HHS Public Access

Author manuscript

Crit Care Med. Author manuscript; available in PMC 2020 July 01.

Published in final edited form as:

Crit Care Med. 2019 July ; 47(7): 894–902. doi:10.1097/CCM.0000000000003773.

Sleep and Work in ICU Physicians During a Randomized Trial of Nighttime Intensivist Staffing

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Abstract

Objectives: To compare sleep, work hours, and behavioral alertness in faculty and fellows during a randomized trial of nighttime in-hospital intensivist staffing compared to a standard daytime intensivist model.

Design: Prospective observational study.

Setting: Medical Intensive Care Unit (MICU) of a tertiary care academic medical center during a randomized controlled trial of in-hospital nighttime intensivist staffing.

Patients: 20 faculty and 13 fellows assigned to rotations in the MICU during 2012.

Interventions: As part of the parent study, there was weekly randomization of staffing model, stratified by 2-week faculty rotation. During the standard staffing model, there were in-hospital residents, with a fellow and faculty member available at nighttime by phone. In the intervention, there were in-hospital residents with an in-hospital nighttime intensivist. Fellows and faculty completed diaries detailing their sleep, work, and well-being; wore actigraphs; and performed psychomotor vigilance testing daily.

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Contributions:

RNB, MB, IMR, DFD, and WDS were involved in the conceptualization and design of the study. RNB, MB and WDS performed analysis of the data and the initial interpretation of the data. RNB and WDS drafted the initial manuscript. Review and approval of the manuscript was completed by all of the authors.

Data Supplement: This article has a Supplemental Digital Content.

Measurements and Main Results: Daily sleep time (mean hours (standard deviation)) was increased for fellows and faculty in the intervention vs control—6.7 (0.3) vs 6.0 (0.2), p<0.001 and 6.7 (0.1) vs 6.4 (0.2), p<0.001, respectively. In-hospital work duration did not differ between the models for fellows or faculty. Total hours of work done at home was different for both fellows and faculty—0.1 (<0.1) intervention vs 1.0 (0.1) control, p<0.001 and 0.2 (<0.1) intervention vs 0.6 (0.1) control, p<0.001, respectively. Psychomotor vigilance testing did not demonstrate any differences. Measures of well-being including physical exhaustion and alertness were improved in faculty and fellows in the intervention staffing model.

Conclusions: Although no differences were measured in patient outcomes between the two staffing models, in-hospital nighttime intensivist staffing was associated with small increases in total sleep duration for faculty and fellows, reductions in total work hours for fellows only, and improvements in subjective well-being for both groups. Staffing models should consider how work duration, sleep, and well-being may impact burnout and sustainability.

Clinical Trial Registration: This trial is registered at clinicaltrials.gov NCT01434823.

MeSH Keywords

Critical Care; Sleep; Work; Burnout; Professional; Intensivist

INTRODUCTION:

The Accreditation Council for Graduate Medical Education (ACGME) first adopted duty hour standards for trainees in 2003 (1) in order to protect patients from errors by fatigued physicians and to protect trainees from the dangers of sleep deprivation. Following the initial work hour regulations, studies demonstrating evidence for both of these concerns were published (2–4). Further work hour reforms were instituted in 2010 and again in 2017 (5, 6). Accordingly, academic centers have been forced to significantly restructure staffing models given less work hour availability of trainees. With this change in staffing models, a greater burden of medical responsibilities may have shifted to attending physicians and advanced practitioners (7–10). Since duty hour reform has been instituted, patient outcomes have not clearly changed (11–14) and the effect on trainees appears to be mixed (14–18).

In contrast, less emphasis has been put on the downstream effects of work hour reforms on providers other than residents. In particular, the work and sleep of physicians who have completed training is seldom studied (19–21). Excessive work hours may result from a combination of obligations (clinical, administrative, research and teaching), limited resources and altruism. Even though senior physicians may be less prone to errors given greater clinical experience; sleep deprivation studies confirm errors in decision-making even in easy and familiar circumstances (22–25).

Minimal research has been conducted to measure work and sleep patterns in ICU physicians. Critically ill patients often have extreme and immediate needs with instability leaving little margin for error; they often require intense decision-making, urgent and unpredictable procedures, and communication and coordination amongst caregivers. Accordingly, some ICUs have implemented 24/7 in-hospital intensivists or telemedicine (26–28). In the

academic setting, these staffing models can supply direct supervision, may reduce intensivist burnout, and may improve nursing satisfaction (29–31). In ICUs with a low intensity daytime staffing model, addition of a nighttime intensivist may reduce mortality (32).

Our academic, tertiary care medical ICU conducted a prospective, randomized study of nighttime staffing that examined patient outcomes (the SUNSET-ICU trial) (33). In this observational study conducted during the trial, we measured sleep, work and behavioral alertness in faculty and fellows during an ICU rotation in which weeks of work were randomized to in-hospital nighttime faculty intensivist staffing versus control.

MATERIALS AND METHODS:

Study Design:

We conducted an observational study of work and sleep patterns in pulmonary and critical care faculty and fellows rotating through the medical intensive care unit (MICU) at the Hospital of the University of Pennsylvania from January 2012 through December 2012. Details of the parent randomized trial, which measured the effects of nighttime staffing models on ICU length of stay and patient outcomes, have been published previously and are detailed below (33). In the context of this parent study, we measured sleep, work, and behavioral alertness in faculty and fellows. The protocol was approved by the University of Pennsylvania Institutional Review Board (IRB Approval 814878) and the trial was registered at clinicaltrials.gov NCT01434823. All subjects gave written informed consent. Results of this study have been presented previously in abstract form (34).

Setting and Participants:

The MICU is a 24-bed academic unit that is “closed” (mandatory intensivist as the primary provider) (35) and is consistently staffed with residents, fellows, and advanced practice providers (APPs—inclusive of Nurse Practitioners and Physician Assistants). Eligible participants included all faculty (intensivists) and pulmonary and critical care (PCC) fellows who were assigned rotations in the MICU during 2012. There were no exclusion criteria.

Randomization and Interventions:

As detailed in the parent study (33), there was weekly randomization of a nighttime staffing model, stratified by 2-week faculty rotation. Daytime staffing comprised two teams, each with six residents, an APP, a fellow, and an attending; daytime staffing was unchanged between the two models (Supplemental Table 1). During the control staffing model, each team was represented by one or two in-hospital resident physicians during nighttime hours with the support of the team’s PCC fellow and faculty member, each available by phone. Generally residents called the fellow first, and calls were escalated from the fellow to the faculty based on informal agreements and individual discretion. Both were available to return to the hospital if necessary. Three nights per week (in order for the fellow to have a both a weeknight off and a 36-hour period off from clinical duties) the attending alone was available for calls. In the intervention nighttime staffing model, the same cohort of in-hospital residents from both teams was fully supervised by an in-hospital nighttime intensivist (7PM-7AM) who was not otherwise involved in daytime patient care. The PCC

fellow and the daytime intensivists did not have any expected nighttime duties after they signed out to the nighttime intensivist.

All subjects completed a baseline demographic assessment and Pittsburgh Sleep Quality Index (PSQI) (36). The PSQI is a validated self-administered measure of sleep quality and habits over the preceding month. Subjects completed the PSQI on day 1 of their MICU rotation in addition to providing their basic demographic data.

Subjects completed daily sleep and work logs detailing hours worked, calls received overnight, and sleep patterns. They additionally reported on their subjective sleepiness (using the Karolinska Sleepiness Scale (KSS), a 9-point verbally-anchored scale ranging from 1, “very alert,” to 9, “very sleepy, great effort to keep awake, fighting sleep”) (37) and their subjective self-assessment of well-being (e.g. alertness, stress, physical exhaustion) by marking visual analog scales. Subjects additionally reported caffeine intake and exercise.

Participants wore a wrist actigraph with accelerometer and light sensors (Actiwatch Spectrum, Phillip Respironics) in order to continuously track rest and activity patterns. Actigraphy data was collected in 1-minute epochs and stored in the watch until downloaded at 1-week intervals. Similar actigraphy devices have been validated and applied to study sleep patterns in physicians on call (38–43).

Subjects also completed a validated 3-minute psychomotor vigilance test- brief form (PVT) on a designated machine (PVT-192, Ambulatory Monitoring, Ardsley, NY) to assess behavioral vigilance (44–46). They took these tests on weekday afternoons between 3 and 6 pm during the last 9 months of the study. The PVT measures alertness based on reaction time to stimuli presented at random 2- to 5- second inter-stimulus intervals.

Outcomes:

The primary outcome was total sleep time (7 pm on one day to 7 pm the next day) as measured by actigraphy with supplemental data from sleep logs. Secondary outcomes were clustered in three domains: work hours, sleep, and behavioral vigilance. In regards to work hours, secondary outcomes included total work duration (hours per 24 hour period starting at 7 am), in-hospital work duration (hours worked in the hospital per 24 hour period starting at 7 am), home work duration (hours worked at home between leaving the hospital and returning to the hospital), nighttime work duration (hours worked between 7pm and 7 am), and number and duration of overnight calls. Secondary sleep outcomes included number of awakenings per night and subjective assessments of sleepiness and alertness. PVT outcomes included response speed (reciprocal response time), median reaction time, the number of false starts (responses without a stimulus or response times <100 ms), and the number of lapses of attention (response times ≥355 ms), and 10% fastest and slowest reaction times.

Statistical Analysis:

The sample size for this study was pre-determined based on the nighttime intensivist trial duration and the fixed rotation schedule for each attending and PCC fellow. The analyses were unadjusted, testing for differences between the intervention and control groups. The unit of analysis was the fellow or faculty day. To account for the correlation among

participants (eg. multiple observations and rotation assignments), all analyses used mixed effects models with random intercept. Intervention and control groups were compared with the least square means. All reported p-values are 2-sided. The a priori level of significance was set at 0.05. All statistical analyses were conducted with SAS 9.3 (SAS Institute, Cary, NC) and StataSE 13.1 (StataCorp, College Station, TX).

RESULTS:

All faculty and fellows assigned to a daytime MICU team rotation during the one year study period participated in the SUNSET-ICU Sleep Study (n = 13 fellows, n = 20 faculty). See Table 1 for baseline characteristics of faculty and fellows. Faculty median age was 38.5 and fellow median age was 32. Baseline sleep quality for faculty and fellows, as assessed by the PSQI, were similar; however, fellows' median score met the conventional threshold (of 5) indicating "poor sleep quality." The most common areas of difficulty with sleep included subjective sleep quality, sleep duration, sleep disturbances, and daytime dysfunction. Faculty estimated a greater number of weekly work-hours than fellows, but similar hours worked per day.

The primary study outcome, daily total sleep time, and secondary outcomes of sleep and work are listed in Table 2. Daily sleep time was increased for faculty and fellows in the intervention staffing model—6.7 hours vs 6.4 in faculty intervention vs control and 6.7 vs 6.0 for fellows (both p-values <0.001). Overnight phone calls, duration of overnight work, and overnight awakening periods differed significantly between intervention and control periods in both faculty and fellows, demonstrating that there was separation between groups (Table 2). In-hospital work duration did not differ between intervention and control staffing models for faculty or fellows (faculty, 11.2 hours vs 11.0; fellows, 12.6 hours vs 12.5; intervention vs control, respectively). However, total work done at home differed. Faculty worked 0.2 hours during the intervention vs 0.6 hours during the control; fellows worked 0.1 vs 1.0 hour, respectively (each p-value <0.001). Behavioral vigilance as assessed by PVT demonstrated no significant differences in response speed, reaction time, lapses of attention, or false starts for faculty or fellows between staffing models (Supplemental Table 2).

Sample double-plots of actigraphy data for an individual faculty and fellow participant are demonstrated in Figure 1. For Figure 1, the control staffing model was in place for week 1 and the intervention staffing model was in place for week 2. Interruptions in sleep (depicted as breaks in the cerulean blue areas) were common overnight during week 1 for both faculty and fellow. The median time of day for time of awakening, getting out of bed, arrival at work and departure from work during work days for faculty and fellows were similar regardless of the staffing model (Supplemental Table 3).

Fellows reported more trouble falling asleep in the control compared to the intervention group (16.6% vs 9.7%, p= 0.02) but faculty demonstrated no difference (Table 3). Both faculty and reported a higher frequency of nocturnal awakening and more difficulty resuming sleep during control weeks compared to intervention periods (faculty 32.3% control vs 10% intervention, fellows 34.9% vs 15.4%, both p <0.0001). Faculty and fellows both reported significantly better sleep quality during the intervention (approximately a

10 /100 point difference on the VAS) and each group felt more refreshed in the morning (5 of 100 points difference for fellows, 12 for faculty). In summary, faculty scored less sleepiness, physical and mental exhaustion as well as more alertness during the intervention. Fellows scored less physical exhaustion and stress as well as more alertness during the intervention.

Coffee intake, soda intake, and energy drinks did not differ between faculty and fellows in the two staffing models (Supplemental Table 4). Exercise and naps were uncommon and did not differ by staffing model for faculty or fellows.

DISCUSSION:

In this single-center observational study of sleep and work in an academic medical ICU, we found that faculty and fellows work long hours each week irrespective of nighttime intensivist staffing. Fellows did work approximately 45 minutes less per day in the intervention model, but faculty work hours did not change. Daily sleep time was modestly increased for both faculty (20 minutes) and fellows (45 minutes) in the nighttime intensivist model. Although these statistically significant durations may seem small, they were accompanied by complementary, small improvements to sense of well-being in terms of sleepiness, alertness, and physical exhaustion.

A novel aspect of this study is that it reports work and sleep hours of non-trainee ICU physicians, which are rarely reported, let alone formally measured. Sleeping 6 hours per night has been reported by other physician groups and mirrors reports of sleep in the general population, but is not ideal (47–51). In other professions, working 80 or more hours per week is unusual so this may be a good reason to evaluate ICU staffing (47, 48, 52). This combination of work and sleep may be risky; however, we did not measure any difference in behavioral alertness. Similarly, no patient-level differences were detected in the parent randomized trial (including length of stay, mortality, and readmissions) (33).

Changes in cognitive performance or motor function between study arms were not detected by the PVT (39, 40). There are several plausible explanations. First, it is important to note that total sleep time in a 24-hour period is predictive of PVT performance, rather than the type of sleep fragmentation produced by being on-call (53). Additionally, given morning work demands, we elected to test faculty and fellows between 3 and 6 pm. This, coupled with only 9 months of sampling, limited our power. It is also possible that intensivists have altered circadian rhythms (from stress or chronic partial sleep deprivation) or chose critical care, in part because of their natural ability to function well despite stress and sleep deprivation (54–56). Interestingly, the effects of sleep deprivation on fatigue and mood are known to be greater than the effects on cognitive performance or motor function (57, 58). Perhaps, then, it is not surprising that the intervention staffing model was associated with a better sense of well-being in when compared to the control.

Even when a colleague covered in hospital at night, clinicians in our study were minimally awake when at home. The group spent little time exercising; they experienced intermittent awakenings and inability to fall back asleep despite coverage. This may be a result of

incomplete implementation, challenges of continuity of care, or our youthful faculty workforce. Assessments of work behaviors are crucial due to the now recognized commonality of burnout amongst ICU providers (59). Although we did not directly measure burnout in our study, a prior pilot study has shown that burnout may be reduced by nighttime staffing (30). Based on our observations, earlier nighttime transitions may be an opportunity to better impact work and sleep, and perhaps even intensify well-being. Alternatively, our physicians may need strategies to learn how to effectively care for patients yet limit their daily work and prioritize healthy sleep habits.

Limitations of this study include the self-reported nature of many data elements, including work hours and well-being outcomes. It is possible that our finding of improved well-being is the result of a placebo effect or due to subject-expectancy effect (subjects are aware that they are being studied and perhaps unconsciously try to have the study demonstrate what they think it should demonstrate). However, this is less likely given that, at the time, the future of nighttime intensivist staffing at the Hospital of the University of Pennsylvania (HUP) was predicated on the results of the parent study, not this observational data. There are other variables which were not formally studied, including nighttime intensivists' sleep, work and alertness; burnout of participants; differential effect by sex; faculty productivity; trainee education and autonomy; the multidisciplinary team's levels of collaboration, communication, understanding and conflict; and finances. The perception of nurses experiencing this clinical trial has only been modestly explored, but suggests perceived value (31). Finally, generalizability is limited given the small number of attendings and fellows on service during this study which occurred in the context of a randomized clinical trial conducted in a tertiary academic environment.

Given the absence of improved patient outcomes studied during the RCT, nighttime MICU intensivist staffing at HUP was abandoned after the trial completed in 2013. However, in 2017, HUP reversed course (in a highly controversial decision) and resumed nighttime intensivist staffing. This decision was driven by clinical expansion; continuous ICU bed strain yielded longer ICU wait times and a geographically distinct MICU was added that was exclusively staffed by advanced practitioners with variable experience levels. In our current state, the night-time intensivists serve as primary clinicians in the new ICU, consultants for both of the established trainee-based MICU teams, on-site experts for bed flow and referring hospital communication, and participants in non-MICU clinical emergencies and procedures. Our participants are volunteers motivated by hands-on clinical care and the additional "per shift" remuneration. We intend to continue a volunteer approach assuming all shifts can be scheduled. This approach has allowed us to avoid adding challenging work hours on two known vulnerable populations: parents of young children and older clinicians. However, debates on equity and sustainability continue.

We acknowledge that one study and our proposed solutions may not fit others. From these experiences, we have learned that standardized data is powerful to guide administrative decision-making. We now conduct short, voluntary surveys of professional fulfillment and well-being across all ICU clinicians during service and non-service blocks (60). This data has served as a means to gauge associations of burnout and fulfillment with existing models and will allow us to measure the effects of pilot projects in schedule design. We encourage

others to do the same. In teaching hospitals, trainee education (and sometimes) autonomy are tracked through standardized rotation evaluations. This data should be reviewed with staffing models in mind. Even with all of this, we and others have many questions about night-time work duties that cannot be answered with this data set, or our current approach. Repeated questions arise on sustainability, academic productivity, administrative duties, and career advancement.

Other health systems have embraced telemedicine for nighttime staffing including a cross-health system ICU e-ICU (61) or contract-based e-ICUs, and, most creatively, temporary relocation of local clinicians to an e-ICU based in a time zone 12 hours apart from local time (NCT02895997). These approaches may work very well assuming existing on-site talent for hands-on care, particularly procedures and ultrasound.

CONCLUSIONS:

This study demonstrates that a change in staffing models from a daytime intensivist model with fellow/ faculty availability by phone at night to a daytime intensivist model with a separate in-hospital nighttime intensivist was associated with a reduction in fellow work-hours and a modest increase in attending and fellow sleep duration. Intervention periods were associated with fewer overnight calls, frequency and duration of awakenings, and self-perceived improvements in alertness and reductions in physical exhaustion. Although the parent randomized trial and systematic analyses of in-hospital nighttime intensivist models have not been proven to change patient outcomes (32, 33, 62), there may be improvements in the well-being of daytime intensivists. As our experience demonstrates, sites should structure themselves to conduct deliberate data collection to guide administrative decision-making. Although no single model will likely be successful, we all should pursue and measure whether our staffing models create an aggregate benefit for well-being, durable benefits against burnout, and valuable impacts on patient and nurse satisfaction as well as trainee education. This all must be done while considering costs. Given our workforce strain, our known high degree of burnout, and our objectively measured intense work hours, further discussions and data about ICU staffing models are highly relevant.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments:

We would like to thank Kyle Smith for his assistance with data entry and Adrian J Ecker for his assistance with actigraphy data analysis. We also would like to thank all faculty and fellows who participated in this study.

Financial Disclosure and Conflicts of Interest:

No financial support for the study. Dr. Bakhru's effort was supported by NIH T32-HL007891 and the Wake Forest University Claude D. Pepper Older Americans Independence Center (P30-AG21332). There are no conflicts of interest.

Copyright form disclosure: Drs. Bakhru, Halpern, and Dinges received support for article research from the National Institutes of Health (NIH). Dr. Rosen received funding from Board of Directors of the American Academy of Sleep Medicine (stipend and travel expenses); Accreditation Council of Graduate Medical Education (sleep

medicine representative to the Residency Review Committee for Internal Medicine (travel expenses); Uptodate, Inc (co-authored a card on oxygen delivery and receive royalties); she disclosed that she has a grant from the NIH to develop online learning sleep medicine learning modules for primary care physicians and an unrestricted educational grant from Jazz Pharmaceuticals to support fellowship training in sleep medicine; and she disclosed that she had unrestricted educational grants from ResMed, Merck and Jazz Pharmaceuticals during the time the study was conducted. Dr. Schweickert received funding from Hill Rom, Arjo Inc, Society of Critical Care Medicine, and American College of Physicians (consulting). The remaining authors have disclosed that they do not have any potential conflicts of interest.

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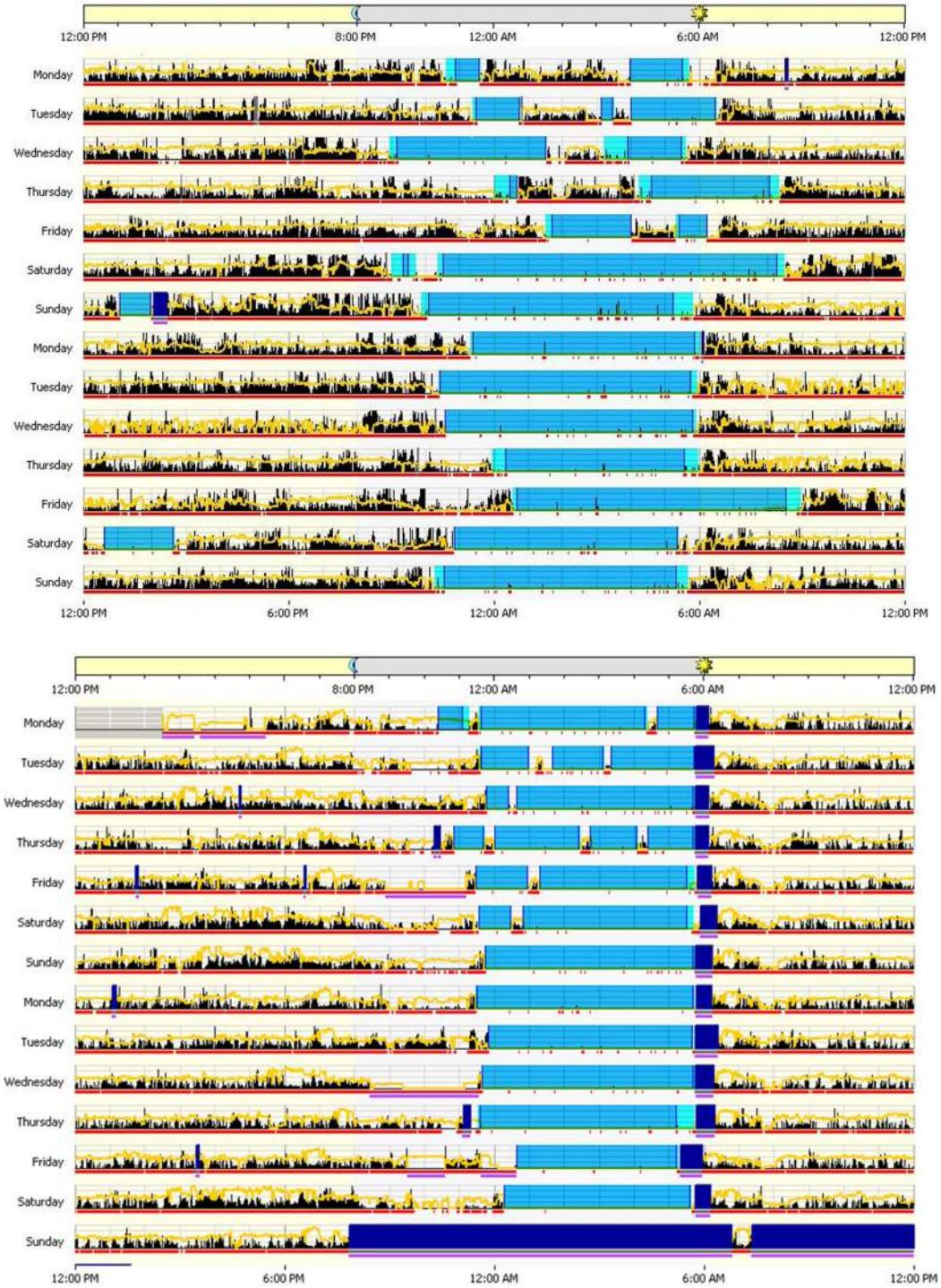

Figure 1:

1A) Sample Fellow Actigraphy: The first week depicted here is a standard staffing week, and the second is an intervention week. The vertical black bars depict activity level and the yellow line indicates degree of light exposure. The light blue shades indicate times of rest (lighter blue) and times of sleep (medium-shade blue), and times where the actigraph has been taken off (dark blue). As can be seen, the first week shows that that fellow's sleep is

highly interrupted, with multiple prolonged awakenings. The fellow was off clinical duties (had a “day off”) on Sunday. He/she had Satuday night off, slept in on Sunday morning, napped on Sunday in the early afternoon, and had Sunday night off. Beginning Monday of the second week, he/she had an intervention staffing model with a nighttime intensivist in-hospital, meaning that the fellow did not have on-call responsibilities that week.

1B) Sample Faculty Actigraphy: The first week depicted is a standard staffing week. As can be seen, there are interruptions of sleep most nights. The second week is an intervention week, with a nighttime intensivist in-hospital, meaning that the faculty member depicted here had no on-call responsibilities that week.

Table 1:

Fellow and Faculty Demographics

DEMOGRAPHICS	FELLOWS (n=13)	FACULTY (n=20)
Age (median, IQR)	32 (30–33)	38.5 (36.5–1)
Sex (% male)	38.5%	70%
Years of Training[a] / Practice[b] (median, IQR)	4 (4–4)[a]	3.5 (2–16)[b]
Pittsburgh Sleep Quality Index (median, IQR)	5 (2–8)	4 (2.5–5)
Self-Reported Characteristics:	6 (5–6)	6 (5–7)
Estimated Average Sleep While Rotating in MICU (hours per night)	72 (70–80)	80 (75–80)
Estimated Work Hours in MICU exclusive of Home Call (hours per week)	81 (78–85)	85 (80–90)
Estimated Work Hours in MICU inclusive of Home Call (hours per week)	23%	50%
Self-Perceived Chronotype, %	38.5%	35%
Morning Person	38.5%	15%
Night Owl		
Neither		

Self-reported demographics of fellows and faculty. Collected prior to MICU rotation or on day 1 of rotation.

Years of Training[a]= years of training inclusive of internship, residency, and fellowship as reported by fellows;

Years of Practice [b]= years of practice since completion of fellowship as reported by faculty.

The Pittsburgh Sleep Quality Index ranges from 0 to 21, with a score of 5 or more indicating significant difficulty sleeping.

Abbreviations: IQR= Interquartile Range, MICU= Medical Intensive Care Unit.

Table 2:

Fellow and Faculty Sleep and Work Hours

OUTCOMES		FELLOWS			FACULTY		
	Outcomes	**Intervention**	**Control**	**P-value**	**Intervention**	**Control**	**P-value**
Sleep	**Daily Total Sleep Time (7 pm - 7 pm, hours)**[c] Days with on-call night and day work Days with no on-call night but day work Days off	6.7 (0.3) 7.0 (0.2) 9.1 (0.2)	6.0 (0.2) 6.7 (0.3) 9.2 (0.3)	<.0001 0.26 0.70	6.7 (0.1) - -	6.4 (0.2) - -	<.0001 - -
	Daily Sleep Outside 11 pm - 7 am (hours) Days with on-call night and day work Days with no on-call night but day work Days off	0.5 (0.2) 0.7 (0.2) 2.2 (0.2)	0.5 (0.1) 0.4 (0.1) 2.2 (0.2)	0.82 0.38 0.94	0.5 (0.1) - -	0.5 (0.1) - -	0.89 - -
	Overnight wake periods (n)	0.1 (<0.1)	0.8 (0.1)	<.0001	0.2 (0.03)	0.7 (0.1)	<.0001
Work	**Daily Work Duration (hours)** Total In-Hospital Home Night (7pm-7am)	12.7 (0.1) 12.6 (0.1) 0.1 (0.02) 1.0 (0.1)	13.4 (0.3) 12.5 (0.3) 1.0 (0.1) 1.9 (0.2)	<.0001 0.52 <.0001 <.0001	11.4 (0.2) 11.2 (0.2) 0.2 (0.02) 0.61 (0.1)	11.6 (0.2) 11.0 (0.1) 0.6 (0.1) 1.0 (0.1)	0.09 0.47 <.0001 <.0001
	Overnight Calls (n)	0.2 (0.1)	2.9 (0.3)	<.0001	1.0 (0.1)	2.4 (0.2)	<.0001

Work and Sleep in fellows and faculty in the intervention staffing model compared to the control staffing model. Mean (standard deviation).

[c]Denotes the primary outcome of the study.

For work outcomes: “Total” denotes total time worked inclusive of work at home and/or overnight. “In-Hospital” work denotes work performed at the hospital. “Home” work denotes work done at home after leaving the hospital (regardless of time that the faculty or fellow left the hospital). “Night work” denotes work done between 7 pm and 7 am, regardless of location of work. “Overnight calls” denotes the number of calls after leaving the hospital. Fellows could have 1 of 3 work schedules for the day (see Supplemental Table 1 for more details): work during the day and home call overnight, work during the day and not on call overnight, or a day off.

Table 3:

Subjective Feelings of Fellows and Faculty as Reported During the Morning

OUTCOMES	FELLOWS			FACULTY		
	Intervention	Control	P-value	Intervention	Control	P-value
Trouble Falling Asleep (%yes)	9.7% (2.0)	16.6% (2.1)	0.02	9.1% (1.7)	11.5% (1.7)	0.31
Trouble Overnight being Awakened and Unable to Fall Asleep (% yes)	15.4% (2.6)	34.9% (2.6)	<0.0001	10.0% (2.2)	32.3% (2.2)	<0.0001
Awoke too Early OR **Overslept OR** **Slept to correct time**	31.2% (2.9) 20.3% (2.3) 48.5% (3.1)	33.7% (3.0) 14.5% (2.4) 51.8% (3.2)	0.54 0.08 0.45	39.6% (2.8) 11.3% (1.9) 49.1% (2.7)	42.6% (2.8) 14.7% (1.9) 42.6% (2.8)	0.44 0.20 0.11
Quality of sleep last night VAS **[0 Very Poorly, 100 Excellent]**	58.9 (1.6)	51.8 (1.6)	0.0019	64.9 (1.4)	53.4 (1.4)	<0.0001
Current Feeling in AM VAS **[0= Extremely Tired, 100= Very Refreshed]**	51.3 (1.5)	45.2 (1.5)	0.0035	57.2 (1.3)	45.2 (1.3)	<0.001
KSS Sleepiness **[1=low; 9=high]**	5.35 (0.43)	5.43 (0.52)	0.0825	4.43 (0.32)	5.06 (0.34)	<.0001
VAS Alertness **[0=not at all; 100=very]**	62.6 (4.1)	56.1 (4.9)	0.0001	66.5 (2.8)	59.8 (3.0)	<.0001
VAS Stress **[0=not at all; 100=very]**	32.1 (5.1)	36.0 (5.6)	0.0319	47.1 (4.0)	46.3 (3.2)	0.9435
VAS Happiness **[0=not at all; 100=very]**	61.8 (5.1)	60.4 (6.0)	0.1494	56.7 (3.6)	54.5 (3.3)	0.1862
VAS Sickness **[0=not at all; 100=very]**	13.2 (2.9)	14.7 (3.1)	0.5095	13.7 (2.2)	15.6 (2.7)	0.1935
VAS Physical Exhaustion **[0=not at all; 100=very]**	39.3 (5.4)	43.6 (5.6)	0.0389	40.9 (4.5)	47.1 (4.0)	<.0001
VAS Mental Exhaustion **[0=not at all; 100=very]**	40.1 (5.7)	43.1 (5.9)	0.1001	44.3 (4.7)	46.5 (4.1)	0.0399

Faculty and fellows reported their subjective feelings of well-being every morning. The questions, “Last night, did you initially have trouble falling asleep?” and “Last night, did you have trouble with being awakened and not being able to fall asleep again?” had binary “yes” or “ no” answers. Participants were also asked to circle the most applicable answer: “Awakened too early”, “Overslept”, or “Just right”. Finally, for each of the “VAS” questions, participants were asked to place an X along a visual scale with verbal anchors at each end, to mark their subjective answer.

Abbreviations: AM= Morning; VAS= Visual Analogue Scale; KSS= Karolinska Sleepiness Scale.