



The Current State of Sleep Medicine Education in US Neurology Residency Training Programs: Where Do We Go from Here?

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Objective: To evaluate the current state of sleep medicine educational resources and training offered by US neurology residency programs.

Methods: In 2010, a 20-item peer reviewed Sleep Education Survey (SES) was sent to neurology residency program directors surveying them about sleep medicine educational resources used in teaching residents. Pearson product moment correlation was used to determine correlation of program attributes with resident interest in pursuing a career in sleep medicine.

Results: Of the programs completing the survey, 81% listed a formal sleep rotation and 24% included a forum for sleep research. A variety of innovative approaches for teaching sleep medicine were noted. Program directors noted that 5.7% residents entered sleep medicine fellowship training programs in the

preceding 5 years. Programs that had a more substantial investment in sleep medicine teaching resources were more likely to report residents entering a sleep medicine training program.

Conclusion: This is the first report providing an analysis of the current state of sleep medicine training in US Neurology Residency Programs. Our data provide evidence that investment by the residency program in sleep education may enhance the ultimate decision by the neurology trainee to pursue a career in sleep medicine.

Keywords: Residency training in sleep, sleep education, US neurology residency

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Sleep disorders are highly prevalent across the general population, but education in their recognition and diagnosis is often lacking for health care providers, including neurologists. Trainees who are not exposed to sleep education during their neurology education run the risk of failing to provide appropriate diagnoses and management interventions that could result in improvement of primary neurological conditions and quality of life. In addition we believe that sleep problems, including central nervous system hypersomnias, sleep related movement disorders, sleep disordered breathing, and complex behaviors at night, all which have underlying neurologic pathophysiology, are the responsibility of neurologists to evaluate, diagnose, and treat. As such, we suggest that neurology residencies have the responsibility of offering trainees sufficient sleep medicine knowledge necessary to assess, diagnose, and treat key sleep problems. At present, no unified curriculum or requirement exists about the scope of sleep education experience residents receive. Over the past twenty years, sleep medicine has dramatically changed from a novelty to a mainstream specialty. Sleep medicine was recognized as a unique discipline by the American Boards of Medical Specialties (ABMS) and the Accreditation Council for Graduate Medical Education (ACGME), with ACGME accredited fellowship programs starting in 2005. An increasing amount of research further tightens the link of sleep medicine to overall health and brain function. A PubMed search for 2010 found

3,101 articles whose title is related to sleep compared to 798 in 1990, a jump of 3.9 times as many articles over the course of two decades. As an example of the neurology literature, the journal *Neurology* published 168 articles on the topic of sleep in 2010 compared to only 11 in 1990, an increase of 15.3 fold. Our understanding of the effect of sleep states and sleep disorders on neurological diseases has also improved. Some sleep disorders such as REM sleep behavior disorder predict the development of neurodegenerative disease such as Parkinson disease, Lewy body dementia, and multiple system atrophy, sometimes decades later. Sleep disorders such as sleep apnea and restless legs syndrome appear to increase the risk of vascular disease including data implicating sleep apnea as an independent risk factor for stroke. Furthermore treatment of sleep disorders can improve various comorbid neurological conditions such as migraine and epilepsy. These and other key data can help neurologists understand the importance of sleep medicine in treating our patients and add insight to the critical need for including sleep disturbances in neurology residency training.

Based on a survey conducted in 1998, the average amount of teaching time devoted to sleep at medical schools was only 2.1 hours.¹ This baseline of instruction in sleep medicine would not suffice for the educational need of the trained neurologist. Residency training may serve as a unique window of opportunity for the neurologist trainee to gain exposure to a wide variety of

Table 1—General statistics of programs and sleep education

	Number of programs	Range
Number of Programs	58	
Mean number of residents per year	3.9	1-10
Percent with affiliated sleep centers	75% (43/57)	
Percent with accredited sleep centers	58%	
Percent of programs with faculty with sleep specialization	69%	
Mean number of sleep faculty	1.1	0-5
Percent of programs with faculty board certified in sleep medicine	61%	
Percent of sleep faculty board certified in sleep medicine	91%	
Mean number of sleep board certified faculty	1.3	0-5
Percent programs with faculty who completed a sleep medicine fellowship	53%	
Mean number of faculty who completed a sleep medicine fellowship	1.04	0-4
Percent programs offering a sleep elective	81%	
Mean length of sleep elective	2.1 weeks	2-4 weeks
Percent of program requiring a sleep rotation	8.6%	
Mean number of didactic hours for sleep topics	5.2	0-48
Percent of programs offering no sleep lectures	7%	
Mean percentage of residents entering sleep medicine fellowships in preceding 5 years	5.7%	0-33

diagnostic and therapeutic avenues for a spectrum of patients with neurological complaints. While disciplines such as pulmonary medicine, otolaryngology-head and neck surgery, and psychiatry have taken initiatives to generate competency-based sleep medicine curricula for their trainees, in contrast, the role of sleep medicine in neurology residencies has been somewhat neglected.²⁻⁷ In 2001, sleep issues were included in the required list of topics to be reviewed during neurology residency, demonstrating recognition of the relationship of sleep medicine to neurology. The July 2007 revision of the program requirements stipulated that faculty with special experience in sleep disorders must be available on a regular basis to neurology residents.⁸ Additionally, residents must be instructed in the effects of sleep deprivation and fatigue on their performance. Now, nine years after initial inclusion of sleep medicine in neurology training, we decided to analyze the adequacy of sleep medicine education in neurology residencies.

METHODS

In March 2010, we conducted an online survey among neurology residency training program directors regarding the resources available and the amount of sleep education offered for the neurology residents. The survey was created by a task force from the American Academy of Neurology (AAN) Sleep Section and received peer review by the section executive committee and the AAN Residency Education subcommittee. Questions focused on sleep education resources available in neurology residencies, and topics included in the survey were those determined from review of the sleep education curriculum described for other subspecialties.³⁻⁶ Our Sleep Education Survey (SES) consisted of 20 questions and was approved by the AAN Education Committee and Program Directors Committee prior to being sent out to the cohort of neurology residency program directors (**Appendix**). Program directors completed the survey on line using an online “Survey Monkey” questionnaire,

and statistics were compiled regarding the responses. Pearson product momentum correlation was used to determine correlation (significance level $p < 0.05$). In addition, we obtained the ACGME data for residents entering a sleep medicine fellowship in the 2009-2010 year, including each resident’s primary residency discipline. We also reviewed the geographic locations of all 126 ACGME accredited neurology residencies and compared them to the list of accredited sleep centers maintained by the American Academy of Sleep Medicine (AASM) for location and proximity.

RESULTS

We obtained 58 responses from 126 neurology residency program directors (46% response rate; **Table 1**). The program directors reported a mean of 3.9 residents per year (range 1-10). Seventy-five percent of programs (43/57) reported that they were associated with a sleep center, and 33 of the 43 centers were accredited by the AASM. Eighty-one percent of programs offer a sleep rotation, and over 80% of these were 1 to 2 weeks in duration. Programs had a median of 2 faculty with expertise in sleep medicine and 1.3 board certified in sleep medicine (by either the American Board of Sleep Medicine or American Board of Psychiatry and Neurology). Thirty-one percent of programs reported no faculty with sleep medicine experience; 24% of the responding programs reported resident participation in sleep research.

Many programs noted incorporating sleep lectures and clinical exposure as part of the EEG or epilepsy rotation. One program that did not have faculty in sleep medicine noted they used a sleep medicine PowerPoint slide module as a teaching lecture set. Overall, lectures were the most commonly used teaching format. The mean duration of didactic lectures was 5.2 h/year, with 37% noting ≤ 3 h per year on sleep education and 7% offering no lectures. The distribution of lecture topics suggested that major neurologically based topics such as REM sleep be-

havior disorder and restless legs syndrome were missing in up to a third of the programs surveyed, and relatively low numbers of programs offered clinical exposure or case review as formats for specific topics (Table 2). Programs have used a variety of innovative approaches to teach sleep medicine including sleep medicine electives, regular weekly sleep clinics, teaching sleep during other neurophysiology rotations, non-continuity subspecialty sleep clinics, and didactic neurophysiology and sleep lecture series.

The correlation analysis demonstrates that neurology programs that had substantial faculty investment in sleep medicine were more likely to be associated with a sleep center, offer lectures, and promote other educational formats (Tables 3A and B). The association of resources and learning opportunities is listed in Table 3A. Highest associations are between the presence of faculty in sleep medicine and hours of lectures and learning opportunities such as research. Experiential learning as indicated by presence of clinical exposure or

case review was also associated with the presence of clinical faculty boarded in sleep medicine ($r = 0.17$) and those faculty fellowship trained in sleep medicine ($r = 0.17$). We identified three programs that participated in experiential learning in sleep medicine despite no sleep faculty.

Program directors reported that over the preceding 5 years, 5.7% of residents entered sleep medicine fellowship training programs. Programs that had a sleep center were more likely to report residents entering a sleep medicine training program. This was similar to the data from the ACGME, which showed

Table 2—Number of programs (%) that offer each sleep topic in particular format

Topic	Lecture Form	Clinical Exposure	Case Review
Sleep Physiology	47 (81%)	19 (33%)	5 (8%)
Polysomnography and MSLT	36 (62%)	37 (64%)	9 (15%)
Sleep Evaluations	31 (53%)	36 (62%)	6 (10%)
Normal Sleep	43 (74%)	24 (41%)	2 (3%)
Hypersomnia	38 (65%)	28 (48%)	5 (8%)
Narcolepsy	41 (71%)	33 (57%)	9 (15%)
Obstructive Sleep Apnea	41 (71%)	37 (64%)	7 (12%)
Central Sleep Apnea	38 (65%)	30 (52%)	4 (6.9%)
Restless Legs Syndrome	41 (71%)	37 (64%)	8 (13.7%)
Parasomnia	40 (69%)	27 (46%)	9 (15%)
REM Sleep Behavior Disorder	39 (67%)	33 (57%)	12 (20.6%)
Insomnia	34 (59%)	32 (55%)	4 (6.9%)
Circadian Rhythm Disorders	37 (64%)	24 (41%)	2 (3%)
Neurological Disorders and Sleep	40 (69%)	28 (48%)	7 (12%)
Psychiatric Disorders and Sleep	30 (52%)	24 (41%)	3 (5.1%)
Medications and Sleep	36 (62%)	35 (60%)	7 (12%)

Table 3A—Correlation of program attributes

	Program with sleep center	Program with accredited sleep center	Program with sleep faculty	Program with board certified sleep faculty	Program with fellowship trained sleep faculty	Association of offering an elective	Association of hours of lectures
Offer sleep elective	0.27	0.29*	0.36*	0.39*	0.28		
Hours of sleep lecture	0.10	0.12	0.37*	0.39*	0.16		
Case base review and Clinical Exposure	0.08	0.14	0.14	0.17	0.17		
Number of resident doing sleep research	0.33*	0.05	0.47*	0.72*	0.53*	0.27	0.22
Number of Residents pursuing sleep fellowship	0.32*	0.17	0.33*	0.32*	0.32*	0.20	0.21
Any residents pursuing sleep fellowship	0.42*	0.34*	0.33*	0.29*	0.23	0.01	0.19

* $p < 0.05$.

Table 3B—Correlation of program attributes: the impact of having a sleep center, sleep lectures, case reviews, and electives in sleep medicine

Effect of the presence of a sleep center on residents entering a sleep medicine fellowship (Pearson $\chi^2 p = 0.053$, Fisher exact $\chi^2 p = 0.10$)		
Sleep Center	Residents entering sleep fellowships	Residents not entering sleep fellowships
Yes	30	14
No	5	8
Effect of the presence of lectures on residents entering a sleep medicine fellowship (Pearson $\chi^2 p = 0.16$, Fisher exact $\chi^2 p = 0.30$)		
Lectures in Sleep	Residents entering sleep fellowships	Residents not entering sleep fellowships
Yes	33	21
No	1	3
Presence of case reviews on residents entering a sleep medicine fellowship (Pearson $\chi^2 p = 0.94$, Fisher exact $\chi^2 p = 0.99$)		
Did the educational curriculum include Case Reviews in Sleep	Residents entering sleep fellowships	Residents not entering sleep fellowships
Yes	11	8
No	23	16
Presence of sleep electives on residents entering a sleep medicine fellowship (Pearson $\chi^2 p = 0.08$, Fisher exact $\chi^2 p = 0.09$)		
Did the educational curriculum include Sleep Electives	Residents entering sleep fellowships	Residents not entering sleep fellowships
Yes	30	17
No	4	7

6.2% of neurology residency graduates entered a sleep residency for the 2008-2009 year.⁹

Of 126 ACGME listed neurology residencies, 117 have an accredited sleep center within the same city as the program. Of the remaining programs, all have a sleep center (accredited or not accredited) within 30 miles of the teaching institution.

DISCUSSION

This is the first study of its kind assessing sleep medicine exposure among neurology residents. Despite the fact that neurologists frequently encounter patients with sleep disturbances and that sleep is a required topic by the Residency Review Committee (RRC), our data show that the exposure to sleep medicine education in neurology residents remains limited. Although the survey did not include exploratory questions to gain insight into barriers to exposure, we found that most program directors noted in the comment section similar hurdles of resources and available faculty. We also found that inclusion of sleep medicine in the training schedule correlates with available resources in sleep medicine, such as the presence of specialized faculty and sleep laboratories.

Programs that had faculty trained or experienced in sleep medicine were more likely to offer electives or rotations in sleep medicine and lectures in sleep. Furthermore, residents were more likely to do research in sleep medicine when they had access to faculty who were board certified in sleep medicine. Our results reveal that approximately three-quarters of programs have access to sleep laboratories, and a similar percentage teach many of the identified topics of sleep medicine. The programs that have access to a sleep laboratory were more likely to provide electives in sleep medicine: 36 of 43 programs with a sleep center offered a sleep elective, whereas only 7 of 14 without a sleep center did so. Offering an elective and the number of hours of sleep lectures correlated strongly with access to faculty. Overall, programs offering sleep electives and having a sleep center associated with the residency appeared to correlate with a greater number of residents pursuing sleep training.

Review of specific topics revealed that sleep physiology and normal sleep were the most commonly covered. This is most likely related to the requirement that all residencies cover duty hour limitation, sleep, and fatigue. Topics of insomnia, psychiatric disorders in sleep, and general sleep evaluation were least likely to be covered. A surprisingly high percentage of programs did not cover sleep issues in neurological disorders and classic neurologic sleep disorders, such as narcolepsy, restless legs syndrome, and REM sleep behavior disorder. The most common format for covering the topics was formal lectures, whereas case review was the least common method utilized. Advantages of lectures are that they can transmit a great deal of information in a tightly compact time frame and use fewer faculty resources. Lectures, however, have many disadvantages: they may not be easily attended by all residents, information may not be reviewed more than once, application of the information may not be readily apparent, and learners assume a more passive learning style. More recent emphasis on active experiential learning has shown improvement in retention and subsequent behavioral application of the subject. In particular, some educators believe that residents may learn more by inclu-

sion of case-based learning with discussion, allowing the transformation of knowledge to clinical applications. We found four programs without faculty in sleep medicine that offered experiential learning, but these case review topics were very limited.

This survey was not completed by all of the program directors. We received information from approximately half of the programs, raising the possibility of type 2 bias. Our survey could have triggered responses from program directors with extreme views—those who view sleep education in neurology positively and are keenly interested in sleep medicine; and those who view sleep education curriculum in residency training negatively and are opposed to teaching sleep medicine. To validate the responses, we looked at the rate at which residents entered into sleep medicine residency. From the survey, we calculated that 5.7% of the resident pool entered into sleep training. We then reviewed the ACGME statistics for number of residents with a neurology background that were in 2009-2010 sleep medicine fellowships and divided that by number of graduates from all neurology residencies. This demonstrated a national average of 6.2% of 398 neurology resident graduates entering sleep medicine fellowship training. Thus we feel the survey provides good cross sectional data of current training practices. These data also suggest that the number of neurology residents entering into sleep medicine, assuming maintenance of the current number of graduates and those graduates on average having a 25-year career, would support approximately 450 neurologists nationally with an interest in sleep medicine at any one time.

We see key opportunities to improve training in sleep medicine in neurology residency programs. The most important requirement is improvement of access of residency programs to sleep centers where infrastructure exists to deliver sleep education, clinical experience in sleep disorders, and exposure to recording and interpreting sleep studies. We also recommend provision of resources for sleep educational modules to ensure uniform teaching material and access to faculty with sleep medicine experience. When reviewing the primary geographic location of all neurology residencies listed by the ACGME, 93% (117 of 126) of programs were located in the same vicinity as an AASM accredited sleep center, which ensures that quality education and clinical training are standardized and available. With one exception, all programs that did not have access to these accredited centers were within close geographic proximity (about 30 miles) to accredited laboratories. These sleep centers can be a valuable resource for residency programs to partner with to foster sleep education. This association could be encouraged by the residency program requirements specifically requiring such a relationship similar to that of clinical neurophysiology laboratories. Other ACGME residency committees have required residents to have exposure to a sleep medicine rotation and sleep laboratory experience. When this was mandated as part of the pulmonary fellowship requirements, the number of pulmonary medicine physicians entering the field of sleep medicine increased sharply. Greater exposure of sleep medicine in neurology residency could result in similar gains.

However, we understand that the requirement of having access to sleep trained faculty would put excessive burden on many smaller programs, and thus more creative mechanisms to include this training are needed. Advances in distance learning can provide exposure to many topics that could be available via

e-learning modules, webinars, or packaged electronic teaching sets and case review. This would allow residency programs to access shared faculty resources, some of which may be available through centralized professional societies, at a relatively nominal cost. The advent of educational modules also fosters a change in mindset from the traditional educational metric of time spent on a clinical rotation equated to successful learning. Competency-based education focuses on the metric of attainment of knowledge and application,¹⁰ allowing learners the ability to learn at an individual rate and show proficiency of a specific topic. This creates the opportunity for development of self-assessment and competency-based tools to be developed for residency programs.

Knowledge of sleep medicine offers an opportunity for improvement in care for patients with neurological disorders. The inclusion of sleep education is not uniformly applied in neurology residencies, despite ACGME requirements. Although this lack of uniformity may be a result of variability of access to faculty in sleep medicine, sleep laboratories, or other valuable resources, most of these issues can be addressed by partnering and newer learning tools.

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DISCLOSURE STATEMENT

Dr. Avidan served as a consultant for Merck; has received speaker honoraria from the American Academy of Neurology, American Academy of Sleep Medicine, American College of Chest Physicians, and book royalties from Elsevier and Lippincott Williams & Wilkins. He received speaker honorarium from Takeda Pharmaceuticals, Sanovian, Somaxon, GlaxoSmithKline, Purdue, and Teva, and received support from the American Academy of Sleep Medicine. He is also serving as the editorial board of *Sleep*, and a special section editor of *Sleep Medicine*.

Dr. Vaughn is on the Editorial Boards and an Associate Editor for Sleep Multimedia, Medlink Neurobase Sleep and Epilepsy 2011 receiving Publishing Royalties, and received an honorarium for serving as guest editor for Neurologic Clinics. He has received speaker honoraria from the following organizations: American Academy of Neurology, American Academy of Sleep Medicine and Medical Education Resources (nonprofit). He serves as chair of the Sleep Examination Committee (a multidiscipline committee) administered by the American Board of Internal Medicine. He is a Professor of Neurology at University of North Carolina, which involves 50% interpreting clinical neurophysiology and sleep studies. His research Support, and Commercial Entities are through the Johns Hopkins University and Glaxo Smith Kline.

Dr Silber is program director of the Mayo Clinic Sleep Medicine Fellowship. He is chair of the steering committee of the Sleep Medicine Program Director's Council. He receives royalties from two books "Sleep Medicine in Clinical Practice, 2nd edition" and "Atlas of Sleep Medicine."

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Appendix—AAN Sleep Education Survey (SES)

SURVEY OF SLEEP EDUCATION OFFERED BY NEUROLOGY TRAINING PROGRAMS

Program:

Location:

Program Director:

DEMOGRAPHICS

Number of residents per year:

Number of neurology faculty with sleep specialization:

How many are boarded in sleep?

Number of neurology faculty with sleep fellowship experience:

Is your department affiliated with a sleep laboratory?

Is the sleep laboratory/center accredited by the AASM?

NATURE OF SLEEP EDUCATION

Does your program have a sleep elective?

If yes, for how many weeks?

Does your program have a required sleep rotation?

If yes, for how many weeks?

How many hours of didactic sleep medicine teaching do you offer each year?

Do you have a formalized sleep clinic in your program for the residents?

If yes, for how many ½ day sessions per week and how many weeks?

Please describe any innovative clinical and educational opportunities your program has put together to expose your residents to clinical sleep medicine:

RESEARCH EXPERIENCE

Are any of you residents participating in sleep research?

If yes, how many

Did the research lead to any publications?

SLEEP AS A CAREER PATH

In the past 5 years, how many residents pursued sleep fellowship training?

Please check which topics are taught in your residency and how

	Lecture	Clinical Exposure	Case Review
Normal Sleep			
Hypersomnia			
Narcolepsy			
Obstructive Sleep Apnea			
Central Sleep Apnea			
Restless Leg Syndrome			
Parasomnia			
Insomnia			
Circadian Rhythm Disorders			
Neurological Disorders and Sleep			
Psychiatric Disorders and Sleep			