Methods and Implications of Limiting Resident Duty Hours

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Context: Current limitations on residency duty hours came about after the death of a patient in 1984 in a New York City hospital. This tragedy served as the catalyst for a new public awareness and subsequent change in philosophy regarding resident duty hours, fatigue factors, and risks to patients from the long and tedious shifts of residency. However, it has proven difficult to limit resident physician duty hours.

Objective: To analyze the impact of resident duty hour limitation (RDHL) implementation on residents, faculty, and patients.

Methods: The authors conducted a survey of faculty and resident attitudes and experiences regarding RDHLS in the graduate medical education department at Arrowhead Regional Medical Center (ARMC) in Colton, California. They also conducted a review of the literature on faculty and resident attitudes and experiences before and after implementation of RDHLS.

Results: Of 60 surveys sent to ARMC faculty members in 2009, 12 (20.0%) were returned. Of 140 surveys sent to ARMC residents, 96 (68.6%) were returned. The survey results and literature review indicated that most faculty physicians initially believed that decreasing resident duty hours would limit the time available to residents for educational experiences and participation in treatment procedures, operations, and consultations. In addition, faculty initially believed that fewer training hours would diminish the quality of residents’ educational experiences. Residents also expected negative outcomes from RDHLS. However, statistical data on actual outcomes revealed that residency programs are not adversely affected by limiting resident work hours to 80 hours per week. Furthermore, benefits of RDHLS appear to include improved patient care and well-rounded and psychologically balanced residents.

Conclusion: A survey and literature review revealed a number of benefits of RDHLS. It is unclear, however, whether additional limitations of resident work hours are necessary or could accommodate the growing amount of information and skills that are required to become a competent physician.

Medical internships have been a requirement in the United States since 1920, and rigorous resident duty hours have been an accepted right of passage for decades.1 The original concept of “resident physician” delineated responsibility for patients 24 hours per day, 7 days per week.1 Until recently, these resident hour requirements had remained essentially unchanged, because the medical establishment believed that only through long hours of training would residents become competent in their fields of medicine and surgery.

However, the tragic death of 18-year-old Libby Zion at one of New York City’s teaching hospitals in 1984 led to investigations of, and subsequent changes to, resident duty hours.2 Investigators determined that acute fatigue, resulting from excessive work and less than 4 hours of sleep per day, affected the judgment of the resident and intern who admitted Ms. Libby. Because of their fatigue, these individuals forgot to transmit crucial information about Ms. Libby during sign-out, resulting in her improper treatment and death.

Mandates for postdoctoral training programs established by the American Osteopathic Association (AOA)3 have forced changes in the number of duty hours that residents are required to work. The AOA mandates, in place since 2003, require every training program to limit daily duty hours, to provide a minimum number of hours off between shifts, to limit days on call, and to provide a minimum number of days off per month.3 The practical application of these mandates has led to a major paradigm shift in the concept of resident duty hours in osteopathic medicine.

In December 2008, at the request of the US House Committee on Energy and Commerce, the Institute of Medicine (IOM) issued a new set of resident duty hour recommendations to prevent medical errors.4 These recommendations would further shift the paradigm if adopted by the AOA.
to the IOM, the 80-hour resident workweek, averaged over 4 weeks, should be maintained to allow for sufficient education. The IOM notes that most of the errors stemming from fatigue and chronic sleep deprivation could be combated by requiring that residents have periods of uninterrupted sleep while at work, though these periods would be subject to violation because they could not be monitored or enforced. The IOM adds that limiting shifts to 16 hours would provide necessary safeguards.

The IOM guidelines state that residents could not work more than 4 consecutive nights, which must be followed by a minimum of 48 continuous hours off duty. Maximum in-hospital on-call frequency, according to the IOM, should be 1 out of every third night (without averaging). Minimum time off between scheduled shifts should be 10 hours after a day shift, 12 hours after a night shift, and 14 hours after any extended duty period of 30 hours or more. The IOM further states that residents should have mandatory time off of 5 days per month, 1 day (ie, 24 hours) per week (without averaging), and one 48-hour period per month.

Moonlighting by residents—whether in internal or external positions—should be counted against the 80-hour weekly limit, according to the IOM. All other duty-hour limits would apply to moonlighting in combination with scheduled work. The IOM allows an exception of an 88-hour weekly limit for select programs in which a sound educational rationale is provided for the extra hours. Residents working in emergency departments are limited by the IOM recommendations to 12-hour shifts, equivalent periods of time off between shifts, and 60-hour workweeks with 12 additional hours for education. These IOM recommendations are based on findings of the Harvard Work Hours, Health and Safety Group. Following these recommendations would require teaching hospitals to hire additional medical personnel costing approximately $1.7 billion.

The present article examines the methods used to limit resident duty hours at Arrowhead Regional Medical Center (ARMC), a 400-bed, level-II trauma center operated by San Bernardino County in southern California. The article also examines the opinions of ARMC faculty and residents (including interns [first-year residents]) as collected in a survey, regarding resident duty hour limitations (RDHLs). Through an analysis of these survey findings—combined with comparisons with findings from previously published studies—we address the potential impact on patients, residents, and physicians of implementing the IOM recommendations while seeking to maintain resident educational competencies. We also probe current concerns within the medical community about RDHLs, and we examine potential solutions for these concerns.

Survey Methods
We conducted a survey of the experience and opinions of faculty members and residents in the graduate medical education department at ARMC in Colton, California. This medical center is located within, and operated by, San Bernardino County, which is geographically the largest county in the United States. There are 10 well-established residency programs at ARMC. A resident at ARMC is on call no more than 1 in every 3 nights for internal medicine or surgery services. However, the rest of the medical services at ARMC include both day and night shifts, with no limit to the number of consecutive night shifts for residents. No resident is scheduled to work more than 80 hours per week.

A survey was sent to 60 faculty members and 140 residents (including interns) in 2009. Surveyed faculty included all full-time academic teachers at ARMC, and surveyed residents included all ARMC residents. Individuals were given 1 month to complete the survey before returning it. No approval was required from the ARMC internal review board, because the study involved no changes to patient care and no patient involvement.

Items in the survey consisted of 20 questions on residents’ activities while on call, risks associated with various work hours and shifts, faculty perceptions of RDHLs, effects of RDHLs on residents’ performance, various resident duties as percentages of hours worked, types of work hour violations, and types of alternative scheduling methods. Most questions were in multiple-choice format.

After faculty members and residents completed the survey and returned it, results were tallied. Answers to multiple-choice questions were analyzed by using a Likert scale. Descriptive and inferential statistics were used to examine both faculty and resident beliefs regarding duty hours. Spreadsheet statistical software was Microsoft Office Excel 2007 (Microsoft Corporation, Redmond, Washington).

Results (and Comparisons With Previous Studies)
Of the 60 surveys sent to ARMC faculty members, 12 (20.0%) were returned. Of the 140 surveys sent to ARMC residents, 96 (68.6%) were returned. Thus, the present study involved the analysis of 108 surveys.

Resident Activities
Data on ARMC resident activities while on duty are presented in Table 1 alongside comparable data from a 2004 study by Morton et al. On average, ARMC residents reported that they slept for 1 hour, 41 minutes when they were on overnight call. During overnight duty hours, patient evaluation via telephone constituted 16% of residents’ time, and direct patient contact made up almost half their time.

Morton et al reported that, on average during overnight call, residents slept for 3 hours, 20 minutes and received 16 electronic pages (Table 1). During those nighttime duty hours, cross-call activities accounted for 41% of pages, with patient evaluation via phone requiring 19% of activity time. Direct patient contact accounted for only 7% of residents’
time, according to Morton et al.\textsuperscript{6}

The main difference between our results and those of Morton et al\textsuperscript{6} is that ARMC residents slept less and had more personal contact with patients. Many resident services at ARMC occur in shifts. Thus, residents perform more routine duties during nighttime (as opposed to only taking care of emergencies), and sleep time is more likely to be interrupted.

**Resident Errors and Risks**

Many ARMC residents reported that working 24 hours or more per shift resulted in increased errors of diagnosis and treatment, communication problems, and personal injury (Table 2). Seventy percent of survey respondents reported experiencing more attention errors and 27% of respondents said they had more diagnostic errors when they were on call 1 in 3 nights and working more than 24 hours per shift. Working more than 24 hours per shift was also associated with 18% of ARMC residents reporting an adverse impact on surgical performance and 7% of the residents saying that they were involved in motor vehicle accidents after their shifts.

Lockley et al\textsuperscript{7} found further evidence that extended resident hour requirements could be not only wasteful with regard to education, but also dangerous to the well-being of the residents (Table 2). Lockley et al\textsuperscript{7} reported that residents working 24 hours or longer per shift were 2.3 times more likely to be involved in motor vehicle accidents after that shift. Furthermore, the monthly risk of car crashes dramatically increased, by 16.2% after each 24 hour or longer shift. Lockley et al\textsuperscript{7} also reported that interns taking call every third night and working more than 24 hours per shift—compared with working 16 hours or less—slept 5.8 hours less per week, had 2 times as many attention failures while on overnight duty, and made 35% more serious medical errors and 6 times more serious diagnostic errors.

In a related study, Baldwin et al\textsuperscript{8} surveyed 3604 residents, finding an average of 83 weekly hours during postgraduate year 1 (PGY-1) and 76.2 weekly hours during PGY-2. The researchers concluded that increased duty hours were correlated with residents’ stress and lack of sleep. Residents working more than 80 hours per week were more likely to be involved in a personal accident with injury, to have a serious conflict with other staff members, and to make a serious medical error.

In other studies of this issue, 24-hour shifts were found to negatively impact residents’ surgical performance,\textsuperscript{9} and heavy clinical workload was found to be associated with adverse effects on the aerobic fitness of residents.\textsuperscript{10} These findings underscore the potential of excessive duty hours to harm residents’ ability to learn and to contribute to residents’ physical deterioration.

**Faculty Perception vs Reality**

Perceptions of RDHLS among ARMC faculty are shown in Table 3. According to our survey results, 73% of faculty believed...
that RDHLS improved residents’ quality of life, 58% believed that RDHLS improved residents’ education, 40% believed that RDHLS improved residents’ board scores, and 31% believed that RDHLS improved residents’ attendance at national conferences. Thirty-one percent of ARMC faculty reported that RDHLS decreased the amount of time that senior residents worked on complex surgical cases, while 22% reported that RDHLS were associated with an increase in research activities. Only 11% of ARMC faculty reported that they were unable to comply with RDHL guidelines.

The findings of actual RDHL outcomes in our survey somewhat contradict the expectations of faculty as revealed in a Mayo Clinic survey of 93 directors of neurosurgery residency programs and 617 neurosurgery residents prior to RDHL implementation (Table 3). Those results suggest that faculty adjustments to RDHLS have been especially problematic in the neurosurgery specialty. Of the faculty members surveyed in the Mayo Clinic study, 11% who provided level-I trauma coverage were unable to comply with RDHL guidelines. Almost all faculty respondents (94%) believed that RDHLS would have an adverse impact on patient continuity of care. Conversely, 33% of the program directors felt that RDHLS would improve residents’ written board test scores, 21% thought that research activities would increase, and 17% felt that resident attendance at national conferences would improve.

The Mayo Clinic survey also found that 74% of faculty believed that RDHLS would decrease the amount of time that senior residents could work on complex surgical cases. A clearer identification of this issue would help faculty and directors of education at medical institutions modify resident schedules to allow for increased operating room time for senior residents.

### Resident Perceptions and Study Findings

Residents—like faculty—do not agree on the number of weekly hours that resident duty should be limited to. In a survey by Kusuma et al., 554 orthopedic residents answered questions about optimal work hours. Twenty-three percent of the residents thought that an 80-hour workweek was appropriate, but 41% believed that 80 hours were too many and 34% believed that 80 hours were not enough.

Published studies have found that RDHLS benefit residents by providing increased opportunities for research, a lower burn-out rate during PGY-1; an increase in sleep, lighter work loads, and increased motivation to work; improved mental health; more time for independent reading; and improvement in residents’ satisfaction with their personal lives. Nurses reported improved resident-to-nursing communication and increased ease of nursing duties with RDHLS.

Results of our survey reveal that many ARMC residents agree that compliance with duty hour restrictions improves residents’ quality of life (Table 4). Sixty-nine percent of ARMC respondents reported that RDHLS led to improved personal satisfaction with their personal lives, 67% reported that RDHLS led to increased sleep time, 62% said that RDHLS were associated with a lower burn-out rate during PGY-1 and improved mental health, and 60% said they had more time for independent reading.

However, ARMC residents also believed that these benefits have come at the cost of surgical and clinical exposure and patient well-being. In the self-reported survey of ARMC residents, less than 30% of respondents believed that RDHLS led to no changes in surgical and clinical exposure and patient well-being. Furthermore, only 38% of respondents reported that RDHLS improved resident-nursing communication, and only 11% believed that RDHLS helped ease the burden of nursing duties.

### Time Management

In our survey, ARMC residents reported that they devoted 22% of their efforts, on average, to the direct patient care required to complete specialty-specific learning objectives, and 20% of their time delivering patient care of marginal or no educational value (Table 5). ARMC residents also reported spending only 11% of their time on organized teaching activities and only 9% on nonpatient/noneducational activities.

Another survey, by Boex and Leahy, mirrors the ARMC results quite closely (Table 5). In the Boex and Leahy survey, residents reported devoting 36% of their time, on average, to the direct patient care required to complete specialty-specific learning objectives, and 35% of their time to delivering patient

<table>
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<tr>
<th>Faculty Perceptions of Resident Duty Hour Limitations (RDHLS)</th>
<th>Faculty Who Agreed, %</th>
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<tr>
<td>ARMC</td>
<td>Cohen-Gadol et al</td>
</tr>
<tr>
<td>Adverse impact on continuity of care</td>
<td>NA</td>
</tr>
<tr>
<td>Chiefs work on fewer complex surgical cases</td>
<td>31</td>
</tr>
<tr>
<td>Improvement in board scores</td>
<td>40</td>
</tr>
<tr>
<td>Improvement in national conference attendance</td>
<td>31</td>
</tr>
<tr>
<td>Improvement in resident education</td>
<td>58</td>
</tr>
<tr>
<td>Improvement in resident quality of life</td>
<td>73</td>
</tr>
<tr>
<td>Increase in faculty hours</td>
<td>24</td>
</tr>
<tr>
<td>Increase in research activities</td>
<td>22</td>
</tr>
<tr>
<td>Worsening of quality of patient care</td>
<td>24</td>
</tr>
<tr>
<td>Unable to comply with RDHLS</td>
<td>11</td>
</tr>
</tbody>
</table>

Abbreviations: ARMC, Arrowhead Regional Medical Center; NA, not applicable.
care of marginal or no educational value. The residents in the Boex and Leahy\textsuperscript{19} survey reported spending 15\% of their time on organized teaching activities and 16\% on nonpatient/noneducational activities.

**Monitoring Duty Hours**

Self-reporting of duty hours is the most common method of monitoring residency training programs. The AOA standards\textsuperscript{3} require a trainee to sign an attestation form of compliance, and the Osteopathic Graduate Medical Education (OGME) committee must monitor resident hours for full compliance. Standard T (Monitoring of Duty Hours) 2.4 states the following:\textsuperscript{3}

> The OGME committee shall be responsible for monitoring full compliance with the AOA and institutional policies and the process established by the medical education department. This monitoring shall be done on [sic] at least quarterly and recorded in the OGME committee minutes for review at the time of on-site visits.

Our survey revealed that duty hour violations reported by ARMC residents are much less than those reported elsewhere in the literature (Table 6). Twenty-seven percent of survey respondents admitted to under-reporting their duty hours. It should be noted that residents tend to record their duty hours only when they believe it is beneficial to their training. Specific violations reported by ARMC residents included violating the 80-hour week requirement (29\% of respondents); the “24+6” consecutive-hour requirement (ie, working up to 24 hours, but staying up to 6 additional hours to complete continuity of care; 16\%); and the 1-day-off-in-7 requirement (13\%).

In a survey by Carpenter et al\textsuperscript{20}, 49\% of resident respondents admitted to under-reporting their duty hours (Table 6). Specific resident violations reported by Carpenter et al\textsuperscript{20} included violating the 80-hour week requirement (65\% of respondents); the “24+6” consecutive-hour requirement (85\%-90\%); and the 1-day-off-in-7 requirement (28\%).

Residency hours are more accurate when reported on a daily basis, as at ARMC, rather than a monthly basis.\textsuperscript{21} Furthermore, electronic submission, as occurs at ARMC, allows for real-time calculation of residents’ hours, comparison with past and future hours, rapid review by supervisors, and daily investigation by administrative personnel.

**Scheduling Methods**

The most difficult change in this era of RDHL is the ability to schedule residents in a manner that provides continuity of patient care and adequate resident service coverage in teaching institutions without full-time, in-house coverage by faculty physicians. In this situation, resident physicians largely provide consecutive-hour requirement (ie, working up to 24 hours, but staying up to 6 additional hours to complete continuity of care; 16\%); and the 1-day-off-in-7 requirement (13\%).

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<th>Table 4</th>
<th>Effects of Resident Duty Hour Limitations on ARMC Residents</th>
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<tbody>
<tr>
<td>Survey Item</td>
<td>Residents Who Agreed, %</td>
</tr>
<tr>
<td>Improved mental health</td>
<td>62</td>
</tr>
<tr>
<td>Improved resident-nursing communication</td>
<td>38</td>
</tr>
<tr>
<td>Improved satisfaction with personal life</td>
<td>69</td>
</tr>
<tr>
<td>Increased ease of nursing duties</td>
<td>11</td>
</tr>
<tr>
<td>Increased motivation to work</td>
<td>42</td>
</tr>
<tr>
<td>Increased opportunities for research</td>
<td>42</td>
</tr>
<tr>
<td>Increased sleep</td>
<td>67</td>
</tr>
<tr>
<td>Lighter workload</td>
<td>31</td>
</tr>
<tr>
<td>Lower burn-out rate in PGY-1</td>
<td>62</td>
</tr>
<tr>
<td>More time for independent reading</td>
<td>60</td>
</tr>
<tr>
<td>No change in clinical exposure</td>
<td>29</td>
</tr>
<tr>
<td>No change in faculty work hours</td>
<td>20</td>
</tr>
<tr>
<td>No change in patient well-being</td>
<td>22</td>
</tr>
<tr>
<td>No change in sleepiness</td>
<td>13</td>
</tr>
<tr>
<td>No change in surgical experience</td>
<td>20</td>
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</tbody>
</table>

**Abbreviations:** ARMC, Arrowhead Regional Medical Center; PGY-1, postgraduate year 1.

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<tr>
<th>Table 5</th>
<th>Daily Resident Duties as Percentage of Hours Worked</th>
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<tbody>
<tr>
<td>Duty</td>
<td>ARMC</td>
</tr>
<tr>
<td>Direct patient care required to complete learning objectives</td>
<td>22</td>
</tr>
<tr>
<td>Nonpatient/noneducational activities</td>
<td>9</td>
</tr>
<tr>
<td>Organized teaching activities</td>
<td>11</td>
</tr>
<tr>
<td>Patient care of marginal or no educational value</td>
<td>20</td>
</tr>
</tbody>
</table>

**Abbreviation:** ARMC, Arrowhead Regional Medical Center.

<table>
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<tr>
<th>Table 6</th>
<th>Duty Hour Violations Reported by Residents</th>
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<tbody>
<tr>
<td>Violation</td>
<td>Residents Who Reported, %</td>
</tr>
<tr>
<td>ARMC</td>
<td>Carpenter et al\textsuperscript{20}</td>
</tr>
<tr>
<td>Under-reporting of hours</td>
<td>27</td>
</tr>
<tr>
<td>1 day off in 7</td>
<td>13</td>
</tr>
<tr>
<td>80-hr week</td>
<td>29</td>
</tr>
<tr>
<td>“24+6” consecutive hours*</td>
<td>16</td>
</tr>
</tbody>
</table>

**Abbreviation:** ARMC, Arrowhead Regional Medical Center.

* Working up to 24 hours, but staying up to 6 additional hours to complete continuity of care.
coverage for off-hour shifts. Although physician extenders may help somewhat in coverage, results of using them to relieve night calls and to maintain optimum patient care have not been fully evaluated.

One of the most successful methods in addressing the issue of RDHL has been the addition of night floats and shift work. However, calls of 24+6 hours and other varying daily work hours, as self-reported after the fact, make coordination of resident scheduling and accurate monitoring of residents’ hours nearly impossible.

Alternative scheduling methods as reported by ARMC residents are shown in Table 7. Forty-two percent of ARMC residents reported using fast rotating shifts in a 2-2-1 schedule (ie, a pattern of 2 night shifts, 2 day shifts, and 1 midnight shift, followed by 2 days off). Thirty-one percent of ARMC residents reported limiting shifts to 16 hours or less, and 13% reported using home calls for services with low case loads.

Comment
In the present study, we compared results of a survey of ARMC residents and faculty with findings from other studies of RDHLs. An examination of some additional studies on this issue can be of benefit to understanding the implications of RDHLs.

Resident Productivity
In a study of resident productivity, residents were grouped according to those who worked 80 hours or less for 57 weeks and those who worked more than 80 hours for 53 weeks. The mean number of hours worked per week was 77. An average of approximately 22% of work hours were unrelated to educational activities. The amount of time spent in nonteaching activities was lowest at community hospitals (17% of residents’ time). Nonteaching activities accounted for 23% of residents’ time at Veterans Affairs hospitals and 22% of residents’ time at academic medical centers (Table 8). Nonteaching hours did not vary by total hours worked, averaging 21% for rotations of more than 80 hours per week and 23% for rotations of 80 hours per week or less.

These findings demonstrate that residents have daily routines that must be performed during each workday, regardless of shift length. Residents’ tasks include recording duty hours, waiting for results of clinical studies, transporting patients, and a host of other requirements. As a result of these everyday activities, nonteaching time remains fairly constant. Eliminating or dramatically reducing nonteaching activities through the use of performance and procedure analyses designed to maximize efficiency may help bring residents’ rotations into compliance with the 80-hour workweek, as well as support residents’ training objectives. However, the tenacity that most training physicians have for learning and the requirements that residents follow faculty role models, many of whom were trained under previous work hour rules, make it difficult to change entrenched traditions and emotional attitudes regarding resident physicians’ duty hours.

The ARMC uses a computerized system for obtaining results of laboratory and radiologic tests. Thus, residents do not have to wait for tests results or spend time tracking down data on patients. Furthermore, ARMC residents do not draw blood, start intravenous lines, or transport patients. Consequently, the amount of nonteaching time for ARMC residents is dramatically reduced, compared with programs at other institutions.

Faculty Attitudes
Extended resident work hours can lead to increased errors of diagnosis and treatment. Although the main goal of decreasing residents’ duty hours was to reduce medical errors, our direct observations of ARMC residents suggest that tension and conflict resulting from decreased work hours can lead to competition among residents for active duty time and for learning opportunities. Observations also suggest that faculty members may react to RDHLs with denial, anger, depression, and bargaining (eg, asking residents to stay a little longer in exchange for better grades)—and eventually reevaluation of their attitudes and finally acceptance.

Our survey and literature review indicate that the effects of RDHLs have been mostly positive—despite preliminary emotional responses of denial and anger by many faculty members. Many residents and program directors initially thought that RDHL guidelines would have an adverse effect on continuity of patient care and resident training. Winslow et al23 questioned surgical faculty regarding the effects that RDHLs (64-80 hours per week) had on faculty work hours and faculty practice. Before the implementation of RDHLs, 70% of faculty predicted that RDHLs would increase faculty hours. However, after implementation of RDHLs, only 47% of faculty reported that their work hours had increased.23 When

<table>
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<th>Table 7</th>
<th>Alternative Scheduling Methods Used by ARMC Residents</th>
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<tbody>
<tr>
<td>Suggested Scheduling Method</td>
<td>Residents Who Used, %</td>
</tr>
<tr>
<td>Call 1 in 4 nights with 5 days off per month</td>
<td>NA</td>
</tr>
<tr>
<td>Fast rotating shift of 2-2-1*</td>
<td>42</td>
</tr>
<tr>
<td>Home call for services with low case loads</td>
<td>13</td>
</tr>
<tr>
<td>Limit night shifts to 8-12 hr</td>
<td>NA</td>
</tr>
<tr>
<td>Limit shifts to &lt;16 hr</td>
<td>31</td>
</tr>
</tbody>
</table>

* Pattern of 2 night shifts, 2 day shifts, and 1 midnight shift, followed by 2 days off.

Abbreviations: ARMC, Arrowhead Regional Medical Center; NA, not applicable (ie, not attempted at ARMC).
Winslow et al23 made a comparison of actual faculty work hours before and after RDHL implementation, no significant difference was found (there were about 70 hours per week both before and after RDHLS).

These findings were reflected in another survey.24 According to the survey by Klingensmith et al,24 faculty respondents also believed that patient care and resident education would deteriorate with RDHLS. In direct contrast to these expectations, however, 94% of the faculty reported no actual decrease in clinical productivity—though 60% said they now had to perform some work previously performed by residents.

Schenarts et al25 compared patient demographic data, mechanism of injury, length of hospital stay, intensive care unit stay, days on ventilator, mortality data, and complication data for patients 11 months before and 11 months after RDHL implementation. Results of this study25 revealed no significant differences in any of these parameters.

The current RDHLS have resulted in faculty perceptions that some additional changes are needed. In one survey, at least 30% of resident program faculty used physician extenders to help cover the intensive care unit during nighttime hours, and 11% did so during nighttime hours.26 In the same survey, 24% of training institutions used a night float system to maintain continuous care.26 In a survey by Dola et al,27 82% of faculty indicated that their residency programs were forced to hire ancillary staff or make changes to the call schedule, such as night-float or home call, because of RDHLS.

To better characterize professional perceptions of RDHLS, Dola et al27 surveyed both resident and faculty physicians. A total of 94 residents and 56 faculty physicians responded to the questionnaire. The study revealed some significant differences in perceptions of residents vs faculty. For example, 52.3% of residents believed that RDHLS improved their education, compared to only 20.8% of faculty (P<.01). Furthermore, only 8.8% of residents vs 45.3% of faculty (P<.01) believed that RDHLS worsened the quality of patient care. However, both residents (84.4%) and faculty (90.7) agreed on an often overlooked priority—that RDHLS improved residents’ quality of life.27

### Resident Compliance and Perceptions
To achieve better compliance with RDHL requirements, trainers and trainees need to shift training practices, learning methods, and work philosophy. Reliable ways must be found to record and monitor residents’ daily hours, to cultivate a willingness among residents to accurately record their hours, and to formulate consequences for noncompliance. Residents must also report their duty hour violations through the proper chain of command—first to faculty, then to the coordinator, and finally to the program director or director of the service performed.

If a resident has either near-violations or flagrant violations, a corrective action plan should be initiated. In the osteopathic medical profession, any violations should result in immediate time off for the resident and the reporting of the violation to the director of medical education, the Osteopathic Medical Education Committee, and the Osteopathic Postdoctoral Training Institution (OPTI). An institution-specific corrective action plan must then be initiated.

Residents at ARMC believe that compliance with duty hour restrictions improves their quality of life, though with some adverse effects on their surgical and clinical exposure and patient well-being (Table 4). As previously mentioned, most resident services at ARMC occur on shifts, thereby decreasing the residents’ time in the hospital and the continuity of patient care.

Some studies suggest that RDHLS have not resulted in significant decreases in residents’ clinical or surgical experiences.20-30 Ferguson et al30 compared surgical case volumes for residents at Massachusetts General Hospital before and after RDHL implementation at different postgraduate levels. During PGY-1 through PGY-4, these surgical case volumes did not change significantly after RDHL implementation. The number of surgical cases in PGY-5 increased slightly, but not significantly, after RDHL implementation.30

Despite strong faculty and resident opinions, actual evidence-based data demonstrate that RDHLS have resulted in little change in residents’ clinical exposure, surgical exposure, or sleepiness,31 in patients’ well-being, or in faculty work hours.29

### Resident Training and Work
Eighty-four percent of internal medicine residents surveyed by Gopal et al32 disagreed with adding more years to their residency training program. However, with limited training time coupled to the increasing complexity of medical care, some residents may not be obtaining the training that is required to help them when they encounter clinical difficulties. Therefore, new methods of teaching and alternatives to current duty hour scheduling will have to be developed.

Goal-oriented training has been found to reduce residents’ rounding time and nonpurposeful time and to improve residents’ punctuality for educational activities.33 Although

| Table 8 Amount of Resident Time Spent in Noneducational Activities* |
|-------------------------|-------------------------|
| Type of Hospital | Amount of Time, % |
| Academic | 22 |
| Community | 17 |
| Veterans Affairs | 23 |

sleepiness continues to be a problem among medical residents, who are more likely than surgical residents to work 24-hour shifts, and administrative load and work stressors are more closely related with residents’ medical errors than with the number of hours below the 80-hour workweek.

Education consisting of structured reading with weekly testing and small group sessions for “problem-of-the-day” presentations provide residents with learning opportunities. These group sessions, led by faculty, have been found to improve training and provide diversity in educational experiences. The sessions can be successfully augmented as part of weekly, academic half-days lasting as long as 3 hours.

Further shortening of the resident’s workday or workweek must not interfere with didactics. There may be a role for less direct patient care in residents’ training, but the time that a resident spends working should be charted separately from the time the resident spends in formal educational activities.

Specialty Implications
In a 2004 survey of faculty surgeons, about 63% of respondents reported that residents should work 81 to 100 hours per week, 11% reported that residents should work more than 101 hours per week, and 26% reported that 80 work hours or less per week was best.

Residents in surgical specialties work the most hours per week, though residents in internal medicine and pediatrics work the most consecutive hours (>30). Subspecialties, such as forensic psychiatry, have limited call schedules and the lowest number of duty hours. The implementation of the 80-hour workweek, and an expected further reduction in daily hours, may result in excessive limits on the time available for residents to complete all work duties and educational experiences—unless new methods of training are implemented. Now is the time to implement creative and innovative approaches for educating and teaching residents. Nowhere is this more important than in the surgical specialties. It is already challenging to provide a comprehensive medical and surgical education while continuing optimal patient care, and new principles and priorities must be applied to this issue to avoid compromising outcomes in education and patient care.

International Perspectives
Resident duty hour restrictions have been instituted by educational bodies in many countries. These changes are here to stay, and hours will most likely be limited further. In France, the government has mandated a maximum 52.5-hour workweek for residents in an attempt to comply more closely with the European Working Time Directive (EWTD). The EWTD is a collection of work-hour regulations established by the European Union and designed to protect the health and safety of workers.

The EWTD maximum limits for workers in general are an average of 48 hours of work per week, with an average of 8 hours of work in a 24-hour period for night-shift workers. A summary of these international work hour limits is shown in Table 9. The EWTD further establishes a right to 11 hours of rest per day, a right to 1 day off each week or 2 days off every other week, and a right to 4 weeks paid leave per year. There is no worldwide consensus regarding appropriate duty hour limits for medical residents.

Time Management, Monitoring, and Scheduling
Fragmented work flow exists in all residency programs, and the development of practice and time management must be mastered early in the training process if the resident is to maximize opportunities for learning. For example, in most of the services they perform, residents use a printed patient list to manage sign-out and daily work duties. This process requires repeated recopying of information from one resident to another during sign-outs, leading to the possibility of copying errors. We suggest that residents’ time can be better used by incorporating current computerized medical information systems into time management. A central system can provide patient sign-out, downloading of daily ward work information (including laboratory results, vital signs, medications, and consults), and generating of progress notes that can be kept in a central location. With the electronic information systems available today, patient information is always available, and this information can be shared without recopying errors, thereby dramatically increasing residents’ time for direct patient care.

As previously noted, residents tend to record duty hours only when they perceive them to be beneficial to their training. Thus, these hours must be accessible for review on a daily basis by faculty, program coordinators, program directors, directors of medical education, and OPTI officials. Residents’ duty hours are most accurate when submitted electronically every day, as is done at ARMC, and when the hours are monitored and reviewed daily. Such a system allows for preemptive measures to be taken as residents approach the RDHL limits.

Unfortunately, recording daily work hours must be left in the hands of the resident—except in limited programs at small institutions where residents remain on-site and in contact with coordinators, or when affordable technology allows for real-time documentation of residents’ presence. Such technology consists of time clocks at each entrance to a hospital and clinic, radio frequency identification tags, or hand-held devices that allow input of hours for off-site rotations.

A substantial increase in residents’ total work hours can occur as a result of problems in continuity of care or inadequate resident scheduling, such as when a resident has to stay late to take care of patient admissions without a concomitant decrease in his or her overnight call frequency. Attempts at releasing residents an hour or so earlier each day have not
been an effective way to reduce residents’ duty hours. Limiting residents’ days off per month to 4 cannot meet RDHLs. Only the addition of a fifth day off, added to the weekend (the so-called “golden weekend”), has been found to effectively reduce duty hours.

Furthermore, working overnight call, whether in the hospital or at “home,” does not negate the errors and other concerns first brought to public scrutiny in the Libby Zion case. Home call from tertiary centers may be effective in limiting the documentation of duty hours, but it does not address any concerns related to residents’ lack of sleep. Home call may be more effective when overnight phone calls are limited to 1 to 4 per night, and when residents’ need to go to the hospital does not exceed 1 of every 4 nights.

Block nights, shift work, and night floats may provide residents with continued clinical and surgical experience if training occurs in an institution at which the number of nighttime duty cases is at least half the number of daytime educational cases. If overnight cases are limited or if residents are placed on extended block nights, night float, or night shifts, there is the potential of limiting educational experiences, which would require remedial education.

Rapid Rotation
Block night for 2 weeks, night float for 2 weeks, and night shift for 2 weeks are essentially equivalent, resulting in circadian rhythm conflicts, less-than-ideal patient care, and increased resident stress. Changing daytime work hours to the night shift causes the body’s circadian rhythm, including body temperature, to become out of phase with nighttime activity. During longer periods in a night shift, the individual biological rhythms re-entrain to the shift at different rates. If shifting of worker hours continues, each shift results in further desynchronized circadian rhythms.

According to research by Knauth and Rutenfranz, body temperature rhythm failed to return after 21 consecutively worked night shifts. The researchers concluded that the circadian system never fully adapts to night work and that the body is not capable of completely adapting to night work.

In Europe, rapid rotation is generally seen as superior to the slow rotation that is more common in the United States. Research in Germany and the Netherlands supports the practice of rapid rotation and the reduction of night work as much as possible. Changing night shifts quickly helps keep the circadian rhythm in a daytime orientation. Rapid shift change also prevents the accumulation of sleep deficits. Air traffic controllers in most parts of the world have rapid rotation schedules, such as the 2-2-1 schedule.

Residents may consider a rapid rotation schedule, such as working 2 day shifts from 12:00 PM to 12:00 AM, 2 day shifts from 6:00 AM to 6:00 PM, and 2 night shifts from 6:00 PM to 6:00 AM, followed by a day off. However, the method of patient coverage required is dependent on the medical specialty and the requirements of that specialty.

Paradigm Shift
A philosophical change in attitudes toward resident duty hours can be accomplished through AOA mandates. Repeatitive national, local, and institutional training sessions for residency program directors and faculty are imperative to fully achieve such a paradigm shift. Reinforcement by mandates from each OPTI will further facilitate change.

Integrity of the resident duty hour system cannot occur unless hours are recorded accurately. Ensuring such accuracy requires monitoring from all levels. Initially, as previously indicated, hours must be monitored daily at the program level. Eventually, after system changes have been in place a while and fortified, the review time can be expanded to no more than once a week. There is a long-standing tradition in medical training of working to maximum capacity without complaint. Thus, the consistent enforcement of RDHLs is crucial to successfully achieve a change in this tradition.

Barriers to Change
Barriers to decreasing resident duty hours are both real and theoretical in nature. The primary concern expressed among faculty is the potential loss of personnel (eg, Who will cover in-house patients during long hours on off shifts?). Another concern involves how residents will obtain their necessary clinical skills within a condensed period of training. These concerns sometimes cause supervisors to instruct residents to not reveal their duty hour violations—under threat of losing their residency positions. A factor to keep in mind regarding this issue is that residents and faculty often take pride in the large number of hours that they are on duty.

In this era of daily medical discoveries and real-time communication, higher education must evolve to incorporate new and exciting opportunities for learning. The use of AOA mandates on duty hour restrictions, together with enforcement of accountability via daily time logs, are not only appropriate methods for change, but also necessary elements of residency training at this time. Leaders at all levels must understand and value standards of resident duty hours. If leaders of res-
idency programs do not follow these standards, they risk governmental interference in what is currently a system of self-regulation.

Some of the less tangible barriers to limiting resident duty hours are associated with attitudes of long-standing tradition. Examples include: “We’ve always done it this way,” “I survived it, so new residents can do it, too,” and “It builds character.” But are these appropriate arguments for a profession that embraces the scientific method, continual and daily medical updates, and evidence-based practices? There is a paradox here—it seems that, despite our professionalism, we are human beings first and medical practitioners second.

Conclusion

Literature retrospectively examined in the present study seems to support the predominantly held opinions expressed by faculty and residents at ARMC, a 400-bed tertiary teaching hospital. Most faculty physicians initially believed that decreasing resident duty hours would limit the time available to residents for educational experiences and participation in treatment procedures, surgery, and consultations. Faculty also initially believed that fewer training hours would diminish the quality of residents’ educational experience. Results of evidence-based studies, however, suggest that resident success lies in the implementation of suitable alternatives to the traditional system of resident duty hours.

Medical educational practices are slow to change. The traditional goal of most residency programs has been to expose resident physicians to as many patient encounters as possible. This apprentice concept of education-by-experience has been a brilliant tried-and-true method. However, much has changed in medicine, and higher education must evolve to accommodate new opportunities for learning. The motivation of the residency program must evolve from maximum exposure of residents to producing the most competent physicians.

It is time that residents are appropriately recognized by their employers as professionals and by their teachers as colleagues. The personal development of residents is another theoretical benefit of a paradigm change. This sounds lofty enough, but is it practical? Examination of recent literature reveals many surveys of attending faculty physicians and residents that indicate discomfort with change. However, statistical data, as well as our experience at ARMC, suggest that residency programs will not be adversely affected by limiting resident work hours to 80 hours per week.

The medical community has formally acknowledged the need for change in resident work hours and has implemented RDHLS with penalties for noncompliance. Some faculty physicians may be offended by such institutional controls and regulations, but the alternative could be governmental oversight, as recommended by the IOM.

Resistance to change also comes from residents, who have been conditioned to expect the personal depravation associated with many hours of residency training. Residents are generally highly motivated and competitive and reluctant to break away from their duties. However, this barrier to limiting duty hours can be overcome with leadership in words and actions by educators, program directors, and institutions.

It is unclear whether additional limitations of the residents’ workweek are necessary or could accommodate the growing amount of information and skills that are required to become a competent physician. Alternately, limiting residents’ direct patient contact hours may or may not improve patient safety, though it would provide for more formal educational moments.

Among the most driven and focused residents, personal introspection and balance are often delayed until later stages in life, and interpersonal relationships and growth are often neglected and suffer as a result. Through the institutional enforcement of the 80-hour workweek, individuals are compelled to limit their work hours without the burden of self-judgment or self-deprecation.

Limitation of work hours will hopefully allow residents to participate in many of the normal developmental tasks and stages of life, concurrently with residency. Thus far, demonstrated benefits of RDHLS appear to include improved patient care, well-rounded and psychologically balanced residents, and—ultimately—healthier and happier attending physicians.

References


