

Competency-based Goals for Sleep and Chronobiology in Undergraduate Medical Education

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Study Objectives: Sleep and circadian rhythms are biologic processes operative in health and disease, but as yet there is no articulated curriculum for undergraduate medical education.

Design: A multidisciplinary expert-opinion approach was utilized to assess and define education objectives and the potential for implementation.

Setting: N/A

Patients or Participants: National Institutes of Health Sleep Academic Awardees

Interventions: N/A

Results: Four competencies with examples of instruction objectives were identified relating to sleep processes and sleep need, the impact of sleep and sleep disorders on human illness, the sleep history, and the applica-

tion of sleep physiology and pathophysiology to patient care. Various strategies and tools are currently available for implementation and assessment of learning objectives for these knowledge and skills.

Conclusion: The core competencies can be designed to improve physician knowledge and skills in recognizing and intervening in sleep problems and disorders. Learning objectives can be immediately incorporated into most medical school curricula. At the same time, these competencies serve as an important bridge across multiple medical content areas and disciplines and between undergraduate and postgraduate training.

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INTRODUCTION

KNOWLEDGE ABOUT SLEEP AND CHRONOBIOLOGY IS INCREASINGLY RELEVANT TO GENERAL MEDICAL EDUCATION.¹ Morbidity or mortality in many common medical illnesses, including gastroesophageal reflux, myocardial ischemia, stroke, and congestive heart failure, exhibit daily patterns and have associated sleep disorders,^{1,2} and the circadian timing of drug administration may influence medical outcome in cancer, asthma, and metabolic disease.^{3,4} Thus, clinical evaluation of sleep/wake routines and an understanding of chronobiology are important in the assessment and management of patients across all medical specialties.

Medical students⁵ and those in immediate postgraduate training programs⁶ experience sleepiness, sleep disorders, and problems with circadian rhythm. Thus, educating medical students about cognitive impairment from sleep deprivation emphasizes the personal health benefit of coming to school and work rested and informs them of a priority for sleep recovery in order to optimize functioning and learning in general.^{6,7} Indeed, presenting a case of narcolepsy or disorders of arousals [eg, rapid-eye-movement (REM) sleep behavior disorder] is an impressive way to present information on brain mechanisms responsible for vigilance and neurobehavioral state and the interactions occurring between the mind and body. Consideration of the consequences of sleep loss will emphasize the importance of recognizing illnesses like obstructive sleep apnea/hypopnea syndrome and restless legs syndrome that are common and amenable to treatment.² Such examples illustrate interesting content for a medical school. Unfortunately, there is limited presentation about sleep and chronobiology in medical education.^{8,9}

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There do exist web-based examples of model curricula for sleep medicine,^{10,11} one of which is also available along with other download-ready instruction resources,¹² as well as one report of a web-based learning program.¹³ There are proposals on the core content and skills for postgraduate specialty training^{14,15}; however, lacking from the literature is a competency-based formulation for a curriculum for undergraduate medical education. Once articulated, competency can be obtained and assessed through the variety of instruction methods and programs now present in the United States and abroad.¹⁶ The purpose of this report is to report a process utilizing expert opinion that derived four objectives that could be utilized to establish threshold levels relevant to sleep and circadian rhythm. In addition, proposals are set forth to facilitate implementation and assessment of this knowledge and skill base.

METHODS

The Curriculum Committee of the Sleep Academic Award program, sponsored by the National Center on Sleep Disorders Research at the National Heart, Lung, and Blood Institute, was organized in the fall of 1999 to identify and articulate objectives for medical education. An initial activity was to articulate why there is a need for such a knowledge system.¹ The committee then began a process of deriving education competencies relevant to sleep and chronobiology.

The process for the development of this document included discussion among education experts, collection of relevant material through personal contact and Internet survey (key words: sleep, education, curriculum, medical school), and presentation at national meetings. The committee collected data on existing sleep medicine curricula^{11,12,17} and exchanged experiences and data gained through education development and assessment activities in all Sleep Academic Award programs. The group held four meetings to synthesize information and created a list of learning objectives and/or goals. Items were grouped in terms of knowledge or skill "competencies."¹⁸ This list was disseminated for comment through the Sleep Academic Awardees and presented at faculty development programs at the annual meetings of the Association of Professional Sleep Societies in 2001 and 2002. The document was also presented for comment by the boards of the American Academy of Sleep Medicine and the Sleep Research Society.

This expert-opinion process resulted in the identification of four core

competencies for undergraduate medical education. As it is the acquired competencies of any graduate rather than the specific process that is the main object for presentation, the instruction examples and the suggestions for implementation are not meant to be a mandate, checklist, or limit. Many examples were selected because Sleep Academic Awardees found they were of interest to or easily understood by students, interns, residents, and other nonsleep audiences as being relevant to their education or interests. The writing group articulated a model for implementation of this curriculum that included reinforcement of these competencies in postgraduate training programs and learning opportunities.

RESULTS

The core competencies and examples of learning objectives that would relate to these expected proficiencies are listed in Table 1. Two are knowledge-based and two are skill-based competencies. Along with each item, there are listed some examples of how to accomplish such competency in a variety of learning opportunities. For example, Item I, “Explain the putative nature for sleep,” is most likely to be introduced to the student as part of a curriculum on neuroscience; however, the committee found examples of this knowledge being effectively represented in other settings, including instruction in endocrinology, in narcolepsy, or on the effects of sleep loss on medical education. As a result, students might have more than one exposure to knowledge competency item I and item II. For a skill item like item III, “Perform a Sleep History,” most commonly this would be presented in a course for clinical history and physical examination; however, this skill would be a part of student assessment of competency in any clinical clerkship. The highest level of competency would be an appropriate routine use in taking a patient history. In a similar fashion, giving advice on sleep (Item IV) could be presented and assessed in settings where preventative health and behavior is a focus for patient care. An important concept is the creation of mul-

multiple opportunities to build and reinforce knowledge and skills vertically throughout the curriculum.¹⁹ Some assessment tools for competency are already available^{12,20,21}; however, once competencies are articulated, it is up to each institution to construct assessments to evaluate local competency objectives at each point in the process of undergraduate education.¹⁹

While the initial presentation of concepts, therefore, would be presented as material in basic science or preclinical instruction, there is the opportunity to add instruction and application skills in the “clerkship” experience. In addition, it is in these environments where personal sleep loss and fatigue are known to take its toll on professionalism, satisfaction, personal health, and patient care.⁶ The committee identified several examples of short presentations that could be used in various settings through which a student might rotate (Table 2). It is not necessary (or wise) to have sleep experts develop programs in all these areas; however, the examples indicate the wide range of programs (neurology, pediatrics, medicine, psychiatry, and otolaryngology) where sleep and chronobiology are relevant to patient care.

Opportunities for advancing knowledge and research by undergraduates are required for medical school accreditation by the Liaison Committee on Medical Education, the nationally recognized accrediting authority for medical education programs leading to the MD degree in medical schools in the United States and Canada,¹⁹ and many medical schools will mandate that the student graduate with evidence of scholarship or research. Examples of opportunities relevant to the four competencies were identified or implemented by the Sleep Academic Award programs (Table 3). These are examples of appropriate research topics

Table 1—Four Competencies with Instruction Examples

Item I. Explain the putative nature of sleep

- Contrast neural systems in the regulation of rapid eye movement (REM) sleep and non-REM (NREM) sleep to that of coma, stupor, anesthesia, and wakefulness
- Distinguish sleep patterns in the newborn with those in the young and older adult
- Give examples of the effects of sleep and its different stages on cardiovascular, neuromuscular, endocrine, and respiratory physiology
- Utilize narcolepsy to illustrate the regulation of sleep-wake state and the consequences of daytime sleepiness
- Describe the impact of 1 night total sleep loss, chronic partial sleep loss, and sleep inertia on physician trainee performance and health risk

Item II. Discuss the ways disorders of sleep and circadian rhythm contribute to symptoms and signs

- Identify the pathophysiology and morbidities of obstructive sleep apnea hypopnea syndrome
- Describe the impact of sleep and chronobiology on common diseases, such as asthma, chronic obstructive pulmonary disease, myocardial ischemia, cerebrovascular ischemia, gastroesophageal reflux, and congestive heart failure and on growth, immune regulation, and homeostasis
- Integrate concepts of sleep and chronobiology into health assessments for attention deficit, mood disorders, memory loss, fatigue, and confusion
- Describe the impact of circadian and sleep disturbances on care in an intensive care unit

Item III. Perform a Sleep History

- Distinguish insomnia from circadian disturbance, restless legs syndrome, psychiatric or medical illness, and medication-induced insomnia
- Establish adequate nighttime routine and sleep schedules for children and adolescents
- Compare the neurocognitive symptoms of sleepiness to those of depression.
- Contrast the presentations of NREM sleep behavioral arousals with REM behavior disorder and nocturnal seizures
- Contrast sleep disturbances in women during pregnancy and menopause

Item IV. Initiate measures to improve sleep and reduce sleepiness

- Prepare advice on optimal sleep habits and environments (sleep hygiene)
- Develop measures to improve sleep in night-shift workers and persons with Parkinson disease or Alzheimer disease
- Educate patients about the risks of fall-asleep crashes, accidents and occupational mishaps
- Design sleep-management programs for physicians in training, caregivers, and shift-workers
- List legal and ethical implications of untreated sleep disorders and societal sleepiness

Table 2—Examples of Instruction Objectives for Clinical Clerkships

Medicine (family medicine, internal medicine, primary care)

- Contrast the symptoms of and causes for sleepiness, inattention, and fatigue
- Distinguish by history nocturnal leg cramps, restless legs syndrome, peripheral vascular disease, and peripheral neuropathy
- Recall the behavioral and cardiovascular correlates of unrecognized sleep apnea
- Compare and contrast treatment options for patients with insomnia
- Enumerate the indications for polysomnography
- Describe a recognition and management strategy for Cheyne-Stokes breathing
- Name three endocrine disorders associated with sleep-disordered breathing
- Describe how the efficacy of cancer chemotherapy, hypertension, asthma, and diabetes management is affected by the timing of medications

Surgery

- List the management issues raised by sleep apnea in the preoperative and postoperative care of the surgical patient
- Identify the circadian variations in pain and need for pain medications and the effect of narcotic withdrawal or lowering on rapid eye movement (REM) sleep
- Correlate the physical examination of the upper airway with anesthetic risk

Obstetrics/Gynecology

- List the role of snoring and sleep apnea in the pathophysiology of preeclampsia
- Take a sleep history in the work-up of menopausal symptoms

Pediatrics

- Contrast the impact of inadequate sleep on behavior in toddlers, young children, and adolescents
- Compare the causes of sleep apnea in children and adults
- Compare apnea of prematurity to apparent life-threatening events (ALTE)
- Provide behavior therapy to parents to improve sleep patterns in toddlers and adolescents

Behavioral Medicine/Neurology/Psychiatry

- Demonstrate the use of a sleep history for assessment of sleepiness and insomnia
- Contrast depressive symptoms with those in circadian phase disorders, sleep apnea, and other hypersomnias
- Identify the role of sleep disruption in presentations of confusion, memory loss, and agitation
- Illustrate behavior-intervention treatments for insomnia
- List indications, efficacy, and risk/benefits of prescription hypnotics and of over-the-counter medications or alternative treatments to promote sleep
- Differentiate REM sleep behavior disorder from sleepwalking, nightmares, and seizures
- Explain the four criteria for a diagnosis of narcolepsy
- Compare methods to evaluate subjective and objective sleepiness
- Discuss the purposes of a multiple sleep latency test (MSLT)
- List the sleep abnormalities associated with chronic alcoholism
- Describe the mode of action of central nervous system stimulant drugs used in narcolepsy

for undergraduate students as well as to those also in PhD or masters-level programs. One of the more innovative programs is based within a National Institutes of Health -sponsored General Clinical Research Center, in which a sleep clinician has organized research opportunities for medical students and residents (J. Catesby Ware, PhD, Eastern Carolina University, personal communication). Graduate research programs (PhD candidates and their mentors) can participate by providing access, enthusiasm, and appropriate projects for student participation.

There is an interdependence of education initiatives along the entire spectrum of medical education. The basis of the medical school curriculum resides in an articulated body of basic or "core" material on the biology of the field and on the desired behavioral outcomes relevant to this knowledge. Subsequently, one would have opportunity to apply such competencies to the routine assessments of patients at all levels of postgraduate medical education.²² There is the opportunity to utilize the current expansion of the resources (teaching materials, aids, tools, etc.) now available to medical school faculty so as to reinforce/mentor students and systems in the advanced application of knowledge.¹² It is the role of postgraduate training and continuing medical education courses to provide information on the value of identifying and treating sleep disorders and to reinforce or recognize the value of competencies accrued by undergraduate students.⁹ There is an ongoing effort to define and refine goals in postgraduate training programs in pulmonary medicine as well as sleep^{14,15} and to support the advancement of knowledge through research and academic training programs.²³

In contrast to the 20th century when there was advocated a more standard approach, the presentation of knowledge and skill acquisition in medical schools is now accomplished by a number of general models and modes of instruction.¹⁶ Some schools divide instruction between basic science and clinical experience, while in others concepts are integrated primarily through activities variously described as organ-system, problem-based, or case-based learning. Schools may utilize small learning groups or committees rather than lectures or ward rounds for the presentation of all or part of the curriculum. Also, at some schools there are requirements for students to exhibit specialized expertise, even "thesis" requirements, while at other schools there may be tracks for various learning groups, including primary care, MD/PhD programs, or other individualized combined degree programs. Instruction on the competencies (see Table 1) can be incorporated into these various models.

In the opinion of the committee, the information and human resources are available in sufficient quality and quantity to implement a curriculum in sleep and chronobiology in most medical schools, at least in the United States and Canada. Sources for content include the major textbooks in the field; however, immediately useful instructional material in a variety of formats is now found on the Internet. The National Center on Sleep Disorders Research of the National Institutes of Health has a web site with links to on-line information and resources.²⁴ The American Academy of Sleep Medicine in collaboration with the Sleep Academic

Awardees has created a web site repository for model slide sets relevant to basic and clinical training.¹² The site includes content case summaries and other material that can be used directly or modified for instruction, assessment, or self study. Such instruction would be enhanced by an involvement of sleep specialists at all levels of undergraduate teaching; however neither the presence of sleep specialists nor new courses would be required to implement these competencies. In addition, this material can (and should) be appropriately modified as to level of complexity to assist in the development of graduate, postgraduate, and continuing medical education instruction and assessment.¹⁶

RELATIONSHIP TO NATIONAL TESTING

The United States Medical Licensure Examination (USMLE) is a fundamental part of the process for assessment of the scientific and applied clinical knowledge of medicine for United States medical schools.^{25,26} Sleep and chronobiology are now an explicit feature of USMLE content areas. Topics recently added to Step 1 (the basic science module) include the ontogeny of sleep; the physiology of sleep; the impact of sleep deprivation on patient behavior; sleep disorders of narcolepsy, restless legs syndrome/periodic limb movement, circadian rhythm disorders, and parasomnias; and the regulation of ventilation during sleep. Topics identified for Step 2 (the clinical science module) include sleep apnea, narcolepsy and idiopathic hypersomnolence, insomnia, and other sleep disturbances in the context of what is currently listed in a category called "paroxysmal disorders."²⁶ Step 3 (postgraduate assessment) may become more explicit in identifying sleep disorders in the context of the diseases or disorders of the nervous system, as well as define competencies in patient interactions and other clinical behaviors¹⁹ in which the knowledge and skills of sleep and chronobiology could apply. To our knowledge, the instruction examples that are listed under the four objectives encompass most if not all of the current areas identified by the regulatory boards for accreditation of medical education.

The American Board of Internal Medicine also has expressed its interest in this topic with the addition of sleep medicine expertise on pulmonary and internal medicine boards, and the American Board of Psychiatry and Neurology is addressing corresponding issues. In these non-sleep residency and fellowship training programs, knowledge is generally tested by written examination, but there is increasing interest in complementary assessments such as observed patient interactions, simulated patients, structured clinical encounters, or chart review as outcomes for assessment during training.¹⁹

SUMMARY

Four competencies, identified by expert opinion, are articulated and include both knowledge and skills. It is apparent that there are a number of opportunities to present and assess these knowledge and skill areas at the undergraduate level and for the application of this knowledge to postgraduate experience and education. In addition, testing agencies appear poised to identify such content as being an important feature of competency for general physicians. Instruction material is available to implement a curriculum in various medical school structures, even in the absence of major programs in sleep medicine.

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Table 3—Examples of Topics for In-Depth Study or Research at an Undergraduate Level

Fundamentals of structure and function

- The acquisition and expression of circadian rhythm and sleep
- The transduction of light and darkness into behaviors
- Intrinsic disease of the brain and sleep
- Sleep and medical illnesses
- Interactions among sleep habits and behavior, eg, learning

Art and science of medicine

- Implementation strategies for teaching the sleep history
- Discrimination of sleepiness, fatigue, and inattention in health and disease
- Strategy for changing perceptions of sleep and sleep habits

Other areas

- Evolution of sleep and sleep behavior
- Sleep habits and education policy
- Sleep and public policy
- Forensic aspects of sleep
- Medical economics of sleep, sleepiness, and circadian rhythm

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