Statement

of the

American Association of Neurological Surgeons
American Board of Neurological Surgery
Congress of Neurological Surgeons
Society of Neurological Surgeons

before the

Institute of Medicine

On the Subject of

Ensuring an Adequate Neurosurgical Workforce for the 21st Century

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Ensuring an Adequate Neurosurgical Workforce for the 21st Century

EXECUTIVE SUMMARY

The array of challenges related to the governance and financing of GME in the 21st century are many and include: a rapidly aging and increasingly diverse patient population; underserved rural and urban populations; growing prevalence of disability and chronic disease; an urgent need for a more cost-effective healthcare system; innovations in healthcare delivery; impacts of GME on state level policies and GME in state institutions; advances in diagnostics, therapeutics, and health information technology; and others. Organized neurosurgery welcomes the opportunity to share our perspective on this important topic and we remain committed to ensuring that the United States trains enough neurosurgeons to provide patient-centered, quality neurosurgical care.

I. NEUROSURGICAL MANPOWER, EDUCATION AND TRAINING

- The country faces a severe physician manpower shortage, which will only worsen as health insurance coverage is expanded to an additional 30 million Americans and the baby boomers continue to reach retirement age. Overall, the shortage will approximate 130,600 physicians by the year 2025 -- 64,800 specialty physicians and 65,800 primary care physicians.

- Neurosurgical training is unique. There are 102 accredited neurosurgical residency programs in the U.S. training nearly 1,200 neurosurgical residents, and each year approximately 160 graduates complete their residency. The length of post graduate residency training for neurosurgeons is among the longest, now at seven years. Subspecialty fellowship training adds an additional one to two years.

- The rigor of a neurosurgical residency attracts a smaller pool of applicants due to, among other things, the length of training and soaring costs of medical school; long work hours, higher case loads and more on-call time; high professional liability insurance premiums and risk of lawsuits; and decreasing reimbursements and escalating practice expenses.

- The average cost to train neurosurgical residents hovers around $1.2 million per resident over the course of a seven-year residency. Medicare's GME contribution does not come close to covering these costs, and therefore much of this expense is borne by the academic departments themselves.

- There are approximately 3,689 practicing board certified neurosurgeons for over 5,700 hospitals in the U.S., serving a population of more than 311 million people. Of these hospitals, approximately 1,600 provide trauma care, 1,000 are certified primary stroke centers and 200 are children's hospitals. As the population ages and more of our citizens face debilitating and life threatening neurological problems such as stroke, degenerative spine disease, and Parkinson's and other movement disorders, this supply-demand mismatch will become even more acute.

- Current workforce shortages in neurosurgery include:

  - Too few neurosurgeons available to provide trauma and emergency care, with only 83 percent of all neurosurgeons providing 24/7 emergency call;
  - Only 178 board certified pediatric neurosurgeons, and at least one-fifth of all neurosurgeons report that they no longer treat pediatric neurosurgical cases; and
  - An overall aging neurosurgical workforce, forty-six percent of which are age 55 and older.

- The pipeline for becoming a board certified neurosurgeon is long – as much as 18 years from the start of medical school to certification -- so replenishing the neurosurgical workforce is no

easy task, and producing 160 neurosurgeons per year will certainly fail to keep pace with patient care demand.

- While the current ratio of neurosurgeons to population is approximately 1:61,000, by neurosurgery's account this is likely inadequate -- now and into the future -- when factoring in new neurosurgical treatments, the demand for pediatric, trauma and emergency neurosurgical care, and an aging neurosurgical population.

II. INNOVATIVE TRAINING FOR THE NEXT GENERATION OF NEUROSURGEONS

The specialty of neurosurgery has been a leader in replacing the era of training as apprenticeship -- which has focused on service – with a deliberate patient-centered education that is focused on patient safety, clinical care outcomes and advancement of the science and practice of neurological surgery. As a specialty, we have re-engineered our training programs in an effort to be more responsive to the concerns that have been raised by policymakers, educators and the public. To that end, organized neurosurgery has implemented the following comprehensive program:

- Medical school graduates entering into their first year of neurosurgical residency attend a neurosurgical boot camp course, which uses model based simulators for technical and cognitive/behavioral skill learning and patient safety;

- As part of the ACGME's Next Accreditation System (NAS), neurosurgical residency training programs are instituting the Milestones system, a concept based upon the need to have tangible objectives for learning and quantifiable goals to assess and measure residents' competency throughout their neurosurgical training; and

- Recognizing the need to develop a more robust process for lifelong learning throughout the duration of a neurosurgeons' career, neurosurgery has taken the additional steps of correlating the Milestones concept to an in-depth and comprehensive curriculum for the specialty. The Matrix Curriculum unifies all of the education, accreditation and certification functions by aligning neurosurgery's educational goals, the ACGME competency and Milestone project requirements, and the medical knowledge and technical skill components required for board certification in neurological surgery.

III. RECOMMENDATIONS FOR THE FUTURE

To address the growing physician workforce shortage and ensure that the graduate medical education system is fully accountable to the public, we must:

- Ensure a physician workforce that is of sufficient size and specialty mix and strengthen the linkage of GME funding to ACGME-approved training programs

  - Expand GME funding to fully cover the entire length of training required for initial board certification, which in neurosurgery's case is six to seven years;
  - Eliminate Medicare's caps on GME financing; and
  - Hold institutions accountable to program directors by reporting GME funding at the program level and establish a clear appeals process if funding is withheld or diverted at the institutional level

- Maintain funding for children's hospital GME.

- Provide additional financial support for GME through an all-payer fund for GME.

- Ensure that the ACGME retains its preeminent role in overseeing resident training and education.

Ensuring an Adequate Neurosurgical Workforce for the 21st Century

On behalf of the American Association of Neurological Surgeons,[1] the American Board of Neurological Surgery,[2] the Congress of Neurological Surgeons[3] and the Society of Neurological Surgeons,[4] we are pleased to have the opportunity to provide the Institute of Medicine (IOM) with organized neurosurgery's perspectives related to the governance and financing of graduate medical education (GME). As noted by the IOM in the description of its consensus study, the array of challenges to the governance and financing of GME in the 21st century are many and include: a rapidly aging and increasingly diverse patient population; underserved rural and urban populations; growing prevalence of disability and chronic disease; an urgent need for a more cost-effective healthcare system; innovations in healthcare delivery; impacts of GME on state level policies and GME in state institutions; advances in diagnostics, therapeutics, and health information technology; and others. We hope that the information contained in this paper will help inform the committee as it considers the complexities of GME policy.

I. NEUROSURGICAL MANPOWER, EDUCATION AND TRAINING

Over a decade ago, researchers recognized that in "striking contrast to earlier predictions… if the pace of medical education remains unchanged, the United States will soon be facing shortages of physicians and that these shortages will become progressively more severe over time."[5] Fast forward to today, and by all accounts the physician manpower shortage is now upon us, and will only worsen as health insurance coverage is expanded to an additional 30 million Americans and the baby boomers continue to reach retirement age. According to the Association of American Medical Colleges (AAMC), we face an overall shortage of 91,500 physicians in 2020, and the shortfall balloons to 130,600 by the year 2025.[6] And while the debate about the adequacy of our nation's physician workforce has focused predominantly on the shortages of primary care physicians, it is equally important to note that our country also faces a significant workforce shortage in the specialty physician disciplines – including neurosurgery. In fact, per the AAMC, in

[1] Founded in 1931 as the Harvey Cushing Society, the American Association of Neurological Surgeons (AANS) is a scientific and educational association with over 8,000 members worldwide. The AANS is dedicated to advancing the specialty of neurological surgery in order to provide the highest quality of neurosurgical care to the public. More information is available at www.aans.org.

[2] The broad aim of the American Board of Neurological Surgery (ABNS) 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 primary purposes of the ABNS are to conduct examinations of candidates who voluntarily seek certification, and to issue Certificates to those who meet the requirements of the Board and satisfactorily complete its examinations. More information about the ABNS is available at: www.abns.org.

[3] The Congress of Neurological Surgeons (CNS), a leader in education and innovation, is dedicated to advancing neurosurgery by providing members with the educational and career development opportunities they need to become leaders and innovators in the field. Additional information is available at: www.cns.org.

[4] The Society of Neurological Surgeons (SNS) is the American society of leaders in neurosurgical residency education, and is the oldest neurosurgical society in the world. Academic department chairman, residency program directors, and other key individuals comprise the active membership of the Society. In its role as the program directors' society for Neurological Surgery, the SNS plays a pivotal role in determining the content and format of residency education with regard to curriculum requirements and program design. Details about the SNS are available at: www.societyns.org.

[5] Cooper RA, Getzen TE, McKee HJ, Laud P. Economic And Demographic Trends Signal An Impending Physician Shortage. *Health Affairs.* 2002;21(1):140-154.

[6] Center for Workforce Studies. The Impact of Health Care Reform on the Future Supply and Demand for Physicians Updated Projections Through 2025. Association of American Medical Colleges: Washington, DC. 2010 (available at: http://bit.ly/hC24Q7).

2025 we face a gap of 64,800 specialty physicians, which essentially equals the estimated shortage of 65,800 primary care physicians by that same year.

Unless changes in our healthcare system occur, the long-term outlook for the future may lead to fewer medical students choosing neurosurgery as a specialty. Unlike many other specialties, there are no good substitutes or physician extenders for a well-trained neurosurgeon, and neurosurgical training is vastly different from other physician training programs. While nonsurgical residencies can be completed in as few as three years, mastering neurosurgery requires extensive training over a substantial period of time. Additionally, the rigor of a neurosurgical residency attracts a smaller pool of applicants due to, among other things, the length of training and soaring costs of medical school; long work hours, higher case loads and more on-call time; high professional liability insurance premiums and risk of lawsuits; and decreasing reimbursements and escalating practice expenses. While it is clearly beyond the charge of this committee to address all of these issues, it is imperative that the GME system is structured to fully support neurosurgical residency training programs and implement appropriate incentives for medical students who may be interested in pursuing a neurosurgical career.

The Uniqueness of Neurosurgical Training

There are 102 accredited neurosurgical residency programs in the U.S. training nearly 1,200 neurosurgical residents, and each year approximately 160 graduates complete their residency. The length of post graduate residency training for neurosurgeons is among the longest, now at seven years. And while we appreciate the concerns expressed by many that this process may be too long, many surgical educators have argued that we may need to actually *lengthen* the training period because of the effect that the current duty hour restrictions have on the numbers of cases residents perform. The length of the basic neurosurgical residency training also does not include any subspecialty fellowship training -- including spine, pediatric neurosurgery, vascular neurosurgery and others -- which may extend training for an additional one to two years beyond completion of the initial residency period. Only a minority of programs has more than one resident per level, per year, which means there is a limited supply of attending and resident neurosurgeons available to provide patient care. Neurosurgical services are characterized by large elective (but urgent) surgical schedules, many emergencies and a large number of inpatients with high disease acuity. The teaching hospitals in which most neurosurgical training programs function are disproportionately responsible for providing care on a 24/7 basis for neurosurgical emergencies. This makes the role of the resident on the service central to the simultaneous optimization of patient care and resident education.

Neurosurgical clinical training is rigorous, as would be expected for a specialty that requires both cognitive and technical expertise. During his or her training the neurosurgical resident must acquire knowledge and experience in dealing with patients with neurosurgical disorders and develop the professional qualities to provide patient-centered, quality neurosurgical care. The resident must master the cognitive information necessary to manipulate the most complex system in nature. He or she must develop the judgment and ability to recognize clinical patterns, which comes from seeing and managing many patients with nervous system disease. Additionally, the resident must accumulate significant technical experience and must actually perform (as opposed to observe) under supervision many demanding operative procedures. 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. Such a long complex training program reduces 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. Furthermore, the length of neurosurgical cases conspires against the ability to train adequately in a highly restricted duty hour environment.

The institutional and departmental costs associated with training neurosurgical residents are significant and impose a challenge for many institutions. Based on an assessment of a number of programs across the U.S., these costs hover around $1.2 million per resident over the course of a seven-year residency. Table 1 provides a sample breakdown of the costs from a typical neurosurgical residency training program from an academic medical center in the northeastern part of the country.

Cost to Train a Neurosurgery Resident	
Institutional Costs	
Total Institutional Costs	$65,621,392
Divided by 442 residents	**$148,465 (per resident/per year)**
Departmental Costs:	
20% Salary & Benefits for Program Director	$260,396
Salary & Benefits for Program Coordinator	$39,741
Travel and Conferences	$14,039
Food	$7,998
Books and Equipment	$5,366
Licensing	$4,761
Interview Costs	$3,641
Miscellaneous	$1,431
Total Department Costs	$337,373
Divided by 14 residents	**$24,098 (per resident/per year)**
Total Costs:	
$172,563 per resident/per year x 7 years	**$1,207,941 (per resident)**

Table 1: Cost per neurosurgical resident in an academic medical center in the northeastern region of the U.S.

Medicare's GME contributions, particularly for direct medical education (DME) expenses, do not come close to covering these costs, and therefore much of this expense is borne by the academic departments themselves. This is particularly true for longer residency training programs, such as neurosurgery, and, as a result, there is a financial penalty associated with lengthier programs.

Neurosurgical Manpower and the Special Characteristics of Neurosurgical Practice

Patterns of neurosurgical practice are somewhat different from those of many physicians; an important consideration when evaluating the adequacy of our neurosurgical workforce. Neurosurgery is a small specialty, constituting only 0.5 percent of all physicians. According to the ABNS, as of January 2012, there were approximately 3,689 practicing board certified neurosurgeons for over 5,700 hospitals in the U.S., serving a population of more than 311 million people. As the population ages and more of our citizens face debilitating and life threatening neurological problems such as stroke, degenerative spine disease, and Parkinson's and other movement disorders, this supply-demand mismatch will become even more acute. In addition, the

effectiveness of deep brain stimulation for treating movement disorders and obsessive-compulsive disorder makes it likely that there will soon be a minimally invasive, reversible and effective neurosurgical treatment for neurobehavioral disorders such as obesity and addiction. These same techniques have also demonstrated early promise for treating other psychological disorders, such as depression. Because of the prevalence of these disorders, more neurosurgeons will likely be needed to meet the demand for neurosurgical care.

The complex issue of determining an ideal workforce size for neurosurgeons in the U.S. depends on how workforce needs are defined. Patient demand for neurosurgery services, hospital demand (i.e., recruitment) for neurosurgeons, and other measures all affect the determination. Workforce decision-making in neurosurgery is typically dominated by the one neurosurgeon per 100,000 population ratio originally proposed in the government-sponsored Study on Surgical Services for the United States (SOSSUS) report completed in 1977.[7] At the time of the report, and in the 35 years since, the actual ratio of neurosurgeons to population has always been higher than suggested. Using full-time equivalency calculations, Popp estimated the ratio to be 1:55,000 in 2000,[8] and the AAMC[3] estimates the current ratio to be roughly 1:61,000.[9] As noted in Table 2 below, the American College of Surgeons Health Policy Research Institute largely confirms these findings.[10]

Physician to Population Ratio	2004	2005	2006	2007	2008	% Change-2004-2008
Active neurosurgeons per 100,000 population	1.46	1.46	1.46	1.45	1.44	**-1.4**
Number of people per active neurosurgeon	68,389	68,604	68,453	68,775	69,365	**1.4**
Patient care Neurosurgeons per 100,000 population	1.24	1.37	1.34	1.32	1.30	**4.4**
Number of people per patient care neurosurgeon	80,573	73,224	74,611	75,603	77,194	**-4.2**

Table 2: ACS HPRI trend profile of neurosurgical surgeons in the U.S.

Despite the critical need for neurosurgical availability, it should also be noted, however, that in most of our vast country, there are many states that have zero to two neurosurgeons per 100,000 population (Figure 1).

[7] Zuidema GD. The SOSSUS report and its impact on neurosurgery. *J Neurosurg.* 1977;46(2):135-144.

[8] Popp AJ. Neurosurgical workforce: Examining the physician supply controversy. *AANS Bull.* 2000;9(1):7-9.

[9] Center for Workforce Studies. 2012 Physician Specialty Data Book. Association of American Medical Colleges: Washington, DC. 2012 (available at: http://bit.ly/UYcemR).

[10] Health Policy Research Institute. The Surgical Workforce in the United States: Profile and Recent Trends. American College of Surgeons and Association of American Medical Colleges. 2010 (available at: http://bit.ly/crAFc5).

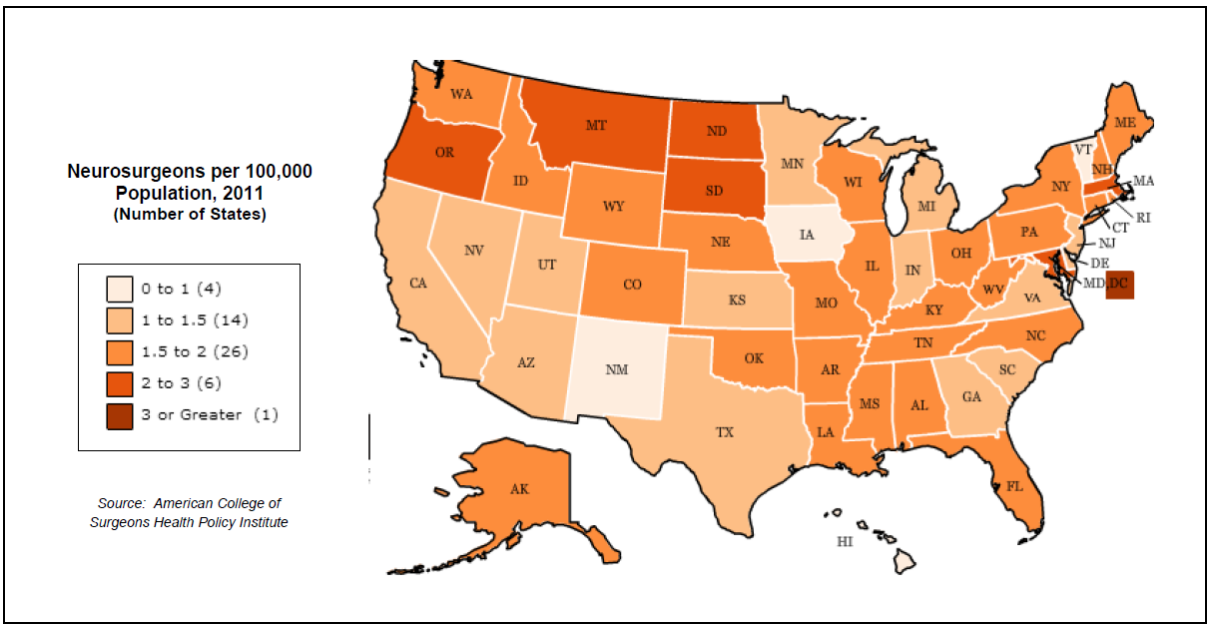

Figure 1: Geographic distribution of neurosurgeons among the states per 100,000 population. *Source:* American College of Surgeons Health Policy Research Institute.

Indeed, as Figure 2 demonstrates, most counties in the U.S. do not have a single neurosurgeon, which can spell disaster – particularly for patients in need of emergency neurosurgical care, when time is of the essence.

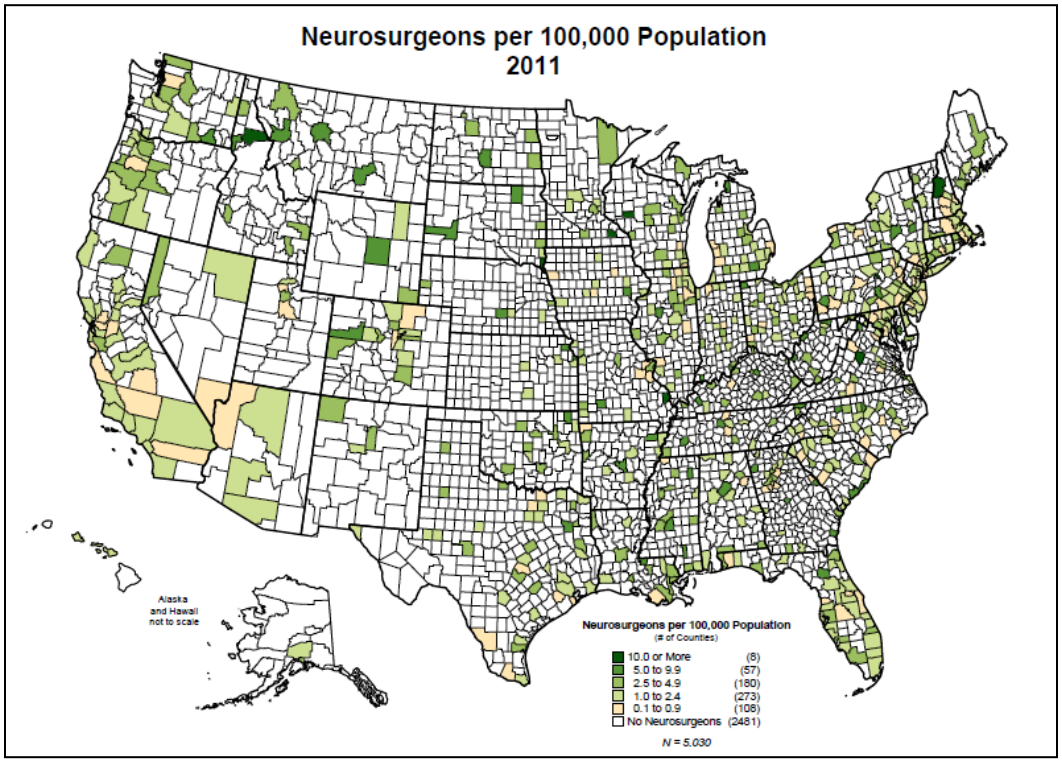

Figure 2: Geographic distribution of neurosurgeons by county per 100,000 population. *Source:* American College of Surgeons Health Policy Research Institute.

Developing benchmarks or ideal ratios of surgeons to population is challenging given the highly specialized nature of many neurosurgeons' practices. Thus, not only are there overall shortages of neurosurgeons in many geographic areas of the country (in part because of the tendency of specialists to cluster around facilities in large urban centers), but certain subspecialties within neurosurgery are also in short supply. Two specific examples come to mind: pediatric neurosurgeons and neurosurgeons available to provide emergency and trauma care. As noted above, there are approximately 3,700 neurosurgeons serving 5,700 hospitals in the U.S. Of these, about 1,600 are designated trauma centers (of one level or another),[11] 1,000 are certified as primary stroke centers and just over 200 are children's hospitals. When you factor in the needs of patients requiring the critical management of life threatening conditions such as trauma, stroke and pediatric emergencies, the neurosurgical manpower challenge becomes apparent.

All Level I and Level II trauma centers require prompt availability of neurosurgeons who can immediately go to the hospital to provide emergency care. Level III centers must have a plan to determine what type and severity of neurotrauma patients can stay there, and they also must have a transfer agreement(s) to send appropriate neurotrauma patients to a Level I or II facility for definitive care. Neurosurgical emergencies frequently arise at night and on weekends and in a highly unpredictable fashion, and neurosurgical diseases and injuries tend to develop rapidly and often continue to progress over hours to days. Concerns related to a shortage of neurosurgeons to provide neurosurgical emergency and trauma care are well documented. Past closures of trauma centers in Pennsylvania, West Virginia, Missouri, and Florida were due, in part, to shortages of neurosurgeons. Other hospitals have been in jeopardy of losing accreditation because of an insufficient number of neurosurgeons to cover emergency/trauma call. Surveys conducted by the AANS and CNS confirm a lack of neurosurgical emergency call coverage at many hospitals throughout the country. While 93 percent of all neurosurgeons provide some emergency call coverage, only 83 percent report providing such coverage 24 hours per day, 7 days per week, 365 days per year. Furthermore, those neurosurgeons providing emergency care are often doing so at more than one hospital at a time and also may be limiting the types of emergency and trauma cases they treat -- leaving critical coverage gaps and more of nation's citizens at risk of delayed care for neurosurgical emergencies such as head and spinal cord injury, cerebral hemorrhages, and ruptured intracranial aneurysms. The Institute of Medicine in its 2006 report series on the *Future of Emergency Care in the United States Health System*, confirmed, among other things, that neurosurgical specialists are often unavailable to provide emergency and trauma care.[12]

On the pediatric front, as of December 2012, there were only 178 neurosurgeons in the U.S. certified by the American Board of Pediatric Neurological Surgery, and according to an analysis that was published in January 2009 in the *Journal of Neurosurgery*,[13] within the next decade, 41.7 percent of the current pediatric neurosurgical workforce may be retired. On the supply side, fewer than ten trainees enter pediatric neurosurgery fellowship training each year and at this rate there will only be an influx of six board certified pediatric neurosurgeons entering the workforce each year – far short of the necessary numbers to meet demand.[14] The shortage of pediatric neurosurgeons is extremely problematic when it comes to treating pediatric emergencies. Given

[11] In the United States, a hospital can receive Trauma Center verification by meeting specific criteria established by the American College of Surgeons (ACS) and passing a site review by the Verification Review Committee. Official designation as a Trauma Center is determined by individual state law provisions. Trauma centers vary in their specific capabilities and are identified by "Level" designation: Level-I (Level-1) being the highest, to Level-III (Level-3) being the lowest (some states have five designated levels, in which case Level-V (Level-5) is the lowest).

[12] *Hospital-Based Emergency Care: At the Breaking Point*. Institute of Medicine. 2006.

[13] Durham SR, Lane JR, Shipman, SA. The pediatric neurosurgical workforce: defining the current supply. *J Neurosurg Pediatrics.* 2009;3(1):1-10.

[14] Boop FA. Emergency Care for Kids, Can Neurosurgery Do Even Better?, *AANS Bulletin.* 2007;16(1): 7-12.

that trauma is the number one killer of children under the age of 14, the limited number of pediatric neurosurgeons available to take trauma call is of great concern. This is further exacerbated given the fact that nearly one-fifth of all neurosurgeons are no longer treating pediatric neurosurgical emergencies.

The country is also facing an aging neurosurgical population. According to data from the ABNS, while the majority of practicing, board certified neurosurgeons are between the ages of 40 and 64, forty-six percent are 55 and older (Figure 3).

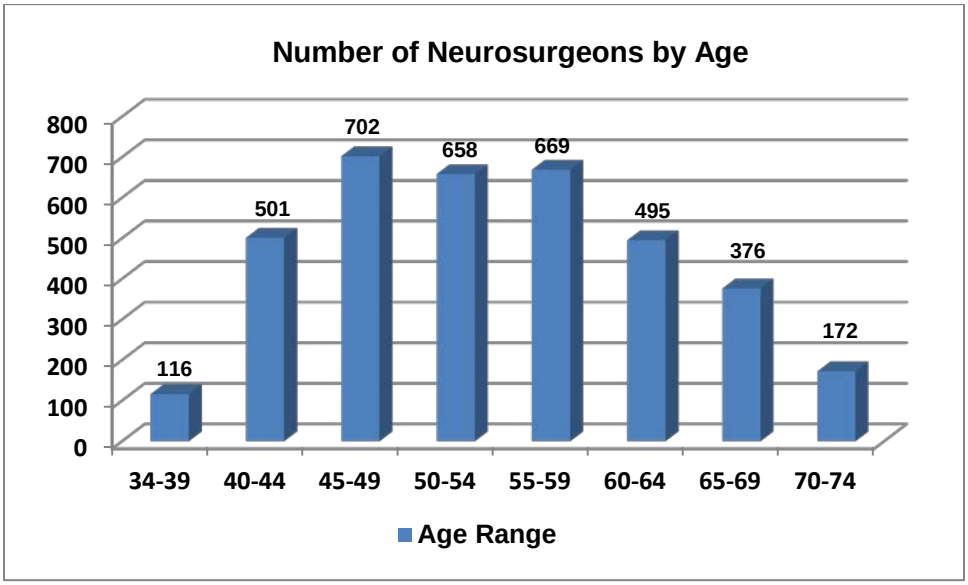

Figure 3: Distribution of board certified neurosurgeons by age cohort.

The pipeline for becoming a board certified neurosurgeon is long, so replenishing the neurosurgical workforce is no easy task. Following four years of medical school, seven years of residency training and perhaps an additional two years of fellowship training, it takes a neurosurgeon an additional three to five years to obtain board certification from the ABNS. The process for certification in neurosurgery is demanding, and requires, among other things, candidates to submit a detailed case log of 150 consecutive cases, as well as pass a rigorous oral examination. The residency and board certification processes are oriented towards developing and certifying safe, competent practitioners. Accordingly, significant alterations in developing a board certified neurosurgical workforce would require as much as 18 years from the start of medical school, and producing 160 neurosurgeons per year will certainly fail to keep pace.

Finally, a recent analysis of neurosurgical job vacancies confirms that the neurosurgical manpower shortage is upon us.[15] As of August 2011, 305 vacant neurosurgery positions in the U.S. were advertised.[16] Of these, 192 were for generalists, spine-focused neurosurgeons, or unidentified, whereas 113 were for subspecialists (Table 3). The largest category of subspecialists was neurovascular, followed by endovascular and pediatric, with 26 unspecified or other. Most of the postings were for hospital-employed positions, followed by private-practice, and academic.

[15] Couldwell WT, Rosman J, Cohen-Gadol A, Vogelbaum M. Is there a shortage of neurosurgeons in the US? *Neurosurgery* (in revision).

[16] Advertisements for U.S. neurosurgeons were collected during the first week of August 2011 from CNS.org, HealthCareers.com, Indeed.com, RosmanSearch.com, SimplyHired.com, and StJohnJobs.com and from 2010 issues of Journal of Neurosurgery and Neurosurgery. All duplicates were deleted. Information about the location, type of position, specialty, and mention of emergency department coverage was collected and associated with catchment area density data.

	Vacancies by Specialty Type	
Specialty	**Frequency**	**Percent**
Generalist	79	25.9
Spine	81	26.6
Other generalist	32	10.5
Specialists		
Pediatric	19	6.2
Endovascular	19	6.2
Neurovascular	49	16.1
Unspecified specialist	26	8.5
Total	**305**	**100.0**
Type of Practice	**Frequency**	**Percent**
Hospital Based	166	54.4
Academic	63	20.7
Private	71	23.3
Unspecified	5	1.6
Total	**305**	**100.0**

Table 3: Job vacancies by specialty based on the advertisements in print journals and on the internet

More Neurosurgeons are Needed to Meet Current and Future Needs

Although current neurosurgical workforce studies suggest that we have a sufficient number of neurosurgeons for the current population, numerous reports have begun to challenge the earlier studies as overly optimistic. The aforementioned studies by the AAMC and others have emphasized that the number of physicians trained in the U.S. has grown only slightly in the last twenty years, while at the same time demand for healthcare services is increasing due to an aging population and because more Americans have health insurance coverage. These factors, coupled with new neurosurgical treatments, too few pediatric neurosurgeons and neurosurgeons available to treat emergency and trauma care, and an aging neurosurgical population, clearly demonstrates that we should begin training additional neurosurgeons. Organized neurosurgery believes that these findings therefore invalidate the SOSSUS 1:100,000 ratio of neurosurgeons to general population, and even suggests that the current ratio of 1:61,000 may be inadequate to meet the country's needs. Indeed, current job vacancy data provides evidence to this effect, given that there are 305 openings in neurosurgery and it would take more than two years to fill just these vacancies.

An adequate supply of well-educated and highly trained physicians is essential in achieving access to quality health care services for all Americans. It is therefore essential that policymakers revisit current GME policy to ensure that our country has an adequate neurosurgical workforce for the 21st century.

II. INNOVATIVE TRAINING FOR THE NEXT GENERATION OF NEUROSURGEONS

As a specialty, organized neurosurgery has re-engineered our training programs in an effort to be more responsive to the concerns that have been raised by policymakers, educators and the public. This includes responding to the call to action brought forth by the Josiah Macy Jr. Foundation,

which sponsored an October 2010 conference in Atlanta Chaired by Dr. Michael M. E. Johns entitled "Ensuring an Effective Physician Workforce for America."[17] Of the seven primary questions asked by this workgroup, two dealt very specifically with oversight and governance of the GME system. The first relevant question asked: "Does the governance of GME promote or inhibit the changes that might be necessary?" The second question to this point was as follows: "Are GME programs optimally structured in duration and assessment to most efficiently produce the most highly qualified physicians for practice and leadership?"

This workgroup concluded that GME is a "public good" which is substantially financed by public dollars and therefore the system must be accountable to the public. Their conclusions also noted that there is a clear need to ensure that adequate numbers of physicians are trained to keep up with public health needs and that GME funding must keep pace with increasing numbers of medical graduates in order to ensure that independent practitioners will be available to the public. Recommendations of this workgroup included the need for an IOM Study of the governance and financing of GME, as well as to enable GME redesign through accreditation policy to ensure that institutional requirements are not excessively burdensome. Further recommendations emphasized the need for the encourage innovation and optimize the composition of the Residency Review Committees (RRC). The activities underway, under the leadership of Dr. Tom Nasca, CEO of the Accreditation Council for Graduate Medical Education (ACGME), go above and beyond the principles and recommendations of the Macy Foundation Report. Neurosurgery would like to take this opportunity to briefly discuss several of these initiatives.

The Next Accreditation System (NAS)

The ACGME has now launched an innovative new project, the Next Accreditation System.[18,19] The first seven specialties (including neurosurgery) began training in July 2012 and for this group, the NAS goes live in July 2013. The remaining medical and surgical disciplines will begin training in July 2013 and their NAS will go live in July 2014. The guiding principles behind the NAS are to reduce the burden of the longstanding accreditation process, free good programs to innovate, assist struggling programs to improve, and provide public accountability for educational and training outcomes. This new system will replace the periodic program reviews with a continuous accreditation model based on annual review of submitted data. The five-year site visits will be replaced by a ten-year self-study visit. It is envisioned that standards will be revised every ten years and will be organized by core processes, detailed processes, and outcomes.

The NAS is truly a substantial departure from the historic role that the ACGME and its RRCs have served. Based on an analysis of all ACGME accredited training programs, it is estimated that 75 to 80 percent of programs will remain on a path of continued accreditation, while ten to fifteen percent of programs will have difficulties -- leading to accreditation with major concerns, accreditation with warning, or probationary accreditation. Under the NAS, the very function of the RRCs will be substantially changed. It is envisioned that the committees will review programs on an annual basis, with data that is either reported by the programs or is electronically available. These annual reviews will likely include the following elements:

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[17] Josiah Macy Jr. Foundation. Ensuring an Effective Physician Workforce for America, Recommendations for an Accountable Graduate Medical Education System. Proceedings of a Conference Chaired by Michael M.E. Johns, October 2010; Atlanta, Georgia. New York: Josiah Macy Jr. Foundation; April 2011 (available at: http://bit.ly/VFcGXx).

[18] Nasca TJ, Miller RS, Holt KD: The Potential Impact of Reduction in Federal GME Funding in the United States: A Study of the Estimates of Designated Institutional Officials. *J Grad Med Educ.* 2011;3(4):585-590.

[19] Nasca TJ, Philbert I, Brigham T, Flynn TC: The Next GME Accreditation System Rationale and Benefits. *N Engl J Med.* 2012; 366:1051-1056.

1. Program Attrition – Changes in Program Director, Core Faculty, or Residents
2. Program Characteristics – Structure and Resources
3. Scholarly Activity – Both Faculty and Residents
4. American Board of Neurological Surgery (ABNS) Pass Rate – Rolling Rates
5. Resident Survey – Common and Specialty Elements
6. Faculty Survey – Core Faculty will be surveyed commencing December 2012 for Phase I Disciplines, including Neurosurgery
7. Clinical Experience – Case Logs or other Information that may be made available to the Committee
8. Semi-Annual Resident Evaluations and Feedback
9. Milestones

As a critical element of the NAS, the Milestones concept was based upon the need to have more objective and quantifiable goals during medical and surgical training. Trainees advance at differing paces throughout the general competency domains of patient care, systems-based practice, medical knowledge, practice-based learning, professionalism and communication. This asymmetry in the learning curve is made more dramatic in surgical disciplines where certain aspects of cognitive knowledge, as well as fundamental clinical skills, come much more rapidly than technical prowess in the most high complexity areas of surgery. For example, in complex cerebrovascular disease or cranial based tumors, this learning curve really only develops during the most senior years of a seven-year program. The program director and faculty can document observable steps on the continuum of increasing ability over time.

While experienced surgical educators intuitively recognize when residents are progressing well, historically we have had very few objective elements to measure. The Milestones are meant to facilitate this process and to include all six domains of clinical competency. The Milestones are created to demonstrate the trajectory from neophyte to independent practitioner with articulated and shared understanding of expectations as well as aspirational goals of excellence. These documents are not meant to represent a curriculum, but rather to track the most important aspects of the learning process. They can be thought of as biopsies into the basic knowledge and experiential capability of residents that should serve as a surrogate for their overall progress toward independent practice. These tools will involve Clinical Competence Committees in each training program, which will include at least one resident, and will represent a balanced means of fairly evaluating each resident as they progress through the training program. The Milestones are constructed using easily interpretable narratives that produce meaningful data without range restriction. In neurosurgery, the RRC will be able to use programmatic compilation of Milestone results to determine if a given training program is performing above, at, or below national norms. This will then give the RRC a tool with high specificity so that struggling programs can be assisted in the improvement process.

The Matrix Curriculum

The specialty of neurosurgery has been a leader in replacing the era of training as apprenticeship -- which has focused on service – with a deliberate patient-centered education that is focused on patient safety, clinical care outcomes and advancement of the science and practice of neurological surgery. We have taken the additional step of correlating the Milestones concept to an in-depth and comprehensive curriculum for the specialty. The SNS, comprised of educational and academic leaders -- including neurosurgical department chairs and residency program directors -- has developed this formal curriculum, known as the Matrix Curriculum.

Recognizing the need to develop a more robust process for lifelong learning throughout the duration of a neurosurgeon's career, in 2011 the SNS developed the Matrix Curriculum to unify all of the education, accreditation, and certification functions of our specialty. The curriculum aligns the educational goals of the SNS, the format of the ACGME Outcome (competencies) and Milestones projects, and the medical knowledge and technical skill components required by the ABNS for successful completion of residency and board certification in neurological surgery. The Matrix defines, by competency category, the objectives of training, teaching methods, assessment tools and educational goals at each training level as measured by the Physician Performance Diagnostic Inventory (PPDI).

The ACGME, and specifically the RRC for Neurological Surgery, defines the educational environment and the technical skills required for residents to successfully complete an accredited training program in neurological surgery. A surrogate for technical skill is the number and variety of procedures performed by the neurosurgical trainee. The total number of procedures performed by a resident during all years of training is one indirect means of assessing skill. More specifically, the accomplishment of a pre-determined number of procedures is another measure. In keeping with recent trends of surgical resident education, however, the RRC for Neurological Surgery has recently moved to change the concept of index cases, as measured by the individual resident's case volume expressed as a percentile rank of the totals for each index case compared to national statistics. Instead, the RRC has developed a new list of case categories with a minimum number of procedures required to satisfactorily complete a residency training program.

Once educational objectives have been defined, then teaching methods appropriate to the requisite knowledge or skills can be determined. Teaching methods may vary from didactic lectures, conferences, seminars, formal course work, case review, ambulatory clinic teaching, hospital teaching rounds, independent reading and study, web-based learning portals and on-line teaching modules, hands-on instruction in dissection laboratories, procedural mentoring in the operating room, peer-to-peer instruction, preparation of operative and sentinel case reports, and resident instructional "boot camps".

The Matrix Curriculum was so named, because it is multidimensional. It involves particular competencies, objectives, teaching methods, assessment tools, and educational goals. Further, the curriculum is training level specific, which means that it has the dimension of time -- that is to say, there are different expectations for junior, senior and chief residents. To better illustrate this program, several specific examples are presented below.

Knowledge of neuroanatomy is essential for a neurosurgeon, and a high degree of proficiency is expected. Level 4 is what is expected of a graduating resident, as reflected in the educational goals for overall training (Table 4).

Competency	Objective	Teaching Methods	Assessment Tools	Educational Goals
Medical Knowledge and Skills	Neuroanatomy	•Lecture series •Textbooks •AANS/SNS On-line modules •Resident courses •Bootcamps	•Inservice Exams •SANS •ABNS Primary Exam	Proficient (4)

Table 4: Overall medical knowledge in neuroanatomy for a Level 4 (graduating) resident.

In contrast, since training is level specific, the technical skills required of a Level 1 resident are limited, but proficiency within this limited domain is still the expected outcome (Table 5).

Competency	Objective	Teaching Methods	Assessment Tools	Educational Goals
Medical Knowledge (Technical Skills)	• Lumbar Puncture • Ventriculostomy • CSF Sample • Shunt tap • Traction • Stereotactic frame placement	•AANS/SNS On-line modules •Conferences •Supervised learning •Bootcamp	•Faculty and Program Director evaluations	Proficient (4)

Table 5: Technical skills expected for successful completion of Level 1 by a resident.

Of course, technical prowess increases with each level of training, such that the resident successfully completing training (Level 4) has achieved proficiency in all aspects of medical knowledge and technical skills. An example is the surgical approach to cerebral aneurysms, a technical skill for which a graduating resident should have achieved proficiency by the time of graduation (Table 6).

Competency	Objective	Teaching Methods	Assessment Tools	Educational Goals
Medical Knowledge (Technical Skills)	• Craniotomy for Aneurysm clipping • Aneurysm coiling	•AANS/SNS On-line modules •Conferences •Supervised learning	•Faculty/ Program Director evaluations	• Competent (3) • Early learner (2)

Table 6: Technical skills expected for the surgical approach to cerebral aneurysms for a Level 4 (graduating) resident.

Working closely with the leadership of all of the major neurosurgical stakeholders, a process for linking each ACGME Milestone to the elements of the Matrix Curriculum will now pivot on our new Web Portal,[20] which will facilitate Milestone assessment and tracking.

[20] Organized neurosurgery has committed to the development of a web-based portal, which will be used as a means to provide targeted educational opportunities as well as track the participation and results of the educational activities across the spectrum of professional development. The initial content is based entirely on the Matrix Curriculum approved by the ACGME and RRC for Neurological Surgery. Each curriculum element is linked to educational content provided by the national neurosurgical societies, which a resident can use to develop competencies relevant to educational milestones. Program directors are informed of resident participation in didactic activities. Furthermore, the portal will contain information for the program director regarding agreed upon standards for the achievement of competency for the individual milestones. The unique features of the portal relate to the ability to deliver educational content specific to the learning needs of the resident irrespective of level and the ability to help program directors ensure that basic competencies are met using similar metrics regardless of program location.

The Matrix Curriculum defines, for the first time, the roadmap for residency training in neurological surgery. It has the further advantages in that it adheres to the ACGME format, it uses established goals of the ABNS and RRC for Neurological Surgery, and it acknowledges the ACGME levels of training. Expert faculty educators at each individual training program teach the majority of Matrix Curriculum elements. In two circumstances, however, national educational resources, marshaled by the SNS, are brought to bear as part of coordinated and systematic regional courses:

1. At key points in training (such as inception), fundamental skills and attitudes closely related to patient safety, clinical outcomes, and educational success, are taught collaboratively by faculty with carefully designed educational processes in place.

2. Particular cognitive, behavioral, and technical skills that merit deliberate practice in faculty mentored, simulated environments, prior to live clinical training, are also taught regionally, in order to leverage complex or expensive educational resources.

The Neurosurgical Boot Camp

Neurosurgery was the first specialty to institute this approach for an entire cohort of resident trainees at the national level, with a deliberate and approved central curriculum. In 2009, pilot 'Boot Camp' courses teaching fundamental professional and technical skills, knowledge and attitudes were launched in Portland, Oregon, and Chicago, Illinois, with participation at each regional course by multiple residency programs.[21] With sponsorship from, and further curricular development by, the SNS, the 'Boot Camp' fundamental skills courses were held at 6 regional centers for 94 percent of U.S. ACGME accredited program neurosurgery residents in 2010, expanding to 100 percent of programs and residents in 2011 and ever since.[22]

The SNS Boot Camp courses teach procedural skills that must be mastered early in residency, such as lumbar puncture and drain placement, as well as cognitive and behavioral skills, such as clinical decision making during an acute neurological deterioration (Figure 4). In both cases, residents learn using model based simulators and explicit curricula, with direct faculty mentoring.

Figure 4: Trainees at neurosurgical Boot Camp course use model based simulators for (left) technical skill learning (lumbar drain placement) and (right) cognitive/behavioral skill learning (acute neurological deterioration).

[21] Selden, NR, Barbaro, N., Origitano, T.C., and Burchiel, K.J. (2010) Fundamental skills for neurosurgery interns: Report of a western region 'boot camp' pilot course. *Neurosurgery.* 2009;68(3):759-764.

[22] Selden, NR, Origitano, TC, Burchiel, KJ, Getch, CC, Anderson, VC, McCartney, S, Abdulrauf, SI, Barrow, DL, Ehni, BL, Grady, MS, Hadjipanayis, CG, Heilman, CB, Popp, AJ, Sawaya, R, Schuster, JM, Wu, JK, and Barbaro, NM (2011) A systematic fundamentals curriculum for incoming neurosurgery PGY1 residents: The 2010 Society of Neurological Surgeons boot camp courses. *Neurosurgery*. 2012;70(4):971-81.

Illustrating the New System of Training

A clinical vignette is useful to tie together the strategy and impact of deliberate neurosurgical education in the new era. A previously independent and vigorous elderly patient presents with a hypertensive cerebellar and intraventricular hemorrhage, lethargic. She will be cared for by a neurosurgical team that must be familiar with best practices for advanced directives, communicate well with her family, be cognizant of relevant medical ethics doctrines, be professionally dedicated to timely, patient-centered care, and be excellent at the simple but technically demanding and risky ICU procedure -- ventriculostomy placement -- if a decision is made to try and save her life. The patient and her family, entrusted to an expert team for this highly impactful care episode, must count on their neurosurgeon's explicit training in, and mastery of, these multiple complex areas of clinical competency, as reflected in the **Neurosurgery Matrix**. The granular outcomes of that training will have been tracked and reported using the **Milestones**. Many of the pivotal training experiences and safety checks for their surgeon (simulated ventriculostomy placement, teaching of professionalism principles, structured teaching of how to break bad news, etc.) will have occurred first in a simulated and mentored educational environment, such as the neurosurgical **'Boot Camp' courses** (Figure 5).

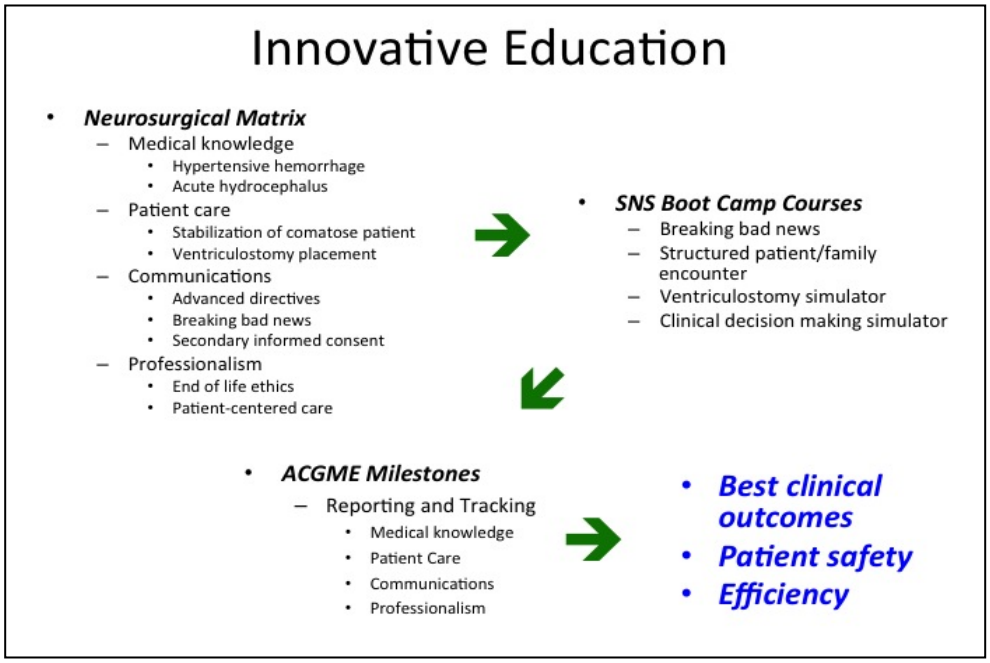

Figure 5: The role of innovation in modern neurosurgical education: The *Neurosurgery Matrix*, milestones, and Boot Camp courses.

Neurosurgery Leading the Way

Episodes of neurosurgical care such as the one in this vignette are associated with the expenditure of huge health system resources and have tremendous impact on quality of life and clinical outcomes -- disproportionate to the size of our specialty and to the number of individual encounters. The complex medical, social and ethical dimensions of these interventions preclude substituting mid-level providers, such as physician assistants and nurse practitioners, for the neurosurgeon. Many neurosurgical care episodes are concentrated at the extremes of age (i.e., at the beginning and end of life), focus on an unforgiving nervous system, and/or require continuous subspecialty coverage for stroke, hydrocephalus, and neurotrauma, and thus have tremendous impact on both healthcare and health system outcomes. For these reasons, neurosurgical educators have passionately embraced the modern era of medical education and training as a method of improving the outcomes of our patients and for advancing our specialty. Neurosurgery

has emerged as a leader and innovator, and is therefore an area of medical practice that should be targeted for additional support and enhanced attention to educational best practices, rather than cuts in economic support.

Existing challenges to safe, effective, and efficient GME are constantly evolving. Meeting these challenges requires, in part, prospectively designed, carefully supervised, and patient-centered innovation.[23] The specialty of neurosurgery is highly committed and uniquely positioned to design, study, implement, and disseminate innovative educational approaches in a technologically intensive, acute care, high impact setting. Neurosurgery already has a substantial record of accomplishment in this regard and is poised to add further value to American medicine.

III. RECOMMENDATIONS FOR THE FUTURE

Over the coming decade, neurosurgery will face substantial challenges. We will be challenged by the rapid increase of knowledge and new technology in our field. This knowledge and technology will open a wide range of neurobehavioral disorders to neurosurgical treatment. We will be challenged by demands on us to treat an aging population at increased risk from cerebrovascular disease, neuro-oncological disease, neurodegenerative disease and degenerative spine disease. We will be challenged by the implementation of the Patient Protection and Affordable Care Act (ACA), with its promise of expanded access to care for 30 million people and a higher quality of care for all. One essential challenge to overcome, if we hope to meet the others, will be financing a GME system that will produce the increasing numbers of highly trained neurosurgeons who will be needed to treat an ever-expanding patient population.

Ensure a Workforce of Sufficient Size and Specialty Mix and Strengthen Linkage of GME Funding to ACGME-Approved Training Programs

The magnitude of the physician workforce shortage projected in several reports emphasizes the need to expand GME to train additional physicians – primary care and specialty care alike. Although the number of medical students being trained in the U.S. is increasing due to the opening of new medical schools and expanding the class size of existing schools, no increase in the number of practicing physicians will occur unless the number of residency positions is increased. It is not the number of medical students trained, but rather the number of positions in the GME system that determines the supply of physicians. In recognition of the need to increase the size of the physician workforce, and the time it takes for a resident to finish training, it is essential that we approach this problem with a sense of urgency. Additionally, it should be noted that the reports of physician workforce shortage do not address how changing technology may also affect the need for various specialists. This is of particular importance to neurosurgery, where advances in neuroscience and neurosurgical technology make it likely that many patients with neurobehavioral disorders -- from depression and obsessive-compulsive disorder to addiction and obesity -- may optimally be treated by non-destructive neurosurgical procedures.

To best serve the public, the GME system must ensure that medical school graduates are prepared to provide high quality care in each specialty of medicine upon the completion of residency training. It then follows, that the financing system should be better aligned with the current ACGME accreditation process – both at the institutional and program level. Currently, Medicare does not provide full direct GME financial support for the length of training required for a resident's initial board certification in several specialties – including neurosurgery. Rather, full support is only provided for the first five years and then the direct GME payment is reduced by fifty percent for years six and seven. To better strengthen the linkage of GME funding to ACGME-

[23] Rosenbaum, L., Lamas, D. (2012) Residents' duty hours – towards an empirical narrative. *N Engl J Med*. 2012;367(21):2044-2049.

approved training programs, organized neurosurgery believes that it is imperative that GME funding should be expanded to fully cover the entire length of training required for initial board certification. In addition, institutions should be accountable to program directors by reporting GME funding at the program level and an appeals process should be established if funding is withheld or diverted at the institutional level.

Fifteen years ago, Congress took steps to control GME spending by including provisions in the Balanced Budget Act (BBA) freezing Medicare's support for physician training at 1996 levels. As noted above, however, unless the number of funded residency training positions expands at the nation's teaching hospitals, the U.S. will face a declining number of physicians available to treat our country's growing population. Thus, in addition to expanding GME support for the full length of training, Congress must eliminate Medicare's caps on GME financing and provide support for all ACGME-approved residency training programs.

Maintain Funding for Children's Hospital GME

The Children's Hospital Graduate Medical Education (CHGME) payment program must also be continued. Originally authorized by Congress in 1999, the CHGME has provided federal funds to those children's hospitals that have graduate medical education programs. Since its implementation in 2000, the program has allocated more than $2.5 billion dollars to children's hospitals that support residency training. Children's hospitals supported through the program train general pediatricians, pediatric medical subspecialists, pediatric surgical subspecialists, adult medical subspecialists and dentists. As of 2010, the program has supported 56 children's hospitals located in 29 states and Puerto Rico and has provided support for 5,800 residents. In fiscal year 2011, $268 million was appropriated for the CHGME program and it is essential that funds for this program continue.

Provide Additional Financial Support for GME

A fundamental challenge facing the GME system in the coming years is how resident physician training will be financed. We recognize that with the country's current financial crisis and the political pressure to decrease Medicare spending, growth in Medicare funding for GME will be a challenge. Because of the BBA caps, we estimate that less than half of the real costs of resident training are presently borne by Medicare. Additional funds are contributed from hospital margins and professional revenues. The ACA will decrease both of these, making it more difficult for hospitals and physician groups to subsidize GME. A clear plan needs to be developed for how Medicare and other sources of funding will contribute to financing GME in the future.

New sources of funding for GME also need to be considered. A number of mechanisms have been proposed by a variety of stakeholders over the past decade. These include all-payer systems and other alternatives to the current Medicare dominant approach. In an all-payer system, private insurance companies would be required to explicitly fund GME. It should be noted, however, that many private insurance companies already contribute indirectly but substantially to GME financing via payments made to teaching hospitals and physicians for patient care. If explicit GME funding resulted in lower hospital and physician reimbursement, it is likely that little real benefit for GME funding would occur. One option to consider would be to have all private payers contribute to a financing pool for GME and allow these companies to include such contributions as part of their medical loss ratio. State and local governments could also contribute funds to support GME needs, as much of the benefit from GME accrues to the population in the vicinity of academic health centers and other resident teaching venues. Because GME is in fact a public good, we must find the resources to continue to support the education and training of our physician

workforce to ensure that the U.S. continues to have one of the preeminent healthcare systems in the world.

Ensure that the ACGME Retains its Preeminent Role in Overseeing GME

Because GME is a public good and is significantly financed with public dollars, the GME system must be accountable to the needs of the public. The ACGME, which serves as the accrediting body for more than 8,800 medical residency programs, is charged with setting and enforcing standards to ensure that trainees obtain the needed skill sets through innovative training that will better prepare residents for a changing practice environment. Organized neurosurgery firmly believes that the ACGME has demonstrated time and time again that it is *the* single most appropriately qualified entity to oversee and govern GME in the United States. Working with its Residency Review Committees and other stakeholders in the GME enterprise, the ACGME is a dynamic body that continues to promote an education and training paradigm that is patient-centered, efficient, effective, and adaptable to the ever-changing needs of a diverse population. It is therefore essential that the ACGME retain its preeminent role in overseeing graduate medical education.

IV. CONCLUSION

It is essential that our country support the education of physicians to provide care for all Americans now and well into the future. This will require an enduring system that takes the best of the current system and enhances it with sustainable financing and a learning environment that meets the needs of the public and carries physicians forth into a lifetime of practice in medicine. We must encourage high-performing programs to innovate and work to create a system that will raise the quality bar for all residents and training programs. Neurosurgery has taken steps in this direction, and it is important that the entire GME system is capable of embracing these changes.

As noted in the summary of the second Macy GME conference[24]

> It is critical that all GME stakeholders recognize both the urgency and the opportunity of reform. Failing to accomplish necessary change will leave an enlarging gap between society's needs and what the graduates of our GME system can provide. We have the tools, talent, and commitment to accomplish reform of the GME system and must seize this moment to ensure that current and future patients get the care they need and deserve.

Organized neurosurgery stands ready to work with policymakers to meet this challenge.

[24] Josiah Macy Jr. Foundation. Ensuring an Effective Physician Workforce for America, Recommendations for Reforming Graduate Medical Education to Meet the Needs of the Public. Proceedings of a Conference Chaired by Debra Weinstein, May 2011; Atlanta, Georgia. New York: Josiah Macy Jr. Foundation; November 2011 (available at: http://bit.ly/U4EZBD).