Intern to Attending: Assessing Stress Among Physicians

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Abstract

Purpose
Organizations have raised concerns regarding stress in the medical work environment and effects on health care worker performance. This study's objective was to assess workplace stress among interns, residents, and attending physicians using Ecological Momentary Assessment technology, the gold-standard method for real-time measurement of psychological characteristics.

Method
The authors deployed handheld computers with customized software to 185 physicians on the medicine and pediatric wards of four major teaching hospitals. The physicians contemporaneously recorded multiple dimensions of physician work (e.g., type of call day), emotional stress (e.g., worry, stress, fatigue), and perceived workload (e.g., patient volume). The authors performed descriptive statistics and *t* test and linear regression analyses.

Results
Participants completed 5,673 prompts during an 18-month period from 2004 to 2005. Parameters associated with higher emotional stress in linear regression models included male gender ($t = -2.5$, $P = .01$), total patient load ($t = 4.2$, $P < .001$), and sleep quality ($t = -2.8$, $P = .006$). Stress levels reported by attendings ($t = -3.3$, $P = .001$) were lower than levels reported by residents ($t = -2.6$, $P = .009$), and emotional stress levels of attendings and residents were both lower compared with interns.

Conclusions
On inpatient wards, after recent resident duty hours changes, physician trainees continue to show wide-ranging evidence of workplace stress and poor sleep quality. This is among the first studies of medical workplace stress in real time. These results can help residency programs target education in stress and sleep and readdress workload distribution by training level. Further research is needed to clarify behavioral factors underlying variability in housestaff stress responses.

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The 1984 Libby Zion case brought hospital workplace conditions and patient safety to national attention.[1] Many organizations have since raised concerns regarding the medical work environment and its impact on health care delivery.[2–4] Fatigue among residents has been the target of the Accreditation Council of Graduate Medical Education, resulting in mandatory duty hours restrictions.[5] Fatigue is associated with impaired memory, increased anxiety, and compromised problem-solving abilities.[6,7] Further, the impact of both health care worker fatigue and emotional stress on patient care, workplace accidents,[4,6,8,9] and automobile accidents[10] is of real concern. Emotional stress is complex, derived from a number of factors such as unhappiness and worry. Although implemented to reduce fatigue, the full impact of duty hours changes on emotional stress is not clear. In fact, some investigators have proposed that duty hours reductions have both reduced time to coordinate patient care postcall and increased the frequency of patient handoffs, which may increase stress in residents.[11] Stress in health care providers can stem from frequent intense interactions with patients with complex problems[12] and stressed interactions with colleagues.[13] Persistent stress is a significant contributor to burnout and resultant job absenteeism and performance deficits.[14] Residents working in inpatient settings are particularly vulnerable to stress, working in environments with acutely ill, diagnostically challenging patients.[11] McManus et al[15] report that physician stress and emotional exhaustion reciprocally increase each other. They suggest decreased clinical workload as one component of a physician stress reduction program.[15] However, the current extent and causes of resident stress in the hospital workplace are not known.

Older studies on physician stress suggested that night shift work and prolonged work schedules can impair cognitive functioning with effects on vigilance, short-term memory, and processing speed.[16,17] Other studies have noted links among medical errors, sleep deprivation, and duty hours.[7,18] Most published studies have used retrospective time diaries,[19] indirect surveys, or experimental protocols[7,11,18,20,21] and have focused predominantly on duty hours rather than stress.[7,18,21,22] Data specifically comparing performance patterns, clinical experience (resident/attending), and work environment are limited. Many studies[23,24] have also suffered from small sample sizes, limited measurement points, and reliance on memory recall of stress factors.

When coupled with new handheld computer technology, Ecologic Momentary Assessment (EMA) can more directly assess physicians' perceptions of the workplace environment in real time. In contrast to typical strategies for capturing dynamic changes in individual mood, behavior, and motivation that rely primarily on retrospective methods or those that aggregate data over longer time periods, EMA permits the reliable

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assessment of multiple work dimensions during the actual moments in which events occur.[24] Behavioral psychologists first developed EMA almost 20 years ago, building on the work of Czikszentmihalyi and colleagues; Shiffman et al[25] coined the phrase "ecologic momentary assessment" and further expanded the work in 1994. The practice of EMA, born in response to biases inherent in retrospective recall, is a collection of methods with shared features: collection of current mood or state, repeated assessments over time, and study performed in the real-world ("ecologic") setting.[25,26] Specific methods vary in tools used (paper, computer) and features of interest assessed. Behavioral psychologists have validated EMA and consider it a standard method for assessment of self-reported data.[25,26] A reliability study with trained observers indicated good agreement between subjects' and observers' responses.[24] EMA can go beyond assessments of work activities to include real-time measures of stress, fatigue, and perceptions of workload. Investigators, using handheld computers and similar technological tools customized to prompt users for information about factors under study, have examined a variety of health outcomes, such as blood pressure associations with negative emotions, clinical disorders such as depression, and adaptation processes such as medication compliance.[25–27] EMA's greater sensitivity, validity, and wide applicability make it a current gold standard for real-time measurement of psychological characteristics.[25] To our knowledge, investigators have not adapted EMA methods to the study of interrelationships between workplace factors and stress among physicians. Determining relationships among these factors is a first step toward quantifying what has traditionally been only qualitatively described. In this study we addressed the following hypotheses:

1. Using EMA methods, intern and resident physicians would show higher work stress compared with attending physicians.
2. *Workplace* factors such as patient load, admission volume, and familiarity with patients, and *clinician* characteristics such as the amount and quality of the previous night's sleep, would each be associated with work stress ratings.

Method

Participants

Study participants included internal medicine and pediatric housestaff, traditional attending physicians, and hospitalist attending physicians caring for patients in pediatric or internal medicine inpatient settings in the four largest core training sites in San Diego: Veterans Affairs San Diego Healthcare System, University of California San Diego (UCSD) Hillcrest, UCSD Thornton, and Rady Children's Hospital San Diego. Team structure at all sites was similar, with either a senior resident and one to two interns per team, or two postgraduate-year-2 residents constituting a team. Attendings were predominantly team-specific, but they also admitted with the other teams on service depending on resident schedules and patient flow needs. A traditional trainee on-call system was in place at all sites (in house, 24-hour call with 6-hour postcall work time). Call frequency was no more than every fourth night at all sites. Daily ward rotation schedules (work rounds, conferencing time, etc.) were similar across all sites. Attendings took call from home after approximately 7 PM. Hospitalist attendings also had other duties such as transport coordination and bed management. We recruited all physician participants during an 18-month period, beginning in April 2004, through announcements at conferences, rounds and meetings, or through direct contact with a member of the research team. We obtained approval from the institutional review boards of all participating institutions, and all participants provided written informed consent.

EMA tool

We applied EMA methodology, a key feature of this study, by using a survey tool we designed specifically for a handheld application. We developed a computer-assisted, branching logic work survey with a corresponding database of questions based on prior work to capture specific daily information (e.g., patient load, sleep patterns) as well as multiple work activities (e.g., communication with patient).[24] The sleep quality scale, derived from the Pittsburgh Sleep Quality Index,[28] guided participants in choosing numeric self-ratings regarding sleep quality on a four-point scale, where higher numbers indicated better sleep. In addition, the survey incorporated previously validated instruments to measure both short-term memory (a story recall task from the Weschler Memory Scale)[29] and emotional state.[30] We assessed emotional stress using a 10-question instrument, in which participants rated different states (e.g., unhappy, tired, tense, alert, worried) on a 10-point Likert-like scale, with the item content derived from the Diary of Ambulatory Behavioral States,[30] a tool specifically designed for Palm Pilot assessment.

Data collection

Three to four participants at any one time at each site carried handheld computers (Zire 21, Palm Computing Cupertino, Calif) for up to seven consecutive calendar days. We redistributed the instruments to new participants each week. Participants were able to carry the computers for more than one session during the 18-month study period. Sampling occurred concurrently across the four study sites, consistently throughout the study. We downloaded data for offline analyses after each participant's study period using Hot Sync Manager (Palm Computing) into a central Microsoft Access (Microsoft Corporation, Redmond, Wash) database.

Each participant completed an initial one-time sign-on at the beginning of his or her participation to capture baseline clinician factors such as age, gender, and experience level and to complete memory testing. At the start of each workday, participants first responded to a series of survey questions addressing workplace factors (such as type of call day, continuity clinic attendance, current number of patients being cared for, and number of admissions or new patients in the prior 24 hours) and clinician factors, specifically sleep patterns (hours and quality of sleep the preceding night). A handheld-device-generated audible alarm then prompted study participants to initiate the EMA survey of work activities and emotional state randomly within consecutive 90-minute intervals throughout each duty shift. During pilot testing, we found this sampling rate to be acceptable in terms of response burden. Sampling occurred during all duty hours, including educational conferences and night shifts, although participants were able to turn the computer off during

Table 1
General Demographic and Response Information by Experience Level (Intern, Resident, Attending) of 185 Physicians Who Participated in an Ecologic Momentary Assessment Study to Evaluate Stress

Description	Interns (N = 82)	Residents (N = 62)	Attendings (N = 41)
Sex—no. (%) female*	53 (65)	31 (50)	16 (39)
Age in years [standard deviation]†	27.9 [2.0]	29.4 [2.0]	35.9 [5.6]
Length of workday in hours [standard deviation]	10.4 [2]‡	10.5 [1.4] ‡	8.9 [1.6]
Mean (median) number of days of participation by physician [standard deviation]	8.0 (7) [6.0]	7.6 (7) [5.5]	9.3 (8) [7.1]
Total number of days of participation	655	473	381
No. (%) of responses			
Complete	1,953/2,504 (78)	1,397/1,862 (75)	967/1,307 (74)
Partial	150/2,504 (6)	186/1,862 (10)	105/1,307 (8)
Missing	401/2,504 (16)	279/1,862 (15)	235/1,307 (18)

* Interns differ from attendings $P < .05$.
† All groups differ, $P < .01$.
‡ Interns, residents, differ from attendings, $P < .001$.

periods of sleep and when at continuity clinic. The "workday" included all activities occurring on the hospital site, whereas "total hours worked" also included any offsite work such as continuity clinic.

Statistical analysis

We used simple descriptive statistics to determine the percentage of completed work assessments and the mean and variability for completed work samples, and to assess distribution of work category and emotional stress factors. For analyses, we classified multiple work activities as direct patient care (with patient), indirect care (documentation, communication), education, transit, or personal, based on published literature.[24,31] We oriented all individual emotional stress factors on a Likert-like 0 to 9 scale, with 9 as worst except for the "alert" variable. We created a reverse-scored "Antialert" variable to accommodate analysis. We summed the values for these 10 items to create an emotional stress score. We also created a second emotional stress score after removing the fatigue and tired items to avoid confounding relationships with the sleep measures. We dichotomized the sleep quality scores into a poor/good sleep variable by merging the very poor/poor scores and good/very good responses.

We used pairwise tests with a per-variable correction for multiple comparisons to compare interns, residents, and attending physicians on demographic variables, work characteristics, and emotional stress factors. We made a conservative adjustment of standard errors to account for the fact that we obtained different numbers of multiple observations per subject on some variables. Because of the number of statistical comparisons, we employed a modified Bonferroni correction such that a P value of 0.016 was our standard for determining statistical significance.

Finally, we used mixed-effects linear regression to examine factors associated with workplace emotional stress in the physician sample. Emotional stress scores (both the total score and the score with two fatigue-related items removed) served as the dependent measure in these analyses. Both returned similar significant results; however, we report only the latter regressions as the focus of this paper. We initially considered all demographic, workplace, and clinician factors captured for analysis. We then chose primary potential predictors based on factors of interest from previously published studies on both stress and sleep.[4,11,12,15] Final potential associated factors included age, gender, familiarity with patients, average patient load, number of admissions in 24 hours, percentage of time performing direct patient care, sleep quantity, and sleep quality. We modeled potential predictor variables as fixed effects and added a random (subject-specific) intercept to account for within-patient dependence.

Results

Of the 185 physicians in the study, 82 (44%) were interns, 62 (34%) were residents, and 41 (22%) were attendings, with participation days as noted in Table 1. Resident participants represented 73% (144/198) of total residents rotating at these sites during the study period. Hospitalists represented >70% (30/41) of attending participants. More intern respondents were female 65% (53/82) compared with residents or attendings. Length of workday was significantly shorter for attendings compared with interns and residents, $P < 0.001$. For each of the three groups, responses were similar both for average days of participation per physician and for total percentage of completed responses per group. All subjects generated a total of 5,673 random survey responses.

The number of patients assigned ($P < .016$ between all groups) increased with level of training (Table 2). Average number of admissions per 24 hours was lower among interns (1.3 [SD = 1.8]) versus attendings (3.3 [SD = 3.1]) at $P < .001$ with resident number in between (2 [SD = 3.0]). Discharges were similarly distributed, with interns (1.1 [SD = 1.2]) lower than attendings (1.9 [SD = 1.4]) at $P = .014$ and residents in between (1.6 [SD = 1.6]). The maximum number of admissions per 24 hours was reported by residents (15 admissions), compared with interns and attendings (11 and 12 admissions, respectively). Familiarity with patients based on a rating scale was similar among all three groups, whereas

Table 2

Workplace and Clinician Factors by Experience Level (Intern, Resident, Attending) of 185 Physicians Who Participated in an Ecologic Momentary Assessment Study to Evaluate Stress*

Description	Interns	Residents	Attendings
Workplace factors			
Number of patients assigned (i.e., total patient load)† [standard deviation]	5 [2.7]	7.7 [4.8]	9.7 [3.7]
Total hours worked in hours [standard deviation]	11.3 [6.4]	10.2 [7.3]	9.4 [3.8]
Clinician factors			
Sleep quantity in hours [standard deviation]	6.3 [2.5]	6.4 [2.1]	6.7 [1.3]
Sleep quality‡ [standard deviation]	1.9 [0.8]	1.9 [0.7]	2 [0.7]
Emotional stress score§ [standard deviation]	31.5 [19.7]¶	24.9 [18.6]	21.2 [15.6]

* Statistical significance $P < .05$.
† All groups differ.
‡ Scale of zero to three, where three is best.
§ Ten parameters at zero-to-nine scale (nine is worst) for each, with max total of 90.
¶ Interns differ from attendings.

familiarity with the environment (amount of time on unit) demonstrated an expected increase from intern to attending (data not reported). Percentage of time spent on direct and indirect patient care, personal time, and education was similar for interns, residents, and attendings. Memory recall scores on initial daily sign-on were similar among interns (12.1 [SD = 2.2]), residents (12.1 [SD = 1.7]), and attendings (12.6 [SD = 1.6]). Sleep quality scores reported were very poor/poor (432 of 1,509 total responses; 28.6%) and good/very good (1,077 of 1,509; 71.4%). Average sleep quantity and quality did not differ significantly among the groups. Interns' emotional stress score, however, was significantly higher than that of attendings, at $P = .002$ (Table 2).

Comparison of intern, resident, and attending stress factors

Emotional stress ratings showed trends of increasing means across attending (21.2), resident (24.8), and intern (31.5) physicians (Table 2). Figure 1 shows comparisons of individual emotional stress scale items. Item differences were present between interns and attendings for all items at the $P < .016$ level, with the exception of fatigue ($P = .02$) and stress ($P = .026$). Alertness was not significant ($P = .42$). Item difference trends were also present between interns and residents, suggesting that interns were more angry ($P = .05$), worried ($P = .06$), tense ($P = .08$), upset ($P = .08$), and unhappy ($P = .09$).

Factors associated with reported workplace emotional stress

Table 3 presents the significant results of the linear regression model correlating demographic and workplace factors with emotional stress scores, excluding tired and fatigued scale items. For all physicians, total number of patients assigned and sleep quality were significantly associated with higher stress scores; however, sleep quantity was not related ($P = .07$). Male gender was also significantly linked to higher stress. We noted in comparing results by training levels that both attending status (relative to interns) and resident status (relative to interns) were associated with lower stress scores. Familiarity with patients ($P = .6$), time spent in direct care of patients ($P = .09$), age ($P = .73$), and admissions in 24 hours ($P = .738$) were not associated with emotional stress scores. Finally, we also performed separate regression models across the three physician groups (data not shown); however, these results generally paralleled the main findings and did not suggest substantial relationship differences.

Discussion

In this EMA study of physicians in adult and pediatric inpatient medical wards, we found that poorer sleep quality and larger total patient loads were significantly associated with higher stress. Interns reported the highest stress scores, both in total and across individual stress scale items when compared with residents and attendings. The lowest stress scores were reported by attendings despite greater total patient load and similar reported

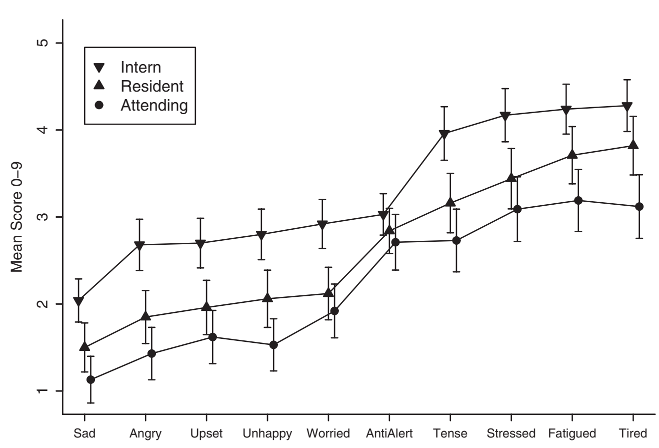

Figure 1 Relationship of experience level to individual emotional stress item. Scores: Intern–resident–attending comparisons. On this 0 to 9 scale, 9 is worst. A total of 185 physicians from four hospitals participated in an ecologic momentary assessment to evaluate stress.

Table 3
Significant Predictors of Emotional Stress*

Predictor	Gender (male)	No. of patients assigned (total patient load)	Sleep quality	Attendings†	Residents†
ß‡	−4.2	0.36	−1.8	−10.18	−5.27
Standard error	1.74	0.09	0.66	3.05	2.0
P value	0.015	<0.001	0.006	0.001	0.009

* The dependent variable is the emotional stress scale scores among 185 physicians and excludes tired and fatigue items from the total score.
† Values using interns as reference group.
‡ ß = Unstandardized beta coefficient.

sleep quality and quantity scores. Because most attendings in this study were hospitalists, these lower scores may reflect experience or the consequences of a well-matched career choice.[32,33] Total hours worked per day were lowest for attendings, which could impact their perception of emotional stress either positively (less time at work) or negatively (more compressed day in which to do work). However, we would anticipate greater experience in clinical decision making to reduce stress even in the face of a shorter day with a greater patient load. Career satisfaction may also reduce perceived stress in the face of higher daily patient volume. This may be at least in part reflected in our study's findings of attendings' lower individual stress ratings for angry, unhappy, upset, and sad items. It is important to note that whereas these factors (experience, career satisfaction, and fewer total work hours) may combine to abate the impact of patient load on attending stress, they do not offset the impact of poor sleep quality. Taken together, these are potentially important findings because coping with emotional stress is critical for professional performance and to avoid burnout.[15]

Distribution of resident work activities has been reported in publications on time management and emotional stress.[23,24] In this study, the percentage of time spent in work activities was remarkably similar across all levels of training, despite differences in total patient numbers and length of workday. Time spent in direct patient care was not linked to increased stress, suggesting that simple categorization of work types may not be adequate to reveal factors affecting stress responses. Of the workplace factors, only total patient load was associated with increased stress. One of the more concerning consequences of resident duty hours restrictions and patient number limitations has been the increased number of patient-care handoffs. Surprisingly, lack of familiarity with patients, often cited as a concern with increased cross-covering of patients or acceptance of new patients admitted by a night float team, was not associated with increased stress. Many possible factors, such as increased resident reliance on attending or nursing involvement, use of a reliable resident handoff system, or, perhaps, more limited time to bond with patients and families, could interplay to abate emotional stress associated with decreased patient familiarity.

Many studies have now addressed the impact of sleep and fatigue on housestaff medical performance,[7,18,34] but few have reported on any stress parameters.[35] A recent national survey of interns since duty hours implementation reported an increase in mean sleep duration of only 6.1% (22 minutes) from 5.9 hours to 6.3 hours per night.[36] Intern sleep quantity was similar in our study, at 6.4 hours and 6.2 hours, respectively, for every-fourth-night and every-fifth-night call schedules. Although sleep quantity and quality did increase slightly during the training years, the median for both was surprisingly the same for interns, residents, and attendings (seven hours for quantity, and two out of a high of three for quality). This may reflect the predominance of hospitalist attendings and their duties. Yet, most striking were the regression data showing that increased stress was significantly correlated with sleep quality. This association occurred despite removing fatigue and tired items. This observation suggests that despite reports suggesting that duty hours restrictions are associated with reduced fatigue,[7,21] a relationship between sleep patterns and stress persists. These data suggest that parameters such as fragmented sleep may be more critical than sleep duration in perceptions of stress.

Implications

How might these data inform efforts to reduce housestaff stress? While total patient load in isolation is an indirect and incomplete measure of patient-care-related workload or stress, the results of this study suggest the need for further assessment of the maximum number of patients assigned to housestaff. Medical educators should acknowledge and address stressors unique to different training levels that are related to patient load. Attendings and residents traditionally give interns task-oriented responsibilities on the inpatient ward. Greater patient volume may increase the frequency of competing priorities and stress multitasking skills. Enhanced support staff assistance and education in time management and organizational skills may therefore be beneficial to interns. For residents, responsibility for supervising clinical care, teaching, and leading a team may be reasons for increased stress. More focused senior resident training in clinical supervision, teaching methods, and team leadership may be valuable. In addition to this area of focus, interns and residents should be educated in self-assessment and modification of sleep practices to improve both sleep quantity and quality. Compared with attendings, poor sleep quality may be more disruptive to trainees who, for the first time, face a rigorous schedule and different clinical and personal demands not present during medical school. Medical educators and practitioners should both teach and practice stress recognition and management techniques in didactic and clinical settings. We cannot ascertain whether gender-specific stress education is necessary; we did not design our study to address this issue. In contrast to our findings, a previous study on gender and emotional stress in residency noted a greater percentage of stress reports by females as well as gender differences in sources of emotional stress.[37] Investigators need to do further research to define the relationship of gender and emotional stress.

Study limitations

There are potential limitations to our report. These results reported here may not be generalizable to physicians in other hospitals or residents in other training programs. The data are self-reported and largely subjective, and some are dependent on short-term memory, with risk of recall bias. Our protocol neither included objective measures of stress and perceived workload characteristics (e.g., blood pressure responses[27]) nor verified participant reports. In addition, individuals perceive emotional stress to different degrees and may appraise a similar situation differently. Hospitalists who should be more comfortable with the inpatient environment composed a large proportion of the attendings. Despite attempts to limit disruptions caused by the tool, the alarm enunciated by the handheld device may itself have been stressful. We addressed this possibility by having an appealing alarm tone that slowly increased in volume over several minutes.

The most important factor balancing these limitations was the use of EMA methodology with frequent real-time assessment of physician work, emotional stress, and task demand performed by multiple participants over a prolonged period at four major academic medical centers. This design makes the reliability of our data quite high. Further, the overall percentage of missing responses was relatively low and was distributed over multiple subjects. Finally, although we evaluated emotional stress in this study as a negative behavior, it is also true that a certain amount of stress and emotional arousal may be necessary for optimum clinical performance.

Conclusions

These results suggest that emotional stress is still prevalent in housestaff working on inpatient units. Sleep quality, total patient load, and intern status were each significantly associated with increased physician stress, even when controlling for fatigue items. Sleep quantity did not correlate with stress when controlling for fatigue items. These findings reinforce the need for sleep and stress management education of housestaff and faculty and for reassessment of total patient load for housestaff. Further studies on the impact of sleep patterns, patient load, and emotional stress during residency are needed.

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Did You Know?

In the 1930s, researchers at the University of Pennsylvania School of Medicine successfully made the self-contained underwater breathing apparatus that is popularly known today as "scuba."

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