

Emerging Subspecialties in Neurology: Sleep medicine fellowship after child neurology residency

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Pediatric sleep medicine is a multidisciplinary field specializing in the diagnosis and treatment of a wide range of sleep disorders in childhood. Child neurology residency training provides highly desired skills keenly applicable for a prospective sleep medicine fellowship applicant. A fundamental neurophysiology background helps foster an advanced proficiency in the scoring and interpretation of overnight polysomnography and multiple sleep latency tests (MSLTs). Attuned skills in differentiating complex paroxysmal movements are key to distinguishing parasomnias from nocturnal seizures. The clinical evaluation for developmental delay is augmented by learning and applying the normative developmental milestones of sleep in evaluating the sleepy, or sleepless, child. Herein the authors provide an overview of pediatric sleep medicine as it relates to the child neurology trainee seeking subspecialty fellowship opportunities.

A brief introduction to the state of pediatric sleep medicine

Although there is evidence that humans have theorized about sleep since the time of ancient civilizations, the development of the human EEG in the 1920s jump-started the field of modern sleep medicine.^{1,2} In the 1960s, the first sleep research society was created and the first sleep center opened at Stanford University.² In 1988, the American Academy of Sleep Medicine (AASM) established the Sleep Medicine Fellowship Training Committee to formalize and streamline training.² Due to physicians coming from various training backgrounds, there were multiple ways to qualify for the American Board of Sleep Medicine (ABSM) examination.² In 2007, the American Board of Internal Medicine (ABIM), American Board of Psychiatry and Neurology, and several other American Board of Medical Specialties member boards began offering an examination in Sleep Medicine as part of a Sleep Medicine Certification Program distinct from the ABSM.³ Presently, physicians must complete a 1-year Accreditation Council for Graduate Medical Education (ACGME)-accredited sleep medicine fellowship training program in order to qualify for the examination, which is offered and administered every other year by the ABIM.^{3,4}

A 2018 compensation report by the AASM provided a snapshot into the current state of sleep medicine. In this report, 23.2% of respondents were board-certified in neurology, whereas only 1.9% were certified in neurology with special qualification in child neurology.⁵ The survey revealed that ~51% of sleep medicine physicians treat solely adults, ~41% treat adults and children, and ~9% treat solely children.⁵ These results demonstrate the opportunity and need for substantial growth in the field of pediatric sleep medicine, particularly from child neurology.

What does a sleep medicine fellowship entail?

ACGME-approved sleep medicine fellowship programs are 1-year-long multidisciplinary clinical fellowships. Applicants may matriculate from multiple specialties including pediatrics, internal medicine, family medicine, child or adult neurology, pediatric or adult pulmonology, psychiatry,

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anesthesiology, or otolaryngology. These fellowships have specific adult and pediatric exposure requirements in regards to both patient encounters and the scoring/interpretation of different diagnostic sleep tests detailed by the ACGME.⁶

There are 86 total ACGME-accredited sleep medicine fellowship programs as of March 2019.^{7,8} Three programs are housed within pediatrics departments and 20 programs are housed within neurology departments; the clear majority is within internal medicine and pulmonary/critical care departments.⁸ Through the 2019 National Resident Matching Process (NRMP) match, 180 spots were offered; 54 of 56 (96.4%) US medical graduates and 147 of 160 (91.9%) total applicants successfully matched.⁷ Applicants got their first rank choice in 63.1% of instances, 13.1% got their second rank choice, 5.6% matched into their third rank choice, and 10% matched higher than their third choice.⁷ There are no available public data that discern the different disciplines of ranking applicants to assess their match success.

Through the NRMP in 2019, there were only 8 institutions that designated a specific pediatric track into which an applicant may match⁷; however, numerous other institutions offer enhanced pediatric exposure and concentration to interested and qualified applicants without explicitly providing a rank spot designation through the match.

What is the process of applying to a sleep medicine fellowship?

Sleep medicine fellowships accept applications through the Association of American Medical Colleges Electronic Residency Application Service (ERAS) on the July cycle. The ERAS application system opens in early June the year prior to the prospective fellowship start date, thus child neurology residents would typically be in their fifth postgraduate year (PGY-5) when applying. The requisite application, personal statement, and at least 3 letters of recommendation would ideally demonstrate high visibility in clinical and academic interest in sleep medicine as a future subspecialty. A sample timeline for child neurology resident application preparation is provided (table 1); interested adult neurology resident applicants would be applying during their PGY-4 years. One advantage to this timeline, compared to some other neurology subspecialties that require applications 18 or more months in advance of prospective fellowship start date, is that it provides residents more opportunity for clinical exposure and research development.

The patients of pediatric sleep neurology

Choosing a sleep medicine fellowship provides an opportunity to learn a great deal about an essential neurobiological process, its normative features, and the clinical consequences of

disruption. Sleep-disordered breathing is one of the most common consultation requests, and the child neurology-trained sleep fellow will become adept at understanding and utilizing treatment options, including positive airway pressure modalities as well as the foundations of mechanical ventilation. A better knowledge of how sleep breathing may influence other health processes such as in children with neuromuscular disorders, epilepsy, and leukodystrophies will help the pediatric neurologist care for the whole patient. Furthermore, the experience of the pediatric neurologist in diagnosing and managing patients with complex genetic and neurodevelopmental disorders will aid the practicing pediatric sleep physician in diagnosing and managing the straightforward to complex sleep disorders of such patients, using behavioral and pharmacologic interventions.

With such a focus on differentiating abnormal paroxysmal events during child neurology residency, sleep medicine fellowship continues to provide opportunities to distinguish sleep-related paroxysmal episodes, from nocturnal seizures to complex parasomnias. The clinical reasoning learned in untangling episodes of altered awareness aids in the evaluation of hypersomnolence, from children with narcolepsy (with or without cataplexy) to Klein-Levin syndrome to insufficient sleep. These patients provide an opportunity to apply a critical understanding of the indications, limitations, and interpretation of MSLTs and maintenance of wakefulness tests. There are continued opportunities to diagnose and treat sleep-related movement disorders, including restless leg syndrome and propriospinal myoclonus.

Research, advocacy, education, future opportunities, and jobs

Now is an exciting time to be a sleep medicine specialist, especially given the abundant overlap that exists between sleep medicine and neurology research. The complex relationship of circadian rhythms and seizures has exploded into multifaceted clinical research paradigms, such as seizure prediction models, optimization of antiseizure therapeutics based on seizure patterns and influence of sleep on drug delivery to the CNS, and the use of wearable technology in detecting sleep-related seizures. These have essential ties to understanding the complex relationship between and the prevention of ictal apnea and sudden unexpected death in epilepsy. There are exciting investigations in machine-based sleep state analysis from the EEGs of polysomnography to better understand normative sleep parameters across the lifespan and how perturbations may influence outcome and neurodevelopment. At the bench side, there are continued advances in unlocking the intricacies and biological prerogatives of the human circadian clock in various model organisms. Within the realm of complex neurodevelopmental genetic disorders, keen phenotyping of sleep measures and behaviors may help discern molecular underpinnings of sleep disorders and provide avenues for novel therapeutic approaches.

Table 1 Timeline for applying for Accreditation Council for Graduate Medical Education–accredited sleep medicine fellowships in child neurology residency

Timing	Procedure
PGY-1 through PGY-4	Obtain clinical exposure with/without research experience in sleep medicine on elective or selective basis as available during general pediatric or neurology training
Late PGY-4	Ask faculty for at least 3 letters of recommendation; consider obtaining from at least 1 sleep medicine physician
Early June of PGY-4	Applications open via ERAS
Early July of PGY-5	Applications can be sent to fellowship programs
Late July to early October of PGY-5	Interviews
Mid-October of PGY-5	Rank list deadline via NRMP
Late October/early November of PGY-5	Match day

Abbreviations: ERAS = Electronic Residency Application Service; NRMP = National Resident Matching Program; PGY = postgraduate year.

Numerous opportunities exist for patient advocacy in pediatric sleep medicine. A national and public health debate is underway regarding delaying school start times, especially for adolescents due to inherent high sleep needs and the delayed circadian sleep phase they often develop. This has widespread implications, such as limiting risks of sleepy driving. For student athletes, ongoing research is being conducted regarding how adequate sleep improves performance as well as effective mechanisms to minimize concussions, which can negatively influence sleep.

Recently, there has been a push to incorporate more sleep medicine education into medical school curricula.⁹ A survey of neurology residency programs showed an average of only 5.2 hours devoted to sleep medicine didactics in responding programs while 81% offered a sleep medicine rotation.¹⁰ This demonstrates a substantial opportunity for growth regarding exposure to sleep medicine. Several organizations provide additional online resources for trainees (table 2).

The sleep medicine–trained child neurologist seeking employment should consider the desired balance of clinical (between sleep medicine and child neurology) and research activities and

the appropriate setting. Academic appointments, particularly in departments/divisions outside of neurology or pediatrics, may incur added nuance due to the complexities of salary sources. Finding the ideal position, as with any career, will require vision, communication, and negotiation.

Future directions/recommendations

Early exposure to sleep medicine in residency is paramount. In institutions with pediatric sleep medicine faculty, an elective rotation during pediatrics training would provide a background of the breadth of sleep medicine's influences on pediatric care and initiate exposure to neurophysiology concepts prior to commencement of neurology training. Sleep medicine should also be available as an adult neurology clinical elective. Child neurology residencies should consider how to fortify the sleep medicine exposure of their trainees, not only to enhance the training of the general child neurologist, but also to provide trainees with adequate exposure to consider this field as a future career option. In doing so, the child neurology residency programs will allow their trainees to take full advantage of the many opportunities for clinical and research leadership in this young and important discipline.

Table 2 Additional online resources for child neurologists seeking more sleep medicine exposure, information, and education

Organization/source	Website
American Thoracic Society Pediatric Pulmonary and Sleep Case Series	thoracic.org/members/assemblies/assemblies/peds/ped-case-conference-series/
American Academy of Sleep Medicine	aasm.org/professional-development/choose-sleep/
Sleep Research Society	sleepresearchsociety.org/career-education/
International Pediatric Sleep Association	pedsleep.org/
American Council for Graduate Medical Education	acgme.org/Portals/0/PFAssets/ProgramRequirements/520_SleepMedicine_2019.pdf?ver=2019-06-25-122915-670

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Name	Location	Role	Contribution
Robert C. Stowe, MD	Children's Hospital of Philadelphia	Author	Design and conception of study and drafted the manuscript for intellectual content
Stacey D. Elkhathib Smidt, MD	Children's Hospital of Philadelphia	Author	Drafted the manuscript for intellectual content
Thornton A. Mason, MD, PhD, MSCE	Children's Hospital of Philadelphia	Author	Drafting and revision for intellectual content

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