Introduction to Neurosurgery

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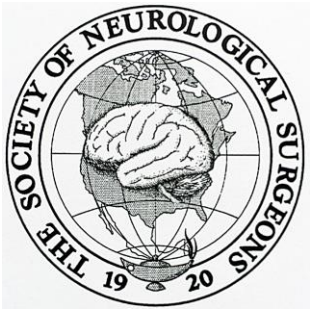

THE SOCIETY OF NEUROLOGICAL SURGEONS

Disclosures

- No commercial interests

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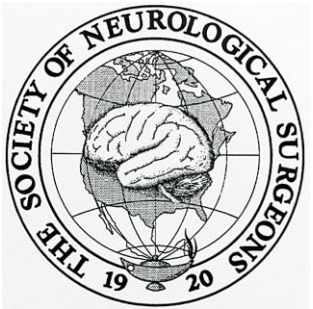

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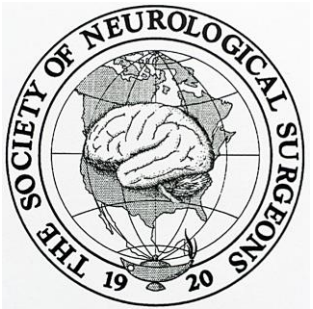
Definition of Neurosurgery



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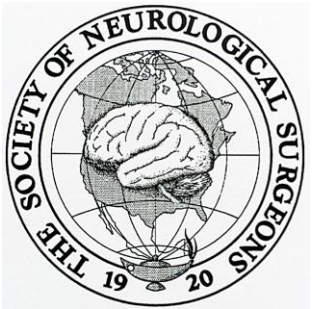
Neurosurgery

- Constitutes a medical discipline and surgical specialty that provides care for adult and pediatric patients in the treatment of pain or pathological processes that may modify the function or activity of the central nervous system (e.g. brain, hypophysis, and spinal cord), the peripheral nervous system (e.g. cranial, spinal, and peripheral nerves), the autonomic nervous system, the supporting structures of these systems (e.g. meninges, skull & skull base, and vertebral column), and their vascular supply (e.g. intracranial, extracranial, and spinal vasculature).
- Treatment encompasses both non-operative management (e.g. prevention, diagnosis – including image interpretation – and treatments such as, but not limited to neurocritical intensive care and rehabilitation) and operative management with its associated image use and interpretation (e.g. endovascular surgery, functional and restorative surgery, stereotactic radiosurgery, and spinal fusion – including its instrumentation).

American Board of Neurological Surgery, Definition of Neurological Surgery

History of Neurosurgery



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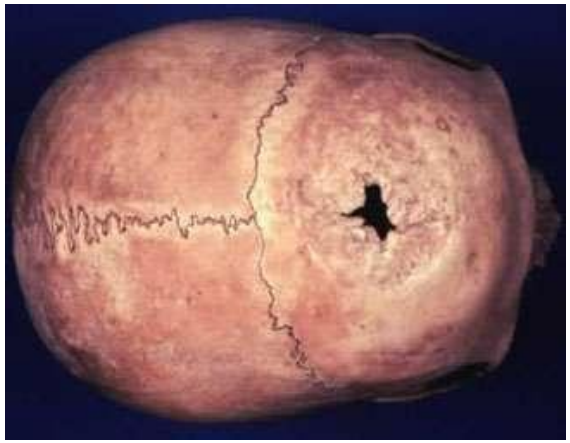
History of Neurosurgery

- Evidence suggests that the first trepanations may have occurred up to 10,000 years ago
- 460-370 BC Hippocrates describes types of trauma in which trepanation may be performed
- 129-200 AD Galen describes trepanation for hydrocephalus



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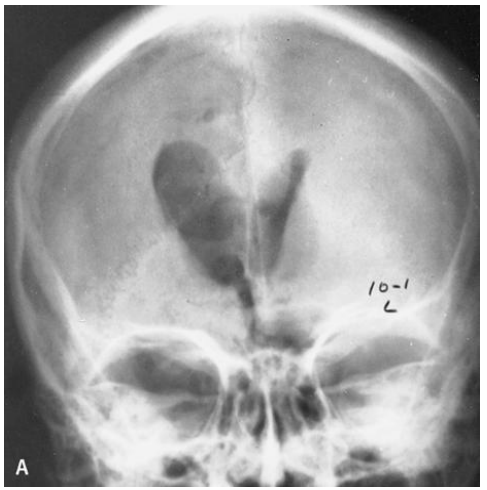
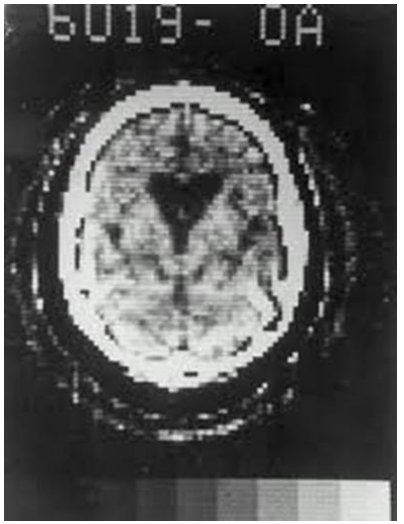
History of Neurosurgery

- Pierre Paul Broca localizes and drains brain abscess 1876 in Paris
- Sir William Macewan excises meningioma in 1879, performs laminectomy in 1883

History of Neurosurgery

- 1918 Walter Dandy develops pneumoencephalography
- 1927 Egas Moniz performs cerebral angiography
- 1971 Godfrey Hounsfield & Allan Cormack develop CT scan; won Nobel Prize in 1972





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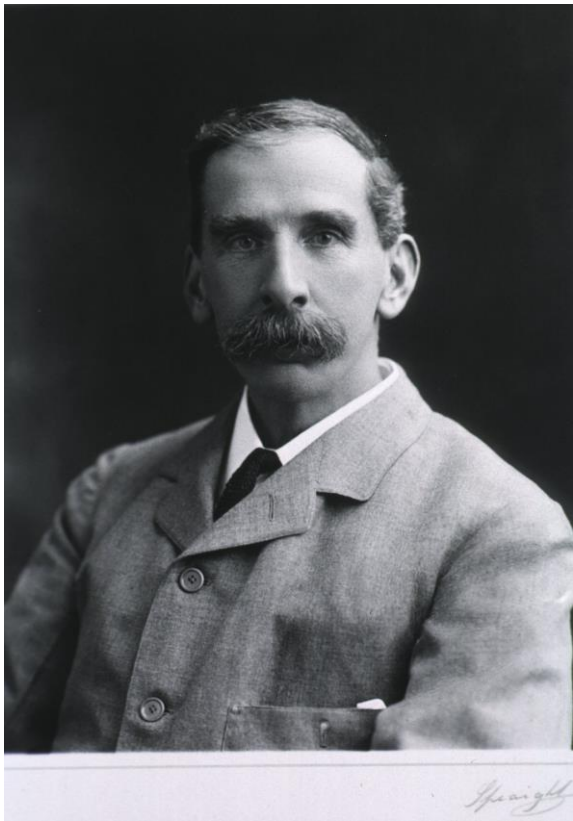
History of Neurosurgery

- Sir Victor Horsley (1857-1916)
  - Intraoperative cortical stimulation to localize epileptic foci
  - Bone wax
  - Transcranial approach to pituitary
  - Ligation of carotid artery to treat aneurysm
  - Intracranial division of trigeminal nerve root to treat trigeminal neuralgia
  - Horsley-Clarke stereotactic frame



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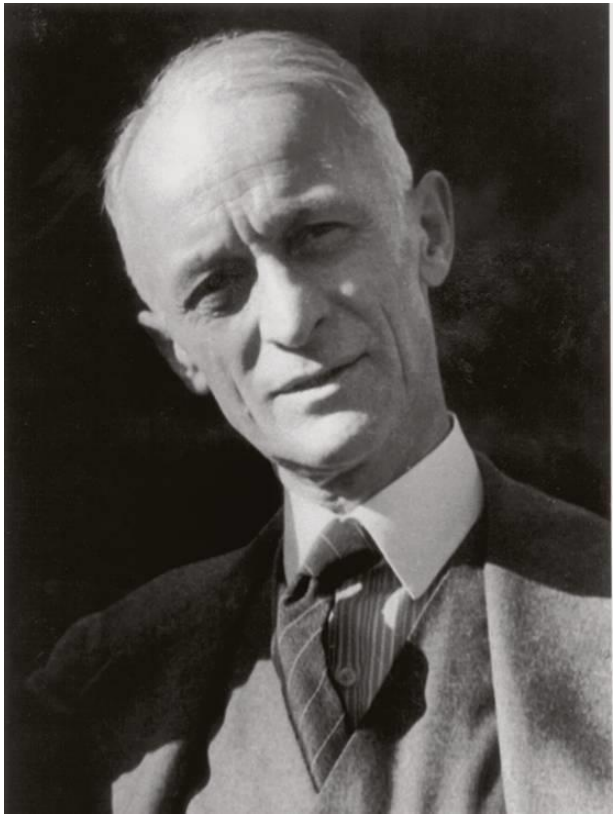
History of Neurosurgery

- Harvey Cushing (1869-1939)
  - Developed anesthesia record
  - Cushing response to intracranial hypertension
  - With Bovie developed electrocautery
  - Function of the pituitary gland – Cushing's disease
  - Reduced mortality from neurosurgical operations from 80-90% down to 10%
  - Father of American Neurosurgery



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History of Neurosurgery

- Walter Dandy (1886-1946)
  - Trained under Cushing
  - Described CSF physiology and hydrocephalus
  - Developed pneumoencephalography
  - Dandy-Walker malformation/syndrome
  - First described clipping of cerebral aneurysm 1938

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History of Neurosurgery

- Wilder Penfield (1891-1976)
  - Modernized epilepsy surgery
  - Research utilizing intraoperative electrical cortical stimulation
  - Published first homunculus
  - Penfield's syndrome

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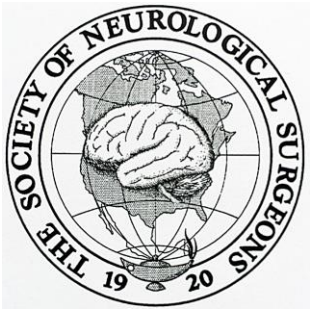
Neurosurgery Practice Demographics



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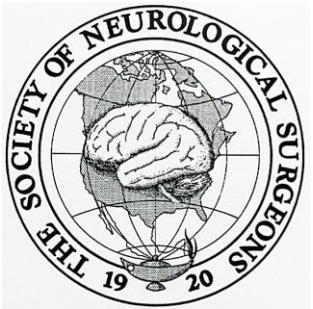
Neurosurgeons in US

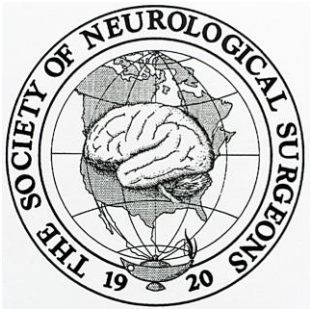
- Approximately 3800 practicing neurosurgeons in the US



Demographic Profiles

	2011	2006
Gender		
Male	90%	91%
Female	10%	9%
Age		
Younger than 35	3%	4%
35-45	35%	40%
46-55	35%	37%
56-65	23%	15%
Older than 65	4%	4%
Nationality		
Caucasian	76%	80%
Asian	12%	9%
African-American	2%	2%
Hispanic	5%	4%
Other	5%	4%

	2011	2006
Years in Practice		
Less than 10 years	28%	35%
10-19 years	36%	36%
20-29 years	25%	21%
30-39 years	9%	7%
40 years or more	1%	0%
I am no longer practicing	1%	0%
Primary Practice Region		
South Atlantic	19%	19%
Pacific	16%	13%
East North Central	14%	17%
Middle Atlantic	12%	11%
West South Central	11%	10%
East South Central	9%	8%
West North Central	9%	7%
Mountain	7%	6%
New England	4%	6%
Non-US or blank	1%	2%



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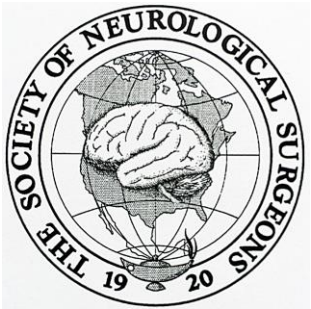
Demographic Profiles

Type of Practice	2011	2006
Private practice	48%	49%
Private practice *(Academic affiliate or appointment)*	19%	20%
Full-time academic	30%	28%
Military	1%	1%
Other (Federal government)	2%	1%

Neurosurgery Practice Setting	2011	2006
Neurosurgical group practice *(2-5 neurosurgeons)*	29%	34%
Neurosurgical group practice *(6-15 neurosurgeons)*	20%	22%
Neurosurgical group practice *(16+ neurosurgeons)*	6%	4%
Multi-specialty group practice *(2-5 physicians)*	14%	3%
Multi-specialty group practice *(6-15 physicians)*	11%	7%
Multi-specialty group practice *(16+ physicians)*	3%	11%
Solo	13%	16%
Solo practice, shared facilities	6%	4%

Procedure Setting		
Hospital	96%	95%
Freestanding Surgical Center	3%	3%
Other	0%	2%
Office Facility	1%	0%



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Reported Procedures Performed in 2011 by Specialty

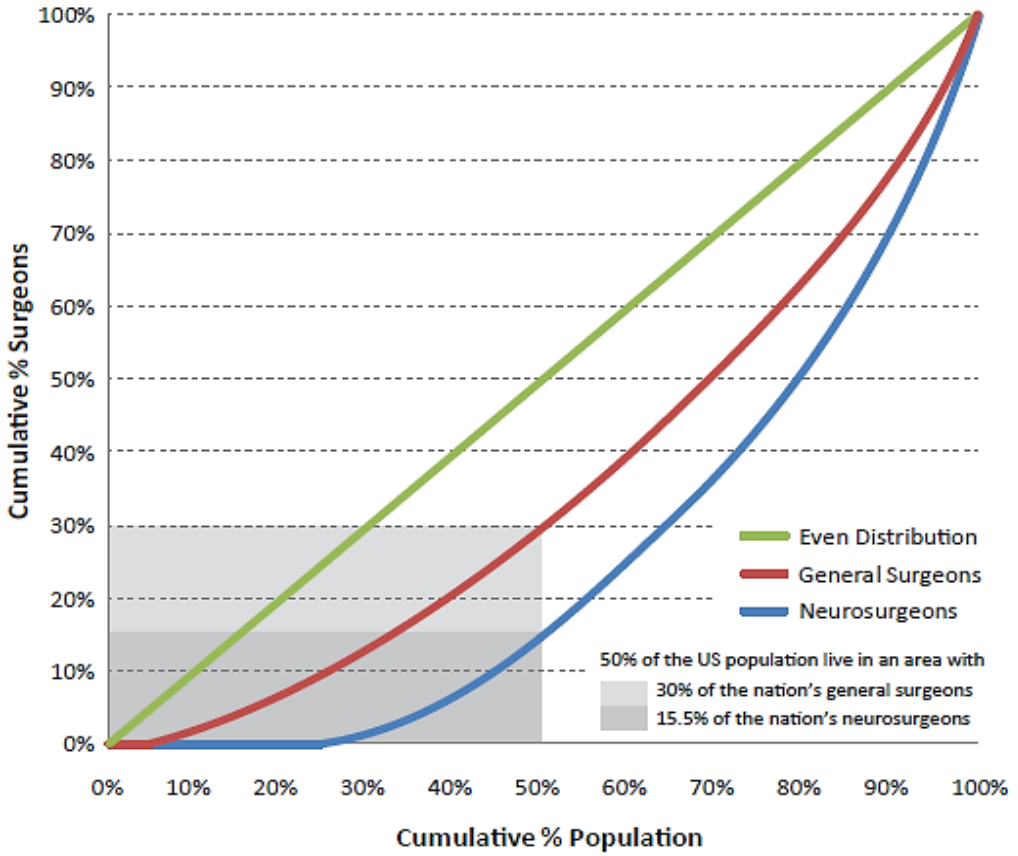
Type of Procedures Performed	Total Procedures Performed
Spine	1,448,400
Cranial	579,376
CSF Shunting	103,895
Pain/Interventional/Functional	59,605
Peripheral Nerve	55,992
Catheter/Endovascular/Percutaneous	42,193
Extracranial Cerebrovascular	6,870
TOTAL	**2,296,331**

Note: The annualized total procedures performed by all U.S. Neurosurgeons in 2011 is estimated at 2,296,331. This estimate is based on survey responses provided by a portion of membership that participated in the 2011 survey and provided procedure data.

Maldistribution of Surgeons

- 25% of the U.S. population lives in county w/out a neurosurgeon

- 50% percent of the U.S. population lives in counties w/ 15.5% of neurosurgeons



Source: American College of Surgeons Health Policy Research Institute

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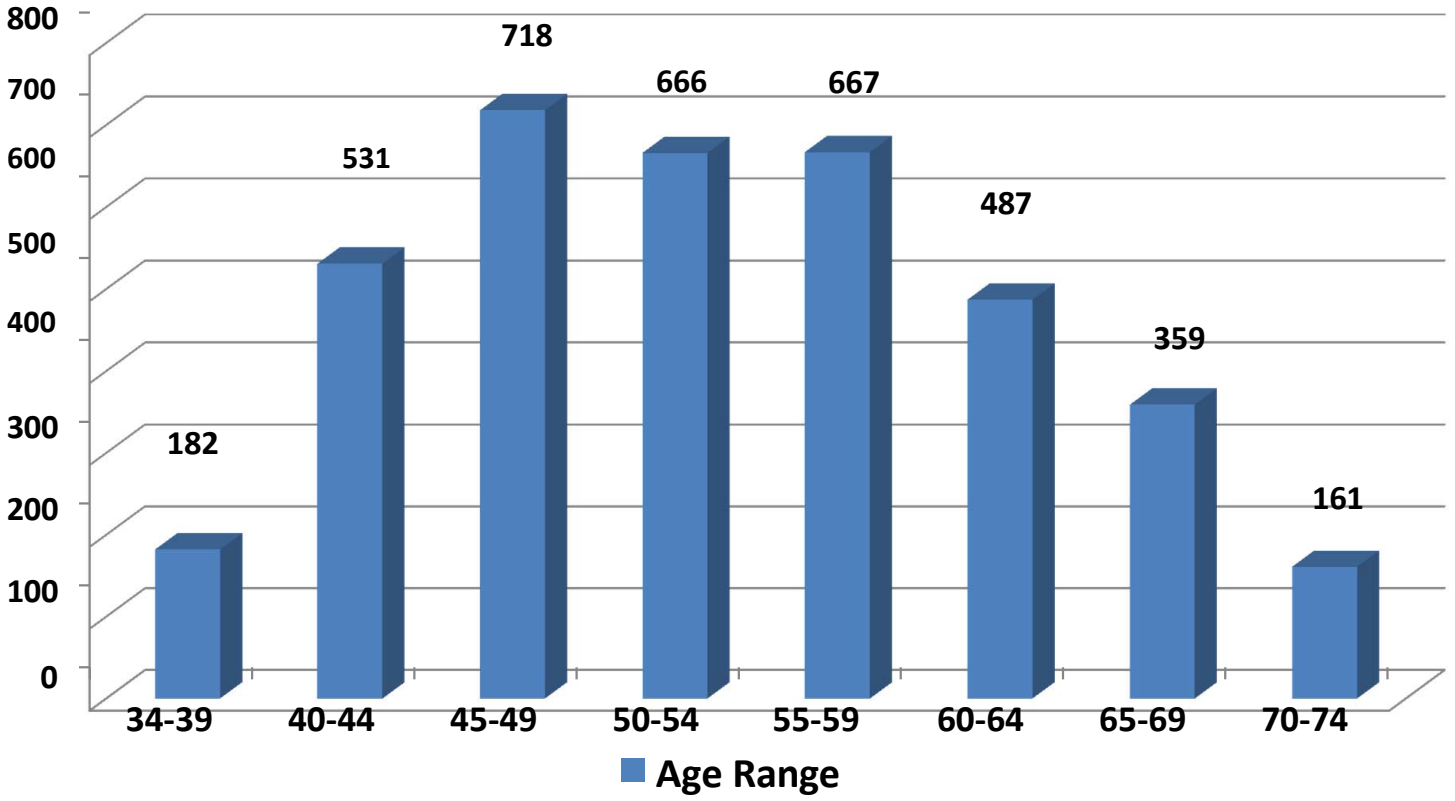
Number of Neurosurgeons by Age



44% of practicing neurosurgeons over the age of 55

Source: American Board of Neurological Surgery

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Neurosurgical Workforce Shortages

- Only 83% of neurosurgeons take emergency call 24/7/365
- 178 board certified pediatric neurosurgeons
  - 42% will retire within the next decade
  - Only 6 enter workforce each year, falling short of demand
- 305 vacant neurosurgery positions in the U.S. in 2011
  - 192 generalists, spine-focused neurosurgeons, or unidentified
  - 113 subspecialists, including neurovascular, endovascular, pediatric

Sources: Neurosurgery Statement to IOM -- Ensuring an Adequate Neurosurgical Workforce American Board of Neurological Surgery

Neurosurgery Compensation

	Mean	Median	90th percentile
Overall	$812,079	$670,100	$ 1,417,038
Private practice	$924,426	$759,662	$1,707,635
Academic	$675,521	$569,529	$927,093

Sources :NERVES 2014 report based on 2013 data

Neurosurgery Malpractice Insurance

	Mean	Median	90th percentile
Overall	$50,723	$42,290	$ 89,672

Sources :NERVES 2014 report based on 2013 data

Neurosurgery Residency Match Data

Year	PGY 1 Applicants	Positions Offered	Positions Filled	Percent Filled
2009	317	191	191	100.0
2010	309	191	188	98.4
2011	283	195	192	98.5
2012	318	196	194	99.0
2013	314	204	203	99.5
2014	335	206	206	100.0

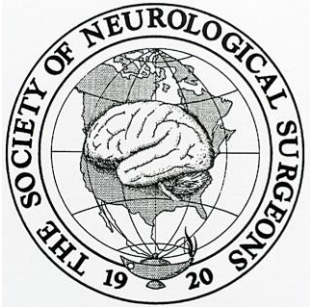
Source: National Residency Matching Program

Neurosurgical Subspecialties

- Spine
- Peripheral Nerve Surgery
- Vascular Neurosurgery (open and endovascular)
- Neuro-Oncology
- Neuroendocrinology
- Skull Base Neurosurgery
- Pediatrics
- Functional Neurosurgery
- Neurocritical Care

Residency Training:

- Year 1: Internship year: May include some rotations outside neurosurgery like ICU, trauma surgery, neurology.
- Year 2: Junior resident: Learning the basics of neurosurgical assessment, patient management, and surgical procedures
- Year 3: Senior resident: Learning more advanced degrees of patient care and surgical procedures
- Year 4/5/6: There are frequently some permutation of pediatric neurosurgery, neurological electives, research (3mons to 2 years), and directing some services at a Chief Resident level of management
- Year 7: Chief Resident: Learning how to direct a large neurosurgical service, transition toward being able to independently do the routine neurosurgical procedures



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The Spectrum of Neurosurgery Residencies

- Residencies vary in size with some programs matching 1 resident a year up to 4 residents per year
- Residencies vary in regard to the cities in which they reside: Some are in large metropolitan centers with many large academic centers while others are in relatively smaller cities
- Residencies vary in regard to the degree of research time that is incorporated into the curriculum however research is a part of all residency programs
- With more than 105 programs, there are a wide range of “personalities” of residencies

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Conclusions

- Neurosurgery is a rewarding and intellectually stimulating career
- Opportunity to profoundly affect the lives of patients, often times to save lives
- Multiple subspecialties with diverse diseases and different types of procedures, or general neurosurgeon who can have a broad practice
- Current and future shortage of neurosurgeons so need for more neurosurgeons