Neurosurgical manpower: the physician's viewpoint

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This paper reports a national study of physicians in 24 medical and surgical specialties, and reveals the opinions of neurosurgeons and their professional colleagues with regard to the adequacy of the supply of neurosurgical manpower. Among neurosurgeons, 30.4% believe the supply to be excessive, 60.1% think it is about right, 7.5% believe that there is a shortage, and 2.0% have no opinion. Neurologists' opinions do not differ significantly from those of neurosurgeons, but physicians and surgeons in 22 other specialties are significantly less likely to regard the supply as excessive, and are more likely to perceive a shortage. Primary care physicians, as a group, are most likely to perceive a shortage, and least likely to indicate an excess. Among the 24 specialties studied, 9.3% of physicians believe the supply of neurosurgeons to be excessive, 55.1% think it is about right, 22.9% believe that there is a shortage, and 12.8% have no opinion.

KEY WORDS • neurosurgical manpower • medical specialists • surgical specialists • manpower survey

The geographic and specialty distribution of physicians has been of great concern since the mid-1960's. There is no evidence to suggest that this interest is waning; indeed, it most likely will remain a concern to educators and health planners who strive to initiate programs to balance available supply of manpower with needs and demands for particular services. Recent reports on manpower requirements pertinent to neurosurgical needs have tended to consider them independently from the overall distribution of medical manpower and from aggregate surgical staff requirements; these reports note that trends in this specialty seem to be inexorably tied to technological advances in the field, and that the future growth of the specialty appears to be strongly contingent upon continued advances in research. A recent review of the plethora of articles on neurosurgical manpower requirements that appeared during the 1970's has indicated that this literature varies markedly with regard to methods, assumptions, and conclusions. The suggestion has been made that the available data on neurosurgical manpower are simply not amenable to the derivation of definitive conclusions.

Studies of physician manpower requirements can be separated into two models: demand-based and needs-based. Demand-based models relate manpower requirements to utilization patterns of a population, whereas needs-based models take into account the capacity of medicine to deal with the physical ailments of mankind by means of well defined technology. Many problems are inherent within each of these models. For example, a population may demand more than is necessary if ability to pay for the service is not a barrier to its receipt, whereas epidemiological data may not be accurate enough to determine need.

Each of these models was represented by a major study of neurosurgical manpower during the 1970's. The Study on Surgical Services for the United States (SOSSUS) found that the demand for specialized neurosurgical procedures, such as craniotomies, was "surprisingly low" and concluded that this "raises serious questions as to whether the volume and type of clinical work is sufficient to maintain high levels of clinical competence for large numbers of practicing neurosurgeons." The SOSSUS study concluded, largely on the basis of surgical workloads, that there was an immediate need for a 20% reduction in the number of new neurosurgeons, and that the subsequent growth of the specialty should be limited to a 1% increase in the number of Board-certified neurosurgeons per 100,000 population every 5 years. More recently, a study conducted by the Graduate...
Medical Education National Advisory Committee (GMENAC) employed an "adjusted needs-based" model to project neurosurgical manpower needs in 1990. The study foresees a 70% increase in the number of neurosurgeons between 1978 and 1990 (from 3000 to 5100), but projects a need for just 2793 in 1990, resulting in a 92% excess in supply.8,17

The American Medical Association (AMA) has taken issue with many of the recommendations that arose from the GMENAC projections, one of which "assumes that the medical profession agrees that there is a physician oversupply in need of correction."2 In the case of neurosurgery, however, there are empirical data that bear upon the way in which the profession views itself. In 1972, when there was approximately one neurosurgeon per 75,600 population in the United States,5,16 the SOSSUS study asked neurosurgeons and all other surgeons about the adequacy of neurosurgical manpower in their communities. Of the 169 neurosurgeons who responded, 10.7% said that there was a shortage, 58.0% said that the supply was about right, and 31.3% thought that there was an excess. Of the other 5313 surgical specialists who replied, 27.5% thought that there was a shortage, 54.2% said that the supply was about right, 6.1% thought that there was an excess, and 12.2% had no opinion.21 In 1975, when the supply of neurosurgeons had grown to one per 72,800 population,5,16 two studies investigated neurosurgeons' opinions regarding the overall supply of neurosurgeons in the United States. Of 132 neurosurgeons who took part in a Surgical Neurology study, 61.1% thought that there were too few neurosurgeons, 51.5% that there were about the right number, and 42.4% that there were too many neurosurgeons.4 Similarly, a study conducted by the Neurosurgical Manpower Monitoring Committee of the American Association of Neurological Surgeons (AANS) in 1975 found that "5% felt there were too few neurosurgeons, 50% felt there were enough and another 45% indicated there were too many as of this time."17

While the phrasing of the 1972 and 1975 surveys of neurosurgeons differs (manpower in "your community," versus "in the nation"), presumably neurosurgeons' perspectives of national manpower derive primarily from personal experience in their own practice locations, and thus the results are comparable. Assuming that this is true, the apparent change in neurosurgeons' opinions as to the adequacy of the supply of neurosurgical manpower, although this supply actually grew between 1972 and 1975, serves to establish the validity of this type of question as a relative barometer of manpower trends as seen from within the specialty. Also, the pronounced differences in opinion regarding neurosurgical manpower as expressed by neurosurgeons and by their surgical colleagues in the SOSSUS study point to the importance of gauging specialty manpower requirements from more than one perspective.

Recognizing that most patients receive neurosurgical care as a result of referral from other physicians,13,19 the study reported here was conducted under the assumption that the referring physician is the objective arbitrator of the differences between demand and need. It was further assumed, based upon the first author's experience in both private and academic neurosurgical practice, that: 1) primary care physicians can be grouped together by their patterns of referrals, and tend to refer patients in an elective manner; 2) surgeons can be grouped together by their patterns of referral, and tend to refer emergency patients; and 3) the nonprimary care nonsurgeons refer relatively less to neurosurgeons than do other physicians; rather, they receive referrals or requests for consultations from neurosurgeons.

Study Method

This investigation was part of a nationwide study of practitioners of 24 medical and surgical specialties conducted over a 30-month period from February, 1976, to August 1978, by the University of Southern California School of Medicine, Division of Research in Medical Education (USC/DRME). The study encompassed non-federal physicians, excluding first-year residents. Participation of neurosurgeons in the study was obtained through the collaboration of the AANS and the Congress of Neurological Surgeons (CNS). Each practitioner was asked to keep a detailed log or diary of his professional practice for 1 week, the results of which are part of a previous report.13 As part of the study, the practitioner was also asked to render an opinion based upon community practice habits concerning the supply of physicians by specialty category—shortage, about right, excess, or no opinion. The opinions of all physician groups concerning neurosurgery form the basis of this report.

The AMA master file of physicians was used for the physician stratification and sampling procedures. The physician response rate for the total study was 55%, with the response rates for individual specialties reaching as high as 82% for the specialty of endocrinology. The response rate for neurosurgery was 62%. These figures exceed expectations of most carefully designed surveys of physicians. Statistical analyses reported in this article were performed using Pearson chi-square tests, followed by an analysis of adjusted standardized residuals.9

Results

For purposes of this analysis, the 24 physician groups studied by USC/DRME are divided into three classifications (Table 1): 1) primary care physicians; 2) nonprimary care, nonsurgical physicians; and 3) surgeons. The primary care physicians include those in family practice, general practice, general internal medicine, pediatrics, and obstetrics/gynecology. Classified as nonprimary care nonsurgeons, are: physicians in psychiatry, neurology, dermatology, allergy gastro-
Neurosurgical manpower

**TABLE 1**  
*Specialty concepts of neurosurgical manpower*

<table>
<thead>
<tr>
<th>Specialty</th>
<th>No. of Replies</th>
<th>Shortage (%)</th>
<th>About Right (%)</th>
<th>Excess (%)</th>
<th>No Opinion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family practice</td>
<td>683</td>
<td>28.8</td>
<td>59.5</td>
<td>4.4</td>
<td>7.3</td>
</tr>
<tr>
<td>General practice</td>
<td>469</td>
<td>26.4</td>
<td>58.0</td>
<td>2.1</td>
<td>13.5</td>
</tr>
<tr>
<td>General internal medicine</td>
<td>885</td>
<td>22.0</td>
<td>57.8</td>
<td>11.7</td>
<td>8.5</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>733</td>
<td>21.9</td>
<td>57.5</td>
<td>7.1</td>
<td>13.5</td>
</tr>
<tr>
<td>Obstetrics/ gynecology</td>
<td>882</td>
<td>27.3</td>
<td>53.8</td>
<td>6.7</td>
<td>12.2</td>
</tr>
<tr>
<td>Nonprimary care, nonsurgical psychiatry</td>
<td>695</td>
<td>15.9</td>
<td>41.0</td>
<td>11.8</td>
<td>31.3</td>
</tr>
<tr>
<td>Neurology</td>
<td>280</td>
<td>10.3</td>
<td>56.8</td>
<td>28.6</td>
<td>4.3</td>
</tr>
<tr>
<td>Dermatology</td>
<td>385</td>
<td>18.4</td>
<td>46.0</td>
<td>7.9</td>
<td>27.8</td>
</tr>
<tr>
<td>Allergy</td>
<td>293</td>
<td>18.9</td>
<td>57.0</td>
<td>5.4</td>
<td>18.6</td>
</tr>
<tr>
<td>Gastroenterology</td>
<td>338</td>
<td>19.2</td>
<td>57.2</td>
<td>14.5</td>
<td>9.0</td>
</tr>
<tr>
<td>Pulmonary disease</td>
<td>275</td>
<td>20.2</td>
<td>55.8</td>
<td>6.9</td>
<td>17.2</td>
</tr>
<tr>
<td>Cardiology</td>
<td>358</td>
<td>24.6</td>
<td>55.9</td>
<td>11.2</td>
<td>8.3</td>
</tr>
<tr>
<td>Endocrinology</td>
<td>326</td>
<td>11.0</td>
<td>54.9</td>
<td>17.1</td>
<td>17.0</td>
</tr>
<tr>
<td>Infectious diseases</td>
<td>164</td>
<td>13.9</td>
<td>46.0</td>
<td>21.0</td>
<td>19.1</td>
</tr>
<tr>
<td>Rheumatology</td>
<td>312</td>
<td>14.3</td>
<td>61.8</td>
<td>11.2</td>
<td>12.8</td>
</tr>
<tr>
<td>Nephrology</td>
<td>316</td>
<td>9.2</td>
<td>56.8</td>
<td>12.8</td>
<td>21.1</td>
</tr>
<tr>
<td>Hematology</td>
<td>333</td>
<td>13.2</td>
<td>55.6</td>
<td>11.5</td>
<td>19.8</td>
</tr>
<tr>
<td>Oncology</td>
<td>253</td>
<td>9.7</td>
<td>68.0</td>
<td>14.2</td>
<td>8.1</td>
</tr>
<tr>
<td>Neurosurgeons</td>
<td>389</td>
<td>20.8</td>
<td>54.4</td>
<td>9.1</td>
<td>15.7</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>353</td>
<td>23.6</td>
<td>58.0</td>
<td>10.0</td>
<td>8.4</td>
</tr>
<tr>
<td>Otorhinolaryngology</td>
<td>459</td>
<td>22.1</td>
<td>56.0</td>
<td>14.1</td>
<td>7.9</td>
</tr>
<tr>
<td>General surgery</td>
<td>273</td>
<td>39.8</td>
<td>48.5</td>
<td>5.3</td>
<td>6.4</td>
</tr>
<tr>
<td>Emergency medicine</td>
<td>478</td>
<td>29.7</td>
<td>52.8</td>
<td>10.8</td>
<td>6.7</td>
</tr>
<tr>
<td>Orthopedic surgery</td>
<td>425</td>
<td>7.5</td>
<td>60.1</td>
<td>30.4</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* Percentages indicate weighted row percents.

enterology, pulmonary disease, cardiology, endocrinology, infectious diseases, rheumatology, nephrology, hematology, and oncology. The surgeons are practicing ophthalmology, otorhinolaryngology, general surgery, emergency medicine, orthopedic surgery, and neurosurgery.

Because of the various ways non-neurosurgical specialty groups relate to neurosurgeons with regard to referral patterns, the following questions were addressed:

1. **Do primary care physicians differ from surgeons in their perceptions of the adequacies of the number of neurosurgeons?** More primary care physicians believe that there is a shortage of neurosurgeons and, conversely, more surgeons feel there is an excess of neurosurgeons (chi-square = 67.4, p < 0.005). However, there are no significant differences between the groups with regard to those who express the opinion that the number of neurosurgeons is about right, and those who render no opinion.

2. **With regard to the number of neurosurgeons, does the opinion of neurosurgeons differ from that of the other surgical specialties studied?** Neurosurgeons differ from the remainder of surgeons in every case (chi-square = 158.5, p < 0.005). Fewer neurosurgeons believe there is a shortage, more think there is an excess, more think the supply is just right, and fewer have no opinion.

3. **How do the opinions of the nonprimary care, nonsurgical physicians compare with those of the primary care and surgical physicians combined with regard to neurosurgical manpower estimates?** The nonprimary care, nonsurgeons are less likely to feel that there is a shortage and more likely to feel that there is an excess of neurosurgeons than are the primary care physicians and the surgeons (chi-square = 353.8, p < 0.005). Although more of the nonprimary care, nonsurgeons register no opinion, an analysis of the adjusted standardized residuals indicates this finding is not the sole explanation for the differences noted in the "shortage" and "excess" columns. No differences are noted among those groups that believe that numbers of neurosurgeons are about right.

4. **Do neurologists differ from the remainder of the nonprimary care, nonsurgical physicians in their opinions concerning neurosurgical manpower?** Neurologists' opinions differ significantly (chi-square = 118.7, p < 0.005) from those of the remainder of the nonprimary care, nonsurgical physicians, except for the group that believes the supply of neurosurgeons is about right. More neurologists feel that there is an excess, whereas the remainder of the physicians express no opinion more frequently than the neurologists.

5. **How do the opinions of neurologists compare with those of neurosurgeons with regard to the supply of neurosurgeons?** Overall, the opinions of these two groups do not differ significantly (chi-square = 5.4, p < 0.10). However, the opinions of these two groups do differ on the question of a shortage, as more neurologists than neurosurgeons believe that there is a shortage.

The aggregated opinions of each of the major subgroups of physicians included in this analysis are shown in Fig. 1. Neurologists are included, but not shown separately, as their overall distribution of responses does not differ significantly from that of the neurosurgeons.

**Discussion**

The release in 1980 of the seven-volume report of the Graduate Medical Education National Advisory Committee (GMENAC) signaled the beginning of a new era in medical manpower planning. As reflected in newspaper articles and wire service reports which summarized the Committee's findings, no longer is there much question that the nation's total supply of physicians is adequate, if not excessive. Rather, considerations of physician supply are increasingly being focused upon questions of geographic and specialty maldistribution.

The problem of geographic maldistribution, although undisputed remains unresolved. Questions
related to specialty maldistribution have been even more difficult to deal with. Attempts to obtain concrete answers by developing schema for predicting specialty physician ratios or ratios between specialties have generally been unrewarding. A major problem has been the inability to define individual specialties and to adequately separate the care rendered by specialists from that which is considered “primary care.”

With regard to neurosurgery, for example, there is considerable overlap with orthopedic surgery in the management of diseases of the spine, especially trauma and disc disease, with vascular surgery in the treatment of carotid vascular disease, with plastic surgery in peripheral nerve disease and skull reconstruction, and with neurology in the nonsurgical management of disease of the central and peripheral nervous systems. A recent study suggests that 30% of patient encounters by neurosurgeons not related to the intraoperative treatment of disease can be classified as “primary care” based upon arbitrary, but nevertheless currently acceptable, criteria.

Thus, it is unreasonable to expect a specialty to define itself, except in quite general terms, in a manner that will be acceptable to all. Moreover, because of a general lack of sophistication of the public with regard to the therapeutic provinces of some of the smaller, more complex specialties, it is also unreasonable to expect the public to define a specialty. In the final analysis, a specialty such as neurosurgery is defined based upon regional and local perceptions and traditions. Since patients generally are seen by neurosurgeons only upon referral from other physicians, it is the perceptions of the local physicians that determine the definition of neurosurgery for all practical purposes. If the local physician refers his patients with ruptured discs to a neurosurgeon, disc disease is a neurosurgical disease; if, instead, he refers those patients to an orthopedic surgeon, it is an orthopedic disease.

The most important consideration in the determination of the appropriateness of the size of the physician manpower pool is patient access. The key to patient access is the referring physician, as most patients enter the care of neurosurgeons by referrals from other physicians. The referring physician, who is primarily concerned with the welfare of his patient, can objectively balance the concerns of patient demand versus those of patient need in making the determination to refer. It is this action of the referring physician which triggers the demand for neurosurgical services. Thus, this study is based upon the assumption that the local referring physician is the best...
Neurosurgical manpower

arbiter between demand and need and is also the definer of neurosurgery. Because of these considerations it was felt important to solicit the opinions of non-neurosurgeons concerning the availability of neurosurgical care for their patients, that is, opinions concerning the number of neurosurgeons in this country.

Of primary interest is the apparent consensus that the number of neurosurgeons is about right. The individual specialty expressions of this opinion range from 41% by psychiatrists to 68% by oncologists; 60.1% of the neurosurgeons render this opinion. This opinion is expressed by less than 50% of the physicians in only four specialties: psychiatry, dermatology, infectious disease, and emergency medicine. Large numbers of psychiatrists and dermatologists expressed no opinion (31.3% and 27.8%, respectively), suggesting little direct concern or information about the question consistent with their general lack of direct contact with patients with neurosurgical disease. While physicians specializing in infectious diseases are fairly divided in their distribution of expressed opinions, it is clear that physicians in emergency medicine feel that there is a definite shortage of neurosurgeons.

The largest numbers of physicians who believe that there is a shortage of neurosurgeons are those in emergency medicine (39.8%), orthopedic surgery (29.7%), general practice (28.8%), obstetrics/gynecology (27.3%), and family practice (26.4%). It appears these findings can be explained by referral patterns. The nature of the practice of emergency medicine would suggest that these physicians would be more desirous of closer neurological availability than would most other groups of physicians. The distances separating the general practitioner and the family practitioner from neurosurgeons (especially in rural settings), and their relatively uncomfortable state with regard to potential neurological diseases suggest that these physicians might desire closer neurological coverage, and thus more neurosurgeons, than would others who may be less directly involved. There is increasing collaboration between orthopedic surgeons and neurosurgeons in spine disease which may be the explanation for the belief of a third of the orthopedic surgeons that there is a shortage of neurosurgeons. The opinions of physicians in obstetrics and gynecology are unexplained by a consideration of contemporary patterns of patient referrals. Perhaps it relates to the differential diagnoses of back and pelvic pain which includes conditions treated by neurosurgeons (disc disease, spinal tumors) and obstetricians/gynecologists (pelvic tumors, bladder infection).

The largest expressions of excess were registered by neurosurgeons (30.4%) and by neurologists (28.6%). The patient population cared for by neurologists and neurosurgeons overlaps considerably, with 30% of the neurosurgeons' time spent in office practice, in hospital nonsurgical consultation, and in diagnostic procedures which neurologists feel capable of handling.

Thus, the neurologists' opinion may be explained on the basis of professional competition. Approximately one-third of the primary care physicians and the non-neurosurgeons feel more strongly than do the nonprimary care, nonsurgical physicians that there is a shortage of neurosurgeons. This is undoubtedly because the former two groups work more closely with the neurosurgeon and thus are more likely to feel concerned at times when neurosurgical coverage is not as available as the individual physician wishes. This relationship is further elucidated by the fact that more of the nonprimary care, nonsurgeons registered "no opinion" than did either the primary care physicians or non-neurosurgeal surgeons. Further evidence of a lack of concern about the issue of neurosurgical manpower numbers by the nonprimary care, nonsurgical physicians is the relative uniformity of expression noted in the "shortage," "excess," and "no opinion" estimates.

Thus, this study has found that the consensus among both neurosurgeons and non-neurosurgeons is that the number of neurosurgeons in this country is about right (see Fig. 1). This was also suggested by another study which indicated that less than 1% of the United States population does not have adequate access to neurological care, suggesting the need for regional solutions. Regional studies of the type reported in this paper would certainly be of interest to regional planners. Hopefully such studies will help identify the reason why substantial numbers of certain specialists who interface closely with neurosurgery feel that there is a shortage. It may be found that "shortages" can be corrected not by increasing the numbers of neurosurgeons, but by increasing neurological availability through such mechanisms as improved communication, transportation, and facility-based technology.

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