

Effect of 16-Hour Duty Periods on Patient Care and Resident Education

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OBJECTIVE: To measure the effect of duty periods no longer than 16 hours on patient care and resident education.

PATIENTS AND METHODS: As part of our Educational Innovations Project, we piloted a novel resident schedule for an inpatient service that eliminated shifts longer than 16 hours without increased staffing or decreased patient admissions on 2 gastroenterology services from August 29 to November 27, 2009. Patient care variables were obtained through medical record review. Resident well-being and educational variables were collected by weekly surveys, end of rotation evaluations, and an electronic card-swipe system.

RESULTS: Patient care metrics, including 30-day mortality, 30-day readmission rate, and length of stay, were unchanged for the 196 patient care episodes in the 5-week intervention month compared with the 274 episodes in the 8 weeks of control months. However, residents felt less prepared to manage cross-cover of patients ($P=.006$). There was a nonsignificant trend toward decreased perception of quality of education and balance of personal and professional life during the intervention month. Residents reported working fewer weekly hours overall during the intervention (64.3 vs 68.9 hours; $P=.40$), but they had significantly more episodes with fewer than 10 hours off between shifts (24 vs 2 episodes; $P=.004$).

CONCLUSION: Inpatient hospital services can be staffed with residents working shifts less than 16 hours without additional residents. However, cross-cover of care, quality of education, and time off between shifts may be adversely affected.

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ACGME = Accreditation Council for Graduate Medical Education; PGY = postgraduate year

In 2003, the Accreditation Council for Graduate Medical Education (ACGME) implemented duty hour requirements that restricted the total hours that residents can work during the course of a month to an average of 80 hours per week and mandated 4 days off per 28 calendar days.¹ Because prolonged shifts may be associated with increased errors² and decreased attendance at educational conferences,³ the Institute of Medicine responded in 2008 to a Congressional request to study resident duty hours by issuing a report with several recommendations, including limiting the length of duty shifts to no longer than 16 hours, unless allowed a protected sleep period of 5 hours.⁴ In June 2010, the ACGME proposed changes to the 2003 duty hour accreditation requirements that would limit shifts to 16 hours for first-year residents, ie, postgraduate year (PGY) 1.⁵

Previous attempts to eliminate overnight call systems have required additional resident support to the team.^{2,6}

To follow the Institute of Medicine and ACGME recommendations, we sought to replace a traditional “overnight” or “24- plus 6-hour” call model with a template in which shifts were less than 16 hours, without requiring additional resident staffing or reducing the number of patients cared for by the teams. With reduced shift length, we sought to evaluate the possible effect on patient care, education, and duty hour compliance.

PATIENTS AND METHODS

STUDY DESIGN

The study involved 2 gastroenterology teams, with each team staffed by 3 PGY-2 residents, a gastroenterology fellow, and a board-certified gastroenterologist. Although the proposed 16-hour requirement by the ACGME is specifically for PGY-1 residents, PGY-2 residents are the primary providers of direct patient care (rather than performing supervisory roles) on this service. The gastroenterology teams alternate admission of new patients every other day. Each team had a census cap of 18 patients (with a combined census cap of 28 between the 2 services); the on-call team had a daily cap of 8 new admissions. During the control months of September and November 2009, the usual schedule was retained in which the residents take call every sixth night and provide cross-cover to the other team overnight. All the residents on the admitting team assist with admissions during the day. The on-call resident typically arrives at 7 AM and takes admissions until 7 AM the following day, leaving after rounds and the educational session, which is typically between noon and 1 PM. With this traditional schedule, residents also have a continuity clinic 1 afternoon each week.

For editorial comment, see pages 176 and 179

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During the intervention month of October 2009, 1 resident from each team was assigned to a night shift every other night for 12 consecutive days (6 night shifts each). During the remainder of the month, the resident worked daytime shifts. The nonadmitting daytime residents typically worked from 6 AM until 5 PM; the admitting resident worked from 7 AM until 9 PM, and the admitting night shift resident arrived at 8 PM to allow time for sign-out (Figure 1). For most training programs, residents are required to see patients in half day continuity clinic sessions during most months of the residency program. As an Educational Innovations Project program,^{7,8} the Residency Review Committee for Internal Medicine prospectively approved allowing residents to not have continuity clinics during the intervention month; however, additional continuity clinic sessions were assigned during the month preceding and after the intervention month so that net clinic sessions did not change for each resident during the 3-month period to meet accreditation requirements. Core conferences were defined as noon lectures given as part of the required didactic curriculum of the residency program.

All residents in the control and intervention months were sent a weekly survey regarding work hours, shift length, conference attendance, and perception of transitions of care. The residents also completed an additional survey at the end of the rotation that addressed education, burnout, fatigue

(Epworth Sleepiness Scale⁹), and overall experience. Medical records were reviewed retrospectively to collect patient care metrics (length of stay, 30-day readmission rates, 30-day mortality, cardiac pulmonary arrests [ie, “codes”], rapid response team calls, and intensive care unit transfers) for all patients whose entire episode of care occurred exclusively during either the intervention or the control month. A care episode was defined as admission or transfer to the service and all care provided during the hospitalization until discharge. Readmission after discharge counted as a separate episode. Continuity of care was measured via review of the electronic medical record noting whether the same resident (1) admitted a patient, (2) wrote a majority (>50%) of the daily progress notes, and (3) signed the discharge summary for that patient. The study was approved by the Mayo Clinic Institutional Review Board.

STATISTICAL ANALYSES

Patient care metrics, resident-reported burnout and fatigue, and educational experience (conference attendance, time for scholarship, and overall perception) were compared between the intervention month and control months. The interval-scaled variables of patient length of stay, hours spent on various activities, conference attendance, and Epworth sleepiness scores were compared using *t* tests. The counts arising from patient safety indicators, continuity of care,

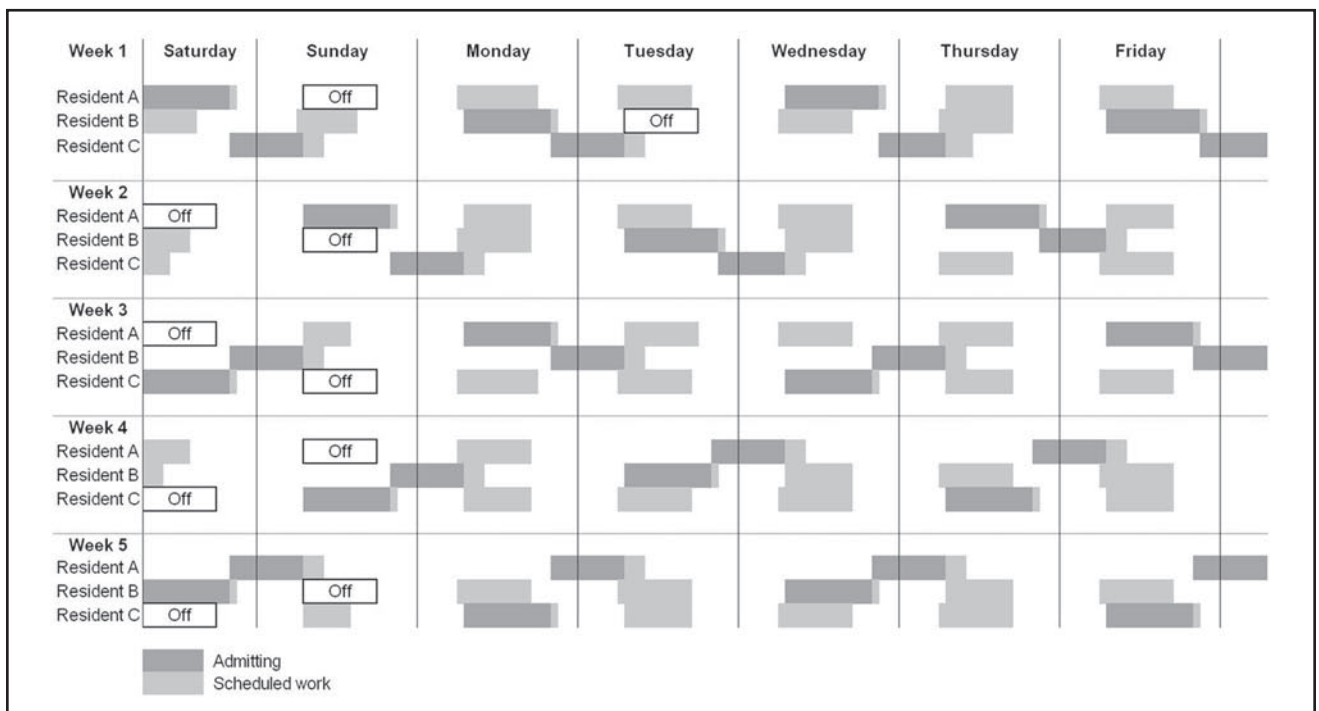


FIGURE 1. Intervention schedule diagram for one of the gastroenterology teams

TABLE. Patient Care Metrics^a

Variable	Intervention month (October) (N=196)	Control months (September, November) (N=274)	Difference, %	P value
Emergency response team calls	6 (3.06)	6 (2.19)	0.87	.57 ^b
Pulseless resuscitation events—code team calls	0 (0.00)	0 (0.00)	0.00	...
Transfers to ICU care	11 (5.61)	6 (2.19)	3.42	.08 ^b
Patient died within 30 d	7 (3.57)	17 (6.20)	-2.63	.29 ^b
Patient readmitted within 30 d	19 (9.69)	26 (9.49)	0.20	.99 ^b
Length of stay (d), mean (SD) [range]	3.00 (2.78) [0-16]	2.58 (2.65) [0-19]	0.42 (95% CI, -0.91 to 0.08)	.10 ^c
Admitted and followed by same resident	91 (46.43)	140 (51.09)	-4.66	.35 ^b
Admitted and discharged by same resident	91 (46.43)	145 (52.92)	-6.49	.19 ^b
Followed and discharged by same resident	91 (46.43)	120 (43.80)	2.63	.57 ^b
Admitted, followed, and discharged by same resident	82 (41.84)	135 (49.27)	-7.43	.13 ^b

^a Values are No. (percentage) unless indicated otherwise. CI = confidence interval; ICU = intensive care unit.

^b Fisher exact test.

^c Independent 2-sample *t* test.

and reported duty hour violations were compared using the Fisher exact test. Responses to ordinal scaled survey items regarding resident well-being and the educational environment were compared using Mantel-Haenszel χ^2 exact tests. An α level of .05 was used to determine statistical significance. All calculations were performed by one of us (A.J.H.) using SAS statistical software, version 9.1 (SAS Institute, Cary, NC).

RESULTS

A total of 196 complete patient care episodes occurred during the 5-week intervention month. Patients admitted before the start of the intervention month or discharged after the intervention month were not included in the analysis. There were 274 complete patient care episodes during the 2 control months (total of 8 weeks) (Table). During the intervention month, the teams averaged 39 patient care episodes per week, whereas there were 34 episodes per week during the control months. The patient care metrics did not differ during the intervention month vs the control months, including length of stay ($P=.10$), transfers to the intensive care unit ($P=.08$), readmission within 30 days ($P=.99$), death within 30 days ($P=.29$), number of codes (P value not calculable), and rapid response team calls ($P=.57$). There was no consistent trend for increased or decreased continuity of care during the intervention month vs control months. However, residents subjectively felt less prepared to manage cross-cover patients during the intervention month ($P=.006$) (Figure 2).

During the intervention month, there was a nonsignificant trend toward decreased perception of the overall quality of education. Residents were less likely to attend the core conferences for the residency program during the intervention month vs the control months ($P=.02$). Although residents reported more hours per week of scholarly re-

search during the intervention (9.5 vs 2.0 hours; $P<.001$), they reported fewer hours of reading medical topics in general (3.7 vs 5.3 hours per week; $P=.09$).

The residents worked fewer hours per week during the intervention month, but the time frame was not significantly different from those reported during the control months (64.3 vs 68.9 hours; $P=.40$). During the intervention month, 1 resident reported working more than 80 hours per week, with no 80-hour violations during the control months; however, there were significantly more reports of fewer than 10 hours off between shifts during the intervention month than during the control months (24 vs 2 episodes; $P=.004$). Although residents reported sleeping slightly more hours per week at home (42.0 vs 40.2; $P=.35$) and at work (2.3 vs 1.9; $P=.68$) during the intervention month, there was no significant difference in the Epworth sleepiness scores between the 2 groups (7.3 vs 9.3; $P=.39$) at the end of the month. Also, the trend was toward a decreased balance of personal and professional life during the intervention month ($P=.14$). Residents were more likely to rate the overall experience lower for the intervention month vs the control months ($P=.04$) (Figure 3).

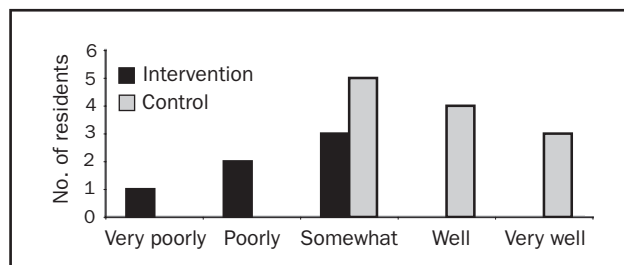


FIGURE 2. Perception of how prepared residents felt to handle cross-cover issues.

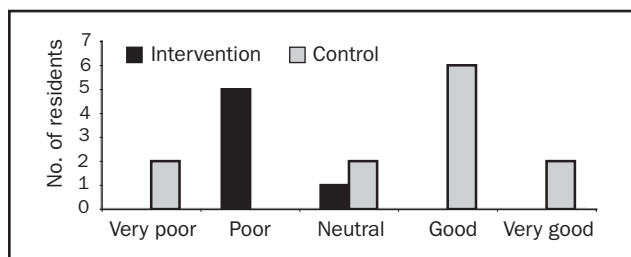


FIGURE 3. Overall resident perception of the intervention and control schedules.

DISCUSSION

During our study of an alternative inpatient resident service schedule, we implemented duty periods of 16 hours or less without increasing resident staffing or altering admission capacity. However, our study demonstrated 3 areas of concern with shortened resident shifts: residents felt less prepared to handle cross-cover issues, education was compromised because of the inability to attend teaching sessions, and the number of times residents had less than 10 hours off between shifts increased significantly.

Previous studies that have examined quality-of-care measures after implementation of the 2003 ACGME duty hour requirements^{10,11} demonstrated no benefit or harm. Our results, although limited by the short time frame, are consistent with no apparent clinical harm or benefit to patients. The residents in the intervention month indicated that they did not think sign-out on cross-cover patients was adequate. Our sign-out system engages many features that have been recommended elsewhere, including an electronic document automatically populated with clinical data.⁸ However, the designated sign-out time often coincided with new admissions, which disrupted communication about cross-cover of patients.

Residents thought that the educational environment was negatively affected by the reduced duty periods. The reported effect of duty hours on the educational environment is mixed.¹² In the current study, residents thought they missed educational opportunities when they were assigned to the night shift and thus were not able to attend lectures. Overall, when residents evaluated their educational experience, the difference between the 2 groups was not statistically significant. This may reflect the perception that the educational sessions were beneficial when they could be attended, but the intervention schedule limited the opportunity to attend. The timing of required lectures and the need to maintain a curriculum will be important factors as programs devise new schedules related to changes in shift length.

Although the number of hours worked per shift was reduced, the number of “10-hour” violations increased, suggesting that we may have substituted one duty hour requirement violation for a different violation. Overall, resident satisfaction with the intervention month was reduced. Informal discussion with the residents after the completion of the month further elucidated concerns about providing cross-cover care, as well as the length of the admitting day. The busiest time of the admitting day was from 4 PM until 9 PM, which resulted in the daytime resident staying after 9 PM to complete patient admissions.

As with any observational study, there are limits to the interpretation of our data. First, it was conducted during 3 months at a single institution and included a small number of residents (6 in the intervention, 12 in comparator months). Team members may not have had time to become accustomed to the schedule. Second, although intervention residents were less likely to attend the core educational conferences, these individual residents had attended fewer conferences during their intern year compared with the control residents ($P=.008$). Third, the residents did not attend continuity clinic during the intervention month, which was allowed through an Educational Innovations Project exemption. Although the ACGME requirements for internal medicine residency programs allow this schedule,¹³ it may not be feasible for other programs. Fourth, a more formal method of work hour recording, such as a card-swipe system, may have given more accurate work hour results compared to weekly resident surveys and may have shed more light on the exact timing of the 10-hour violations that occurred. Fifth, the 16-hour duty period pilot consisted of PGY-2 residents, whereas the new duty hour guidelines note that these duty hour periods are required only for PGY-1 residents; if this pilot had consisted of PGY-1 residents, some of the results may have been different, but this model could be used with PGY-1 residents if in-house supervision is present. Finally, the residents were surveyed at the end of each week regarding hours spent working, sleeping, researching, and reading, which leads to potential recall bias.

CONCLUSION

The ACGME has proposed new duty hour requirements that limit PGY-1 duty periods to a maximum 16 hours. Our study demonstrates that it is feasible to implement a schedule compliant with the maximum duty hour limit without increasing resident numbers or decreasing admission capacity. Our study also highlights areas for further improvement and study. We think this model could be improved in future iterations with attention to unintended consequences of our study related to patient care transitions, education,

and complementary duty hour requirement violations. We recommend creating a “protected” sign-out time during which the handoff of patient care between residents at the transition of duty periods is not disrupted by new admissions or other interruptions.⁸ New paradigms of education are likely necessary with shorter duty periods to ensure that resident learning is optimized even when the resident is on a nighttime duty period. Finally, the potential for exchanging duty hour violations (eg, the “10-hour rule”) as a consequence of the reduced total duty period needs to be appreciated and closely monitored.

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