Sleep Medicine Training Across the Spectrum

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There is now a new pathway and examination for sleep medicine, sponsored by the American Board of Internal Medicine, and a number of accredited sleep medicine fellowship programs through the Accreditation Council for Graduate Medical Education. This review takes an historical approach to discuss the process of education for sleep physiology and disorders not only in the postgraduate period but also at all levels of instruction. In reality, there is a continuum of knowledge that needs to be reinforced up and down the educational system, of which Sleep Medicine subspecialty training is just one part. Although progress has been made at all educational levels up to this point, the future of training and education will depend on a sustained effort at several levels from undergraduate to postgraduate continuing medical education and will be facilitated by professional societies and other specialties who will collectively promote the value of and outcomes for clinical sleep medicine.

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Abbreviations: AASM = American Academy of Sleep Medicine; ABIM = American Board of Internal Medicine; ABMS = American Board of Internal Medicine; ABPN = American Board of Psychiatry and Neurology; ABSM = American Board of Sleep Medicine; ACCP = American College of Chest Physicians; ACGME = Accreditation Council for Graduate Medical Education; ASDA = American Sleep Disorders Association; ASDC = Association of Sleep Disorders Centers; ATS = American Thoracic Society; BSM = Behavioral Sleep Medicine; NCSDR = National Center for Sleep Disorders Research; NHLBI = National Heart, Lung, and Blood Institute; NIH = National Institutes of Health; SAA = Sleep Academic Award

In November 2007, 1,882 candidates took the first Certification Examination in Sleep Medicine and the pass rate was 73%¹; in November 2009, 2,014 candidate (371 second takers) took the examination with a 76% pass rate. The tests were administered under cosponsorship of five member boards of the American Board of Medical Specialties (ABMS)—the American Board of Internal Medicine

(ABIM as the designated administrative board), the American Board of Family Medicine, the American Board of Otolaryngology, the American Board of Pediatrics, and the American Board of Psychiatry and Neurology (ABPN). After 2011, all candidates for the Certification Examination in Sleep Medicine will have completed a 1-year fellowship, and those who had or professed to have sleep as a major part of their practice but who have not completed a fellowship will no longer be eligible to apply for the examination.

Thus, Sleep Medicine is an established subspecialty now and one that some consider as the only novel major field of medical practice in the past 30 years.² It is relevant to understand its process of development in order to predict where the field is going.

The purpose of this article is to describe the educational processes that have promoted sleep and circadian rhythm as an essential feature of professional medical training. A second goal is to provide a framework for looking forward in terms of future opportunities.

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Sleep medicine is based on neurophysiologic measures.³ The discovery of the stages of sleep and the first attempts to dissect the physiology and relevance of rapid eye movement sleep are detailed well in other articles.⁴ For clinical medicine, the technology in the 1950s used first by clinical specialists to describe epilepsy and neuromuscular disorders was used to describe sleep and sleep states. This electrophysiology was then complemented by sensors to measure breathing (airflow and effort), heart rhythms, and limb movements to understand what was going on in patients with hypersomnolence.⁵ This was a time of paper recordings as the basis for diagnostic interpretations.

In 1961 the Association of Professional Sleep Societies was formed to sponsor annual meetings for sleep research and emphasized recording methodology and physiology. The 1968 manual, *A Manual of Standardized Terminology, Techniques and Scoring System for Sleep Stages in Human Subjects*, published by Michael Chase at the Brain Information Service,⁶ codified sleep staging initially for research, but the manual became a standard not only for reporting research but also for definitions used for clinical testing for sleep disorders, up until recent times.

In 1974 the term “polysomnography” was used in an effort to convince insurance companies to reimburse for an overnight test⁵; before this time, payment was denied because the procedure, and the field in general, was deemed experimental medicine. The core measures at the time were sleep (EEG and electromyogram), ECG, leg movements, ventilation (effort and flow), and oxygen saturation. Other physiologic measures (penile tumescence, H-reflexes, invasive measures of BP, and so forth) were used in research, and in some studies blood gases were measured. Before the development of Nellcor pulse oximeter (originally for anesthetic monitoring) in the 1980s, the noninvasive measure of oxygen saturation was performed using first the Waters and then the more user-friendly Hewlett-Packard ear oximeter, a cumbersome and expensive device. Noninvasive monitoring for carbon dioxide, transcutaneous oxygen, and BP became available later on in the 1990s. The modern sleep study is based on 20 years of improvements (eg, nasal cannula) and refinement in technology, data collection and display, and scoring.⁷

The initial reluctance to embrace polysomnography, and sleep medicine in general by the general medical community was attributed by Dement³ to three general factors. First, sleepiness and insomnia were and continue to be seen as “negative” social features. In addition, these symptoms were complex and

difficult to measure and the measures led to pattern recognition rather than diagnostic specificity. Second, there was reluctance to embrace a need for an overnight test, especially one that was complex compared with the “simple” diagnostic tests of the day (chest radiograph, ECG, blood gases, blood tests, and so forth) that took relatively little time for the patient. Third, the interpretation of polysomnographic data was confusing as the medical practitioner had no general knowledge of sleep, its purpose, or its disorders. This continues to be a problem, compounded by an absence of a common interlaboratory format for interpretation and standardized reporting criteria across centers and laboratories.

Additional testing for sleepiness, pupillometry, the multiple sleep latency test, actigraphy, and other measures were added to define clinical symptoms and still are finding their role in sleep medicine.⁵ Each had problems of perception to overcome because they are not biochemically or anatomically based. For instance, the multiple sleep latency test was counterintuitive to a medical system that at the time did not consider it important to measure variations in vigilance—full alertness to extreme sleepiness—in the management of patients. Actigraphy still is considered as a physiologic rather than a pathophysiologic or therapeutically useful test, despite increasing data on the importance of circadian rhythm in health and disease.^{8,9} As discussed later in this article, the skills domain in sleep medicine is still based on how this technology works and why it is important from a physiologic and pathophysiologic sense, rather than its role in clinical outcome.

European academic conferences initially established the clinical importance of sleep disorders. The first was a symposium on sleep held in France in 1963: *Sommeil de Nuit, Normal et Pathologique: Etudes Electroencephalographiques*. The second was in 1967, *The Abnormalities of Sleep in Man*, organized by Henri Gastaut.¹⁰ Presentations included initial descriptions of sleep-related breathing and leg movements. In 1972 there was the Rimini Symposium, at which the emphasis was on sleep apnea: *Les Hypersomnies Avec Respiration Periodique*, and a symposium on narcolepsy in 1975, *First International Symposium on Narcolepsy*, from which derived the diagnostic criteria currently used for the disease.

In the United States, the first course in sleep medicine, “The Diagnosis and Treatment of Sleep Disorders,” was offered in 1972 through the Stanford University Division of Postgraduate Education.³ This 1-day course was deemed a success as it was well attended and financially viable.⁴ There followed the founding of the Stanford School of Sleep Medicine, designed as much for technologist as for physician training. A seminal book on narcolepsy and other sleep

disorders was published in the United States in 1975.¹¹ In 1976, at the 16th annual meeting of the Association of Professional Sleep Societies, originally started as much for research as for clinical purposes, the Association of Sleep Disorders was formed with Stanford University and four other centers (Montefiore Hospital, Ohio State University, University of Cincinnati, University of California Los Angeles) and issued standards for sleep laboratories (a term that still resonates today)⁵ to address “practical, clinical issues.”⁴ The journal *Sleep* was first published in 1977 with Christian Guilleminault and William Dement as coeditors,³ and the *Diagnostic Classification of Sleep and Arousal Disorders* was published in 1979 under the leadership of Howard Roffwarg.⁵ The same year there was the seminal conference sponsored by the Institute of Medicine that focused attention on sleeping pills and the prevalence of insomnia.¹² About the same time, the National Institutes of Health (NIH) began to formally announce interest in proposals for sleep research through the National Institutes of Aging, the National Institute of Mental Health, the National Institute for Neurologic Diseases and Stroke, and to some extent the National Heart, Lung and Blood Institute (NHLBI).

Throughout this period the mainstream medical specialties were psychiatry and neurology, a natural pairing at the time in part because of a common specialty board (American Board of Neurology and Psychiatry), and an organized role for other specialties in sleep research and clinical medicine was limited. This was to change. Although the term “sleep apnea” was used in the European literature in the 1960s,¹³ the field of sleep-disordered breathing was defined by Elio Lugaresi in a 1972 European conference and book called *Hypersomnia with Periodic Breathing*.¹⁴ In 1978 the proceedings of the Kroc symposium called *Sleep Apnea Syndromes* was published.¹⁵ At this symposium, US and European researchers and some clinicians presented papers that largely framed the importance of sleep-disordered breathing not only as a common cause of sleepiness but also as a risk factor for arrhythmia and hypertension and as a product of abnormal respiratory control. Electromyographic recordings of the genioglossus muscle by John Remmers and his group¹⁶ at the University of Texas Galveston resonated with the pulmonary community. Despite the impression that sleep apnea was “rare and curious” to those who were largely involved in the clinical diagnosis and treatment of diseases of the lungs and chest wall, this line of research was then embraced by those studying ventilatory control,^{17,18} and by the NHLBI.¹⁸ There was then the emergence of research facilities for sleep apnea in pulmonary medicine and some interest in developing academic sleep centers. An NIH NHLBI Spe-

cialized Centers of Research program in sleep apnea was instituted in 1988¹⁹ and further accelerated the research activities in the field. One immediate result was the publication in 1993 of the first epidemiologic report (the Wisconsin cohort) and the estimate of a significant prevalence (2%-4%) of sleep apnea syndrome in an employed population.²⁰

A rapid development of sleep laboratories occurred in the 1980s largely as a result of the availability of therapeutic alternatives to tracheostomy and the commercial availability of CPAP (circa 1983), an improvement on the initial application of the technique that required custom masks and industrial blowers.²¹ As better described in other historical reviews, in the 1990s there occurred a rapid expansion in private and academic sleep programs when it became evident that obstructive sleep apnea syndrome was a significant public health problem,²² and noninvasive ventilation as well as positive pressure therapy became accepted treatment. The clinical interest in sleep disorders grew rapidly and independently. A recognition by industry of the business opportunities in sleep occurred at this time. The entities of the American Sleep Apnea Association (established 1991) and the National Sleep Foundation (established 1991) were the first nonprofit entities for the field. By 1997 at the NIH there was the legislative mandate for the establishment of the National Center for Sleep Disorders Research in the NHLBI.¹⁹ In recent times there continues to be growth in all areas of patient care, research, and informational sources, including more established journals and for-profit publications that focus on sleep as a topic area.

KNOWLEDGE ACQUISITION

Before codification of sleep training, a doctor became interested in sleep medicine initially through focused programs in neurology or psychiatry or through research programs on insomnia and sleep apnea. Learning was by doing the sleep testing, discussing results within a local clinical group, and by 1978, going to a national meeting of the Association of Sleep Disorders Centers to present, acquire, and exchange ideas about sleep physiology and pathophysiology. The initial focus for the field was on presentation of illness as represented by its first nosology. Sleepiness had the prototypic disease of narcolepsy and its differential diagnosis, and poor sleep had insomnia. Sleep-disordered breathing was also a theme, but developed rapidly with the interest in the pulmonary community. By the mid-1980s the issues of recognition and therapy were reasonably well developed, and a new nosology was proposed that began to focus on mechanisms. Thus, one could find a body of literature in medical journals, a roadmap

of disorders, and a community of physicians and psychologists, and one could sit for a national examination sponsored by the American Sleep Disorders Association (ASDA). Formal support for this training was lacking, and those interested in the field worked either in research programs or more commonly in sleep centers where clinical revenue could justify their presence. The development of a textbook, *Principles and Practice of Sleep Medicine*,²³ was a milestone and a model for other publications. In the United States the pulmonary side of sleep was organized through symposia and featured talks at the annual meetings of the American College of Chest Physicians (ACCP) and the American Thoracic Society (ATS) and by a focus in the NHLBI on sleep apnea. This included a book, *Sleep and Breathing*, in the highly recognized series on pulmonary disorders conceived by Claude Lenfant and edited by Colin Sullivan and Nicholas Saunders.¹⁷

A major role for the pediatrician in sleep has become established in clinical practice. Although the advice might not be as evidence-based as one might like, the need for adequate sleep has been a regular feature in major textbooks since the 1930s. The descriptions of neonatal and infant sleep physiology and detailed examination by Roffwarg and his team of the role of rapid-eye-movement sleep in brain development were important events that also established sleep as a topic in pediatric research.⁴ There is now an annual meeting on pediatric sleep. The educational system for sleep medicine in children has in general evolved in parallel with adult sleep medicine but generally at a smaller scale. The first textbook, *Principles and Practice of Pediatric Sleep Medicine*,²⁴ came hard on the heels of the general textbook, and has produced a second edition. At present those who would pursue credentials in Sleep Medicine for a pediatric population enter the practice through the Accreditation Council for Graduate Medical Education (ACGME) program. Although there is an emphasized, strong requirement for exposure to pediatric patients in these accredited fellowship programs, whether there is enough experience to immediately be called a pediatric specialist is being currently debated.

TRAINING FOR SLEEP DISORDERS

In 1948 Clinical Neurophysiology was established as a subspecialty certificate under the ABPN. This one-year added ACGME program is in Neurology, and encompasses training not only for EEG, electromyography, evoked potentials, nerve conduction studies, and magnetic and mechanical tools but also for sleep recordings. The ACGME program requirements currently encompass not only conditions such

as epilepsy and neuropathy but also sleep disorders.²⁵ Sleep disorders are listed as a content area under the knowledge and skills required in the area of EEG. A requirement for experience and acquisition of competency in clinical sleep medicine is not explicitly addressed. The role for this training pathway in community practice is still not clear, and there is substantial variation in how this certificate is perceived as validating staff privileges for the interpretation of sleep studies.

In 1984, a group of clinicians from disciplines in neurology, psychology, and psychiatry formed the Clinical Sleep Society as part of the Association of Sleep Disorders Centers (ASDC, established 1975) and began issuing certificates as an Accredited Clinical Polysomnographer. In 1987, the ASDC-Clinical Sleep Society reorganized to form the ASDA, with two branches of membership: centers and individuals. In 1988 the Sleep Medicine Training Committee was established by the ASDA and in 1989 certificates, rather than notice of passing the American Board of Sleep Medicine (ABSM) examination, were awarded.⁷ The test, offered in two parts, became known as Sleep Medicine. By 1990, the ASDA created an independent entity called the American Board of Sleep Medicine,^{3,5} and the successful examinee could be called a Board-Certified Sleep Specialist.

In 1991 there was a meeting among members of the ASDA, the ABSM, the ACCP, and the ATS to address skills needed to sit for the Sleep Medicine examination. The eligibility rules were amended to permit pulmonary fellows to sit for the ABSM by showing 6 months of training in nonpulmonary disorders of sleep. At this meeting, the 1989 1 month recommendation for experience in pulmonary consultation was amended to be 6 months of "training in sleep disordered breathing." The ASDA became the American Academy of Sleep Medicine (AASM) in 1999,⁷ and reaffirmed the independence of the ABSM. In 2001 guidelines were established for an institution to apply for designation as a 1-year Sleep Medicine Fellowship accredited by the ASDA/AASM. Alternative pathways were explicitly defined, based on sleep experience in another ACGME specialty program or a certain amount of practice experience; PhDs could still sit for the ABSM. Overall, in a 28-year period ending with the 2006 examination, 3,445 MD and PhD candidates were certified with a lifelong certificate.²

In 1988, Bob Rogers successfully petitioned the ACGME medicine specialties of Pulmonary and Pulmonary Critical Care Medicine to issue requirements that included the topics of sleep disorders and sleep testing as critical knowledge and skills to be taught in an accredited fellowship program. Questions about sleep disorders began to appear in the ABIM specialty boards. Currently the language in

the ACGME requirement carefully recognizes the role for pulmonary specialists in the management of sleep-disordered breathing as part of their special knowledge in the control of breathing and respiratory mechanics of the upper airway, lungs, and chest wall. The requirements are supported by a consensus document,²⁶ and include a roadmap for the presentation and formative assessments of skills and knowledge in the course of a fellowship program in pulmonary and critical care medicine. The 2008 ACGME revisions list management of sleep-disordered breathing as an essential part of disease competency and a requirement for access to diagnostic facilities for sleep-disordered breathing.

Subsequent to 1988 and up to the present time, the only other ACGME program that explicitly mentioned sleep was Emergency Medicine, in which knowledge of sleep deprivation was considered as part of the knowledge needed for professionalism. This recognized the reality that practicing physicians in Emergency Medicine worked in shifts and had to organize the shift work of others. The specific methods for instruction are not listed, but this topic is part of all textbooks in the field. At this point it is notable that the ACGME specialties of geriatrics, neurology, and psychiatry do not list sleep disorders as a domain of knowledge or clinical management.

In 2005, there began the transition to the ABIM examination in Sleep Medicine under cosponsorship of five member boards of the ABMS—the ABIM, the designated administrative board, the American Board of Family Medicine, the American Board of Otolaryngology, the American Board of Pediatrics, and the ABPN. The ACGME developed recommendations for a 1-year Sleep Medicine Fellowship with the eventual goal of it being the only pathway, with prior experience, including ABSM certification, being obsolete after 2011. A Sleep Medicine Fellowship program could be established in Medicine, Neurology, Pediatrics, Psychiatry, or Otolaryngology, provided there were sufficient board-certified instructors and resources for instruction, including access to other specialists and research opportunities.

The results of the first two cycles of the Sleep Medicine Certification Examination in Sleep Medicine

Table 1—Certification Examinations in Sleep Medicine: Numbers of Takers and Pass Rates for the 2009 and 2007 Certification Examinations in Sleep Medicine

Test Takers	2009		2007	
	No.	% Pass	No.	% Pass
First takers	2,140	78	1,882	73
Repeaters	371	66	...	...
Total group	2,511	76	1,882	73

Data courtesy of the American Board of Internal Medicine.

Table 2—Certification Examinations in Sleep: 2009 First Takers and 2007 Candidates from Each Cosponsoring Board

Board	2009 First Takers		2007 Candidates	
	No.	%	No.	%
ABIM	1,392	65	1,228	65
ABPN	487	23	460	25
ABOto	111	5	78	4
ABP	83	4	83	4
ABFM	67	3	33	2
Total	2,140		1,882	

Data courtesy of the ABIM. % = percent of the total; ABFM = American Board of Family Medicine; ABIM = American Board of Internal Medicine; ABOto = American Board of Otolaryngology; ABP = American Board of Pediatrics; ABPN = American Board of Psychiatry and Neurology; ABSM = American Board of Sleep Medicine.

were discussed earlier, but it is interesting to note the distribution of candidates from each cosponsoring board (Tables 1-3). Those from ABIM were predominantly board certified not only in Internal Medicine but in Pulmonary Medicine as well, and these individuals in general would have benefited from the grandfather clause, being eligible for the examination without having to take another year of training. The current high proportion of pulmonary specialists may not persist as the 1-year ACGME fellowship becomes mandatory after 2011. In our program there has been substantially more interest from those entering the fellowship directly from Internal Medicine and less interest from pulmonary/critical care trainees who would then be entering a seventh year of postdoctoral training.

Because ACGME programs are not open to PhD candidates, in 2005 a pathway called Behavioral Sleep Medicine (BSM) was established to acknowledge the pivotal role of clinical psychologists in the delivery of sleep medicine.^{2,7} The AASM acts as the accrediting agency for training programs for the treatment of sleep disorders through behavioral and cognitive methods. The program would provide the training required to sit for the Behavioral Sleep Medicine Examination. Training requirements include 1,000 h of supervised, clinical BSM training, or 500 h of BSM training and 500 h in general behavioral medicine.

Table 3—Certification Examinations in Sleep Medicine: Number (%) and Pass Rates for 2009 First Takers and 2007 Candidates from Each Pathway

Pathway	2009 First Takers		2007 Candidates	
	No. (%)	% Pass	No. (%)	% Pass
Practice experience	1,215 (57)	67	1,034 (55)	59
Certified by ABSM	573 (27)	91	683 (36)	93
Training pathway	352 (16)	93	165 (9)	82

Data courtesy of the ABIM. See Table 2 for expansion of abbreviations.

The period of training should not take more than 4 years.

Now that there is an ABMS specialty of Sleep Medicine, it will be appropriate to evaluate its role of specialty certification in the quality of care for patients. There is only a loose connection between outpatient outcomes and board certification.²⁷ Given that training and certification in sleep apnea management can be provided by Pulmonary Medicine, as well as Sleep Medicine, comparisons of care outcomes are appropriate to assess. The role of Clinical Neurophysiology in the diagnostic and care pathways also remains to be clarified.

THE NATIONAL SCENE

Project Sleep was a program announced in 1979 by the Surgeon General's office to focus government programs on sleep research and sleep disorders. Before this time, sleep education was a topic found in the popular press and in the psychiatric literature.⁴ A coordinated effort among the NIH and, at that time, the Alcohol, Drug Abuse, and Mental Health Administration, resulted in a number of initiatives directed toward the medical community, including a slide-and-tape set on insomnia, posters, and pamphlets. Participants from Project Sleep and the ASDC included Steve Kennedy, PhD (Director, Project Sleep); Julius Cinque (Associate Director); Richard M. Coleman, PhD (Chair, ASDC Case Series Committee); William C. Dement, MD, PhD (then the President of the ASDC); Christian Guilleminault, MD (Chair, ASDC Clinical Polysomnography section and Education Committee); and Howard P. Roffwarg, MD (Chair, ASDC Nosology Committee). One outcome of this program was the publication of a listing of sleep disorders encountered across several sleep disorders centers, the so-called Coleman project.²⁸

In 1986, the process for expanding the federal government's role in sleep was formalized through the creation of the Trans-National Institutes of Health Sleep Research Coordinating Committee, consisting of staff appointed from the NHLBI, National Institute of Aging, National Institute of Neurologic Diseases and Stroke, National Institute of Mental Health, and the National Institute of Child Health and Human Development, with representation from the Alcohol and Drug Abuse Agencies. This program has continued up to the present time. The establishment of a National Center for Sleep Disorders Research (NCSDR) in 1993 funded this interagency forum and identified for the first time a federal agency for sleep disorders. The NCSDR was placed in the NHLBI, and among the many reasons for this decision was the congressional mandate to this NIH institute for public education. The only other NIH institute with

such a mandate to support educational research and outreach to the medical community is the National Cancer Institute.

The Sleep Academic Award (SAA) program was conceived in 1996 by the NHLBI and developed through the NCSDR as a vehicle to develop and promote educational material for sleep. This program was an extension of an established NHLBI program to address educational needs in smoking cessation, asthma, and so forth. The program was based on a need to address the paucity of formal training in sleep in medical education, and in effect was a continuation of Project Sleep. In 1978, the percentage of medical schools that included sleep disorders in their curricula was 54%,²⁹ and this figure had increased to 63% in 1993.³⁰ The latter study, commissioned by the National Commission on Sleep Disorders, reported that the time devoted averaged a little more than 2 h in a 4-year curriculum, and 89% of medical students had never performed a clinical evaluation of an individual with a sleep disorder.^{30,31}

The primary objective of the SAA was to develop model curricula for sleep medicine for adaptation into academic institutions, and to promote interdisciplinary learning environments and faculty development. Over the 7 years of this award 20 grants involved 23 primary investigators. One result was that program development at a medical school level was defined,³² but in addition there was identified a need for sleep to be addressed at other levels of education, including elementary school and graduate medical education. Professional education initiatives included the addition of sleep questions to national board examinations in psychiatry, pediatrics, otolaryngology, and pulmonary medicine and the creation of a sleep clinical case vignette bank for use in objective structured clinical examinations and problem-based learning seminars. Initiatives included collaboration with the American Medical Association and the ACGME on work hours for residents. The enduring features of this program appear to be (1) the articulation of the competencies expected as a result of undergraduate medical education,³³ with insertion of sleep topics in Parts 1 and 2 of the National Board of Medical Examiners and in inserting the content of sleep physiology and disorders in the American Association of Medical Colleges; (2) establishment of the MedSleep section of the American Academy of Sleep Medicine,³⁴ and (3) creation of a network of physicians who learned to apply educational theory and practices to professional education.

CONTINUUM OF EDUCATIONAL TRAINING

Sleep medicine is a discipline ideally suited to develop a vertical theme in medical education.³⁵ This

means that like the field of heart disease in the field of sleep medicine there would be instruction at many levels and a progression from basic knowledge to undergraduate medical training to graduate training that involves not only the specialist but also other specialties (Fig 1). The information on sleep and circadian rhythm are immediate and biologic in nature, fundamental to healthy life. Topics are interesting, amenable to instruction, and important.

The issues of sleep habits could be inserted into curricula in elementary and high schools, not only to raise the level of public information about sleep to that of nutrition and exercise but also to prepare our patients for instructions when or if a diagnosis or management of a sleep disorder is needed. College psychology curricula can be better informed about sleep disorders, given that instruction now in college textbooks only addresses, and briefly too, the topics of the stages of sleep, insomnia, and dreaming. At several junior colleges certificate courses in polysomnography and sleep diagnostics in general are now offered, and sleep specialists should align themselves with these certificate programs and develop these resources.

In regard to medical school education, the underdiagnosis and undertreatment of sleep disorders is understandable, but not excusable, considering the lack of representation of the topics of sleep and chronobiology in current medical school curricula. A complete undergraduate curriculum in chronobiology and sleep disorders must (1) establish a knowledge base, (2) train students/residents in clinical applications of this knowledge base, (3) recognize the

effects of sleep problems on professional training, and (4) emphasize the public health implications of sleep disorders.³²

The SAA recipients advocated for testing of these topics in step 1 and step 2 of the National Board of Medical Examiners for medical student education. In step 1 was the content of sleep and circadian biology, and in step 2 was the recognition and diagnostic strategy of narcolepsy, restless legs syndrome, insomnia, and sleep apnea.³² This content is now being tracked in medical school curricula, and thus it is fair game for those in sleep medicine to offer to teach these subjects in any and all courses where they can be feasibly inserted. In those schools in which small-group learning or case discussion form some or most of the content of instruction, insertion of sleep content in cases and in learning objectives can be instituted rather easily, given that the topics are listed as learning objectives for medical school instruction.

POSTGRADUATE INSTRUCTION

In order for undergraduate instruction to be taken seriously there needs to be a reinforcement of the importance of content at other levels of medical practice. A neglected area is residency requirements. None of the primary specialties (internal medicine, surgery, family medicine, obstetrics-gynecology) have sleep or chronobiologic illness as an explicit part of the requirements for instruction. However, there is the ACGME requirement for lectures on fatigue management,³⁶ a problem very well known to those in postgraduate training.³⁷ Thus, the sleep specialist has an opportunity, even a mandate, to provide information. At this point a discussion of the neurophysiology and consequences of sleep restriction can be offered to those subspecialties, such as pulmonary and critical care medicine, in which sleep disorders are within the domain of practice.²⁶ Case conferences, grand rounds, and morning report should be seen as opportunities to present the concepts of sleep medicine and the recognition of sleep disorders.³³ In addition, there is the requirement for standardized patient assessments, and another approach is to insert topics on sleep into routine clinical assessments of medical student performance.³⁸

The importance of sleep in residency programs is a direct result of the attitudes of the attending physicians and the program directors. To reach these individuals requires a concerted effort within a division interested in sleep on departmental educational efforts. This means that a Sleep Medicine program should engage the leadership in a dialogue about sleep disorders, presenting the evidence for its importance and offering opportunities for outpatient rotations in the subspecialty.³⁵ How to do this effectively

FIGURE 1. Educational opportunities to inform, instruct, and assess attitudes and knowledge in sleep and chronobiology. The expertise in Sleep Medicine and Behavioral Sleep Medicine is crucial to this continuum of instruction. Reinforcement of ideas would ideally come not only through instruction from undergraduate and postgraduate training but also through continuing medical, nursing, health professional, and public education informing those who instruct at all levels.

is a topic for research using educational principles and appropriate methodology.

There is a need to develop a national agenda for sleep medicine, not that there is an absence of individual presentations. Specialty-based postgraduate and advanced training in sleep medicine is available through the AASM, the Sleep Institute of the ACCP and its courses, and the postgraduate courses at the ATS, including the new Sleep State-of-the-Art course on Sleep Medicine. Local/regional continuing medical education efforts by major academic sleep centers have undergone rapid expansion, funded by industry as well as participant fees. At present there is no formal national agenda for this postgraduate education. Review of the major purveyors in this field in regard to national organizations suggests much overlap in topics and in presenters (personal observation). One could advance the process by developing a general curriculum and assessment tools for the basic topics and goals for management pathways. These could be relevant to any number of other fields (family medicine, anesthesiology, psychiatry, and so forth) and would present a more uniform message and identify needs for management of disorders of sleep and circadian rhythm.

PREGRADUATE COLLEGE AND ADVANCED TRAINING IN BASIC RESEARCH

The field will progress scientifically and intellectually only to the extent that there is recruitment of new people to the field in basic, applied, and clinical research and practice. There are opportunities at most medical schools to be involved in undergraduate BS or BA degree research. Some of this is funded nationally for underrepresented minorities. Programs that can attract additional funds for such students are noticed, and national organizations could develop funding for this initial experience in sleep.

There are funds available for doctoral and postdoctoral positions through the American Sleep Medicine Foundation, the ATS, the American Lung Association, American fellowship grants, the American Heart Association, and the Parker B. Francis Foundation. Federal programs include NIH T32 institutional training programs (currently there are five), some of which have only postdoctoral positions. In addition, there are the individual research awards available through most of the NIH institutes, but primarily focused in the Institute of Aging, NHLBI, and National Institute of Neurological Disorders and Stroke.

There is a major concern that the strategy to recruit, train, and support research across the continuum, including junior faculty, is fragmented and cannot be sustained.³⁹ The pool of those interested in research

may not be enhanced by this 1-year fellowship that does not have a research mandate, and research funding is no longer a pathway to attain clinical privileges or sit for the examination. For clinical psychologists, the pathway to BSM also does not have a research mandate,⁷ and PhD training for clinical practice is less research oriented than that for experimental psychology. One potential solution is to have centers of academic excellence in sleep medicine that are interdisciplinary and vertically aligned to promote both basic and applied clinical, multidisciplinary research.^{40,41}

PRECLINICAL EDUCATION

Sleep in grade school and elementary school education has no organized curriculum. Project Sleep commissioned an instructional program in the Brooklyn, New York school system on sleep directed at elementary school grades 4 and 5. This approach was reinstituted when the NCSDR in 2001 launched the "Sleep Well. Do Well. Star Sleeper Campaign." The iconic figure for this program was Garfield, as a "spokescat" for sleep.⁴² The fact that this character was notable, like Fat Boy Joe, for being chronically sleepy and overweight was never noted in this campaign. The message was that children aged 7 to 11 need at least 9 h of sleep each night on a regular basis. Some have found problems with this approach, however well intended, because this cartoon character has a lack of evidence of attempting to modify his health-risk behavior in general.⁴³

It should be noted that the NCSDR has developed a high school curriculum for sleep and circadian rhythm.⁴⁴ This is designed for grades 9 through 12 and has teacher materials and interactive instruction for students. This curriculum was developed by educational experts and is available for free. The problem is one of implementation. Although a local advocate can promote the use of this in high school science or psychology classes, the current climate of high school education is focused on state requirements and federal goals for certain fields of interest. Finding a place for sleep and circadian rhythm in the high school curriculum is difficult, but the instructional materials are now available.

In a 2000 program entitled *Clockwork Genes: Discoveries in Biologic Time*, the Howard Hughes Institute presented the concepts of circadian rhythm hosted by their funded scientists and directed toward the education of high school students. This is a rather sophisticated web resource with animation of the gene networks. It is available through iTunes and online. This is an enduring resource not only for elementary school instruction but for all levels of training.

ONLINE RESOURCES

The field of sleep medicine intersects with societal interest and behavior in the organization of sleep and circadian rhythm. The internet offers a wealth of instructional material, not only through posted educational material but also, for example, through MEDSLEEP, the public portal of the AASM. Any material posted should be viewed as a teaching opportunity. YouTube videos on fall-asleep car crashes, cataplexy, and sleep apnea are powerful images and prompt discussion on the medical issues of sleep apnea. Studies of the impact of this material as well as a survey of its scope and major message are needed.

SPECIAL MENTION

During the course of the SAA (1997-2003) it became evident that other health professionals needed to be not only informed but also involved in addressing the issue of clinical recognition and management of sleep disorders. The diagnosis and management of sleep problems are often done by nurses, who are now the largest number of health care providers in the United States. Nurses can contribute to new knowledge about sleep and health promotion, provide primary care, disseminate information to patients, and enhance patient compliance with treatment.⁴⁵ Curriculum recommendations for somnology and chronobiology education for nursing in undergraduate and graduate-level programs have been published,⁴⁵ and research now is within the domain of nursing.⁴⁶⁻⁵⁰ Coordination of medical and nursing education at fundamental levels may be possible, and research alliances can disseminate new knowledge quickly.

The Association of Polysomnography Technologists (est. 1978) has developed in parallel with sleep medicine. This organization is a member of the Association of Professional Sleep Societies and in 2005 changed its name to the American Association of Sleep Technologists. Its annual meeting now is concurrent with the AASM and the Sleep Research Society joint annual meeting. One main effort is to standardize education and expertise across laboratories.⁵¹ There is an independent Board of Registered Polysomnographic Technologists, which offers an examination (<http://www.aastweb.org/SleepTechnologist.aspx>), but only in English.

Early on, sleep technology and respiratory therapy societies communicated well about defining competencies and pathways that would acknowledge the special needs of each group.⁵² There remains interest among respiratory therapists to enter the field of sleep medicine, based on expertise in managing patients with respiratory disorders in general and sleep-disordered breathing in particular.

In addition, the American Society of Electroneurodiagnostic Technologists has issued its own recommendations for polysomnography⁵³ with some input from individuals in the sleep field but certainly backed by the medical professionals in Clinical Neurophysiology. Thus, there continue to be some friction points concerning who can do this test, who should titrate CPAP, and who can be involved in outpatient pathways for the management of sleep apnea.⁵⁴

There has been an increase in the scope of training opportunities through pathways that involve not only experience but also more formal education, through community colleges.⁵¹ The challenges in terms of health professional education are to develop competency-based assessment (rather than degree-based entitlements) and to address the needs for training in the new technology of home diagnosis and treatment that is independent of the measurement of sleep. Furthermore, there is an international need to disseminate training, information, and technology.

SLEEP MEDICINE TRAINING: GOING FORWARD

The clinical problem of sleep problems and disorders is significant, and it is necessary to engage other forces and to develop a number of curricular elements to address the public health needs regarding sleep. Table 4 is a list of ideas resulting from the construction of this article.

There is a need for public education and the creation of materials for instruction in elementary school and college level courses and for competency assessments at all levels of specialty and subspecialty

Table 4—Recommendations

Provide public education to raise general knowledge of sleep health
Reassess instruction on sleep in elementary and secondary school education
Develop public service programs to explain sleep and the process of diagnosis and treatment of sleep disorders
Provide training outside of Sleep Medicine
Provide training materials for use in other ACGME fellowship programs
Participate in health professional education in community colleges
Identify allies and instructors in other fields to appropriately acknowledge the role of sleep in disease management
Develop Sleep Medicine programs including Behavioral Sleep Medicine
Establish national goals and objectives for continuing medical education
Realize a common interlaboratory format for reporting and interpretation of testing results
Create investigators in clinical decision making and comparative effectiveness research
Engage primary care provider and specialty professional organizations in the creation of evidence-based pathways to extend care
Disseminate and compare training, information, patient care, and technology internationally

ACGME = Accreditation Council for Graduate Medical Education.

training. The organizations for primary care physicians should be engaged to develop explicit, rational approaches to detect and manage patients once they are diagnosed. Taking a lead from cardiology, one could use primary care to reinforce the goals and need for therapy and to institute preventative efforts.⁵⁵ Specialty practices, such as cardiology and neurology, wherein sleep affects the progression of disease either directly through pathophysiologic mechanisms or indirectly through effects on quality of life, should be engaged through care pathways or preferably evidence-based outcome studies. There needs to be coordination with other specialties regarding instruction on circadian rhythm, chronopharmacology, and sleep disorders. Such coordination is best done by engaging other specialties with an interest in applied and clinical research to teach in a sleep program and by sleep medicine offering their expertise in these subject areas in the other specialties.

One area of concern for this author is the lack of training in clinical decision making in sleep medicine.⁵⁶ We take for granted that clinical assessment and testing are rational and lead to optimal outcome, when in reality there is variance in each area.⁵⁷ One example found in pulmonary medicine is the difference in physician interpretation in oximetry over time, where it appears that there are no standards.⁵⁸ Are there such standards across laboratories or within each center? Is there a standard reporting format? How are studies from one center or laboratory regarded by another center? There is the opportunity to address these important issues using a multidisciplinary program⁴¹ and thus inform the manner and purpose of future patient management in sleep medicine.

Finally, there are other professional organizations that have a stake in this educational mandate for sleep physiology, pathophysiology, and medicine. These groups can succeed by coordinating their efforts with us to provide a synergy in management from primary care to subspecialty care, and determining appropriate care pathways with best outcomes that are effective, cost-effective, and patient-based.

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