

The Effects of Sleep Loss and Fatigue on Resident-Physicians: A Multi-Institutional, Mixed-Method Study

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ABSTRACT

Purpose. To identify and model the effects of sleep loss and fatigue on resident-physicians' professional lives and personal well-being.

Method. In 2001–02, 149 residents at five U.S. academic health centers and from six specialties (obstetrics-gynecology, emergency medicine, family medicine, internal medicine, pediatrics, surgery) were recruited for the study. Residents were all in good standing in their programs. In a mixed-methods design, focus groups consisted of an average of seven (range, three to 14) individuals in the same year of training and residency program, for a total of 60 interns and 89 senior residents. Trained moderators conducted focus groups using a standardized, semistructured discussion guide. Participants also completed a 30-item quantitative questionnaire assessing sleepiness and workplace sleep attitudes that included the Epworth Sleepiness Scale (ESS).

Results. Residents described multiple adverse effects of sleep loss and fatigue on learning and cognition; job

performance, including professionalism and task performance; and personal life, including personal well-being and relationships with spouse or significant other and family. Only 16% of the sample scored within the “normal” range on the ESS; 84% scored in the range for which clinical intervention is indicated. Sleepiness was consistent across institution, specialty, years of training, age, gender, marital status, and having children.

Conclusions. More residents perceived that sleep loss and fatigue had *major impact* on their personal lives during residency, leaving many personal and social activities and meaningful personal pleasures deferred or postponed. Sleep loss and fatigue also had *major impact* on residents' abilities to perform their work. This finding further substantiates the growing concern about the potential impact on professional development. These observations should be taken into account in developing new training guidelines and educational interventions for housestaff.

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Housestaff may be characterized as functioning in a state of chronic, partial sleep deprivation during much of their

training. In a study of 26 internal medicine residents in a major teaching hospital, investigators found that interns spent an average of less than five hours per call night in bed, and obtained an average of only 3.7 hours of sleep, as measured by ambulatory EEG recording.¹ Other studies corroborate a similar high level of chronic, partial sleep deprivation.^{2–5} Chronic sleep loss has been shown to adversely affect mood, family and personal relationships, and

perceived quality of life. In addition, learning and workplace performance have been shown to be significantly affected, especially when tasks dependent upon high levels of vigilance or newly learned procedural skills are examined.⁶ Recent reviews have addressed the deleterious effects of sleep loss and fatigue on medical education.^{7,8}

The term “sleep loss” refers to both short-term sleep loss (recent 24-hour complete sleep loss) and chronic partial

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For articles on related topics, see pp. 379–380, 381–383, 384–385, 407–416, and 447–452.

Table 1

Level of Resident	Specialty						Total No. of Focus Groups
	Emergency Medicine	Family Medicine	Internal Medicine	Obstetrics and Gynecology	Pediatrics	Surgery	
Senior residents	3	4	1	3	2	1	14
Interns	2	0	2	2	1	1	8
Total	5	4	3	5	3	2	22

sleep restriction (<six hours of sleep per night on average for at least one week), and, according to *Merriam Webster's Dictionary*, third edition, "fatigue" is the consequential weariness, exertion, or the loss of power from continued work that is removable by rest.

Previous studies in this area have used quantitative methods to examine the impact of sleep loss and fatigue on residents. As of the writing of this paper, no qualitative studies had been reported to identify residents' perceptions, attitudes or beliefs concerning the role of sleep loss and fatigue in medical education. These qualitative aspects are important in understanding the individual effects of sleep loss and fatigue, and in designing appropriate interventions to counteract these effects. To this end, we used a mixed-methods design (i.e., using qualitative semistructured focus groups followed by a quantitative questionnaire instrument) to elicit attitudes, beliefs, and experiences from residents in a variety of specialties and across training levels regarding the effects of sleep loss and fatigue. The use of a qualitative methodology afforded the unique opportunity to examine how residents interpret and give meaning to their experiences and explore related meanings, processes, and contexts. The quantitative aspects of the study allowed us to analyze perceptions and beliefs at the individual level. Quantitative analyses

were conducted to complement the qualitative findings. Methods were administered sequentially; the questionnaire items were completed immediately following participation in the focus group. We anticipated that the focus-group results would provide a rich source of information about residents' perceptions and beliefs and the questionnaire items would allow us to assess the prevalence of perceptions and beliefs held by participants. We sought to maximize questionnaire response rate by linking methods in this way.

METHOD

Participants

A total of 149 residents in 22 groups participated at five U. S. academic medical centers affiliated with Brown Medical School, Case Western Reserve University School of Medicine, University of Kentucky College of Medicine, University of Michigan Medical School, and Robert Wood Johnson Medical School. Residents represented six specialties: emergency medicine, family medicine, internal medicine, obstetrics and gynecology (ob-gyn), pediatrics, and surgery. In all, eight groups of interns (60 interns) and 14 groups of predominantly senior residents (89 residents) participated. (See Table 1). Sites were selected to represent a range of

geographic locations as well as public and private institutions. Participating residents were in good standing (i.e., not on probation or in jeopardy of dropping out of residency).

The method of recruitment varied somewhat by institution. At some, program directors were asked to inform residents of the study and to invite all members of a given class to participate. At others, focus groups were held in place of a regularly scheduled conference when a last minute cancellation occurred. Participants were given a \$30 gift certificate. All participating sites obtained Institutional Review Board approval and participants provided full written informed consent. Participants' characteristics are shown in Table 2.

Procedures

Focus-group moderators were medical education consultants on sleep academic award grants, physicians, or post-doctoral students in the behavioral sciences. In most cases, there were two moderators: a faculty member with experience in conducting focus groups and an assistant who took notes, kept time, and handled forms. Assuming that residents would be less candid in the presence of an attending physician in their own department, faculty participating in this study did not conduct focus groups within their departments.

Measures

Qualitative focus-group questions. Moderators used a semistructured discussion guide to elicit participants' responses to set questions. Moderators followed the flow of conversation, changing the order of questions when it made sense to do so.

The semistructured interview guide had four main questions:

1. Describe your personal experiences with sleep loss and fatigue during medical training.

Table 2

Characteristics of 149 Residents in Focus Groups on the Effects of Sleep Loss and Fatigue, Five U.S. Academic Medical Centers, 2001–02	
Characteristic	No. (%)
Specialty	
Internal medicine	24 (16)
Pediatrics	28 (18)
Family medicine	35 (24)
Surgery	19 (13)
Obstetrics–gynecology	20 (13)
Emergency medicine	23 (15)
Institution	
Brown Medical School	35 (24)
Case Western Reserve University School of Medicine	37 (25)
University of Kentucky College of Medicine	26 (17)
University of Michigan Medical School	41 (27)
Robert Wood Johnson Medical School	10 (7)
Sex	
Male	73 (49)
Female	73 (49)
No response	3 (2)
Postgraduate year (PGY)	
PGY interns	60 (40)
PGY residents	89 (60)
Marital status	
Married	69 (46)
Single	51 (34)
Divorced	29 (20)
Had children	
Yes	29 (20)
Age in mean years (SD)	30 (4)

2. Has sleep loss and fatigue affected you personally during your residency training? If so, how?
3. What strategies or countermeasures have you used in dealing with the effects of sleep loss and fatigue?

4. How could circumstances be changed to reduce sleep loss and fatigue in your training program?

Focus-group discussions, each lasting 40–60 minutes, were audiotaped and transcribed.

Quantitative questionnaire. At the conclusion of each focus group, participants completed a 30-item questionnaire assessing sleepiness, workplace sleep attitudes, and perceptions of how, if at all, sleep loss and fatigue affected them.

The first eight items of the questionnaire consisted of the Epworth Sleepiness Scale (ESS),⁹ a measure of the likelihood of falling asleep. These items asked participants to rate, using a four-point scale, situations on the chance of dozing during the day (0 = “would never doze,” 1 = “slight chance of dozing,” 2 = “moderate chance of dozing,” and 3 = “high chance of dozing”). The range of situations makes it possible to distinguish between highly alert and highly sleepy individuals. The ESS scores are 0–5 = desirable, 6–10 = mild sleepiness, 11–15 = moderate sleepiness, and 16–24 = severe sleepiness, usually associated with impaired performance. Studies indicate that individuals who score 0–10 on the ESS are in the clinically “normal” range with a mean of 4.6.¹⁰ Clinical intervention is typically suggested for scores of 11 or more. The ESS has good internal and test-retest reliability and has also shown moderate correlation with objective sleep-propensity tests.^{11,12}

In the next four questionnaire items, we paired four additional residency specific situations with the ESS: “During grand rounds or noon conferences,” “Writing up a patient history and physical,” “Talking on the telephone,” and “Preparing a presentation.” These ratings were summed to create the Residency Specific Supplementary Epworth Items (ESS-Res).

The final 18 items on the questionnaire asked about attitudes and percep-

tions of the impact of sleep loss and fatigue in residency training. Participants were asked to indicate the extent of their agreement with statements about sleep loss and fatigue using five-point scales: 1 = strongly disagree, 3 = neutral, 5 = strongly agree for negatively worded statements; and 1 = strongly agree, 3 = neutral, and 5 = strongly disagree for positively worded statements. Item phrasing was counterbalanced to include both positively and negatively worded items and scaled such that when these items were summed, higher scores indicated greater concern and perceived problems due to sleep loss and fatigue; possible scores ranged from 18–90.

Anonymized, unedited focus group transcripts as well as questionnaire data were forwarded to Case Western Reserve University School of Medicine for analysis and interpretation. We collected data between May 2001 and May 2002.

Data Analysis

Qualitative analyses were conducted in the grounded theory tradition.¹³ Four of us (KPS, EPS, BOE, KKP) separately analyzed six focus-group transcripts, independently reading and identifying themes using open coding. Investigators met to review coding and classification of the transcripts. As codes evolved, additional focus groups were analyzed to challenge, expand, and refine the categories. The final confirmed coding structure was then applied to the entire set of transcripts (by PS) using NVivo (QSR International, Melbourne, Australia), a qualitative data management software.

With the quantitative analyses, we sought to describe residents' level of sleepiness; assess the relationship between the level of sleepiness and specialty, residency year, gender, age, and marital status; and determine the association between level of sleepiness and

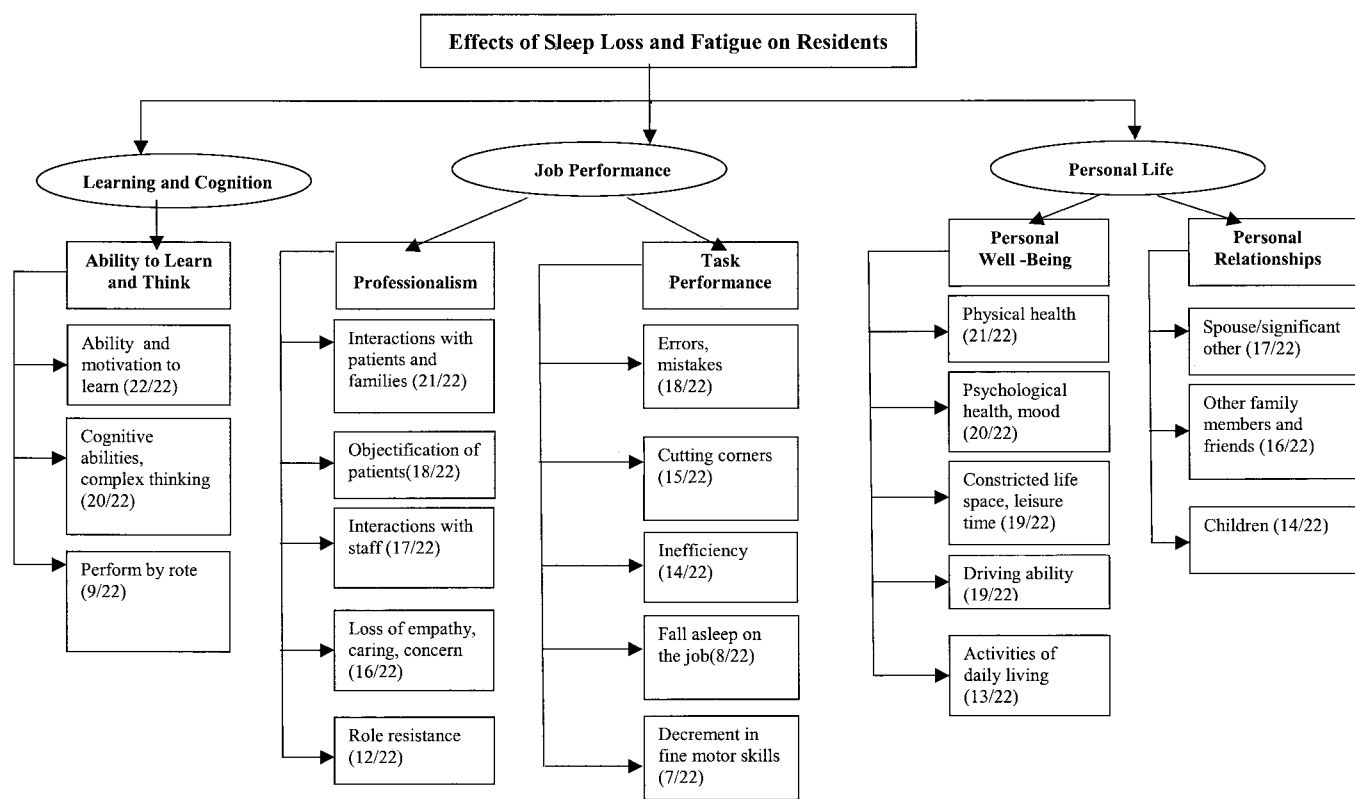


Figure 1. Conceptual model of the effects of sleep loss and fatigue on resident-physicians from focus groups with 149 residents at five U.S. academic health centers, 2001–02. Numbers in parentheses indicate the number of focus groups in which this theme was discussed.

attitudes and perceptions of the impact of sleep loss and fatigue in residency training. In subsequent papers, we will detail perceived adaptation to sleep loss and fatigue and model resident and systems factors associated with sleepiness. In order to allow participants to feel comfortable sharing their perceptions and experiences, identifying information about speakers was not included either in the group transcripts or on questionnaires.

In the qualitative analysis that follows illustrative quotations are identified by focus groups (specialty and year of training) only. From our perspective, this approach encouraged candidness among participants. However, it precluded our linking the qualitative and quantitative data at the individual level.

RESULTS

Residents had little difficulty identifying and describing their personal experiences with sleep loss and fatigue during residency training. A wide variety of effects were identified across different groups. These effects were reliably coded into several categories or themes, which we combined into an overall impact model (see Figure 1). Two coders independently rated selected categories resulting in moderate agreement, as measured by the kappa statistic ($\text{kappa} = 0.703$; $p < .001$). We counted categories or themes across groups to identify each theme's relative position in the model (see Figure 1). Since the focus group is the unit of analysis, when we report that a category was discussed—

and therefore coded—in a given number of focus groups, this means at least one resident in each focus group made a comment in that category.

The following is a brief description of the major categories and the themes within the categories, in descending order of frequency of responses.

Category 1: Learning and Cognition

First and foremost, residents reported adverse effects of sleep loss and fatigue on their abilities to learn, either in short-term or long-term acquisition of cognitive or noncognitive material. Both formal and informal learning opportunities were affected, such as learning from reading, lectures, conferences,

and other structured learning opportunities.

All 22 focus groups discussed the effect of sleep loss and fatigue on ability and motivation to learn. One resident said "It affects me in terms of my education, because I'm always in a state of exhaustion. I was exhausted, even when I was not reading. You don't have energy and the stamina to do the reading. That falls by the wayside." (Family medicine, third year) Residents described attending lectures, rounds, and teaching conferences with little or no retention of information, especially postcall. They reported signing in at teaching conferences solely to avoid being penalized, as one resident admitted: "I mean I can't retain anything when I'm post call, especially if somebody is sitting there lecturing me." (Ob-gyn, first year)

Twenty of the 22 focus groups noted that sleep loss and fatigue adversely affected their higher-order thinking skills (cognitive abilities and complex thinking). This category of responses included comments pertaining to patient diagnoses, medical decision making, and complex thought processes, as illustrated by the comments of one resident:

There have been a lot of times where I'll be looking, staring at the computer at a blatantly abnormal lab result. You know, say a cardiac enzyme level is 5 instead of 0.5; sometimes I just don't even recognize it. I see it, but it's like my brain can't do the processing that it would ordinarily when I'm awake. Things just don't register. (Emergency medicine, third year)

Nine of the 22 focus groups described their performance when they had experienced sleep loss as "performing by rote" and "following algorithms," as opposed to "thinking intellectually" when caring for patients. This is illustrated by the following comment: "If the situation doesn't fit a protocol, I would be stuck, because that's the way I've done it all

along out of necessity." (Ob-gyn, third year)

Category 2: Job Performance

Respondents identified specific effects of sleep loss and fatigue on job performance. We classified these effects into two subcategories. First we describe the effects on professionalism, including the adverse effect on residents' attitudes toward patients and their families, interactions with staff, objectification of patients, loss of empathy and concern for patients, and role resistance. Second, we describe the effects on task performance, including residents' abilities to discharge their responsibilities and do the job expected of them as physicians. They talked about the increased risk of making mistakes, their urge to cut corners, their inefficiency, falling asleep on the job, and decrement in fine motor skills.

Professionalism. Twenty-one of the 22 focus groups described themselves as inattentive and abrupt in their relationships and interactions with patients and family members. As one resident said,

I definitely find myself when I'm fatigued; I have much less patience with patients. I tend to be much more brief in terms of my history and physical exam. I tend to zone out sometimes when I'm listening to people. I tend to probably interrupt more often than I should to try and get to the heart of the matter more quickly. (Emergency medicine, first year)

Residents also had less patience with families, as the following comment illustrates:

It was at the end of a call at 4 AM and I was fine with the patient herself and her husband, but there was a sister and mother there who kept questioning why I was doing what I was doing and I explained it three times. The fourth time I just lost my patience. I was like . . . 'Are you a doctor? If you

are not a doctor, don't ask me. I have already explained it three times!' and that is not me, I mean I am not usually like that. (Ob-gyn, first year)

Eighteen of the 22 focus groups spoke specifically of "moving" and "managing"—objectifying—patients, rather than "caring" for them. "And that's what it feels like, you're just moving patients. You know, like a traffic controller" (Emergency Medicine, first year), said one resident. Residents lacked time or energy to invest in caring activities, as one resident commented, "I think what I found mostly in the first year was... how to manage patients. Not how to really care for patients or learning about medicine, but just how to manage people, how to manage the hospital system." (Family medicine, third year)

Sleep loss and fatigue negatively affected residents' interactions with staff, as discussed by 17 of the 22 focus groups. One resident noted:

. . . I'll have a lower threshold in the morning when I'm postcall and . . . I get a little cranky in the morning and I don't really have much talk . . . whereas if I see them in the afternoon, I can talk to them for a while. And yet I think it negatively affects that interaction (with patients) and as well with nurses. I may snap at nurses but I don't want to but it just . . . it's kind of information overload but . . . you just need answers and you can't screw around with a bunch of B.S. or whatever. (Surgery, first year)

At times, residents expressed regret at how they had behaved in these situations.

Sixteen of the 22 focus groups described a noticeable loss of empathy and concern for their patients. Several residents noted having less compassion in postcall clinic, particularly when evaluating less severely ill patients. In the words of one resident, "You really see it in the postcall clinic. The next day

when you're in clinic, you get people who, for whatever reason, you don't think are as medically 'significant' as they think they are, and they come in and you're like, 'Look, go home!'" (Internal medicine, first year). Another said, "If you're not dying, don't talk to me." (Internal medicine, third year)

Twelve of the 22 focus groups mentioned resistance to performing basic medical responsibilities and roles. For example, residents reported reluctance to teach junior residents or medical students, to take on responsibility for care of new patients, and to care for terminally ill patients, as one resident commented, "And the worse thing is when you say, please let this person go to the unit; it's the worst. I'm a horrible person. What kind of person am I, hoping that this person is so sick that I don't have to take care of them?" (Family medicine, third year)

Task performance. Eighteen of the 22 focus groups had frequent concerns about medical errors occurring due to potential effects of sleep loss and fatigue. Most frequently cited examples pertained to entering information into the patient record, prescribing medications, and either writing incorrect dosages or prescribing for the wrong patient. One resident commented,

Even in writing labs . . . One night I didn't get sleep and I was admitting someone like at 6:00 in the morning and I noticed the next morning I wrote the potassium as the creatinine. And my chief is like 'This lady has a creatinine of 4.2?' and I was like, 'I don't remember that.' It turned out it wasn't that. (Surgery, first year)

Misdiagnoses were also reported. A resident commented,

When I was on the pediatrics rotation, we got a 2 AM transfer from another hospital that was admitted as a respiratory infection. . . . We got up the next morning and when things were clearer and people were less sleepy,

someone said, um, I think this baby's got a heart murmur. And it turned out that it was all cardiac-related and not a respiratory infection at all. So I carry that around with me every day. (Pediatrics, first year)

Another reported effect of sleep loss and fatigue described by 15 of the 22 focus groups was "cutting corners" or "taking the easy way out." Events that ordinarily would have received attention and been of concern were downplayed. Said one resident: "Certainly, near the end of my time I had become a 'minimizer.' At the beginning you're very methodical, very detailed, very thorough, and you become less and less thorough. Details become less and less important." (Family medicine, third year)

Fourteen of the 22 groups spoke about inefficiency and tasks taking longer to accomplish as a result of sleep loss and fatigue. One resident commented, "The morning after the end of call, you know, that's when rounding on patients is tough. Even simple things like writing orders and discharge paperwork can take two to three times longer." (Ob-gyn, first year)

Eight of the 22 focus groups described instances of falling asleep on the job at inappropriate times, for example, during sign outs, writing notes, talking with patients, on rounds, while dictating, on the elevator, reading laboratory reports, even while performing minor surgical procedures or while delivering a baby. As one resident said, "I just can't help it. My body . . . when I'm falling asleep looking at labs, my body's telling me I need sleep. There's nothing I can do." (Surgery, first year)

Seven of the 22 focus groups noted marked decrements in fine motor skills following periods of sleep restriction or deprivation. The most frequently reported effect was in regard to chart notes as illustrated by the following comment:

If you look at my notes, and it's about 3 AM, the note is dated but it becomes illegible. Kind of like those hypoxic studies when they take people's oxygen away and you can't read the writing anymore. The note looks like that. Of course, it's an unacceptable medical record and I have been reprimanded several times, but what can you do? (Internal medicine, first year)

These effects were also noted in other areas of task-related performance. As one resident said, "I think that the physical response of the body after you've been up for like 36 hours . . . this isn't supposed to happen when you are trying to put in an IV at 35 hours, and your hands are shaking." (Pediatrics, third year)

Category 3: Personal Life

Personal well-being. Residents' personal lives were often affected by sleep loss and fatigue, including negative effects on interpersonal relationships, ability to manage tasks of daily life, and physical and emotional health. Residency is a highly demanding phase of professional development, which places major demands on residents' abilities to manage their personal lives outside the hospital. One emergency medicine resident characterized this period as brutal and depressing: "Brutal while you're there. Depressing because all you do is work every single night. You don't see your significant others and other people that are important to you." (Emergency medicine, first year)

Twenty-one of the 22 focus groups mentioned the negative impact of sleep loss and fatigue, combined with the intense demands of residency training, on their physical health and health habits. As one resident said, "It takes its toll on my health. I've lost ten years from my life . . . the food I eat, lack of exercise and sleep. It all adds up. I know it's unhealthy, and I don't like myself for living this way." (Ob-gyn, third year)

Twenty of the 22 focus groups described a range of adverse effects on emotional well being and on their psychological health and mood, describing themselves as more irritable, impatient, anxious and short-tempered. One resident said, "Residency changes you as a person. You become more jaded." (Emergency medicine, first year). Sleep loss and fatigue were cited as strongly associated with feelings of detachment from everyday life. Residency training demands full-time effort, and taking time away from patient care or medical education is experienced as a threat to their identities as "ideal residents."¹⁵ One resident complained that she felt guilty when engaging in recreational activities: "I feel as if I didn't have a right to have a life outside of my work." (Ob-gyn, third year) Fatigue also leads to diminished interest, and as one resident put it, "in anything but sitting on the couch." (Internal medicine, third year)

Nineteen of the 22 focus groups felt they had constricted life space and no leisure time. As one resident said, "For me it's like I do everything to keep just my family and my work life going and everything else has suffered." (Ob-gyn, first year) Another comment illustrated this concern:

I've lost too much of my life during residency. . . . I don't know current events. I used to be interested in history and politics and art. I used to be an interesting person. Now I'm just boring, the only thing I know is the woman who went blind this morning after delivering her baby. (Ob-gyn, third year)

Nineteen of the 22 focus groups described situations in which their driving ability had been impaired by sleep deprivation and fatigue. A few reported having accidents involving injury or vehicular damage; others reported being fearful about driving while cognitively impaired by sleep loss and fatigue. A

number also reported getting traffic tickets for speeding or running stop signs, because of lapses of attention or concentration. The most frequently reported experiences were driving on "autopilot" and experiencing "microsleeps." "I'm pulling into my driveway and I really don't recall the last fifteen minutes or anything," said one resident. (internal medicine, first year) Another resident said, "What's worse is falling asleep in the car at a stop light and having someone bang on your window." (Internal medicine third year) This concern was echoed by a resident who said, "You're driving and you fall asleep for maybe two seconds and you catch yourself and you are so frightened when you wake up that 'Oh, God, anything could have happened.'" (Internal medicine, first year)

The effect of sleep loss and fatigue on activities of daily life was a topic in 13 of the 22 focus groups. One resident said,

You have this list of things you might do and it's like totally overwhelming to go to the dry cleaners. You sort of end up wasting . . . and that might happen for a few days and all of a sudden it's like weeks have gone by and you haven't done anything and that's sort of disconcerting. I mean I hear of people who work a couple of jobs trying to make ends meet that feel that way all the time. I don't think we're unique. But it is strangely anxiety producing. Your days are going by and you have not accomplished all these things. I mean even a simple phone call to the bank or something. (Emergency medicine, third year)

Personal relationships. Seventeen of the 22 focus groups discussed the effect of sleep loss and fatigue on the residents' spouses and significant others. Forty-six percent of participants were married. The negative impact of sleep deprivation on relationships with spouses or significant others not only added to the stress of residents' lives, but also under-

mined a primary source of emotional support. As one resident noted,

Sleep loss affects marriage. My partner doesn't understand; he wants to do things when I come home and am off-call. My spouse doesn't understand the pressure and the fatigue. It's really hard to get myself to do anything but sleep when I get home. (Ob-gyn, third year)

Another said, "If you're not already married, it's impossible to find a spouse. If you are married, it's hard to maintain your relationship." (Ob-gyn, third year). Relationships are put "on hold" during residency; in the words of one resident, "I think a lot of relationships are in this waiting game." (Family medicine, third year)

Relationships with family members and friends also suffered, as 16 of the 22 focus groups discussed. One resident said, "You don't even feel like talking to your mother even, if you haven't talked to her in two weeks, if she happen to call when you're postcall." (Internal medicine, third year) Another resident in the same focus group added that "family members feel the effects of that, and they kind of distance themselves." (Internal medicine, third year). Relatives and friends were reported to personalize changes in residents' behavior, interpreting low levels of engagement as a reflection on the quality of the relationship. A resident said, "It's hard going out to dinner with friends or loved ones or whatever, and sometimes you're just sitting there going, 'How about a little passive entertainment tonight, because I can't really communicate?'" (Emergency medicine, third year)

Fourteen of the 22 focus groups talked about the effects on their children. Twenty percent of all the residents had children, and some reported that sleep loss and fatigue affected their performance as parents. One resident reported difficulty staying awake while playing with his children: "I'd be sitting

Table 3

Observed Mean and Standard Deviations for the Ratings of 149 Residents on the Likelihood of Falling Asleep in Situations, Shown in Descending Rank Order, Five U.S. Academic Health Centers, 2001–02	
Situation	Mean* (SD)
Epworth Sleepiness Scale (ESS)	
Lying down to rest in the afternoon when circumstances permit	2.7 (0.6)
Sitting and reading	2.5 (0.6)
As a passenger in a car for an hour without a break	2.3 (0.9)
Watching TV	2.1 (0.8)
Sitting and inactive in public place (theater or meeting)	1.8 (0.9)
Sitting quietly after lunch without alcohol	1.7 (0.9)
In a car while stopped for a few minutes in traffic	1.0 (1.0)
Sitting and talking to someone	0.6 (0.8)
Overall summed	14.6 (4.4)
Residency-specific supplementary ESS items	
Grand Rounds or Noon Conferences	2.1 (0.8)
Preparing for a presentation	1.1 (1.0)
Writing up a patient history	0.6 (0.8)
Talking on the telephone	0.5 (0.6)
Overall summed	4.3 (2.4)

*Ratings were given on a four-point scale: 0 = "would never doze," 1 = "slight chance of dozing," 2 = "moderate chance of dozing," 3 = "high chance of dozing."

there slapping myself. I'd pinch myself, just because you almost go comatose." (Emergency medicine, third year) Another reported that "my wife would find me asleep on the floor playing with blocks." (Surgery, third year) Several residents described feeling guilty about their performance as parents, particularly when they felt irritable towards their children. As one said, "It's hard to tolerate what the children do. You're just tired. You want them to go away . . . you want it all to go away. It's like being gone when you are at home. . . . You're feeling guilty that you're a bad parent." (Family medicine, third year) Another resident commented, "My three-year-old actually puts me to bed now instead of me putting her to bed, because I go to bed before she does because I'm always tired." (Family medicine, third year) A resident confessed that his five-year-old daughter had told him that "she wished I'd never gone to medical school." (Pediatrics, third year)

Quantitative Findings

All 149 residents who participated in focus groups completed the 30-item questionnaire. On the ESS, only two (1%) participants scored in the "desirable" range and 22 (15%) scored in the "mild sleepiness" range. The remaining 125 (84%) scored in the range for which clinical intervention is typically indicated, with 61 (41%) falling in the "moderate" category and 64 (43%) falling in the "severe" category. On average, residents responded that they had a high to moderate chance of dozing in six of the eight situations encountered in daily life as measured by the ESS (see Table 3). ESS scores varied widely (from 1–23), and averaged 14.6 (SD = ± 4.4); the scale was unidimensional (Cronbach's alpha was 0.82 for eight items). (See Figure 2.)

On average, in the ESS-Res, residents responded that they had a high to moderate chance of dozing during grand

rounds or noon conferences (the same observed mean as "watching TV" on the ESS) (see Table 3). For the other three items, preparing a presentation, writing up a patient history, and talking on the telephone, the chance of dozing was estimated to be either never or slight. The ESS-Res scores ranged from 0 to 10, and had a mean of 4.3 (SD = ± 2.4); the scale was unidimensional (Cronbach's alpha was 0.74 for four items).

Neither the ESS nor the ESS-Res were significantly associated with resident age, gender, marital status, or number of children (all r s < .15], all p s ns).

The 18 items on the questionnaire about attitudes and perceptions of the impact of sleep loss and fatigue in residency training asked participants to indicate the extent of their agreement with statements about sleep loss and fatigue on a five-point scale. A total of 133 (89%) residents either strongly disagreed or disagreed with the statement that "My thinking is unaffected by sleep loss." A total of 124 (85%) residents did not agree "My work is unaffected by sleep loss and fatigue." Interestingly, 95 (64%) residents either strongly agreed or agreed that "Sleep loss and fatigue have *major impact* on my personal life." These items were in the upper quartile in terms of affecting the majority of residents. By contrast, 68 (46%) residents agreed or strongly agreed that "Sleep loss and fatigue have *major impact* on my work." Of the 95 residents who agreed that "Sleep loss and fatigue have *major impact* on my personal life," only 59 (62%), (i.e., 39% of the total participants) also agreed that "Sleep loss and fatigue have *major impact* on my work." Only four residents disagreed with the statement that "Sleep loss and fatigue has *major impact* on my personal life" and agreed with the statement that that it has "*major impact* on my work." In the bottom quartile, only 37 (25%) strongly disagreed or disagreed with the statement that "I can tell when I am too tired to drive home." Only 28 (19%) residents disagreed or strongly disagreed

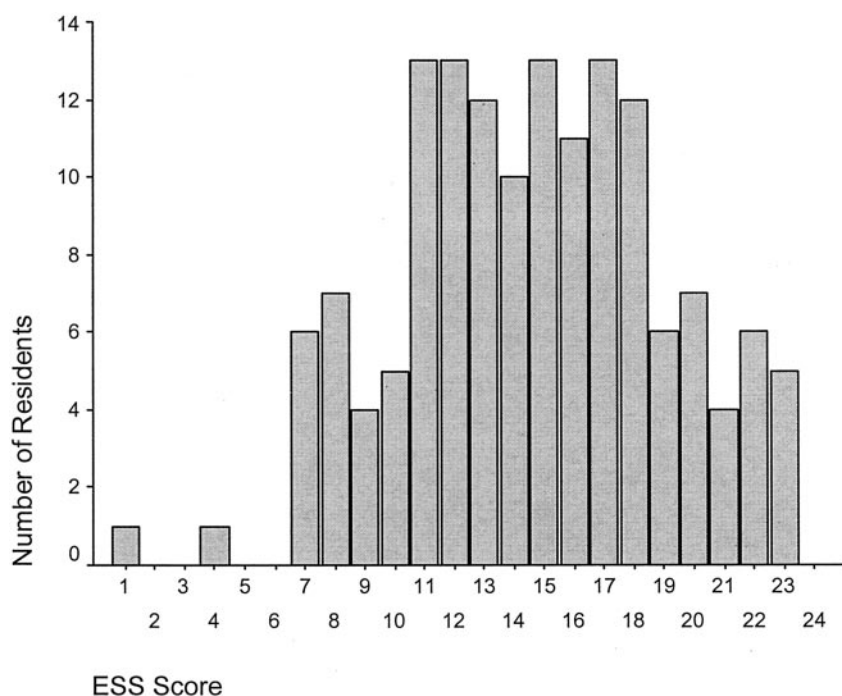


Figure 2. The distribution of Epworth Sleepiness Scale (EES) scores across all residents and specialties. The ESS scores were normally distributed with 84% of residents scoring >11, the upper limit of "normal." The ESS scores are 0–5 = desirable, 6–10 = mild sleepiness, 11–15 = moderate sleepiness, and 16–24 = severe sleepiness, usually associated with impaired performance.

that "My body has adapted to less sleep." (See Table 4.)

Items were scaled such that when they were summed, higher scores indicated greater concern and perceived problems due to sleep loss and fatigue; scores ranged from 38–79, the observed mean of summed scores was 57.1 (SD = ±9.4). Cronbach's alpha was 0.77 for these 18 items.

Principal components factor analysis was conducted to reduce the set of perceived impact items into empirically defined dimensions; we adopted the standard eigenvalue extraction criterion of 1.0, and used varimax rotation to facilitate interpretation of orthogonal factors. Five factors emerged (see Table 5). All items loaded on at least one factor, and the overall factor solution explained 62% of the total variance. These factors were readily interpretable as Personal Impact (five items), Performance Disruption (five items), Denial

of Performance Disruption (three items), Perceived Adaptation (three items), and Family Empathy (two items). The third and fourth factors had skewness indices >0.4, and thus were converted to ranked scores for analysis. Items were averaged rather than summed within each factor, to aid interpretation of their relative magnitudes (see Table 6).

Finally, multivariate analysis of covariance (MANCOVA) was conducted, with ESS and ESS-Res as dependent variables, institution, program specialty, and intern (versus resident) as categorical independent variables, and year of residency and the Impact factors as continuous independent variables. There were significant multivariate effects for all predictors except for Family Empathy and Perceived Adaptation (all others $p < .05$). Univariate follow-up analysis of covariance (ANCOVA) analyses (including all the above covari-

ates) indicated that residents had higher ESS scores than interns did ($F = 19.0$, $p < .001$), whereas ESS-Res scores did not differ between these groups ($p = ns$). Independent of this effect, residency year was also associated with ESS scores ($p < .01$), but not ESS-Res scores ($p = ns$). The direction of the year by ESS association indicated that residents who were more advanced in their program tended to report less sleepiness. Specialty had a significant multivariate effect on both sleepiness scores ($p < .05$ for both). Follow-up Bonferroni-corrected pairwise ANCOVA analyses indicated that ob-gyn residents had significantly higher ESS-Res scores than did internal medicine residents (adjusted $p < .05$), with no other differences emerging among specialties on either scale. There were additional independent associations between three of the Impact factors and sleepiness scores. The Personal Impact factor was significantly associated with both ESS and ESS-Res scores ($F > 4.4$, $p < .05$ for all scores), such that both types of sleep propensity were associated with greater Personal Impact. The Performance Disruption factor was associated with ESS-Res scores ($F = 39.0$, $p < .005$) such that performance was poorer among residents who rated themselves as sleepy in professional situations, but this factor was not associated with sleepiness in situations identified on the ESS ($p = ns$). Finally, Denial of Performance Disruption was associated with both ESS and ESS-Res scores ($F > 2.9$, $p < .05$ for all scores), such that greater denial was evidenced among less sleepy residents.

DISCUSSION

Increasing evidence supports the view that physiologic and cognitive functions in humans vary significantly in accordance with circadian rhythms. Alertness and the ability to perform complex mental or psychomotor tasks also vary as a function of homeostatic sleep-wake

Table 4

Observed Mean and Standard Deviation of the Ratings of 149 Residents on the Perceived Effects of Sleep Loss and Fatigue, Shown in Descending Order of Concern, Five U.S Academic Health Centers, 2001–02	
Statement	Mean* (SD)
My thinking is unaffected by sleep loss.†	4.3 (0.9)
My work is unaffected by sleep loss and fatigue.†	4.2 (0.8)
I chose my medical field, in part, because I function well on little sleep.†	4.0 (1.1)
Sleep loss and fatigue have major impact on my personal life.	3.6 (0.1)
I never make errors in writing prescriptions on postcall days.†	3.5 (1.0)
I have heard about others making medical errors due to sleep loss and fatigue.	3.5 (1.3)
I have worried about having a car accident driving home postcall.	3.3 (1.5)
Sleep loss and fatigue have major impact on my work.	3.3 (1.2)
Sleep loss and fatigue affect my medical decisions.	3.3 (1.2)
I have written an incorrect order because of sleepiness.	3.1 (1.2)
I sometimes look forward to sleeping at grand rounds.	3.0 (1.1)
I have effective countermeasures to sleep loss and fatigue.†	3.0 (1.0)
I have made medical errors because of sleep loss and fatigue.	3.0 (1.0)
My family does not understand how demanding my job is.	2.8 (1.2)
I can tell when I am too tired to drive home.†	2.6 (1.1)
My family understands my demanding job and sleep needs.†	2.4 (1.1)
My body has adapted to less sleep.†	2.3 (1.1)
I might fall asleep while examining a patient.	2.2 (1.4)
Overall mean summed	57.1 (9.4)

*Ratings were given on a five-point scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

†Positively worded items were reverse scored on a five-point scale: 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree.

factors such as sleep duration, sleep quality, and time awake. Acute and chronic sleep loss, whether partial or complete, has been shown to markedly impair performance across a variety of domains including cognitive, behavioral, and emotional functioning. Whatever historical and professional influences might account for the tradition of sleep loss and fatigue during residency training, our study provides further evidence that physicians are not exempt from these effects. Residents in our study provided qualitative and quantitative evidence of these effects across a wide array of circumstances and situations.

Residents are aware that sleep loss prompts a number of neurobehavioral and cognitive deficits in performance, including lapses in attention, loss of alertness and vigilance, task inefficiency, cognitive slowing, and decline

in capacity of working memory, which put them at increased risk of making mistakes. Residents across specialties reported that “adrenaline surges” allowed them to accomplish what was necessary, but they noted repeatedly that performance slipped when complex thinking and sustained attention were required. Some residents expressed concern that they became inefficient, lost full cognitive capacity, and developed ineffective coping strategies following extended periods of sleep loss. Some reported falling asleep at inappropriate times on the job or while driving, and had experienced involuntary microsleeps.

Quantitative results in this study strengthen and extend the qualitative findings. First, ESS scores indicate that four out of five residents scored in the range of sleepiness for which clinical

intervention is usually required. ESS scores observed in this study (mean = 14.6; SD = 4.4; range, 0–23) are higher than the mean for patients with obstructive sleep apnea syndrome (mean = 11.7; SD = 4.6; range, 4–23) and just below the mean for patients with a diagnosis of narcolepsy (mean = 17.5; SD = 3.5; range, 13–23).⁹

As seen also in our qualitative findings on the impact of sleep loss and fatigue on mental performance, the quantitative findings highlighted the extraordinary impact that these factors have on aspects of cognitive function related to professional performance. The rank-ordering of residents’ ratings suggests that the most pronounced adverse effects can be seen in the area of disrupted cognitive processes and the potential impact of this disruption on decision making. Beyond the general comments on this, we received specific reports of errors in prescription writing and placing incorrect medical orders. Qualitative data lead us to conclude, however, that although this was a significant source of worry for residents in our study (they had both heard about others making errors and had themselves made errors due to sleep loss and fatigue), the reported actual incidents that would raise patient safety concerns were rare. The team approach, which is common in academic health centers, and the systems’ checks in place may avert many serious errors.

Contrary to expectations, we noted few differences in the amount or type of sleepiness reported among the five specialties sampled. The only detected difference was that residents in ob-gyn rated themselves as having a higher likelihood of falling asleep in specific situations than did internal medicine residents. This difference may be attributable, in part, to the demanding lengthy labor and delivery responsibilities that result in extended periods of sleep deprivation for ob-gyn residents. In contrast, internal medicine residents are likely to experience briefer interrup-

Table 5

Factor Structure and Descriptive Data for Sleep Loss and Fatigue Impact Items, Five U.S. Academic Health Centers, 2001–02		
Factor	Loading	Mean* (SD)
Factor 1: Personal Impact (alpha = 0.41)		
Sleep loss and fatigue have major impact on my personal life.	0.82	3.6 (1.5)
I sometimes look forward to sleeping at Grand Rounds.	0.51	3.0 (1.1)
I have heard about others making medical errors due to sleep loss and fatigue.	0.78	3.5 (1.3)
I might fall asleep while examining a patient.	0.78	2.2 (1.4)
I have worried about having a car accident driving home postcall.	0.75	3.3 (1.5)
Factor 2: Performance Disruption (alpha = 0.79)		
Sleep loss and fatigue affect my medical decisions.	0.74	3.3 (1.7)
Sleep loss and fatigue have major impact on my work.	0.64	3.3 (1.2)
I have made medical errors because of sleep loss and fatigue.	0.81	3.0 (1.0)
I have written an incorrect order because of sleepiness.	0.72	3.1 (1.1)
I never make errors in writing prescriptions on postcall days.†	0.56	3.5 (1.0)
Factor 3: Denial of Performance Disruption (alpha = 0.60)		
My thinking is unaffected by sleep loss.†	0.85	4.3 (0.9)
I chose my medical field, in part, because I function well on little sleep.†	0.49	4.0 (1.1)
My work is unaffected by sleep loss and fatigue.†	0.71	4.2 (0.8)
Factor 4: Perceived Adaptation (alpha = 0.49)		
My body has adapted to less sleep.†	0.68	2.3 (1.1)
I have effective countermeasures to sleep loss.†	0.55	3.0 (1.0)
I can tell when I am too tired to drive home.†	0.75	2.6 (1.1)
Factor 5: Family Empathy (alpha = 0.60)		
My family understands my demanding job and sleep needs.†	0.79	2.4 (1.1)
My family does not understand how demanding my job is.	0.80	2.8 (1.2)

*Ratings were given on a five-point scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.
†Positively worded items were reverse scored on a five-point scale: 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree.

Table 6

Factor Score Means, Standard Deviations, and Intercorrelations, Five U.S. Academic Health Centers, 2001–02					
Factor	Mean (SD)	Intercorrelations			
		Factor 2	Factor 3	Factor 4	Factor 5
1. Personal Impact	3.1 (0.7)	0.65*	0.16†	0.17†	0.16†
2. Performance Disruption	3.3 (0.8)	–	0.29*	0.21‡	0.20†
3. Denial of Performance Disruption	4.1 (0.7)	–	–	0.37*	0.23‡
4. Perceived Adaptation	2.6 (0.7)	–	–	–	0.16†
5. Family Empathy	2.6 (0.9)	–	–	–	–

* $p < .001$.
† $p < .05$.
‡ $p < .01$.

tions in sleep, in general, when on call. We were not surprised to find no differences between male and female residents in terms of their reported amounts of sleep loss, or their ratings of the likelihood of falling asleep when other factors were controlled for.

The multivariate analysis indicated that these factors (training year and diverse impacts upon functioning) have robust, nonoverlapping effects. Importantly, all effects were assessed after accounting for variance related to institution, which certainly may exert its own effects due to interinstitutional variation in factors such as resident work policies, staffing adequacy, economic factors, on-call schedules, and paging rate. Because we sampled across institutions and specialties, and controlled for other potential sources of variance (e.g., gender, year of training) these findings are compelling.

Our study sought to identify the effects of sleep loss and fatigue on residents' personal as well as professional lives. Sleep loss and fatigue affect learning and job performance, and residents perceive that they are not functioning at optimum levels. Yet residents make every effort to keep up with the demands of the job. Most are doing most of what is required of them to get by; they learn the "system," and carry out the tasks expected of them. Substantially more residents in our study perceived sleep loss and fatigue as having *major impact* on their personal lives. As one surgical intern stated,

I can stay up for whatever amount [of time] I need, to and I don't feel tired and I don't feel exhausted . . . but when I go home, I realize how tired I am. So, while I'm working or I'm busy I don't realize how badly sleep-deprived I am, but once I sit on the couch, that's when I crash.

They frequently place their own needs, including physical and psychological well-being, and relationships with sig-

nificant others “on hold” during residency. One can only speculate concerning the potential long-term impact this might have on personal and professional growth. Residency training is a socialization process. Attitudes and practices learned during this period may become the basis for a lifetime of practice.¹⁴ Some residents espouse the belief that residency is a rite of passage or process to be endured, before embarking on their chosen profession and resuming their normal lives. A surgical intern expressed it in this way:

It seems like we're taking all this care of the patients and we forget about ourselves. And that's something that I have to deal with because that's how I feel now is that I'm talking better care of the patients than I am of myself. I'm totally neglecting myself for the betterment of the patient. But that's just, I guess, that's part of residency and whether that's right or wrong that's how it is now and that's just something I accept getting into this. But, you know, I think if it could be made better that would be great, where it could be we take care of ourselves and have lives outside of the hospital and look out for ourselves better. Right now honestly, we are really giving up a lot for the good of the patient.

As Brady et al. have written, these “years of training are not lived in a vacuum but are inextricably interwoven into the fabric of residents’ personal and professional lives” and “experiences—both the highs and the lows—will profoundly influence them as future physicians.”¹⁵ Residents’ inability to develop in healthy ways during residency—a time when each is establishing his or her own identity as a doctor—profoundly influences them as future human beings in, as yet, undefined ways.

Our focus-group findings should be qualified by the understanding that residents may have been restricted, to some degree, in their willingness to express certain viewpoints in the company

of their peers. Our results may have also been influenced by the fact that each institution participating in this study had been recipient of a Sleep Academic Award. These awards were given in the late 1990s to about 20 U.S. academic medical centers to increase medical students’ and graduate physicians’ knowledge skills and attitudes about sleep loss and fatigue. Consequently, these institutions are likely to give greater attention to the importance of sleep. Further studies are urgently needed to examine the generalizability of these findings.

Residents described to us, in detail, how they cope with the effects of sleep loss and fatigue and what self-care strategies they adopt to cope with sleep loss during residency; however, these results are beyond the scope of the present report. However, this is a topic of growing interest in both medical training and other areas of application, such as road transportation or public safety, and will be addressed in-depth in a future paper.

Our study adds to the growing body of research on the effects of sleep loss and fatigue on cognitive, behavioral, and emotional aspects of physician performance. It provides further corroboration that physicians are not immune to the effects of sleep loss and fatigue and that these can adversely affect education, work performance, and overall well-being. It is high time to address these needs and to make basic changes in the way this aspect of residency training is addressed. Education about sleep as a core biological phenomenon and the potential deleterious effects of sleep loss and fatigue on performance should be clearly impressed on all incoming residents. They should be made aware of these factors and given guidance or strategies to better cope.⁸ In addition, programs should address the underlying pejorative or negative attitudes toward sleep, along with the prevailing attitudes among some educators that “extended periods of sleep deprivation con-

tribute positively to medical education and patient care.”⁸

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Cover Note

THE UNIVERSITY OF SOUTH ALABAMA COLLEGE OF MEDICINE

Mobile, Alabama, on the Gulf Coast, was the home of the Medical College of Alabama from 1858 to 1920. The College then moved northward to Birmingham, Alabama, leaving Mobile and lower Alabama without a college of medicine. In 1969 the Alabama Legislature established the University of South Alabama (USA) College of Medicine in Mobile. Twenty students comprised the first graduating class from USA College of Medicine in 1976. Since that time, USA College of Medicine has produced 1,663 graduates. The Medical Science Building on the USA campus (shown on the cover) was dedicated in 1974, and it is the site for the basic science curriculum in the first two years of medical school, the PhD programs, and the myriad of research undertakings.

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