Resident duty hour regulation and patient safety: establishing a balance between concerns about resident fatigue and adequate training in neurosurgery

Special topic

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In 2003, the ACGME established the Standards on Resident Duty Hours for resident physicians that limit their duty hours to 80 hours per week and 24 hours per shift. In response, neurosurgical educators completely changed the training paradigm to comply with the 2003 requirements, and these standards have been fully incorporated into resident training programs in the US. Most neurosurgical educators believe that the current standards have improved resident education overall, but some aspects have made it difficult to effectively prepare neurosurgical residents for ultimate independent practice.

Now, there is a recent initiative by the IOM that could reduce resident duty hours even further. The IOM formed a committee entitled “Optimizing Graduate Medical Trainee (Resident) Hours and Work Schedules to Improve Patient Safety” (http://www.iom.edu/CMS/3809/48553.aspx) to study “medical errors associated with physician and resident work schedules” (Fig. 1) in response to a request by the US House of Representatives Committee on Energy and Commerce (Rep. John Dingell [D], Chairman) to the Agency for Healthcare Research and Quality. On December 2, 2008, the IOM committee issued its report (http://www.iom.edu/CMS/3809/48553/60449.aspx) calling for a number of new changes in the ACGME duty hour rules, including a recommendation that resident duty hours be reduced to 16 hours for a maximum shift length. Others continue to advocate further reductions in the work week, perhaps not to exceed 56 hours as is the case in Great Britain. Clearly, resident fatigue has the potential to cause adverse patient outcomes, but if the neurosurgical educational process is further compromised, it is very likely that more adverse outcomes will result from inadequately trained residents.

To express our concerns about this possible further reduction in duty hours, we prepared a report to present at the second meeting of the IOM committee that took place on March 4, 2008. Our report was approved by representatives of the 3 major neurosurgical organizations primarily associated with resident education: the Society of Neurological Surgeons, the American Board of Neurological Surgery, and the Residency Review Committee for Neurological Surgery. In this editorial, we present the content of that report, which outlines the characteristics of neurosurgical education and practice and evaluates the
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Fig. 1. Letter from US House of Representatives Committee on Energy and Commerce requesting the Agency for Healthcare Research and Quality to study the relationship between physician work hours and patient safety.
on numerous repairable human errors common in America’s healthcare system. The report suggested that the healthcare delivery system design jobs with attention to human factors, including: attending to the effect of work hours, workloads, staffing ratios, sources of distraction, and an inversion in assigned shifts (which affects worker’s circadian rhythms) and their relationship to fatigue, alertness, and sleep deprivation. The report also claimed that there is a need to have the right equipment, which is well maintained and reliable; a skilled and knowledgeable workforce; reasonable work schedules; well-designed jobs; and clear guidance on desired and undesired performance. In sum, the IOM reported that factors such as these are the precursors or preconditions for safe production processes.

More recently, the Institute of Medicine released a study in 2004 entitled *Keeping Patients Safe: Transforming the Work Environment of Nurses*. This study was funded and directed by AHRQ’s Center for Quality Improvement and Patient Safety. The study concluded long work hours was one of most serious threats to patient safety and that this issue needed to be addressed by Congress. The study also recommended that healthcare organizations need to create organizational cultures of safety that promote the reporting, analysis, and prevention of errors.

The Committee requests that AHRQ assist us in ascertaining if the long work hours of physicians and residents also are among the most serious threats to patient safety. Perhaps the most efficient way to achieve a scientifically sound answer is for AHRQ to fund an IOM study similar in design to the 2004 work hours of nurses study involving the extended work schedules of physicians and residents.

We appreciate your prompt attention to this request. If you have any questions about this matter, please contact us or have your staff contact Kristine Blackwood of the Majority Committee staff at (202) 225-2927 or Krista Lynn Carpenter of the Minority Committee staff at (202) 225-3641.

Sincerely,

John D. Dingell
Chairman

Joe Barton
Ranking Member

Bart Stupak
Chairman
Subcommittee on Oversight and Investigations

Ed Whitfield
Ranking Member
Subcommittee on Oversight and Investigations
Residents must acquire knowledge and experience in dealing with patients with neurosurgical disorders and develop the professional qualities to sustain a career in neurosurgery. Neurosurgical training takes place during a minimum of 6 years after medical school. During this training, the resident must master cognitive information to enable him/her to manipulate the human nervous system, which is the most complex system in nature. He/she must develop the judgment and ability to recognize clinical patterns, and this comes from seeing and treating many patients with nervous system disease. The resident must also accumulate significant technical experience and to this end must actually perform many demanding operative procedures under supervision as opposed to simply observing. These procedures are broadly dissimilar in nature and range from spinal surgery with fusion to microsurgery for tumors and aneurysms to radiosurgical and stereotactic techniques. Simulation technology is at a rudimentary level at this point and is unlikely to replace actual surgical training in the near future.

Special Characteristics of Neurosurgical Practice

Patterns of neurosurgical practice are somewhat different from other disciplines. There are approximately 3300 actively practicing board-certified neurosurgeons in > 6000 hospitals in the US, serving a population of > 300 million individuals. Neurosurgical emergencies frequently occur at night and on weekends and in a highly unpredictable fashion. Neurosurgical diseases and injuries tend to develop rapidly and often continue to progress over hours and days. This time profile and the clinical implications of brain and spinal cord injuries require that neurosurgeons be equipped to rapidly synthesize clinical histories, physical examinations, radiographic findings, and laboratory data to develop individualized treatment plans that can be urgently deployed. In many critical neurosurgical cases, it is necessary to observe the patient carefully over an extended period of time. Experience has shown that it is best to have 1 responsible person to apply a systematic approach that will assess the subtle neurological deficits involving language function and level of consciousness that often precede clinical deterioration.

Differentiating Aspects of Neurosurgical Training

Of the 129 US medical schools, 97 have neurosurgical training programs, and the total number of trainees at present is ~ 800. As a consequence, in almost all programs relatively small teams of faculty members and residents are involved with neurosurgical training and patient care. Most training programs have 1 resident per year for 6 years. Only a minority of programs have > 1 resident per level per year. This means that there is a limited number of attending and resident neurosurgeons available to provide care to an aging US population.

The teaching hospitals in which most neurosurgical training programs function are disproportionately responsible for providing care on a 24-hour, 7-day basis for neurosurgical emergencies. Although midlevel practitioners may play an important role on a neurosurgical service, the requirement for urgent surgical judgments and procedures makes it necessary for neurosurgeons to be available in their hospitals over somewhat-extended periods. Neurosurgical services are characterized by large elective yet urgent surgical schedules, many emergencies, and large numbers of inpatients with high disease acuity. This makes the role of the resident on the neurosurgical service central to the simultaneous optimization of patient care and resident education.

Acquisition of Advanced Technical Skills

The best way to learn a technical skill in neurosurgery is by repetition, and the more repetition, the better. It is a well-established principle in surgical care that improved outcomes are seen when technical skills are honed through frequent practice, and this has been demonstrated widely in numerous surgical specialties. Neurosurgery is unusual in the breadth and depth of skills that must be mastered during residency. For example, cranial, spinal, and peripheral nerve cases each require a variety of nonoverlapping psychomotor skills. To allow time for mastery of these diverse technical skills, neurosurgical residencies have evolved from 4 years to much longer training periods. About 50% of all neurosurgical programs are 7 years in duration, and ~ 50% of trainees at the conclusion of residency continue for an additional year in subspecialty training for spine surgery, pediatric neurosurgery, vascular neurosurgery, and other areas. These rigorous and complex neurosurgical residencies reduce the likelihood that allied professionals and colleagues from other surgical and medical disciplines would be able to reduce the burden of care demanded of most practicing neurosurgeons.

Continuity of Care

Because most neurosurgical cases last an average of 4 hours, further reduction in the number of resident duty hours could lead to inadequate neurosurgery technical training. This can be contrasted with other surgical disciplines in which cases are shorter in duration (Table 1). Many of the most complex neurosurgical cases take a long time to complete; for example, some complex skull base tumor operations require 12–16 hours. At all levels of neurosurgery training, but particularly in the chief resident year, the ability to learn the nuances of pre-, intra-, and postoperative care for the most demanding of neurosurgical cases requires a large commitment of time. It is easy to envision a scenario in which an uncommon surgical complication cannot be dealt with by the responsible resident surgeon because duty hour standards require that he or she be off duty.

In addition, when a patient decides to undergo a complex procedure, such as the removal of a large arterio-
venous malformation, he/she expects that the neurosurgeon will have the ability to see the procedure through to the end. The ability to do this does not develop overnight, but instead is the product of many years of training and psychomotor conditioning. The neurosurgeon-in-training learns over time what his/her limits are and develops the ability to patiently complete a microsurgical procedure where intense concentration and psychomotor persistence are required until the task is finished.

In an opinion survey given to neurosurgical program directors and residents within 2 years of implementation of the present duty hours, 93% of all respondents believed that patient continuity had suffered. Sixty-eight percent of the programs had hired ancillary personnel. The majority of residents and program directors believed that the duty hour regulation had an adverse effect on training. A recent review of data used by the Neurosurgery Residency Review Committee to determine surgical volume showed no evidence of a substantial decline in resident case volume. However, since training is a minimum of 6 years, the cumulative effect of duty hour regulations may not yet be apparent.

Self-Selection for a Neurosurgical Career

There are aspects of neurosurgical training that are less well defined yet just as important. For example, when it comes to career decisions, there is a significant self-selection process that takes place during medical school. Currently, there are ~ 16,000 medical students in training. Of those, only ~ 310 apply for the 171 first-year neurosurgical residency positions in the US. This select group has been exposed to and recognizes the rigor of training and competitiveness to obtain a neurosurgical residency. Virtually all candidates have had medical school rotations on the neurosurgical service, which results in a match between the candidate’s ability and temperament to the demands of the educational program and clinical practice. Emotional and physical stamina must be developed by these candidates to provide quality care at all hours of the day and over irregular spans of time.

TABLE 1: Operating room statistics by service at a major teaching hospital

<table>
<thead>
<tr>
<th>Surgical Specialty</th>
<th>Mean Case Duration (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>general</td>
<td>2.4</td>
</tr>
<tr>
<td>urological</td>
<td>2.8</td>
</tr>
<tr>
<td>plastic</td>
<td>2.4</td>
</tr>
<tr>
<td>orthopedic</td>
<td>2.5</td>
</tr>
<tr>
<td>gynecological</td>
<td>1.9</td>
</tr>
<tr>
<td>cardiothoracic</td>
<td>3.4</td>
</tr>
<tr>
<td>otolaryngological</td>
<td>2.7</td>
</tr>
<tr>
<td>ophthalmological</td>
<td>1.3</td>
</tr>
<tr>
<td>neurosurgical</td>
<td>4.1</td>
</tr>
<tr>
<td>overall</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Accommodation to Present Duty Hours Regulations

Numerous adjustments were made when resident duty hours were changed to 80 hours per week and 24 hours per shift. These changes included employment of midlevel practitioners, shift of clinical work from residents to faculty, performance of neurosurgical procedures without resident participation, reduction of elective time, an increase in the number of residents in training, and altered conference schedules.

The ACGME permitted residency training programs to request an 8-hour education (not service) extension to the 80-hour requirement if there was strong evidence of educational need. Of the more than 8000 US training programs, ~ 60 of these duty hour exceptions were granted and 45 were in neurosurgery (46% of neurosurgical programs). Oversight of the educational rationale and compliance with duty hours is at the local institutional level where close inspection and documentation is more readily accomplished.

The European Experience

Our European colleagues have voiced substantial concern about the EWTD regarding the expertise of their trainees. The EWTD was established in 1998 and aims to reduce duty hours to 48 hours/week (European doctors in training were not previously regulated). European neurosurgeons have reported that a reduction in duty hours has led to seriously reduced levels of experience among trainees, thereby making it necessary for graduating trainees to resort to prolonged periods of postresidency apprenticeship before they can operate independently. In a position paper to the European Union requesting modification of the duty hours, surgical educators noted that full implementation of the duty hours will result in the following: 1) “Destruction of training structures successfully developed and improved over several decades.” 2) “Reduced presence: trainees experience only about 150–160 days/year during core working time instead of about 225 days as before the introduction of the EWTD.” 3) “Participation in approximately 30% less operations per year, i.e. acquisition of adequate surgical experience is impossible leading to decreased professional expertise and quality of medical care.” 4) “Discontinued presence and disruption of cooperation with an assigned trainer (tandem model of training). Education and supervision by the trainer is effected at random.” 5) “The available time will be taken up with predominantly routine work; structured training will be reduced. Education in clinical research will largely disappear.” 6) “Loss of motivation and of attractiveness of the profession in general.” 7) “Education of a competent and experienced surgical specialist within 6 years is no longer possible.”

Furthermore, European surgical educators have noted that there is substantial noncompliance with the present duty hour regulations.

Anticipated Adverse Consequences of the Proposed Duty Hour Standards

In light of proposed changes in residency duty hours, a group of US neurosurgical program directors, neurosurgical residents, directors of the American Board of Neurological Surgery, and members of the ACGME’s Resi-
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The Proposed Standards Will Further Diminish Continuity of Care in the Nation's Teaching Hospitals

Neurosurgical educators believe that continuity of care is a defining characteristic of neurosurgical practice. Neurosurgeons obviously cannot be on call constantly, but they must learn a sense of persistent commitment to the patient that may involve irregular hours. The time profile and clinical implications of brain and spinal cord compression within the rigid confines of the craniospinal compartments demand that neurosurgeons recognize and surgically treat patients urgently after exercising careful clinical judgment. Under the proposed 16-hour shift standard and a 56-hour work week, it would be routine for patient care to be arbitrarily compartmentalized and would necessitate more frequent “handoffs” with documented loss of important clinical information and an increase in medical errors that would compromise patient safety. Multiple groups are working now to develop and use systems for more effective handoffs. However, no matter how much the handoff process is improved, it is very likely that the subtle nuances of the neurological examination that often herald critical neurological deterioration will have the potential to be misunderstood.

When a patient and neurosurgeon embark on a course of neurosurgical treatment, the patient must trust the surgeon to be available. The relatively small number of neurosurgeons in the US combined with the importance of first-hand knowledge and observation of the patient dictates that the transfer of patient care be carried out with extreme caution and on a relatively limited basis. Residents must learn this reality and learn how to manage their practices. We believe that this cannot be learned in the setting of the proposed work hour restriction.

Some polls reflect that the public has expressed concern about being treated by a physician who has been working for an extended period. However, patients and families are also extremely concerned about a lack of continuity of care as they encounter numerous physicians with very frequent handoffs during the course of a hospitalization. This concern about continuity of care is exacerbated when patients face critical neurological illnesses.

The Proposed Standards Will Weaken the Infrastructure of Neurosurgical Training Programs

Excellent neurosurgical education can only take place in hospitals and in training programs that are strong. The proposed standards will undoubtedly put great strain on neurosurgical training programs. Given the current financial picture for the nation's teaching hospitals, it is not likely that additional nonphysician providers will be available to assume care for neurosurgical patients if the proposed standards create conditions in which groups of neurosurgeons are unable to cover the nation's teaching hospitals. Emergency care for head and spinal cord injury and for hemorrhagic stroke (both large public health problems) falls disproportionately on neurosurgeons because of their small numbers. The current well-publicized problems concerning access to neurosurgical care in trauma and emergency situations will likely be severely exacerbated.

The systematic weakening of the educational infrastructure for our specialty at a time when there is a shortage of neurosurgeons could produce dire consequences that are unanticipated. Affiliated institutions will be especially hard hit. For example, most freestanding children's hospitals have a maximum of 2 neurosurgical trainees caring for the hospital's pediatric population. Given the constraints of the proposed duty hours, these hospitals would have to be enfolded into the affiliated parent adult hospital for call purposes, thereby diluting the pediatric experience and specialty expertise.
The Proposed Standards Will Adversely Affect the Educational Content of the Residency

In every high-quality training program, there must be a balance between supervision and independent progressive responsibility. The proposed duty hour regulations have the potential to markedly affect the balance between supervision and responsibility in neurosurgical residency training programs. Too much independence is not optimal because opportunities for teaching are not used and patient care may be jeopardized. Too much supervision—especially for senior residents—may prevent a resident from developing the necessary judgment, skills, and responsibility to function as an independent practitioner.

If residents are not integral to the care of the patient, they will rapidly become marginalized since care is then assumed by faculty or midlevel practitioners. If a resident must leave in the middle of an operation, the interaction between the resident and the patient and the resident and attending staff will change. In this situation, the resident becomes more of an observer and less of a responsible physician and it is likely that the resident will have a less intensive training experience and a reduced sense of accountability for patient safety and outcome.

The Proposed Standards Will Marginalize Neurosurgical Residents in the Care Process

Elective rotations have always been an important part of resident training. Time spent on complementary clinical rotations have the potential to significantly augment the resident’s experience and perspective. Research training is commonly done during this period. With the implementation of the present 80-hour work week, important elective experiences have already been abridged or eliminated in an effort to preserve the core neurosurgical operative and clinical training. The proposed reduction will further compromise these experiences.

An increased emphasis on the requirement for outpatient training has developed because of the belief by neurosurgical educators that an understanding of the indications for neurosurgical procedures, appropriate patient counseling, and postoperative follow-up constitute highly important aspects of neurosurgical training. Because a neurosurgical attending can deliver outpatient care without neurosurgical residents and because of the concern for providing adequate intraoperative instruction, there has been a tendency to make outpatient training a second priority.

The New York state experience has demonstrated that when restrictive duty hour regulations are applied to surgical training programs, overall outpatient clinical exposure decreases. It is likely that the proposed duty hours will make it more likely that a patient who the resident sees in the clinic will undergo surgery at a time when the resident is unavailable to participate in the operation. This is an important aspect of continuity of care, specifically that the neurosurgeon-in-training and in practice (within reasonable limits) is expected to see the patient through his/her illness from inception to resolution.

The scholarship of the faculty is shared with the residents during large teaching conferences and in smaller group sessions that include rounds. If the proposed new duty hours mandate that residents must go home instead of attending teaching conferences and rounds, the sense of team involvement and commitment will be eroded, and the conferences will be seen as optional. In the best neurosurgical training programs, a busy clinical practice is supplemented by a vigorous teaching schedule. Having one component without the other is suboptimal. It has always been a challenge to balance the patient care and academic aspects of neurosurgical training because it takes time to be successful in both areas. If the proposed duty hours take effect, more pressure will be placed on program directors to staff their clinical services with more residents to accommodate clinical patient care and call schedules. This means that valuable experience in clinical neuroscience (neuroradiology, neuropathology, and so on) will likely be shortened or eliminated. Research electives that previously were “protected” will likely be eliminated or compromised by interruptions for call.

Depicted in Tables 2 and 3 are 2 resident rotation schedules from a large neurosurgery program composed of 13 residents covering 2 hospitals. The situation becomes increasingly complex with more hospitals or fewer residents. As shown in Table 2, residents work fewer than 80 hours per week and are on call only 2 nights per month. A “night float” resident does most of the overnight call, working shifts of fewer than 12 hours. Most neurosurgical educators believe that this is the minimum intensity of work and practice that is consistent with adequate development of competence in neurosurgical residents. As shown in Table 3, junior residents would be working relatively short shifts. They would be compelled to leave the hospital in the middle of key operations and their learning would take place at a much slower rate. Their residencies

### TABLE 2: Current schedule*

<table>
<thead>
<tr>
<th>Shift</th>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
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</thead>
<tbody>
<tr>
<td>6 a.m.–6 p.m.</td>
<td>NF</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>JR 2</td>
</tr>
<tr>
<td>6 a.m.–7 p.m.</td>
<td>NF</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>JR 2</td>
</tr>
<tr>
<td>6 p.m.–6 a.m.</td>
<td>NF</td>
<td>NF</td>
<td>NF</td>
<td>NF</td>
<td>NF</td>
<td>JR 1</td>
<td></td>
</tr>
<tr>
<td>6 p.m.–7 a.m.</td>
<td>NF</td>
<td>NF</td>
<td>NF</td>
<td>NF</td>
<td>NF</td>
<td>JR 1</td>
<td></td>
</tr>
</tbody>
</table>

* Four junior residents work on average 78.5 hours per week: 5 days for 13 hours/day plus 1 Friday night call and Sunday morning in 4 weeks (<18 hours/6 days) and 1 Saturday call in 4 weeks (<30 hours). The night float works 76 hours/week. Chief residents (postgraduate year [PGY] 7) are on call as back-up. The Children’s Hospital is covered by a PGY 4 resident and PGY 5 and 6 residents as an 18-month elective (2 of 3 nights). Abbreviations: JR = junior resident; NF = night float.
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TABLE 3: Proposed 56-hour compliant schedule*

<table>
<thead>
<tr>
<th>Shift</th>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 a.m.–6 p.m.</td>
<td>NF 1</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>NF 2</td>
</tr>
<tr>
<td>6 a.m.–5 p.m.</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
<td>4 JRs</td>
</tr>
<tr>
<td>6 p.m.–6 a.m.</td>
<td>NF 2</td>
<td>NF 1</td>
<td>NF 2</td>
<td>NF 2</td>
<td>NF1</td>
<td>SR/lab</td>
<td></td>
</tr>
<tr>
<td>5 p.m.–6 a.m.</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

* Four junior residents work 55 hours/week (all PGY 2–4 residents at the hospital between on-service and night float). Night floats 1 and 2 work 50 hours/week. The senior/laboratory resident (SR/lab) works 13 hours/week. Chief Residents are on call as backup. The Children's Hospital is covered by PGY 5 residents (both) electives for 6 months only.

A 56-hour compliant schedule would have the following consequences: There would be less continuity of care by junior residents (junior residents would have to leave the operating room at 4 p.m. to sign out at 5 p.m. to night floats). Residents would have decreased months in elective and on call every Friday for the 6 months in elective—21 months to 6 months. Work previously done by 5 residents now done by 7 residents means less clinical exposure for each individual resident. Resident physicians would need a longer stay in residency (8–9 years, which is 1.4 times longer) to get the same clinical exposure. More work would be shifted from residents to attending physicians and midlevel practitioners. There would be no flexibility to stay for long skull base cases/spinal fusion procedures that frequently last beyond 4 p.m. There would be no chance to stay late for interesting short cases in the evenings or on weekends.

The Proposed Standards Will Undermine the Critical Importance of the Chief Residency Experience

The chief resident year is probably the most important part of the resident experience. During this year, the chief resident holds a high level of responsibility for patient care in anticipation of his/her imminent responsibilities as an independent practitioner. The senior resident must be accountable over extended periods of time with appropriate periods of rest to become fully engaged in patient care. It is only through this type of multitasking experience that a chief resident learns his/her limits and develops the emotional stamina to care for sick neurosurgical patients. Primary accountability for patient treatment by necessity involves progressive responsibility and relatively continuous availability (with appropriate cross-coverage) for patients admitted to the neurosurgical service. Most neurosurgical educators believe that chief residents who are working as shift workers will gradually be marginalized in the patient care process as part-time workers, thereby diluting the intensity of their operative experiences and their emotional commitment to patient care decisions. The chief resident experience is the essential transition year to independent practice, and most residents report that they make the final transformation to confident and technically proficient surgeons during this period. The current reality in practice is that neurosurgeons must care for emergency patients without regard to their other responsibilities under the Emergency Medical Treatment and Active Labor Act regulations. It is important that chief residents learn under conditions that approximate those they will soon encounter in practice.

The Proposed Standards Will Have Significant Financial Consequences

Loss of workforce through a reduction in duty hours will have a broad major impact on costs of graduate medical education. Strategies to meet this challenge include increases in faculty, increases in midlevel practitioners, lengthening of training to gain requisite experience, increase in number of residents, or a combination of all of the above. In a study at a single large Midwestern academic medical center, the institution of a 16-hour shift/56-hour work week would result in an incremental increase in costs ranging between $15 and 22 million/year.

Conclusions

Most neurosurgical training programs are characterized by very close supervision of the residents, with faculty members on site for critical decision-making while operative procedures are being performed. Neurosurgery is almost unique among the surgical specialties due to its origins in the great US teaching hospitals in which in-viduals such as Harvey Cushing developed a training paradigm built on personal responsibility and concentrated study and practice. These neurosurgical training programs are the models for neurosurgical training around the world. The concerns outlined in this document represent collective thoughts of members of the 3 organizations most concerned with educating the neurosurgeons who will be responsible for taking care of us in the years to come. Further radical changes in resident training and experience through further reduction of duty hours has potential for significant harm to the public. Much more study is warranted to determine the consequences of fatigue and adequate training on patient safety.

Disclaimer

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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References


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