

# Honoring Our Public Responsibility: Creating Milestone and Matrix-Based Training in an Era of Duty Hour Restrictions

*H. Hunt Batjer, MD, Salah G. Aoun, MD, Rudy J. Rahme, MD, and Bernard R. Bendok, MD*

After remaining somewhat static for the past century, graduate surgical education has undergone enormous upheavals in the past 10 years. It has been changed fundamentally and irreversibly. The burden is on us as educators in our specialty to use our resources and creativity to ensure that neurosurgeons who arrive at the bedside to treat patients are well educated in the neurosciences and are technically proficient in the management of a broad range of neurosurgical problems. The purpose of this presentation is to review some of the dramatic changes that have occurred in American medicine, discuss their unique impact on the specialty of neurosurgery, and offer some guidance as to where we might focus our energies to ensure that the next generation of neurosurgeons is as well trained as prior generations. I have had a unique experience in having served as a residency program director, a department chair, a director of the American Board of Neurological Surgery (ABNS), chair of the ABNS, member of the Accreditation Council for Graduate Medical Education (ACGME) Resident Review Committee (RRC) for neurological surgery, and currently chair of the neurosurgical RRC. I hope these collective experiences can lend some guidance to our educational bodies going forward. At its core, this presentation must consider the following question: "How can we continue to attract and train the best and the brightest and ensure that they share their core values?"

## HISTORICAL FOOTNOTES

Over the past 100 years, 6 events have had a dramatic impact on graduate surgical education:

1. 1910—The Flexner Report
2. 2003—New ACGME Standard on Duty Hours
3. 2007—Institute of Medicine (IOM) Committee on Duty Hours
4. 2008—IOM recommendations
5. 2009-2010—ACGME task force
6. 2011—New ACGME standards

It is quite remarkable that 5 of the 6 events have occurred over the last 9 years.

In 1904, the American Medical Association created its Council on Medical Education to restructure American medical education. The Carnegie Foundation was commissioned to survey all medical schools. Dr Abraham Flexner was chosen to lead this effort. During his work, 155 medical schools in North America were surveyed. He found that they were remarkably diverse and included university-based schools, proprietary schools, allopathic schools, and numerous others. In one of his summary comments, he stated "...students, if fortunate enough to gain entrance to a hospital, observed more than participated."<sup>1</sup> I was particularly amused to note Flexner's comment on Chicago's 14 medical schools at that time: "A disgrace to the state whose laws permit its existence....indescribably foul....the plague spot of the nation." He gave particular place for several institutions, including Harvard, Western Reserve, Michigan, Wake Forest, McGill, the University of Toronto, and Johns Hopkins. Key elements of his recommendations included the following:

1. Admission to medical school should require a high school diploma plus 2 years of college study, primarily basic science.
2. The length of Medical School should be 4 years.
3. The curriculum should be developed by the Council on Medical Education.
4. Medical school should be part of a larger university.
5. Proprietary schools should close or be incorporated into a university.
6. Full-time faculty should be barred from all but charity practice.
7. Medical training should adhere to the scientific method.

The impact of his report was profound. Overall, average physician quality improved over the next couple of decades. Between 1910 and 1935, more than one-half of American medical schools closed or merged. The number of medical students was dramatically reduced from 28 000 in 1904 to 13 800 in 1920.

## IOM SHENANIGANS

It is important to note the distinction between what could be called a trade organization, in which the officers of such a society pay a membership due, and academies. Trade

societies in neurosurgery include organizations such as the American Association of Neurological Surgeons, the Congress of Neurological Surgeons, and the American College of Surgeons. Obviously, well-chosen leadership serves broader societal responsibilities, not just the special interest of their members, but from a broad perspective, leaders do in fact serve the members who pay dues and allow the organization to function in its other agendas. Academies, on the other hand, do not have dues-paying members and in general serve the public interests. The ABNS, for example, functions as an academy and includes in its bylaws the following language: “The broad aim of the American Board of Neurological Surgery is to encourage the study, improve the practice, elevate the standards, and advance the science of neurological surgery, and thereby to serve the cause of public health.” The IOM includes the following language in its charter: “The Institute of Medicine serves as an adviser to the nation to improve health. Established in 1970 under the charter of the National Academy of Sciences, the IOM provides independent, objective, evidence-based advice to policymakers, health professionals, the private sector, and the public. The mission of the IOM embraces the health of people everywhere.” I would challenge the activities of the IOM over the past few years as consistent with its charter.

In 2007, a senior IOM executive was approached by a congressional committee chairman, representatives from Leapfrog, and representatives of organized labor. This individual was approached with “the result,” which was 56 hours, and told to have the IOM produce the science “to get us there.” A project was initiated entitled “Optimizing Graduate Medical Trainee: Residents, Hours, and Work Schedules to Improve Patient Safety.” This project was launched in September 2007 and had a second meeting in early December 2007. Organized surgery learned of this project in mid-December when Katie Orrico stumbled on a link to the committee’s activities. At its December meeting, the committee referred to surgical program directors as “slave owners” and residents as “slaves.” Numerous reports were heard from the Harvard group, including a presentation by Dr Landrigan<sup>2</sup> titled “Effects of Traditional 24-Hour Work Shifts on Physician and Patient Safety.” Interestingly, during these deliberations, 3 key articles were published. Shetty and Bhattacharya<sup>3</sup> reported a very large series of patients from community hospitals and compared outcomes before and after the 2003 duty hour restriction to 80 hours. The authors reported *no effect* on surgical patient. Volpp and colleagues<sup>4</sup> reported a large series of Veterans Affairs patients over the same time frame and noted *no effect* on surgical patients. Volpp and colleagues<sup>5</sup> also reported 8.5 million Medicare patients and noted *no effect* on surgical or medical patients. One possible interpretation of these reports is that resident fatigue may not be a driver of inpatient mortality. The committee’s interpretation, however, focused on the notion that the reason the results were negative was that we had not reduced the duty hours enough yet. Both Dr Sean Grady and I were invited to make a presentation to the IOM committee on March 4, 2008, in our roles as leaders of the ABNS.

We were preceded by Dr Tom Nasca, representing the ACGME, and Dr Gerald Healy, representing the American College of Surgeons. In our presentation, we tried to focus on the balance between the risks of fatigue and the risks of loss of professional commitment and continuity of care. We drew direct comparisons between the requirements of a neurosurgical resident and those in other fields such as internal medicine. In particular, we mentioned that the neurosurgical resident had to finish rounds by 6:30 AM so that preoperative patients could be evaluated and history and physicals could be placed on the chart. Preoperative imaging must be scrutinized to ensure that the surgical team had all of the navigation information required for that case. On a hypothetical day, a clival meningioma was treated. The operation concluded around 6:30 PM. The resident team then made rounds again and began the process of information transfer. At that time, around 10 PM, the patient developed a surgical complication, a postoperative hematoma requiring reoperation. We asked the committee, “Who should do this operation, the surgical team that knows the patient and knows all the details of the original procedure, including a minor tear of the sigmoid sinus, or a night shift?” They concluded the following:

1. We risk creating a new generation of surgeons who have less surgical experience and do not feel the same commitment to patients.
2. Handoffs cause errors and fail to communicate the nuances from surgery.
3. One size does not fit all (Neurosurgery differs from other specialties such as pathology, radiology, etc).
4. If lower standards are enforced, we will harm the public.

We asked the committee to specifically consider the following points:

1. In neurosurgery, there is a robust preselection process for individuals entering training.
2. Technical mastery (which is what all of us would want in our surgeon) requires prolonged supervised repetition.
3. Patients expect their *surgeon* to take care of them.
4. Further reduction of duty hours will harm the public.

Ultimately, the IOM committee was influenced by the presentations that they heard from us and many other specialties and left the 80-hour standard in their recommendation. On the other hand, maximum shift length was recommended to be 30 hours; during that time, physicians could admit patients for up to 16 hours with a 5-hour protected sleep period between 10 PM and 8 AM and remaining hours to be used for transition and educational activities. Shift length was recommended as 16 hours with no protected sleep. There were also some major implications for minimum time off between scheduled shifts; the IOM recommended that the physician have 14 hours off after any extended duty period of 30 hours and that the physician should not return until 6 AM the following day. The committee also recommended a change in the mandatory time off and an increase in days off per month to 5 with 1 day off per week and one 48-h period off per month. In addition, the IOM recommendations

included important supervision elements. The committee recommended that first-year residents have immediate access to in-house supervision. This is an important historical note and is one of the reasons that the ACGME task force included significant changes in the PGY1 levels of supervision. In response to the IOM recommendations, Dr Nasca created an ACGME task force with the following goals:

1. To ensure the safety and quality of care in teaching hospitals
2. To ensure the safety and quality of care for *future patients of current residents*
3. To ensure the environment for our residents to learn professionalism and effacement of self-interest

This extraordinary charge is altruistic and broad and appropriately trivializes the issue of duty hours as simply one of the elements of a complex milieu that is graduate medical education. Dr Ralph Dacey represented neurosurgery on this task force, and his opinions were very important in shaping the ultimate standards. The new standards included new sections on professionalism, personal responsibility, and patient safety, as well as transitions of care, clinical responsibilities, teamwork, and the maximum frequency of in-house night float. Transitions of care were identified as a potential source of medical errors, and very detailed language was included in that domain. PGY1 in particular was changed substantially in that PGY1s who had experienced the Society of Neurological Surgeons (SNS) boot camp were considered capable of standard evaluation and management services, including history and physical, neurological examination, treatment planning, and writing orders. Postoperative patients could be serviced by PGY1s in the writing of medication orders, fluid therapy, nutritional therapy, and patient transfers. The procedural competencies included only basic venous access, placement of nasogastric tubes, placement of Foley catheters, arterial puncture, and lumbar puncture. During the early months of PGY1, residents must be educated in, directly observe, and assess the patient management areas of urgent and emergent situations, postoperative complications, the management of critically ill patients, and the management of cardiac arrest. Procedural competencies that specifically must be certified include insertion of an intracranial pressure monitor, insertion of a lumbar drain, insertion of a ventriculostomy, advanced vascular access procedures, repair of surgical incisions, and repair of skin and soft-tissue lacerations. Once these competencies had been certified by the program director, the PGY1 can theoretically take independent night call, and the 16-hour standard is not violated. The task force recommended that the 80-hour workweek standard be averaged and inclusive of all moonlighting activities. The PGY1 standard of 16 hours was included. Important language was included on the issue of returning to duty with < 8 hours off. Residents may return to duty with < 8 hours off if any of the following conditions are met:

1. Their presence is required for continuity of care for an unstable patient.
2. Their presence provides continuity of care for a complex patient.

3. They participate in events of exceptional educational value.
4. Their presence provides for the humanistic needs of a patient or family.

### UNIQUE NEUROSURGICAL CHALLENGES

Neurosurgery is a unique profession. Those involved with the ACGME and the SNS face the challenges of ensuring that our residents achieve not only cognitive education but procedural education and are instilled with the concepts of professionalism and the other core competencies. We must ensure that they progress through the Dreyfus model of skill acquisition: from unsatisfactory novice to advanced beginner to competent then to proficient and then, we hope, to expert. All of these requirements must be managed within the timeframe of 6 or 7 years of residency with the new duty hour standards. The challenge is further complicated by the fact that neurosurgical procedures are quite long, considerably longer than in other surgical fields. Neurosurgical residents must manage an extraordinary number of critically ill patients and be immediately available for emergent and urgent consultations. Our procedural domain is quite diverse, and there is very little “skills overlap.” Unfortunately, for a variety of reasons, we have limited simulation or virtual training at our disposal at this time. We also have unique problems in managing a heavy outpatient load. To make matters more complex, we have very limited workforce in terms of both residents and faculty.

Anders Ericsson had some unique observations related to expertise and virtuosity: “The journey to truly superior performance is neither for the faint of heart nor the impatient. The development of genuine expertise requires struggle, sacrifice, and honest, often painful self assessment. There are no shortcuts. It will take you at least a decade to achieve expertise... and you will need to invest that time wisely by engaging in “deliberate practice” —a practice that focuses on tasks beyond your current levels of competence and comfort. You will need a well-informed coach...”<sup>6</sup> His concept of 10 years involved 10 000 hours of deliberate practice. He noted that some fields actually require more. Elite musicians often require 15 to 25 years of training before winning international competitions. The great violin mentor Ivan Galamian stated, “If we analyze the development of the well known artists we see that in almost every case the success of their entire career was dependent on the quality of their practicing...the practicing was constantly supervised by the teacher.”<sup>7</sup>

How do we get to this level in neurosurgery? If one takes a hypothetical 7-year program in which the trainees participated in 5 hours per day of deliberate technical practice (not writing orders, not making rounds, etc) and such practice occurred 6 days per week with no vacations for 7 years, the resident would have just over 10 000 hours. This is obviously a nonstarter. If expertise and virtuosity are likely not accomplishable within traditional training, what about proficiency?

### PROFICIENCY

We believe that proficiency is a laudable and accomplishable goal. We have a number of tools to bring to bear:

1. SNS boot camp
2. SNS Matrix Curriculum
3. ACGME Milestone Project
4. Index case minimums (RRC)
5. Simulation
6. Our unique culture

In recent years, the SNS boot camp has been wildly successful. This 2-day course for incoming residents provides didactics for the development of cognitive skills and hands-on technical training. The SNS is also involved in a very important program, the Matrix Curriculum. This is a collaboration between the SNS, ABNS, and ACGME RRC for neurological surgery. As this project comes to fruition, it is clear that the educational goals will vary based on the training level and the subspecialty area. It is assumed that successful residents will not be expert but that proficiency will be achieved at least in some subspecialty area such as complex spinal surgery. In other areas such as endovascular training in some programs, the residents may not progress beyond the early learner phase.

The ACGME under Dr Nasca's leadership is launching an ambitious new program called the Next Accreditation System. A key element of this project involves milestones. The intent is to translate general competencies into specific competencies that will be met by all residents. The idea is to create "core" resident outcomes in the competencies, not "standardization of all outcomes." Current graduate medical education curricula involve what could be considered circumstantial practice that has some progression over the PGY-level years. The intent of the milestone project is to provide intentional practice with specific evaluation tools to measure outcomes and to provide external accountability for our training outcomes. Proficient physicians would be the end product. Milestones are outcomes assessment tools that measure a resident's progress toward the desired levels of ability in the domains of patient care, systems-based practice, medical knowledge, practice-based learning, professionalism, and communication. In the Next Accreditation System, annual reporting would include how the trainees of a given program compare with national benchmarks in all competency domains.

The concept of entrustable professional activity has been put forward by the ACGME as a mandatory standard. These experiences are meant to involve real-life patient-care episodes and should be composed of elements of most, if not all, competencies. One could think of an entrustable professional activity in the following way: A neurosurgery resident is called to the emergency department to evaluate a patient who was struck by a passing car. The resident has to evaluate the patient, gather as much history as possible regarding the mechanism of injury, order appropriate consultations, order appropriate imaging, and communicate with the family. Once the C-spine has been cleared and the computed tomography demonstrates an acute subdural hematoma, the resident must use communication skills and systems-based elements to alert the operating room and to move the patient to a different care area. He or she then must perform the operative procedure and communicate with the family about the findings and outcome. He or she then must

communicate with the critical care unit personnel to ensure that an effective treatment paradigm is established. The resident must then participate in the critical care of that patient until the patient is moved to a less acute care environment and ultimately to rehabilitation. To complete the cycle, the resident is then involved in the outpatient return visit during convalescence. It is obvious that virtually all the competencies are deployed in that particular patient care paradigm.

The neurosurgical milestones project is being chaired by Dr Alan Friedman, past president of the SNS. The advisory group includes Dr Fred Meyer, secretary of the ABNS; Ralph Dacey, SNS president-elect; Hunt Batjer, RRC chair; Kim Burchiel, RRC vice chair and SNS Secretary; Dan Barrow, ABNS chair; and Arthur Day, SNS president. The neurosurgical milestones working group includes many of the key participants in the matrix curriculum, including Drs Nick Barbaro, Tim Mapstone, Nate Selden, Warren Selman, Charles Prestigiacomo, Bob Harbaugh, Alex Khalessi, Vince Traynelis, Griff Harsch, Aviva Abosch, Alex Valadka, Karin Muraszko, Fred Lang, and Cargill Alleyne. We are working toward 15 to 18 specific milestones documents that will involve patient care and medical knowledge. The 4 other competencies will be developed by an independent expert panel through the ACGME.

Our RRC for neurological surgery made an important decision over the past several months. Historically, the RRC evaluates recent graduates from a given training program using key cases and national normative data including the 20th percentile. We elected to change to a new system involving case categories with minimum acceptable case numbers. The goal with this transition is to "set the bar." It will ideally eliminate experience gaps and empower the residents to manage their own technical curriculum. In addition, it will empower program directors to achieve institutional collaboration that may be needed in areas such as endovascular surgical neuroradiology, peripheral surgery, and extracranial vascular disease. The case minimums were rolled out at the 2011 SNS Annual Meeting and continue to evolve.

The Next Accreditation System is moving toward a concept of "maintenance of accreditation." The Review Committees will review data on each program each year. Such data will include resident and faculty surveys, milestones, board scores, case logs, and hospital accreditation data. Each program will undergo a 10-year review with no program information form. However, it will include a self-study and a site visit. Neurosurgery is 1 of 7 specialties that will pilot the Next Accreditation System beginning in the summer 2012.

## SIMULATION

One of my most respected and admired friends, Dr Don Quest, stated in his 2007 AANS Presidential Address the following: "Simulators provide harmless and repeatable practice, multiple and varied scenarios, immediate feedback, uniform standards, objective measures, and trend analysis... useful in the certification and Maintenance of Certification processes as well as in continuing medical education, refreshment of skills, and even surgical rehearsal." One of

our coauthors, Dr Bendok, has launched an important new initiative in the realm of neurosurgical simulation. It is critical that we move forward quickly in this arena. Our trainees are faced with very complex challenges. Our procedures are very high risk and complex. Many of our most challenging cases are seen only rarely. Technical errors are unforgiving for our patients. The duty hours standards have further complicated the resident's access to these key experiences. Simulation can be thought of as a progression from using animal models to in vitro methods, advanced in vitro and even dynamic in vitro experiences, virtual 3-dimensional experience, and interactive 3-dimensional experience that would set the stage ultimately for participation in the operating room. Dynamic in vitro training can occur now in several areas, including aneurysm coiling and endovascular mechanical clot with removal. It is critical that the required resources and talent be put into this area of study as quickly as possible. If we do this right, our trainees and their patients will be extremely well served by this investment.

### NEW THREATS

Life is never completely predictable, but in this particular domain, there is little question that new threats will emerge that will further challenge us in serving our public responsibility. The concept of shift work appears to be better tolerated by our public. Organized labor is obviously now politically empowered. The US government has a cultural and political desire for increased regulation. The recent effort by the Occupational Safety and Health Administration, although turned back, may resurface. It is clear that the airline, railroad, trucking, and other industries have been very tightly regulated, and we will be forced to look into this critically. Brum and colleagues<sup>8</sup> recently published a paper entitled "Implementing the 2009 Institute of Medicine Recommendations on Resident Physician Work Hours, Supervision and Safety." This publication is a white paper from a consensus conference that was funded by the Committee of Interns and Residents of the Service Employees International Union. This union now has > 1 million healthcare workers at its disposal. The recommendations of this group include the following:

1. Noneducational activities should be eliminated.
2. Real-time mechanisms to identify excessive workload and to intervene with additional manpower should be provided.
3. All critical services should be provided by attendings in-house.
4. Centers for Medicare and Medicaid Services should incent programs with "good" supervision.
5. The shift maximum for all trainees should be 12 to 16 hours.
6. A minimum of 10 hours off between shifts should be provided.
7. The increased workload on attendings should be monitored.

Although the cost of this initiative is \$1.7 billion, which translates to \$1.3 million per year per average hospital, as the authors state, "The impact on preventable events is not known."

In addition, the Macy Foundation has recently commissioned the IOM to study graduate medical education in all of its dimensions. The good news is that many of the elements of their recommendations are included in the language and intent of the Next Accreditation System via the ACGME.

As the new threats emerge, our national leadership must be steadfast. Our posture must be crystal clear: "Show me scientific data that patients or trainees are being harmed." These data cannot be provided by physicians and scientists with conflicts of interest or at least with the priorities of organized labor. *We must demand real science.* We must remember that duty hours are simply 1 element (and not a very important one at that). In the overall complex training environment, it is our responsibility to prepare surgeons for independent practice because this is our public responsibility.

### CONCLUSIONS

Those of us involved in graduate medical education have great opportunities at this point. Without question, proficiency for our trainees is within reach. We must remember to preserve our heritage of dedication to our patients and the principles of continuity of care. We must preserve our heritage of attracting and inspiring the "top guns" of medicine. It is critical that we serve in leadership roles at the American Board of Medical Specialties and the Accreditation Council for Medical Education. We must continue to educate our colleagues and other specialties about the unique problems and demands of neurological surgery. Clearly, changes in our healthcare delivery system will create new and unpredictable opportunities for neurosurgeons and our patients. Finally, in this age of apologies, we must always celebrate our *exceptionalism*. What we do, how we do it, and how we learn to do it are unique to neurosurgery. We must set the bar high and be proud of our accomplishments and responsibilities.

### Disclosure

The author has no personal financial or institutional interest in any of the drugs, materials, or devices described in this article.

### REFERENCES

1. Medical Education in the United States and Canada. *Science*. 1910;32(810):41-50.
2. Lockley SW, Barger LK, Ayas NT, Rothschild JM, Czeisler CA, Landrigan CP. Effects of health care provider work hours and sleep deprivation on safety and performance. *Jt Comm J Qual Patient Saf*. 2007;33(11 Suppl):7-18.
3. Shetty KD, Bhattacharya J. Changes in hospital mortality associated with residency work-hour regulations. *Ann Intern Med*. 2007;147(2):73-80.
4. Volpp KG, Rosen AK, Rosenbaum PR, et al. Mortality among patients in VA hospitals in the first 2 years following ACGME resident duty hour reform. *JAMA*. 2007;298(9):984-992.
5. Volpp KG, Rosen AK, Rosenbaum PR, et al. Mortality among hospitalized Medicare beneficiaries in the first 2 years following ACGME resident duty hour reform. *JAMA*. 2007;298(9):975-983.
6. Ericsson KA, Prietula MJ, Cokely ET. The making of an expert. *Harv Bus Rev*. 2007;85(7-8):114-121, 193.
7. Ericsson KA, Prietula MJ, Cokely ET. The making of an expert. *Harv Bus Rev*. Jul-Aug 2007;85(7-8):114-121, 193.
8. Blum AB, Shea S, Czeisler CA, Landrigan CP, Leape L. Implementing the 2009 Institute of Medicine recommendations on resident physician work hours, supervision, and safety. *Nat Sci Sleep*. 2011;2011(3):47-85.