Toward a New Paradigm in Graduate Medical Education in the United States: Elimination of the 24-Hour Call

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Abstract

Background Sleep deprivation negatively affects resident performance, education, and safety. Concerns over these effects have prompted efforts to reduce resident hours. This article describes the design and implementation of a scheduling system with no continuous 24-hour calls. Aims included meeting Accreditation Council for Graduate Medical Education work hour requirements without increasing resident complement, maximizing continuity of learning and patient care, maintaining patient care quality, and acceptance by residents, faculty, and administration.

Methods Various coverage options were formulated and discussed. The final schedule was the product of consensus. After re-engineering the master rotation schedule, service-specific conversion of on-call schedules was initiated in July 2003 and completed in July 2004. Annual in-training and certifying examination performance, length of stay, patient mortalities, resident motor vehicle accidents/near misses, and resident satisfaction with the new scheduling system were tracked.

Results Continuous 24-hour call has been eliminated from the program since July 2004, with the longest assigned shift being 14 hours. Residents have at least 1 free weekend per month, a 10-hour break between consecutive assigned duty hours, and a mandatory 4-hour "nap" break if assigned a night shift immediately following a day shift. Program-wide, duty hours average 66 hours per week for first-year residents, 63 hours per week for second-year residents, and 60 hours per week for third-year residents. Self-reported motor vehicle accidents and/or near misses of accidents significantly decreased ($P < .001$) and resident satisfaction increased ($P = .42$). The change was accomplished at no additional cost to the institution and with no adverse patient care or educational outcomes.

Conclusions Pediatric residency training with restriction to 14 consecutive duty hours is effective and well accepted by stakeholders. Five years later, the re-engineered schedule has become the new "normal" for our program.

Background

Evidence was emerging in 2003, and has been corroborated quite conclusively since then, that sleep deprivation negatively affects resident performance and safety.[1–5] Concerns over potential deleterious effects of sleep-deprived residents on patient care prompted efforts to reduce resident work hours. Duty hours limitations for all US residents were instituted by the Accreditation Council for Graduate Medical Education (ACGME) effective July 1, 2003, capping duty hours for most residents at 80 h/wk, mandating defined rest periods between assigned shifts, and limiting consecutive duty hours to 24 plus an additional 6 hours to transfer patient care, participate in educational activities, and attend outpatient clinics.[6] Initially implemented for most workers in 1993, the European Working Time Directive was extended to doctors in training in 2004, setting 13-hour shifts and initially 58 h/wk (to be further reduced to 48 h/wk after 5 years) as the maximum permissible for residents in the European Community.[7,8] In 2003 New Jersey was the first state to adopt Maggie's Law,[9] which upgraded vehicular homicide to a crime of the first degree when caused by a driver who was without sleep for a period in excess of 24 hours.

The decision to embark on a major redesign of duty hours for the pediatric residency program at University of Medicine and Dentistry of New Jersey-New Jersey Medical

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School was prompted by these external factors as well as certain local factors. Foremost among these was the program's first-attempt pass rate on the American Board of Pediatrics (ABP) Certifying Examination, which for many years had demonstrated considerable variability despite innumerable attempts to achieve a consistently acceptable pass rate. Given the frequent observation of eyes closing and heads bobbing at noon conference, the program director saw in the new scheduling paradigm a way to assure residents would be awake and alert for the multiple learning opportunities afforded them every day.

This report documents the results of the program's initiative to design and implement a resident scheduling system with no continuous 24-hour calls that would (1) meet all ACGME work hour requirements without increasing the number of residents, preserving no-call rotations and a monthly 2-day weekend for each resident; (2) result in enhanced resident learning; (3) maximize continuity of care; (4) maintain or improve patient care quality indicators; and (5) be accepted by residents, faculty, and department administration at both program training sites.

Methods

The University of Medicine and Dentistry of New Jersey-New Jersey Medical School pediatric residency program is a 2-hospital program with 48 categorical pediatric residents and 16 residents in the combined internal medicine/pediatrics program. For many years prior to 2003, the program had used the traditional 24-hour, every fourth night, on-call scheduling system.

Various coverage options were formulated and discussed for several months with residents and faculty at both training sites during program director and departmental residency committee meetings and with small groups of subspecialists until consensus was developed. The master rotation schedule was re-engineered to assign the needed numbers of junior and senior residents to night team in each block for each inpatient service, typically scheduled to precede or follow 2 weeks of vacation or emergency department shifts. Service-specific conversion of call schedules was initiated in July 2003 and completed in July 2004, with minor modifications implemented annually thereafter following program review by both residents and faculty. Annual rotation and monthly on-call schedules are prepared by the program director, who calculates and documents scheduled duty hours per week for each resident each month. Faculty and residents are reminded at the start of each academic year of scheduling requirements, including the need for residents to be excused from clinical responsibilities 4 hours prior to the start of a night team assignment. The chief residents and program director monitor compliance and offer clarification of duty hours rules for faculty and residents as needed.

The ABP in-training examination (ITE) is administered annually during the second week in July, and is therefore a useful baseline assessment of the knowledge base and/or test-taking skills of incoming first-year (PL-1) residents. Annual ITE and ABP certifying examination performance is tracked, as are length of stay, same-diagnosis readmissions within 30 days, and mortalities. Since June 2004, residents have been asked on the annual mandatory anonymous written program evaluation to indicate the number of motor vehicle accidents (MVAs) or near misses of accidents they had during the preceding academic year traveling to and from work.

First-attempt certifying examination pass rates are simple percentages, and confidence intervals use a normal approximation. Incoming ITE scores before and after implementation of scheduling changes are compared using a Wilcoxon rank sum test and pass rates are compared using the Fisher exact test. Trends in the number of reported MVAs and/or near misses and in resident satisfaction ratings are compared using Spearman correlation. All testing is 2-sided and conducted at the nominal 5% significance level.

Results

Duty Hours Scheduling

Continuous 24-hour call has been completely eliminated from the program since July 2004, with the longest assigned shift being 14 hours. Day team and night team scheduling is used on inpatient and pediatric intensive care unit (PICU) services, with residents assigned to those night teams an average of 4 weeks in the PL-1 year, 6 weeks in the PL-2 year, and 4 weeks in the PL-3 year.

The night team (usually 7:30 PM–9:30 AM Sunday through Thursday or Friday) is assigned in 2-week blocks with average duty hours of 75 h/wk, and is scheduled immediately following a day team rotation on that service whenever possible to enhance continuity of care. There are an additional 1–2 weeks of nights during PL-1 and PL-2 block months in the nurseries. Given the complexity and chronic nature of patients in the neonatal intensive care unit an ''internal night float'' concept is used there; the same group of 8 residents cover essentially all day and night shifts for the entire month, with each junior resident working 7 to 10 nights. This system eliminates the need to hand off care of these babies to residents who are not intimately familiar with the details of their problems and course. Residents on required subspecialty and elective rotations are assigned 2 to 3 weekend nights per month to provide coverage when night team residents have their weekly nights off on inpatient services or in the PICU.

Implementing a consensus proposal from senior residents in academic year (AY) 2006–2007, the PL-3 day team leaders on the general inpatient services work longer weekday hours, typically 7AM to 8 PM Monday through Friday with the exception of their continuity day, when they work 7 AM to 5 PM. The trade-off for longer weekday hours is 3 free weekends per month with no night coverage

TABLE 1 **Scheduled Inpatient Work Hours**

Resident Level	Day Team	Night Team
Senior		
Weekdays	7 AM–9 PM except continuity day 7 AM–5 PM	7:30 PM–9:30 AM
Weekends/holiday	8 AM–9 PM	7:30 PM–9:00 AM
Junior		
Weekdays	7 AM–5 PM with "long call" 5 PM–9 PM average every third day	7:30 PM–9:30 AM
Weekends/holiday	8 AM–9 PM	7:30 PM–9:00 AM

assignments that month. The PICU day team and junior inpatient residents work 7 AM to 5 PM Monday through Friday and have "long call" from 7 AM to 9 PM an average of every third day (TABLE 1). They have 1 free weekend per month, and may be assigned 1 to 2 weekend nights per month. Residents have a minimum 10-hour break between consecutive assigned duty hours for both day and night team assignments. For day team or elective residents assigned a weeknight covering call, there is a mandatory 4-hour "nap" break prior to starting the night team call.

Program-wide, average duty hours are 66 h/wk for PL-1 residents, 63 h/wk for PL-2 residents, and 60 h/wk for PL-3 residents. This compares favorably to the 74 to 77 h/wk scheduled for each resident in the traditional 24 + 6, every fourth night, call system previously used. No-call rotations have been maintained with the re-engineered scheduling, with 2 weeks call-free for PL-1 residents, 4 weeks for PL-2 residents, and 8 weeks for PL-3 residents. Each resident has a call-free weekend from Friday evening through Monday morning (approximately 60 consecutive hours) each month. The call-free weekend is scheduled immediately following a night team block assignment unless requested otherwise. The PL-3 residents on required subspecialty or elective rotations have 2 call-free weekends during those months.

The 3-year curriculum for residents in the new scheduling paradigm reduced emergency department and elective rotations by 1 month each over the 3 years of residency. Current residents work comparable hours per week while on night team assignments and a few less hours per week on day team assignments when compared with the traditional overnight call paradigm. Duty hours for residents assigned to the emergency department and nurseries are unchanged but are substantially reduced for junior and especially senior residents on required subspecialty and elective rotations (TABLE 2).

Resident Complement

The new scheduling paradigm was accomplished without a significant increase in the number of resident full-time equivalents (FTEs), with 58 categorical pediatric and medicine/pediatrics residents in AY 2003–2004 and 59 in AY 2008–2009. There were an additional 6 rotating resident FTEs per month in AY 2003 and 7 rotating FTEs per month in AY 2008–2009. Rotating residents included 3 from family medicine, 2 from emergency medicine, 3 from psychiatry and 1 from another pediatrics program. These rotating residents were assigned to general inpatient, pediatric emergency department, and nursery services.

ABP ITE/Certifying Examination Performance

The median (range) PL-1 ITE performance of residents completing the program in 2002 and 2003, the last 2 years in the traditional 24-hour call scheduling paradigm, was 10 (0–440); their first-attempt pass rate on the ABP certifying examination was 45% (95% confidence interval [CI]: 28%–63%). The median (range) PL-1 ITE performance for residents completing the program in 2007 and 2008, the first 2 classes who trained completely under the new scheduling paradigm, was 10 (0–310); their first-attempt pass rate on the ABP certifying examination was 63% (95% CI: 45%–81%). Interestingly, the last class in the old paradigm (2003 completers) and the first class in the new

TABLE 2 **Mean Resident Duty Hours (Scheduled) After Elimination of 24-Hour Call**

Rotation	Hours/Week
Day team—inpatient/PICU	68–72
Night team—inpatient/PICU	74–78
Nurseries (internal night team)	72–75
ED	55–60
Senior required subspecialty	50 (40 if no call)
Junior required subspecialty	60 (40 if no call)

Abbreviations: PICU, pediatric intensive care unit; ED, emergency department.

paradigm (2007 completers) had a similar entering PL-1 ITE performance with a median (range) of 105 (0–440) and 80 (0–250), respectively; their first-attempt pass-rates on the ABP certifying examination were 53% (95% CI: 28%–79%) and 86% (95% CI: 67%–100%), respectively. A comparison of pass rates using the combination of 2002 and 2003 to 2007 and 2008 does not reach statistical significance with ($P = .20$) or without ($P = .21$) adjustment for incoming ITE, nor does a comparison of 2003 to 2008 ($P = .11$).

Continuity of Patient Care

Day and night team residents on all services become very familiar with the details of each patient's presentation and problems, and "ownership" of patients is shared by both groups. The day and night handoffs are allotted 90 minutes; although sometimes excessive, it was found that 60 minutes was often inadequate. Handoffs are face-to-face and attended by both junior and senior residents; verbal handoffs are supplemented by detailed computerized documents updated twice daily, which include responsible attending contact information, patient demographics, diagnosis, laboratory results, treatment, and needed follow-up. The program's PL-4 chief residents have oversight responsibility for the general inpatient services at both program sites. The day handoffs on the inpatient service were supervised by a chief resident 7 days per week, especially important on weekends when residents on elective may be covering for day/night team residents on their off days. The night handoffs were not supervised.

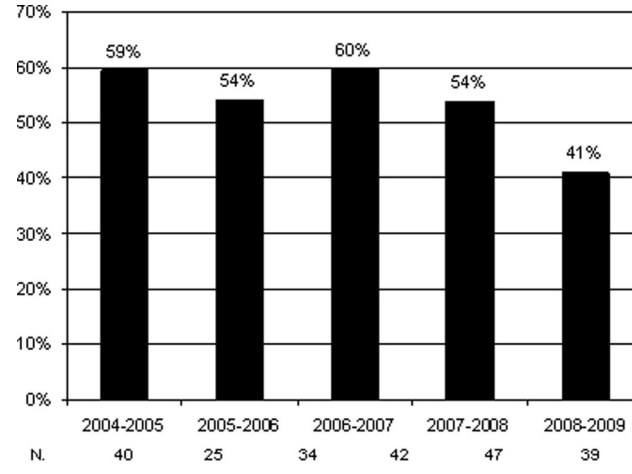
Because the chief residents cover alternate weekends, an additional layer of continuity is provided by the director of general inpatient services at the primary teaching site, who maintains a written log of and discusses all new and problematic inpatients at that site 7 days per week with the covering chief resident. Patient care continuity is further assured by attendings of record, who round and write notes on all patients every day. Senior residents are required to discuss all new admissions with the attending of record prior to handing off care to the incoming day or night team senior; this rule existed in the old paradigm but has been even more stringently enforced since elimination of the 24-hour call.

The number of handoffs per service per week in the old scheduling paradigm was 14, and it is 14 to 16 in the new paradigm. This was facilitated by the implementation in AY 2006–2007 of the longer weekday hours for the inpatient day team seniors, eliminating the "short call" 4 PM to 9 PM cross-coverage and attendant handoff previously required.

Patient Encounters/Mortalities/Length of Stay

In AY 2003–2004 there were 5 671 admissions to the primary training site with 53 mortalities (0.93%), 8 pediatric and 45 neonatal. In AY 2007–2008 there were 5 356 admissions and 24 mortalities (0.45%), 6 pediatric and 18 neonatal. The excess neonatal mortalities in 2003–2004 are due to a difference in reporting, as previable fetuses were included in neonatal mortalities with the data collection system in place at that time. Inpatient length of stay has steadily declined, from 4.68 days in AY 2003–2004 to 3.92 days in AY 2007–2008.

FIGURE 1 **Percentage of Residents Reporting Motor Vehicle Accident (MVA) and/or Near Misses From Academic Year 2004–2005 to 2008–2009.**



Scale: 1 = 0 MVAs/near misses, 2 = 1 MVA/near miss, 3 = 2 MVAs/near misses, 4 = 3 MVAs/near misses, and 5 = More Than 3 MVAs/near misses

Resident Motor Vehicle Accidents

Self-reported MVAs and/or near misses of accidents have decreased from AY 2004–2005 to AY 2007–2008, from 59% to 41% of residents reporting at least 1 MVA and/or near miss (FIGURE 1). A trend test comparing year and the response scores indicated a significant negative correlation over time (Spearman correlation −0.14, $P = .042$).

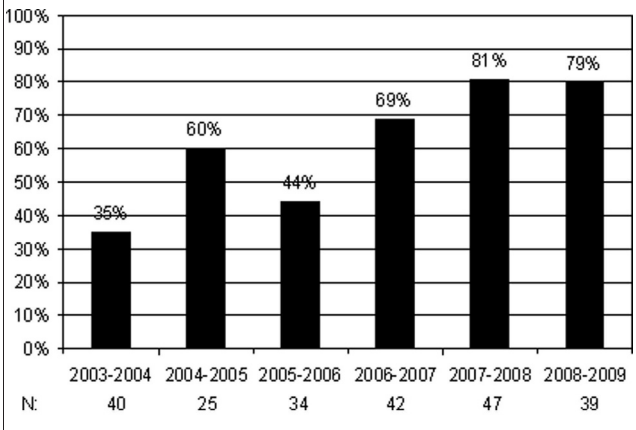
Resident Satisfaction

Resident satisfaction with the new scheduling system has increased on the annual end-of-year program evaluation; the percentage of residents reporting excellent or very good increased from 35% to 79% from AY 2004–2005 to AY 2007–2008 (FIGURE 2). A trend test comparing year and the satisfaction scores indicated a significant positive correlation over time (Spearman correlation 0.42, $P < .001$).

Discussion

Although residency programs have implemented many creative scheduling changes to accommodate the 2003 ACGME work hours standards,[10–13] to our knowledge this is

FIGURE 2 **Percentage of Residents Rating Their Satisfaction as Very Good or Excellent With the Night Team Program From Academic Year 2004–2005 to 2008–2009.**



Scale: 1 = Excellent, 2 = Very Good, 3 = Satisfactory, 4 = Less Than Expected, and 5 = Needs Much Improvement

the first US program to report complete elimination of the traditional 24-hour call. Successful elimination of 24-hour call was accomplished without an increase in resident complement and at no additional cost to the institution, as neither additional residents nor substitute providers were needed to effect the change. This is significant, given the recent estimate of $990,000 to $3.5 million in additional cost per major teaching hospital to achieve compliance with the 4 major recommendations in the new Institute of Medicine report.[14] Other programs have accomplished similar significant reductions in weekly duty hours, but only with an investment of $3 million to $4 million in annual support, limiting the generalizability of such changes.[15] Although there has been some increase in attending responsibility and oversight in our program, the no-cost changes were facilitated by the fact that the program had already transitioned to an every-fourth-night call schedule some years previously.

Initial attempts at scheduling night team assignments in 4-week blocks were not well received by most residents because they felt too out-of-phase with family and friends. Similarly, early attempts at more frequent shifting from night team to day team, and vice versa, with the attendant shift from nocturnal to diurnal living, were similarly unpopular and promptly discontinued. Most of our residents prefer to do as many consecutive night team shifts as possible once they have made the adaptation to nocturnal living, and by so doing, make that adaptation less frequently throughout the course of an academic year. Night team assignments typically begin on a weekend, permitting a prolonged rest period before starting that block. The mandatory 4-hour break between the occasional weekday day and night coverage assignments provides naptime for those residents. Although there is insufficient evidence to support definitive conclusions about optimal speed and direction of shift rotation, a comprehensive review of shift systems used in various industries identified 2 studies that suggested that forward, slow-rotating shift systems are better tolerated.[16] The introduction of brief naps resulted in improved vigilance and reduced cognitive slowing across the shift, especially before the first night shift in a sequence of assigned nights, provided enough time was offered to recover from sleep inertia.[16–18]

Continuity of resident learning has been enhanced with the new duty hours scheduling. A major advantage of the 14-hour shifts for day and night teams is the overlap time provided for both handoffs and teaching, while still preserving the 10-hour break between consecutively assigned duty hours. Night team residents participate in daily inpatient morning report from 8:30 to 9:30 AM prior to concluding their 14-hour shift. Because residents are never "postcall," day team residents on all services are present both physically and mentally for the 3 scheduled teaching hours (morning report, attending rounds, and noon conference) daily. The learning experience has also been enhanced for residents on required subspecialty and/or elective rotations, as they too are present Monday through Friday to participate in patient care and educational sessions for their respective services, unencumbered by postcall fatigue and the need to leave early after call. The PL-3 residents on required subspecialty and elective rotations have no assigned call Monday through Thursday, working 8:30 AM to 4:30 PM, contributing further to continuity of resident learning.

There are limited data on the impact of reduced or altered resident work hours on educational outcomes, and no data from pediatric programs. A comprehensive review published in 2005 identified 2 surgical programs in which a reduction in shift duration or introduction of day and night teams resulted in self-reported increased time for reading by residents in those programs.[10] A 2006 report from a general surgery residency program indicated no change in mean American Board of Surgery In-Training Examination scores or first-attempt qualifying and certifying examination pass rates after changes in resident work hours were made to accommodate the 80-hour work week.[19] Although it is too soon to be certain that the improved ABP certifying examination performance noted in our program will be sustained, these outcomes do provide some evidence that resident learning is at least maintained, and perhaps enhanced, in the new scheduling paradigm.

Continuity of patient care on the general and critical care services has not suffered, and perhaps has improved, since elimination of 24-hour call. All day team members are present all day every day Monday through Friday except for continuity practice assignments, as they are never postcall

and therefore do not need to hand off patient care, as was required in the traditional extended shift paradigm. Differing from ''night float'' systems in which residents cover part or all of the primary team's responsibilities for a defined number of hours, night team residents in our system share ownership of and accountability for patient care; their knowledge of patients is as detailed as that of day team residents. The structured and often supervised face-to-face handoffs, involving all team members and supplemented by word-processed data summaries, mirror recommendations based on review of information transfer systems used in high-reliability organizations.[20] Residents provide feedback to each other on the quality and accuracy of patient handoffs through the program's peer-evaluation system.

Sleep deprivation and irregularity of sleep habits adversely affect driving performance.[21] A recent national multispecialty survey of interns documented that their odds of an MVA while commuting home from work after an extended shift were more than double the odds after a nonextended shift (<24 hours), while near misses were 5 times as likely to occur after an extended work shift.[5] The significant reduction in self-reported MVAs and near misses noted in our program was therefore not surprising, but is especially important given that virtually all of our residents commute by car.

Limitations of this report include the considerable variability in the incoming ITE scores and first-attempt certifying examination pass rates of our residents. Changes noted could be attributable to differences in the incoming classes or to other exogenous factors that were not considered. Inaccurate recall may have affected the data on MVAs and near misses, although it is unlikely that recall would be substantially less accurate in residents who were less sleep-deprived after implementation of the new scheduling paradigm. Selection bias may have contributed to the increase in satisfaction ratings of the new scheduling paradigm because applicants matching to the program had been informed about the new scheduling change during information sessions on interview days. Although the new scheduling system described herein should be generalizable at no or minimal increased cost to any program currently using the traditional every-fourth-night extended call system, other factors related to program size or specialty may interfere with its successful implementation.

There is now clear and compelling evidence that current ACGME work hours regulations, which continue to permit more than 24 hours of consecutive duty, have not fully achieved their intended goals of improving the safety and well-being of patients and residents. A prospective cohort study of 3 large pediatric training programs published in 2008 found that 24- to 30-hour shifts remained common after scheduling changes were made to accommodate the 2003 ACGME work hour limits.[22] Moreover, there was no change in residents' measured total work hours or sleep hours, the overall rate of medication errors, rates of motor vehicle crashes, occupational exposures, depression, self-reported medical errors, or overall ratings of work and educational experiences.[22] Several studies using cognitive psychomotor tasks and driving simulators have indicated that 17 to 21 hours of wakefulness produced decrements in performance of the same magnitude as blood alcohol concentrations of .05% or more, and more than 24 hours of wakefulness degrades performance similar to blood alcohol concentrations of .10%.[21]

A national survey of 500 pediatric residents before and after implementation of the 2003 ACGME duty hour limitations documented significant decreases in reported hours worked, patient errors, and falling asleep while driving or in conferences, but noted that absolute levels of resident fatigue remained a concern. After implementation of the 2003 duty hour limitations, fully 73% of residents in that survey still reported falling asleep during a conference, 20% reported falling asleep while driving from work, 8% reported making an error in patient care because of fatigue, and 14% to 18% reported working more than 80 h/wk on inpatient and critical care services.[23] Consecutive duty hours of 16 hours or less are associated with marked decreases in attention failures and serious medical errors.[24] National and international legal initiatives to hold administrators responsible for medical errors and even MVAs caused by fatigued residents[25] provide additional imperatives for elimination of 24-hour call from all residency programs in the United States.

Conclusions

Using re-engineered annual master and on-call schedule designs that meet all ACGME and Residency Review Committee for Pediatrics requirements, 24-hour call has been completely eliminated from this pediatric residency program since July 2004. This was accomplished at no additional cost to the institution, with no adverse patient care or educational outcomes, and with significant improvement in resident safety and satisfaction. Pediatric residency training with restriction to 14 consecutive duty hours is effective and well accepted by departmental residents, faculty, and administration. Skepticism and resistance to change was most prevalent, not unexpectedly, in the first year of the transition to the new paradigm among residents who had spent the first or second year of residency training in the traditional overnight call scheduling system. Five years later, the re-engineered schedule described herein has become the new normal for our program.

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