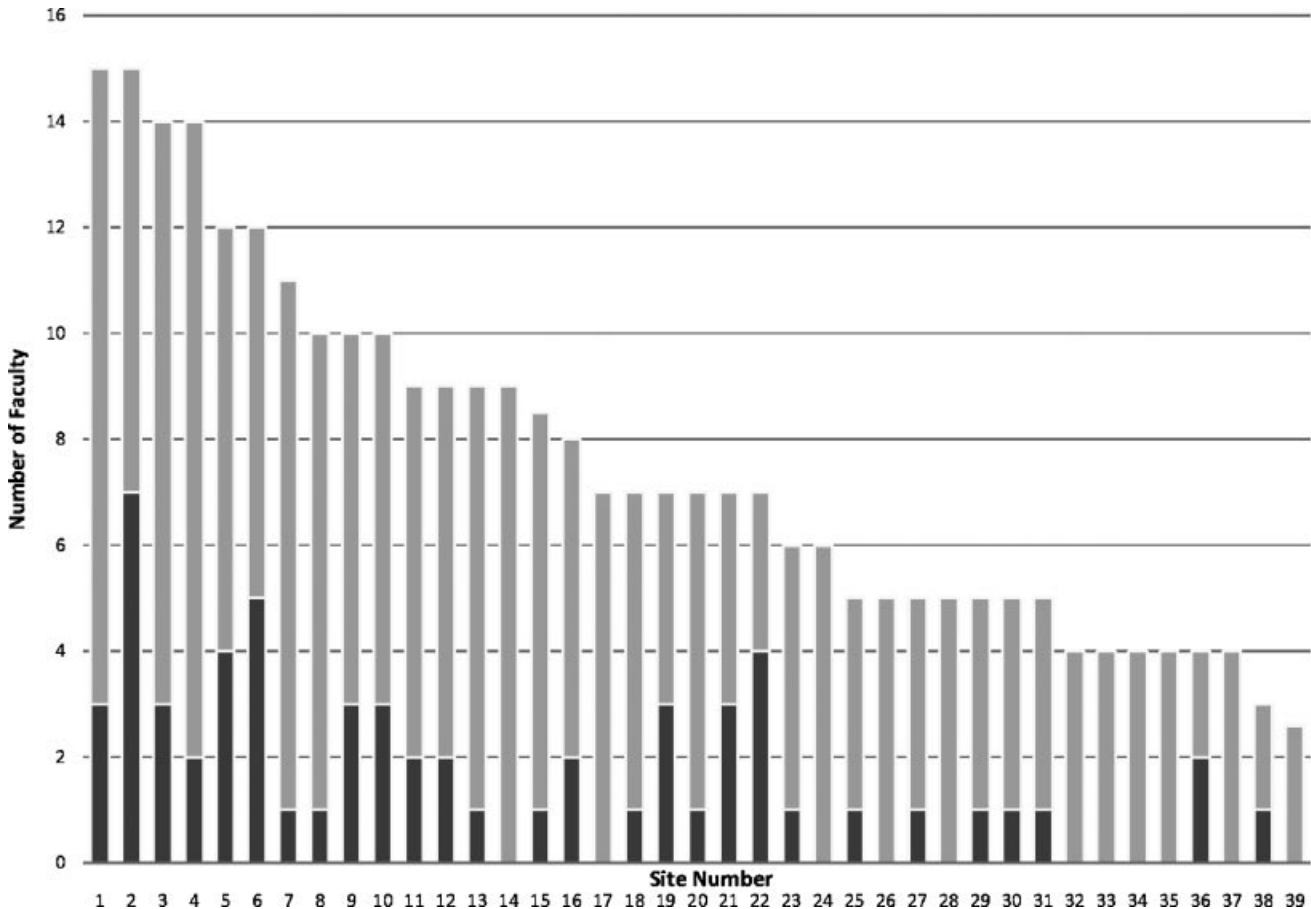
sized departments had established mentorship programs for their young faculty. This survey clearly indicates that there are future opportunities for pediatric pulmonary fellows who are adequately trained in research, yet the current academic pipeline is grossly inadequate to meet this need.

### STATUS OF PEDIATRIC PULMONARY TRAINEES

An 18-question survey was distributed to program directors of all 49 Accreditation Council for Graduate Medical Education (ACGME)-accredited pediatric pulmonology training programs to gather information regarding four elements critical to training: (i) faculty and mentors, (iii) the fellowship training program, (iii) trainee experience and support, and (iv) funding success of recent fellow graduates during the past 5 years (2003–2008). Six programs were inactive and four active programs did not respond by the deadline. Thirty-nine fellowship directors (90.7%) of active training programs returned completed questionnaires.

Based on this survey (Supplemental Materials), the typical “academic” division with an active, ACGME-accredited training program has 7.3 pediatric pulmonologists (range, 2.6–15 pulmonologists). Several pulmonology divisions have additional faculty (PhD scientists, allergists, immunologists, and critical care pediatricians), many of whom have extramural research funding and are central to their program’s research efforts, but their activities were not included in the survey. Approximately 27% of the pediatric pulmonologists involved in fellowship programs have more than 50% of their salary supported by extramural research funding, and 20.7% are PI on NIH-supported projects (Fig. 4).

A total of 217 pediatric pulmonology fellows, an average of 43.4 fellows annually, were trained by participating programs during the period surveyed (academic years 2003–2008). This number is similar to



**Fig. 4.** Number of pediatric pulmonology faculty by fellowship training site (sites 1–39) in order of size (range 15 to <3 per site). Dark portion of bar represents the number of these academic pediatric pulmonology faculty who are PI on National Institutes of Health (NIH)-research grants (range 0–7). On average, ACGME-accredited training programs have 7.3 pediatric pulmonologists with 20.7% principal investigators on NIH awards.

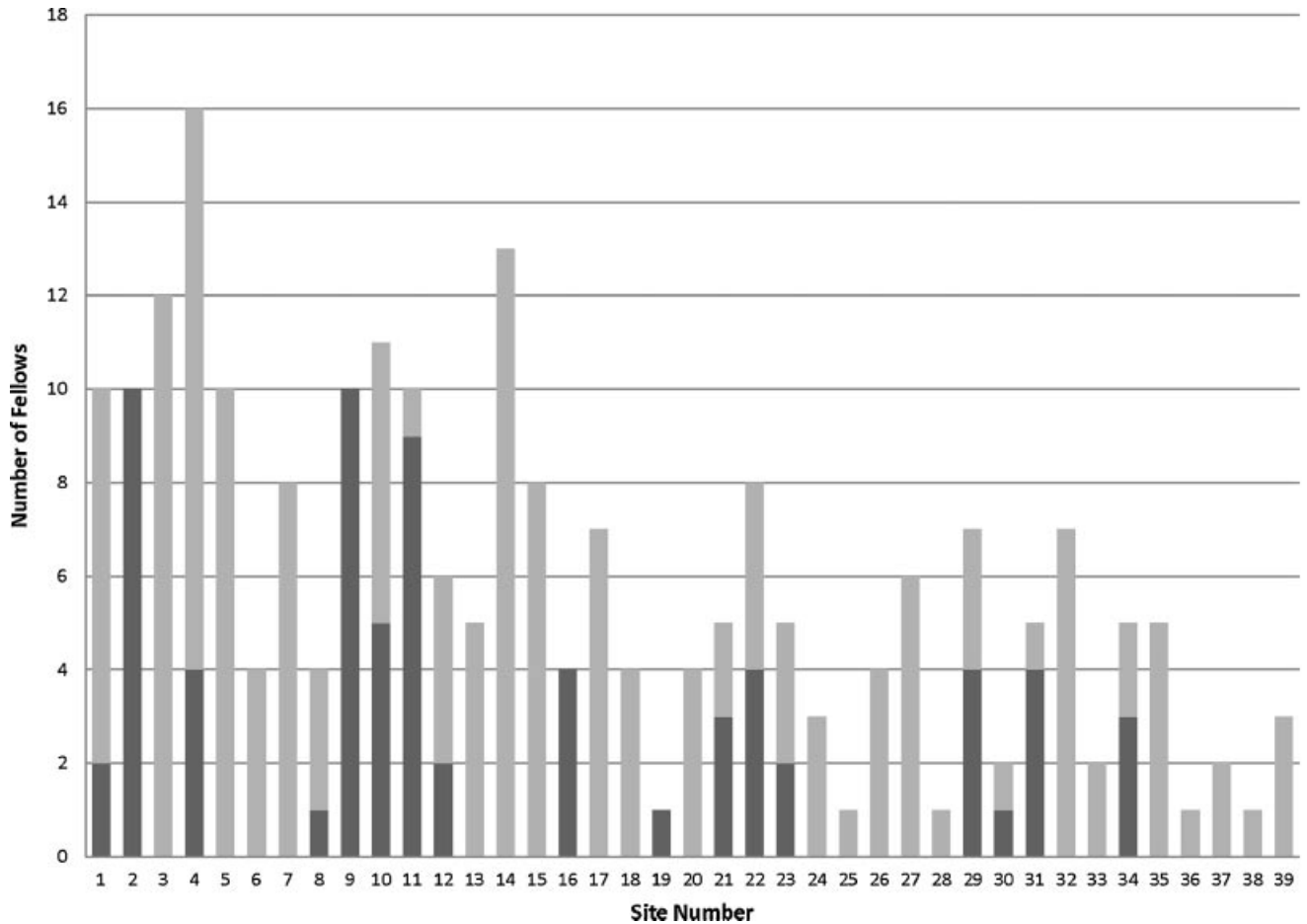
that reported by the ABP. The number of fellows trained by programs varied, ranging from 1 to 16 trainees over 5 years (Fig. 5), which was determined (and often limited) by departmental or extramural funding.

Our field has not attracted committed physician–scientists. Only 2% of the pediatric pulmonology fellows had PhDs or were products of Medical Scientist Training Programs (MSTP) during the period surveyed. Fellows were rarely enrolled (0.9%) in the Accelerated Research Pathway, an ABP program developed to encourage candidates who are committed to an academic career as physician–scientists with strong research emphasis in a pediatric subspecialty (<http://www.abp.org/publicat/trainingrequirements.pdf>). Six (2.8%) pulmonology trainees were selected for the Pediatric Scientist Development Program, a program designed to provide intensive research training and to prepare trainees for research careers in academic pediatrics. Several (12.9%) recent fellow graduates received additional

training in clinical investigation and were awarded Masters degrees (e.g., Masters of Public Health).

The NHLBI funded National Research Service Award (NRSA) Institutional Research Training Grants (T32) enables research institutions to support predoctoral research training in specific areas and fields of shortage (see website for more information: <http://www.nhlbi.nih.gov/funding/training/redbook/gradt32.htm>). While NHLBI funds many T32 programs, few of these are targeted to pediatric pulmonary/neonatology trainees.

Data from the Pediatric Pulmonary Training Director Survey, suggests that the NHLBI T32 program supported the training of 69 of the 230 pediatric pulmonology fellows (30%), but this percentage likely underestimates the true number. Because ~40% of pediatric pulmonology fellows were foreign medical graduates, and therefore not eligible for training grant support, we calculated that 79.5% of fellows who were American graduates were funded by a T32 grant. Every program that has access to



**Fig. 5. Number of pediatric pulmonology fellows trained by site (range 1–16, total N = 230). Sites are presented in the same order as Figure 4 for comparison. Dark portions of bars represent the number of T32-supported trainees (range 0–10, total N = 69).**

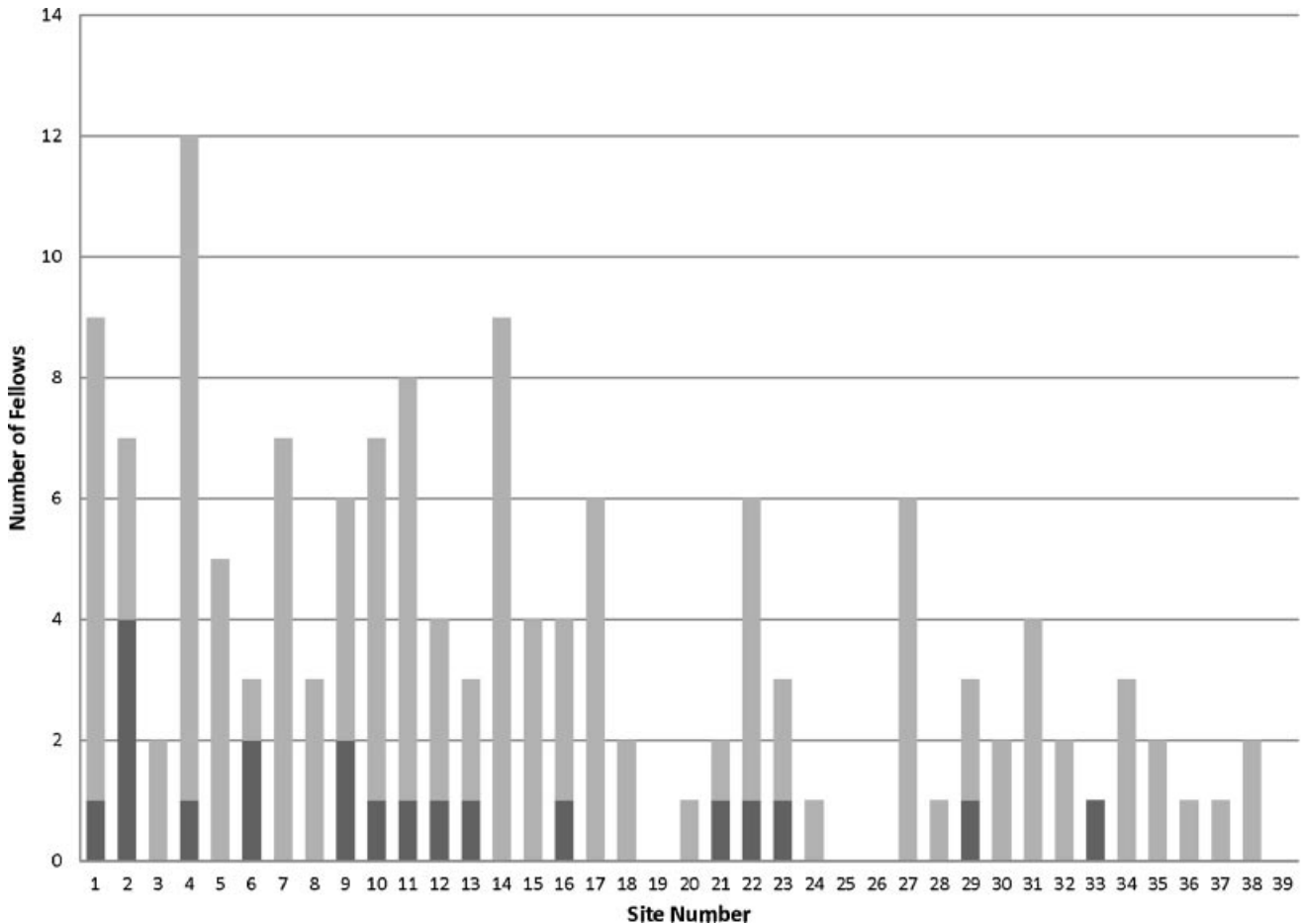
T32 funding had produced at least one NIH-funded young investigator during the past 5 years, some as many as 10. However, the lack of T32 support did not preclude post-graduate research success, as three programs without this funding mechanism also produced NIH-supported young investigators.

After completing their fellowship training, 142 (68.2%) pediatric pulmonology graduates joined university-based programs, and 31 (19.4%) had secured extramural research support from any funding agency, though some of these projects were clinical trials sponsored by pharmaceutical companies. Twenty graduates (10.6%) were PIs for NIH awards (Fig. 6).

These surveys provide us with insights into the problems that confront academic pediatric pulmonology. The shortage of faculty, who can serve as role models and mentors, impacts research effort and training. Trainees observe that research progress can be difficult to maintain with increasing clinical demands, especially for young faculty, which leads to academic failure. Financial support and some protected research time for young

physician–scientist faculty are needed, but that has been difficult in an era of inadequate extramural grant availability. The current financial climate makes it almost impossible to insulate the physician–scientist from clinical care responsibilities. Many applicants are one of dual career couples who are out of sync in timing of fellowship or who find it difficult to secure positions in the same institution or region. Failure to coordinate training across subspecialties may limit the numbers who select academic training.

We are creating few physician–scientists who are capable of conducting discovery research or clinical investigators who can apply advances to patients, in part related to concerns about funding opportunities. Many of the currently funded investigators are older, and the pipeline has far fewer younger, successful academic faculty to replace them. Falling numbers of established “anchor” investigators in our subspecialty will further weaken the specialty, reducing those who can serve as effective role models or research mentors for trainees.



**Fig. 6. Academic and research career status of recent pediatric pulmonology fellowship training graduates. Based on completed questionnaires, N=142 (61.7%) pediatric pulmonology graduates joined academic programs (total gray and black bars), and N=20 (14.1%) of these academics were awarded NIH grants during the first 5 years after fellowship (black bars).**

Undergraduate and medical school debt is a major deterrent, especially for fellows who have chosen pediatrics, who are remunerated at a rate that is significantly lower than their Internal Medicine colleagues. The NIH Loan Repayment Program (LRP) is a financial incentive to enter an academic career, and because it is a competitive process, is not universally available to all pediatric pulmonology fellows. Even promising young fellows/faculty frequently have to apply several times before they are supported, but are encouraged to take learn more about two LRPs in particular: the Pediatric Research LRP supports research that is directly related to diseases, disorders, and other conditions in children, including pediatric pharmacology ([http://www.lrp.nih.gov/about\\_the\\_programs/pediatric.aspx](http://www.lrp.nih.gov/about_the_programs/pediatric.aspx)); and the purpose of the Clinical Research LRP is to recruit and retain highly qualified health professionals as clinical investigators ([http://www.lrp.nih.gov/about\\_the\\_programs/clinical.aspx](http://www.lrp.nih.gov/about_the_programs/clinical.aspx)).

*Pediatric Pulmonology*

New clinical training requirements from the Accreditation Council for Graduate Medical Education (ACGME) have had the unintended effect of reduced trainee time commitment to research activities. The fellowship scholarly activity requirements set by the ABP have also changed, effectively deemphasizing the importance of research training to our subspecialty. Rather than lower the bar, it may be time to reexamine how we train our fellows.

## **STRATEGIES TO REVITALIZE ACADEMIC PEDIATRIC PULMONOLOGY**

### **Increase the Appeal of the Specialty**

Historically, pediatric pulmonary medicine embraced great diversity, with strong roots in cardiopulmonary physiology, neonatal medicine, critical care, and closely related fields. Over the years, pulmonology has become more narrowly focused at many centers with emphasis in cystic fibrosis and asthma, and growing interest in

pediatric sleep disorders, but less involvement in other aspects of childhood lung disease. By proactively extending consultative services and broadening the scope of involvement in the neonatal and pediatric intensive care units, and with other pediatric subspecialties, such as hematology–oncology (e.g., sickle cell disease), neurology (pediatric sleep disorders), and cardiology (e.g., pulmonary hypertension), pulmonary medicine may generate greater appeal to residents in training. This approach is appropriate as the growing spectrum of chronic lung diseases that present in the neonatal period (such as childhood interstitial lung diseases), warrant greater involvement of pediatric pulmonologists. Such programmatic changes would promote greater interest in the field and offer additional academic opportunities for young clinician–scientists.

### **Restructure Fellowship Training**

Training and fostering the early careers of the next generation of academic pediatric pulmonologists, who can become leaders in the field, must become a priority for our subspecialty. The structure and oversight of Institutional Research Training Grants (T32) should be reconsidered, and a network of academic pediatric pulmonary training programs should be created, where best practices and outcomes can be closely evaluated and continuously improved. If one assesses the career paths that their pediatric pulmonology fellows choose after they graduate, it is clear that different pediatric pulmonology training programs have different strengths and all training programs are not comparable. It is important that the structure and outcomes of T32 training grants align with the goals of successfully training a new generation of pediatric pulmonary clinician–scientists able to conduct innovative multidisciplinary science. Given that the field of pediatric pulmonology is so small it will be difficult to create separate tracks within a single fellowship; one solution would be to select some programs as designated NIH Research Fellowship Programs. These programs would be specially designed to offer the best possible training for clinician–scientists and attract pediatric pulmonology and/or neonatology fellows who show a strong interest in or aptitude for research. For this program to be successful, there must be regular, rigorous review of research progress, and continued funding would be dependent on performance benchmarks. Continued attention to training a diverse workforce with respect to gender and ethnicity (or race) is vital towards re-energizing the discipline.

Research exposure must be increased within our training programs. As described above, multiple requirements have been added to the structure of fellowship training by ACGME. Consequently, time preserved for research has become more restricted. For example,

involvement in quality improvement projects, increased seminars and coursework, and mandatory clinics may help achieve certain goals for training, but each of these activities siphons time away from developing research interests and skills. There has also been growing pressure to develop “subspecialty hospitalists,” in which research time is eliminated to allow for fast-tracking care providers into the framework of hospital care, which often makes the academic pediatric pulmonologist less visible to the pediatric resident and medical student. Leaders of pediatric pulmonary sections and training programs need to organize and plan for greater involvement in lobbying and defining the needs of our field. Additional advocacy pressure should be applied through departmental chairmen and medical school deans’ offices to highlight concerns and to address these important issues of training requirements with the ABP and ACGME.

It is clear that a 3-year fellowship cannot fully prepare a trainee for an independent research career. In addition, the extramural funding of young pediatric pulmonologists is often fragmented. Supporting an additional year in fellowship can help to provide a stronger academic foundation and time for developing additional research strengths. For some trainees, however, responding to this problem by only offering a fourth year of fellowship training further delays launching their careers, imposes further financial burdens and stress, and “penalizes” senior fellows who are considering academic careers. Accordingly, grant support should be expanded to include the first 2 years on faculty with substantial protected time for research. These approaches would assist fellows and young faculty in their efforts to secure extramural portable support allowing recipients to move their funding should new opportunities for independent careers arise at other institutions. For instance, T32 grants could be modified to support transitional faculty by folding fellowship slots into short-term, mentored junior faculty awards, thus affording greater flexibility in training dollars.

Finally, some form of loan repayment could be incorporated into the program, providing another powerful inducement for promising fellows to continue along an academic path.

### **Increase Mentorship Within the Field**

With shrinking research dollars and resources to support new faculty, it has become especially important for early and rigorous interactions of trainees with strong mentors. We recommend formal training in mentorship for faculty with close monitoring through greater use of scholarship oversight committees (SOCs). Expanding the roles of SOC with junior faculty may provide stronger mentorship as well. In order to maintain future pediatric pulmonary research, faculty need to be taught better mentorship skills, and could benefit from

“co-mentorship” approaches, in which well-established research mentors work closely with a more junior mentors to provide advice and experience. Those programs that have T32 training programs can utilize the F-mechanism of grant awards for fellows, giving the trainee the opportunity to write his/her own grant, and if successful will provide important positive feedback to the process of peer reviewed and funded science. In addition, a successful F-application will increase availability of a T32 slot for additional trainees at outstanding programs. Finally, to enhance mentorship, the addition of partial salary support (at least 5%) or additional research funding to mentors involved in K awards and training grants would be an effective incentive, increasing formal recognition of the importance of their role in academic training and will justifying the time and effort expended by the mentor.

### **Enhance Public Awareness**

As a subspecialty, we must better inform the public of the broad scope of activities covered by pediatric pulmonologists, which range from the common disorders through to the many different forms of complex pulmonary diseases that are less frequently seen. We must also enhance the understanding of the public and governing bodies of the importance of pediatric respiratory illness as an important determinant of adult respiratory health. Our responsibility as advocates for the care of infants, children, and adolescents who have acute or chronic respiratory diseases at the public and private level will translate into better penetration into the media, and potentially encourage students to consider pediatric pulmonology as a profession. Working closely with foundations that have experience with lobbying at the state and national levels (e.g., the American Thoracic Society, March of Dimes, or the Cystic Fibrosis Foundation) will benefit all groups at getting our message out to the public.

### **Increase the Pool of Potential Trainees**

The recruitment of the next generation of pediatric pulmonologists must begin at the early stages of medical training. Small interventions can have major effects on the career choices of students and pediatric housestaff. We should reach out to high school science teachers and offer summer experiences for high school and college students in our laboratories. Similarly, we can contribute to undergraduate biology and preclinical medical education in the development of courses on respiratory biology and physiology. We should encourage undergraduate trainees to consider Medical Scientist Training Programs (MSTP), and serve on MSTP committees. Once admitted the MSTP student should be encouraged to visit or work in research labs that collaborate with multidisciplinary teams that are discovering better approaches for respiratory diseases.

Departmentally, the recruitment of MD-PhD into our pediatric residencies could increase the likelihood of attracting them into our field. Pediatric pulmonologists as educators and clinicians need to be visible to medical students (especially the MD-PhD student) and residents, engaging them early to consider a career in pulmonary medicine. It will be important that faculty who participate in such endeavors be recognized and rewarded. Finally, inviting promising medical students and pediatric interns to attend a national respiratory meeting and introducing them to the full spectrum of childhood lung research can greatly influence their career paths. The creation of workshops for such students and residents at the national meetings, such as the American Thoracic Society International Conference, would support this goal. It is critical that pediatric pulmonologists remain highly visible to trainees at their respective medical centers. This is especially important as pediatric programs increasingly utilize hospitalists to teach ward medicine to residents, which leads to decreased exposure of subspecialists as role models. Regular attendance at morning reports, attending on the general medicine wards, and conspicuous involvement with mentored scholarship activities on campus should increase exposure to the excitement of pediatric pulmonary medicine as a career.

### **Partner With Professional Societies**

It is important that we partner with others who share a common goal. The mobilization of the membership and leadership of other societies, such as the American Thoracic Society, American College of Chest Physicians, Cystic Fibrosis Foundation, March of Dimes, and the American Academy of Pediatrics, will help us to develop new approaches to recruit trainees into academic pediatric pulmonology, and in turn increase the trainees' involvement in the educational and research activities of the society.

### **Emphasize Intellectual, Personal, and Financial Incentives**

We too often forget to emphasize to our trainees that there are the tremendous advantages of a career in academic pediatric pulmonology. During training many programs provide flexible schedules, travel to scientific meetings, and extended protected time to allow clinician–scientists to dedicate themselves to their research. Fellows and young faculty can apply to the NIH Loan Repayment Plan, which can offset much of the costs of medical education. Finally, a career in pediatric pulmonology can be immensely rewarding from both personal and altruistic viewpoints. By increasing the diversity, scope, and visibility of our field, we can better promote a growing pipeline of academic physicians to pediatric pulmonary medicine.



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