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Essentials of Neonatal-Perinatal Medicine Fellowship: Scholarship Perspective

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Abstract

Neonatal-perinatal medicine fellows must achieve a meaningful accomplishment in scholarly activity as part of their training. Despite the requirement for scholarly training in fellowship, there is a vanishingly small number of MD-only physician-scientists pursuing a research-oriented career. Recent neonatal trainees have identified several factors that preclude their careers in research-focused academic neonatology, including lower pay in academic positions, inadequate training in research techniques, and the perception that individuals in research careers have a poor work-life balance. High competition for limited pediatric research funds also contributes to a diminishing pool of physician-scientists in neonatology. This small number of physician-scientists is threatened by a high rate of attrition among physicians who enter this career path. In order to prevent further declines in the number of neonatal physician-scientists, we need improvements in funding and strong intra- and cross-institutional mentorship to foster individuals interested in a career as a physician-scientist.

Landscape of Scholarship in Neonatal Training

Neonatal-Perinatal Medicine (NPM) Fellowship Programs require training in scholarship to develop future academic neonatologists. In collaboration with the Council of Pediatric Subspecialties and the Association of Pediatric Program Directors, the American Board of Pediatrics (ABP) developed the Entrustable Professional Activities (EPAs) for pediatric subspecialties. A common EPA is engagement in scholarly activities through the discovery, application, and dissemination of new knowledge.¹ Regardless of career pathway, participation in scholarly activities teaches physicians to be critical thinkers and evidence-based practitioners. Subspecialists should engage in scholarly activities that promote lifelong learning, reflective practice, critical thinking and discovery.

Prior to 2004, the ABP required a “meaningful accomplishment in research” for subspecialty certification. Meaningful accomplishment in research was defined as a peer-reviewed publication, Ph.D. degree, or a postgraduate degree thesis. In 2004, the ABP recognized the diversity of roles physicians play after training.² The requirement for a meaningful accomplishment in research was broadened to accommodate a wider variety of scholarly activities tailored for individual career goals. Now, areas of scholarly activity that may be pursued include: basic, clinical, or translational research; health services; quality improvement; bioethics; education; and public policy.² These activities must result in a written “work product”. All subspecialty fellows are required to demonstrate evidence of scholarly activity, and no solely clinical pathway exists. To monitor progress, fellows have a local Scholarly Oversight Committee that reviews their project, determines whether the activity meets the ABP guidelines, evaluates their progress, and reviews the final work product.²

In addition to scholarly activity, all fellowship programs must have a core curriculum, including training in biostatistics, research methodology/study design, grant application preparation, approval of research protocols, literature review, evidence-based medicine, and ethical research principles. Neonatology programs require at least 12 months dedicated to

scholarly activity, and the scholarly experience must begin within the first year and continue throughout the course of training.³

In a 2012 survey of subspecialty program directors (PD), recent subspecialty fellowship graduates (RG, 0–5 years after training), and mid-career (MC) pediatric subspecialists (15–20 years after training), all Neonatal PDs and the majority of RGs (94%) and MCs (95%) agreed that training future researchers in neonatology is an important component of fellowship training.^{4,5} The majority of PDs (93%), RGs (91%), and MCs (84%) agreed that scholarly activity during fellowship should be tailored to the career goals and interests of each fellow.

Current Research Funding

The exposure and training of neonatal fellows to research and scholarship are essential to spark curiosity towards the development of new insights into neonatal-specific diseases and in the pursuit of a physician-scientist career. We define physician-scientists as those who perform any type of biomedical research as their primary professional activity. Since the 1970s, physician-scientists have been described as an “endangered species.”^{6,7} The physician-scientist workforce has been threatened by difficulty in obtaining funding, lack of mentorship, and competing clinical schedules. Obtaining funding as a physician-scientist has been a challenge for decades, as the National Institutes of Health (NIH) shows a funding preference for Ph.D. researchers, over M.D. researchers.⁸ Researchers face inflation within the biomedical community that is not matched by NIH budgetary growth,⁹ requiring the researcher to “do more with less.” For pediatric physician-scientists, research funds are even more limited. For example, even in times of NIH budgetary growth (FY 1998–2003), the budget dedicated to the pediatric research portfolio declined.⁹ Budgetary estimates within the *Eunice Kennedy Shriver* National Institutes of Child Health and Human Development (NICHD), the primary institute for pediatric research, indicate that only about half of the total NICHD budget was awarded to pediatric research in 2015.⁹

There is a vanishingly small number of MD-only physician-scientists ultimately pursuing research-oriented careers.^{9,10} This high rate of attrition creates a “leaky pipeline,” in the already small number of physician-scientists in the workforce (1.5%), with an overall rapid decline in total physician-scientists from 14,467 (2003–2005) to 13,676 (2010–2012, $p < 0.0001$).¹¹ The reasons why physician-scientists decide against the pursuit or continuation of a research career is due to several threats, such as: the extended length of training, inability to obtain funding, overwhelming student loan debt and the lack of successful role models or mentors in their specialty.¹²

Among physician-scientists, neonatologists face particular challenges specific to embarking upon or sustaining a successful research career. In a 2014 survey of 1549 MC subspecialty pediatricians, 36% of neonatologists reported engagement in some form of medical research, compared to 53% of other subspecialty pediatricians ($p < 0.001$).⁵ This number is much higher than NIH data, which indicates that there were only 82 R01-funded neonatologists from 2012–2017.¹⁰ This discrepancy highlights the chasm between neonatologists who are engaged in research, and the smaller sample of neonatologists who are funded for

research. The declining physician-scientist population depletes the pool of available mentors in neonatology, as well as a decreasing rate of success in achieving a pediatric K Award from over a 20 year period.⁹ This has generational implications in maintaining a workforce of physician-scientists in the future. The research-focused workforce has also shifted toward more senior faculty. The age at first independent (R01) grant has increased over time, from 36 years to 45 years;⁷ meaning fewer junior faculty are available to serve as mentors. Despite the limited workforce, there have been extraordinary advances in clinical research within neonatology. For example, there are increasingly more neonatal clinical trials published, with more than 1600 published trials in 2014, compared to less than 200 in 1984.¹³

Funding Changes that Impact Trainees

The NIH and other funders recognize the importance of investment in future generations of physician-scientists. Through early career awards (K99/00, K08, and K23) and institutional awards (T32/K12, KL2), the NIH provides an opportunity for junior investigators to receive research training, mentorship and protected time to focus on a research career. The NIH consistently dedicates 5.5% of its total budget to extramural funding in career development programs.¹⁴ Outside of the NIH, other groups, like the Doris Duke Charitable Foundation, Thrasher Research Fund and March of Dimes provide early career awards for physician-scientists. These awards are important components of a career development strategy for physician-scientists, because they provide structured research support, protected time, mentorship, and training.

Despite the availability of early career awards, the success rate for K08 and K23 awards has been falling over the last decade, and less than 20% of applications were funded in 2015.¹⁴ While these grants are competitive, the awardees are more successful in obtaining future independent grant funding. Among K awardees, the 7-year success rate of receiving an R01 is approximately 30–37%.¹⁵ The NIH has recognized the importance of individual K awards as an entry point for future independent grant funding, and in 2018, the NICHD announced an intention to provide a greater proportion of its career development fund allocation to individual awards, like K08 and K23 awards.¹⁴ We hope that the funding re-allocation will translate into a greater number of physician-scientists entering the pipeline.

Mentorship and Transition to Faculty

Recent neonatal trainees have identified several factors that preclude a physician-scientist career, including lower pay in academic positions, inadequate training in research techniques, and the perception of a poor work-life balance.¹⁶ The perception of poor work-life balance/integration can stem from mentors or institutions not establishing a healthy work climate with flexible benefits policies.¹¹ With regards to lower pay in academia, physician-scientists can alleviate some of the financial burden with the NIH loan repayment program which repays up to \$50,000 annually on a researcher's student loans. While mitigating these potential threats can begin in fellowship, mentorship should extend into the early faculty years. Mentorship is a critical component of building a successful research career. Effective mentorship includes clear enunciation of expectations, explanation of institutional tracks for

promotion, annual benchmarks for publications and grant applications, a clear statement of institutional support, and yearly written evaluations.¹⁷

In addition to mentorship, having adequate protected time and participating in a career development curriculum are necessary components of a successful research career.¹⁷ As fellows transition to faculty positions, ideally, they would be guaranteed 75% of their time protected from clinical and administrative responsibilities for 3 years, which can be a substantial departmental investment.¹⁷ Early faculty should also have access to career development opportunities that include education in grantsmanship.¹⁷ While building these resources is an investment, these are keys to building a successful pipeline of physician-scientists and maintaining the workforce to advance neonatal health.

What happens when scholarship goes wrong?

Even among successful physician-scientists, scholarship can take a wrong turn leading to stress and burnout. Burnout is a common problem in academic medicine, where there is a feeling of a lack of personal accomplishment, emotional exhaustion, or disengagement.¹⁸ Some additional reasons for burnout may be unique to scholarship activities, such as negative experimental outcomes, manuscript feedback or an unfunded grant applications. Insufficient funding opportunities, inadequate time for scholarship, coupled with productivity expectations and excessive clinical burden, may exacerbate feelings of burnout. Acknowledging burnout symptoms and finding fulfillment in one's work and scholarly activities is essential for all fellowship trainees and faculty members. Additionally, it is helpful to seek mentorship and burnout advice from peers, mentors and leaders, as they can provide assistance on coping strategies for this very common challenge or building resilience.

Areas for special attention

Neonatal training programs face a growing number of threats to scholarly education. Work hour rules have decreased resident and fellow time at task. Limited exposure to procedural skills during residency has had a “trickle up” effect into fellowship, resulting in more fellowship time being devoted to achieving procedural competence. Given the critical importance of ensuring clinical competence, experiences in scholarly activities during residency have become more limited. With decreased research exposure during residency, fewer fellows express an interest in research careers. Given the critical importance of well-trained physician-scientists who are instrumental in advancing our understanding of diseases, training programs must be transparent about what they can offer trainees to ensure an optimal match for those few trainees who wish to pursue a research career. As the medical climate changes in response to these threats, fewer academic positions are available. This further discourages fellows from putting in the effort to learn skills they envision may never be utilized. In addition, extraprofessional activities, such as caring for young children or aging parents, further limit time and introduce geographic constraints. Even those who are motivated to pursue an academic career face the reality of having to pay off large educational debts, making private practice positions appealing.

Changes in academic neonatology that favor a relative value unit (RVU)-based structure could threaten the productivity and pipeline of physician scientists. Changing practice models that favor RVU-based systems present a challenge for academic neonatology divisions which are faced with how to distribute the clinical workload equitably, and maintain the academic missions. Furthermore, within neonatology, RVUs do not correlate with clinical full time equivalents (cFTEs).¹⁹ Strategies for developing equitable distribution of workload among neonatal faculty are being developed, but will need to be monitored for effectiveness over time.²⁰

Leadership opportunities throughout fellowship and junior faculty years such as Chief Fellow positions, Associate PD, and PD positions are great achievements for career advancement; however, these positions can inhibit scholarly activity progress and productivity. Leadership positions carry a large administrative burden that can impact the amount of time for scholarship, resulting in having to choose between a leadership position and keeping a basic science laboratory open, for example.

As pediatric faculty progress in academic medicine, they are less likely to continue pursuing a physician-scientist career compared to RGs (9% versus 15%, respectively; $p < 0.0001$).⁵ Looking specifically at Neonatal-Perinatal Medicine RGs versus MC investigators, this number was drastically diminished from 14% to 2%, respectively.⁵ This was further categorized into basic science researchers (9%) and clinical researchers (75%), health services (9%), and educational research (6%) at the MC level. Collectively, this data demonstrates the leakiness of the neonatologist-scientist pipeline and the need for strong intra- and cross-institutional mentorship to foster the individuals that choose to pursue an investigative career.

Opportunities

Many opportunities exist to enhance training and support the physician-scientist pipeline, as outlined below:

Cross-divisional grants:

Encouraging multidisciplinary research complements the Accreditation Council for Graduate Medical Education focus on promoting multidisciplinary care. Cross-divisional grants broaden trainee access to well-funded mentors within their institution, especially strengthening programs/divisions whose faculty may not have enough funded members to support all the fellows. Collaborating with other disciplines adds to the richness and rigor of research, as each participant brings a different breadth of thought and experience.

Cross-institutional mentorship/group mentorship:

Virtual platforms for education and collaboration provide a valuable avenue for cross-institutional mentorship, and are being used with more regularity. What may have originally been a single site project has the potential to become a robust, multi-site study with increased generalizability. This approach also provides trainees an opportunity to network and develop relationships with mentors and colleagues at external centers which may be valuable for their future career opportunities.

Opportunities for alternative funding sources:

While most NPM fellowship program expenses are covered by Graduate Medical Education, departmental or divisional funding, some of the expenses related to scholarship might fall to the research mentor. In addition to the research mentor's extramural funds, financial support from foundations, philanthropic groups or industry can supplement educational costs.

National collaboratives for research:

Trainee and Early Career Neonatologists (TECaN), Organization of Neonatal-Perinatal Training Program Directors (ONTPD), and the Children's Hospitals Neonatal Consortium (CHNC) are all national organizations dedicated specifically to neonatology. Each of these organizations has ongoing scholarly efforts. Specifically, the ONTPD has a Committee on Education that led to the development of the National Neonatal Curriculum. This effort has opened the door for fellows to become involved in education research, to create educational materials they can add to their teaching portfolios, to engage in mentoring relationships with neonatology educational experts across the country, and to publish educational research. Encouraging fellows to become involved in the activities of professional organizations such as these is an excellent and productive way to gain scholarly experience.

Transparency in research training:

As described above, access to well-funded mentors and projects can be a challenge for neonatal fellows. We must be transparent with our trainees regarding the current state of funding and other potential scholarly opportunities available. Starting with their potential career aspirations (physician-scientist, clinical-educator, leadership and administration, advocacy, medical education, etc.), we can direct fellows towards a scholarly project that allows them to develop the skill sets necessary for their desired career. Mentors must be clear and transparent about the milestones that must be reached in order to advance the scholarly work product. Concentrating on developing skills that lead to a successful work product can take the pressure off of the product and allows the program to concentrate on the process to prepare the fellow to be an expert in their field.

Neonatal-Perinatal Medicine Fellowship Tracks

Neonatal-Perinatal Medicine Fellowship PDs surveyed thought the minimum amount of time to establish fellows' clinical competence was 12 months.⁴ Seventy-six percent of PDs believed their fellows should do an equivalent amount of service time regardless of career path. However, these PDs indicated the ideal amount of clinical training for future clinicians/clinician-educators was 24 months, as compared with 12 months for physician-scientist fellows.⁴ Despite these findings, the majority of Neonatology fellowships do not assign 24 months of clinical time to future clinicians and rarely do they provide specialized research tracks.

Programs could modify their fellowship curriculum to include specific tracks, such as clinician-educator, clinical-research, or basic science/translational-research tracks. Neonatal fellows could be matched with faculty mentors to develop clinical excellence in either neonatal intensive care, basic science, or clinical investigation. These specialized tracks

might involve a different amount of clinical time completed by the fellow. For example, a clinician-educator scholar may need extra service time to demonstrate mastery for neonatal critical care (16–18 months), whereas a basic science scholar may need additional time in the laboratory to gain traction as they transition into a faculty position (12 months clinical time, 24 months of research). The successful execution of these tracks likely depends on the mentors' availability, protected time and matching fellows with excellent faculty that possess specific expertise in their respective areas.²¹

Conclusion

Future academic neonatal-perinatal medicine physician-scientists face a challenging road during their fellowship and junior faculty years. One challenge includes the decrease in the availability of research funding that can lead to a shortage of mentors available to train the next generation of physician-scientists. Taken together, we highlight the critical need for institutional and cross-institutional mentorship organized at a national level to foster the small number of trainees interested in a career as a physician-scientist.

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