Trends in the Neurosurgical Workforce in the United States


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Abstract

Object. The purpose of this study was to evaluate the United States neurosurgery workforce as estimated by reviewing journal recruitment advertisements published during the past ten years.

Methods. The number of available academic and private neurosurgery staff positions was determined by examining recruitment advertisements in Journal of Neurosurgery and Neurosurgery for the 10-year period 1994 through 2003. Advertisements were evaluated for practice venue, subspecialization, and location. The numbers of active neurosurgeons and graduating residents also were reviewed.

Results. The number of advertised neurosurgical positions increased from a mean ± S.D. of 141.6 ± 38.2 per year from 1994 through 1998 to a mean of 282.4 ± 13.6 per year from 1999 through 2003 (p<0.05). The means increased from 50.6 ± 11.1 to 95.0 ± 17.5 for academic positions (p<0.05) and from 91 ± 30.4 to 187.4 ± 6.8 for private positions (p<0.05). Subspecialty positions represented a mean percent per year of only 15.6 ± 5.0% during the first period and 18.8 ± 3.0% in the second period (p=0.22), and therefore, the majority of positions advertised continued to be for generalists. The number of practicing neurosurgeons declined after 1998, and by 2002 was less than it had been in 1991. The number of incoming and matriculating residents during the study period was static.

Conclusion. The number of recruitment advertisements for neurosurgeons over the last five years has increased significantly, concomitant with a severe decline in the number of active neurosurgeons and a static supply of residents.
Introduction

There has been considerable discussion about whether there are too few or too many neurosurgeons.\textsuperscript{4,7,9,27,33-35} In the past, the assertion was made that an overabundance of neurosurgeons existed, and there were even calls for cutbacks in training programs.\textsuperscript{8,9,25,28,41-46} From 1963 to 1973, the number of neurosurgeons in the United States increased by 36%,\textsuperscript{9} and a report in 1975 revealed that neurosurgical training rates increased at 6 to 10 times the growth rate for the nation’s population.\textsuperscript{46} Recently, this perception of excess neurosurgeons has changed.\textsuperscript{18,27,30} In a study undertaken in 1997 estimating workforce needs, neurosurgery was one of only four fields (of 21 medical fields evaluated) that did not require downsizing to maintain an ideal physician-to-population ratio.\textsuperscript{30} A 2003 survey of neurosurgery residency program directors revealed that most thought that the number of practicing neurosurgeons in the United States was too low.\textsuperscript{27} The commonly held idea that specialist physicians are in oversupply is being challenged.\textsuperscript{15,39}

In 1999, Friedlich and coworkers\textsuperscript{18} evaluated neurosurgery journal recruitment advertisements to demonstrate changes in the workforce. They found that, contrary to earlier reports and a prevailing perception of a decreased demand, the mean number of advertisements for neurosurgeons increased between the periods 1985–1995 and 1995–1998 (92.6 vs. 102.7 mean advertisements per year, respectively). Friedlich and colleagues\textsuperscript{10} documented the beginning of a trend of increased demand for neurosurgeons starting in 1996. These findings contrasted with data from a study by Seifer and coworkers,\textsuperscript{38} which evaluated journal recruitment advertisements for the entire physician workforce and concluded that advertisements for specialized physicians declined steeply
from 1990 to 1995. However, this study did not evaluate neurosurgery positions specifically.

Review of journal advertisements or creation of a help wanted index as an estimate of workforce demand has been used previously as a quantifiable and objective index of workforce trends over an extended period of time.\textsuperscript{3,4,11,13,14,17,18,20,26,36,38,40} Economists commonly use help wanted indices or job listings as a measure of relative supply–demand imbalances in the employment market, and this method has been used in a variety of fields since at least the 1960s.\textsuperscript{3,10,11,13,14,17,20,36} Forman and coworkers\textsuperscript{17} noted that a review of the previous months’ help wanted indices is described in the business sections of many national news publications including \textit{The New York Times} and \textit{The Wall Street Journal}.

This method was first applied to an assessment of marketplace demands for physicians in the study by Seifer, et al.\textsuperscript{38} in the \textit{Journal of the American Medical Association} (JAMA). Since that time it has been used in studies reported in \textit{Journal of Neurosurgery},\textsuperscript{18} \textit{American Journal of Roentgenology},\textsuperscript{17} \textit{American Journal of Medicine},\textsuperscript{26} and \textit{Radiology}.\textsuperscript{40} Forman and colleagues\textsuperscript{17} used a help wanted index to track changes in the radiology job market and concluded that the job market “can be tracked in a coincident manner with the use of a help wanted index,” that “changes in the make-up of a field’s practice are identified in a well-constructed index,” and that “these findings have validity and can be useful as an adjunct to other information for policy and planning purposes.” Alternative methods of approximating the job market include surveys and mathematical models. The former are subjective and expensive, are often published in a delayed manner, and are subject to sampling variability and non-response bias, whereas
the latter are always based on assumptions about the current market. In contrast, the use of journal recruitment advertisements is a quantifiable, objective, and historically documented measure of available physician positions.38

Since the publication of the article by Friedlich and coworkers,18 neurosurgery has faced many challenges. The current medical liability crisis with increasing costs of malpractice insurance in the United States has resulted in many neurosurgeons restricting their practices to exclude high-risk surgeries, focusing on spine work, not covering emergency treatment, moving their practices to locations where the medical liability system is more stable, and retiring early.16,22,32 We examined the sufficiency of the neurosurgery workforce in the United States by evaluating journal recruitment advertisements from the last 10 years, expanding the research begun by Friedlich and colleagues. We also evaluated the total number of active neurosurgeons to determine whether changes in the numbers of journal recruitment advertisements represented an actual change in demand and examined the future supply of neurosurgeons.

**Materials and Methods**

Advertisements for available neurosurgical positions were collected from all issues of Journal of Neurosurgery and Neurosurgery for the 10-year period from 1994 to 2003 (240 issues). There were no changes in journal policy regarding methods of acquiring recruitment advertisements or advertisement sales during the period studied.

Advertisements were allocated to the monthly issue in which they first appeared. Advertisements that appeared in successive monthly issues in the same journal or that appeared in both journals were recorded only once. If an advertisement specified two or
more available positions, each was recorded as an individual position. All staff positions for clinical neurosurgeons in the United States were included. Fellowship, research, and non-surgical positions were excluded.

Positions advertised were classified as either academic or private-sector positions. An academic employment opportunity was defined as an advertisement by an institution with an Accreditation Council for Graduate Medical Education (ACGME)-approved neurosurgery residency training program. All others were categorized as private practice.

The advertisements were also evaluated for whether they sought general or subspecialty care. We defined a subspecialty advertisement as one that stated a requirement for fellowship training, subspecialty expertise, or necessary (subspecialty) experience within a specific neurosurgical field. The subspecialty fields included pediatric, spine, vascular, endovascular, oncology, stereotactic, functional, epilepsy, pain, stereotactic radiosurgery (SRS), skull base, and trauma. An advertisement was designated as generalist if it contained no information about subspecialty-specific experience or training. Advertisements that used terms such as “preferred experience in” or “interests in [subspecialty]” were not included as a subspecialty position because of the possibility that a neurosurgeon without subspecialty experience or training might ultimately occupy the position. In addition, in cases in which advertisements listed a single position available with several acceptable possibilities of subspecialty expertise, the appropriate fractional designation was made. For example, an advertisement for one academic neurosurgeon with necessary training in functional, epilepsy, and pain was allocated as one-third of a position per subspecialty.
To supplement the understanding of the supply and demand of the neurosurgery workforce, the numbers of active neurosurgeons and graduating residents were acquired from the American Board of Neurological Surgeons. The number of applicants to neurosurgery residencies and the number of residency positions were acquired from the San Francisco Matching program website (www.sfmatch.org).

Values are expressed as the mean ± standard deviation. Differences between the more recent five years (1999-2003) and the preceding five years (1994-1998) were assessed using the nonparametric Mann-Whitney U-test with significance accepted at a probability level lower than 0.05. All analyses were performed using statistical computer software (statistiXL, version 1.4).

Results

The number of neurosurgical positions advertised in Neurosurgery and Journal of Neurosurgery increased from a mean of 141.6 ± 38.2 per year for the 5-year period 1994 through 1998 to a mean of 282.4 ± 13.6 per year for the 5-year period 1999 through 2003 (p < 0.05). The total number of advertisements during each 5-year period increased from 708 to 1412. Figure 1 demonstrates the increasing trend in the number of positions advertised over the entire period studied. The total number of positions almost tripled from a low of 110 for 1995 to 297 in 2003. The mean number of academic positions per year over the entire period studied was 72.8 ± 27.2 compared with 139.2 ± 54.9 for private positions. There were more private than academic positions in all years. The mean available academic positions per year increased from 50.6 ± 11.1 for the first 5-year period to 95.0 ± 17.5 for the second 5-year period (p < 0.05), whereas the mean available
private positions per year were 91 ± 30.4 and 187.4 ± 6.8, respectively (p < 0.05), for the same periods. Thus, both private and academic opportunities increased roughly twofold during the later time period, which was statistically significant.

The number of advertised positions for subspecialized neurosurgeons also increased during the entire period studied. Figure 2 demonstrates the increase in the number of academic and private subspecialized positions advertised starting in 1998 and peaking in 2001, when 46% of academic positions and 10% of private positions were for subspecialized neurosurgeons. The mean number of subspecialist positions advertised per year from 1994 through 1998 was 21.2 ± 5.9 and from 1999 to 2003 was 53.4 ± 10.2 (p < 0.05). The mean number of academic subspecialized positions per year advertised during the two time periods increased from 16.2 ± 5.5 to 38.6 ± 8.9 (p < 0.05) (31.8 ± 9.0% and 40.6 ± 5.4% of mean total academic positions per year, respectively, for the two time periods, p = 0.22). In comparison, the mean number of private subspecialized positions per year for the two time periods increased from 5 ± 2.3 to 14.8 ± 2.2 (p < 0.05) (5.4 ± 1.7% and 8.0 ± 1.2% of mean total private positions per year, respectively, for the two time periods, p = 0.056).

The total number of advertised positions for subspecialists increased at the same rate as the overall growth rate for all advertised positions and was statistically significant, but the percentage or proportion of positions accounted for by subspecialties did not have a statistically significant increase. The number and percentage of advertisements per year for subspecialists was higher for academic positions than for private ones; the mean percentage of subspecialty positions per year was 36.2 ± 8.4% and 6.7 ± 1.9% for academic and private spots, respectively. Overall, subspecialty positions represented a
mean percentage per year of only 17.2 ± 4.3% of all positions with a mean of 15.6 ± 5.0% during the period from 1994 through 1998 and a mean of 18.8 ± 3.0% during the period from 1999 through 2003 (p = 0.22), and therefore, the majority of positions were for generalists. Although the mean number and proportion of advertised subspecialized positions increased during the later period, it is important to note that after the peak in 2001, they declined.

The subspecialties with the highest number of total, private, and academic positions advertised were spine followed by pediatrics (Tables 1 and 2). Overall, spine not only had the most advertisements for a neurosurgery subspecialty but also had the highest growth rate. From 1994 to 1998, there were 42 spine positions advertised, and from 1999 to 2003, there were 114, almost a threefold increase. The growth rate for spine positions was equivalent for academic and private positions. In academic settings, pediatric, cerebrovascular, functional, and oncology openings more than doubled from 1994-1998 to 1999-2003. Of note, only one academic endovascular position was advertised from 1994 to 1998, whereas 25 were advertised from 1999 to 2003. For private subspecialty advertisements, three fields—spine, pediatric, and endovascular—accounted for 87.4% of all private subspecialty positions advertised (Table 2). Most of the private subspecialty positions were in spine (61.6%). It is important to note that the percentage of the total number of positions (academic and private) that these subspecialties represented remained low, with spine positions increasing from a mean per year of 6.2 ± 2.5% to 8.0 ± 1.8% (Total, 7.1 ± 2.3%) (p = 0.31), and endovascular from a mean per year of .1 ± .2% to 2.1 ± .9% (Total, 1.1 ± 1.2) (p < 0.05). No subspecialties other than endovascular in the private or academic setting had a statistically significant
Eight of the 10 states with the highest number of job opportunities for private practice neurosurgery positions in 2002 and 2003 (Florida, New York, Illinois, Pennsylvania, Texas, North Carolina, Missouri, Ohio) are considered to be in a professional liability insurance crisis, as described by the American Medical Association\textsuperscript{32} and the Council of State Neurosurgical Societies.\textsuperscript{16}

Data from the American Board of Neurological Surgeons (Marie-Louise Sanderson, personal communication, 2003) demonstrate that the number of certified practicing neurosurgeons in the United States increased and reached a peak in 1998 and then decreased dramatically over the next 4 years (Fig. 3). In fact, the number of practicing neurosurgeons in late 2002 was less than the number in 1991 (3042 versus 3080, respectively).

The number of neurosurgical residency positions offered through the San Francisco Match has remained stable over the past 12 years, and the number of matriculating residents nearly matches this number of positions (Fig. 4). A decreasing trend in the number of applicants to the neurosurgical match is apparent (Fig. 4; data from San Francisco Match).

**Discussion**

The number of journal-advertised neurosurgery positions for both academic and private practice opportunities doubled from a mean of 141.6 ± 38.2 per year for the period 1994 to 1998 to a mean of 282.4 ± 13.6 per year for the period 1999 to 2003 (Fig. 1). Friedlich and coworkers\textsuperscript{18} recognized the beginning of this trend toward more
available positions when the mean number per year increased from 92.6 (1985-1994) to 102.7 (1995 to 1998). Friedlich and colleagues appreciated “…a shift in demand toward subspecialty neurosurgery…” when the mean percentage of advertised positions calling for subspecialty expertise experienced a statistically significant increase. In our study, the percentage of subspecialized positions advertised increased only slightly, and subspecialty positions represented 15.6 ± 5.0% from 1994 to 1998 and 18.8 ± 3.0% from 1999 to 2003. Although we observed an increase in the total number of subspecialty positions advertised and a small increase in the percentage of subspecialty positions advertised, the shift toward increased emphasis on subspecialty care described by Friedlich and coworkers was not appreciated in our study. Furthermore, after 2001, we observed a new trend in the opposite direction with decreasing numbers and percentage of subspecialized positions advertised within the field of neurosurgery.

It is significant to note that, over the last five years, appeals for neurosurgeons have continued to be predominantly for generalists; 81.2% of all advertisements and 92.0% of private practice advertisements were for generalists. The academic setting continues to request subspecialized neurosurgeons at a greater rate than the private sector as was seen in the earlier study.18 Although requests for spine surgeons accounted for more advertisements than any other subspecialty, spine accounted for only 8.0 ± 1.8% of all advertised positions in 1999-2003 and 6.2 ± 2.5% in 1994-1998, which did not reflect a statistically significant change. In contrast, the study by Friedlich, et al. demonstrated a statistically significant increase in the number of private spine positions advertised. They postulated that this increase might be due to an enlarging market share for the field of neurosurgery. In our study, the stable market share for subspecialists in the setting of an
approximately 100% increase in the number of neurosurgery positions may reflect an early trend to request and hire generalists to fill the many open positions. It might also suggest that the field is doing a better job at training residents in spine work, for example, and that it is not necessary to request a specialist to fill the role.

The significant increase in the number of available positions along with a possible end to the trend described by Friedlich’s group to hire subspecialists as seen in the last few years supports the assertion that the increased number of advertised positions may reflect an actual societal need for neurosurgeons rather than a move to enlarge the market share for the field of neurosurgery or to expand practices. Further supporting the idea that the increased number of available positions reflects an actual need is the fact that 758 board-certified neurosurgeons, representing 25% of the neurosurgical workforce, retired from 1999 to 2001. Additionally, the supply of active neurosurgeons in late 2002 was approximately equivalent to that 12 years earlier, whereas the population of the United States increased by more than 10% from 1990 to 2000, meaning that the number of neurosurgeons is actually failing to keep up with the population. In 2003, there were 297 available positions to be filled, most likely because of increased retirements, and only 124 residents graduated to fill these positions. The increased retirement rate is likely due in part to the current medical liability crisis, which has exerted strain on practitioners of neurosurgery and has made continued practice in many regions of the country fiscally untenable, as well as to other factors that are creating dissatisfaction with practice.

Another way to judge whether there is, in fact, an increased need for neurosurgeons is to evaluate whether the country is receiving adequate neurosurgical care. In this regard, hospitals around the country are reporting difficulties in hiring
neurosurgeons and increased neurosurgery job vacancies, particularly in the private sector. Recently, the Massachusetts Medical Society’s 2004 Physician Workforce Study identified neurosurgery as the only field with a critical crisis and reported that 43% of medical staff presidents of community hospitals noted a shortage in neurosurgeons up from 23% in 2003. The study determined that it took longer to fill a neurosurgery vacancy than one in any other field (30 months), that the applicant pool was inadequate, and that 18% of patients noted a delay in seeing a neurosurgeon. An additional area of concern has been the difficulty in finding a neurosurgeon to cover trauma call. Recent press accounts note closures of trauma centers in Pennsylvania, West Virginia, Missouri, and Florida because of shortages of neurosurgeons. Other media reports describe hospitals in jeopardy of losing their accreditation status because of insufficient neurosurgeons to cover trauma calls.

These reports are supported by evidence that indicates that neurosurgeons are critical participants in trauma care. Next to trauma surgeons themselves, neurosurgeons represent the specialty with the highest percentage of physicians receiving reimbursement for trauma care, exceeding orthopedic surgeons and anesthesiologists. According to that report, physician shortages caused by a variety of factors, including malpractice market turmoil and decreased reimbursement, represent one of the major reasons for the closure of trauma centers. The report noted that difficulties in covering trauma call are also due to emphasis among physicians towards subspecialization. The reluctance among subspecialists to cover trauma call means that trauma care is left to a rapidly shrinking number of physicians. With estimates that 10-20% of the nation’s 600 regional trauma centers will close within 3 years, it appears quite likely that neurosurgeon shortages are...
affecting the availability of trauma care in the United States.

Neurosurgeon shortages impact the quality of care in areas other than trauma care. In some areas, the demand for neurosurgical care is so high that wait times for appointments can exceed 2 months. In one report, 50% of neurosurgical patients waited more than 8 weeks for an appointment, and 14% waited more than 12 weeks.\textsuperscript{37}

Conclusions

To consider our data as indicative of the trend in neurosurgery, it must be assumed that the number of advertisements reflects a constant fraction of the total demand for neurosurgeons. To that end, we have focused on recruitment advertisements in the two major neurosurgical journals. There is no evidence that the other traditional methods of recruitment, including recruitment firms, mailings, or word of mouth, have changed substantially over the last ten years. The evaluation of journal advertisements has been shown to be an objective and historically documented method to track the physician job market. The limitation is that using journals advertisements may underestimate the total number of positions with a bias toward the later time period because of the increased use of electronic advertising and job searching, which is difficult to quantitate.

Our data indicate significant increases in the marketplace demand for neurosurgeons and a continued need for generalist neurosurgeons. We cannot, however, predict from our results whether these demands will persist.
Acknowledgments

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Figure Legends

Figure 1. Graph demonstrating the advertised positions for academic (squares), private (triangles), and total (circles) neurosurgeons from 1994 through 2003.
Figure 2. Graph showing the advertised positions for academic (squares), private (triangles), and total (circles) subspecialized neurosurgeons from 1994 through 2003.

Figure 3. Data from the American Board of Neurological Surgeons showing the number of certified practicing neurosurgeons in the United States. This number increased continuously from 1990 through 1998 and decreased dramatically over the next 4 years.
Figure 4. Graph showing the number of residency applications (diamonds), the number of neurosurgical residency positions (triangles), and the number of matriculating residents (squares) for 1991 through 2003. Whereas the number of positions matched and the number of residents graduating did not change significantly over the period shown, the number of applicants to the neurosurgical match shows a downward trend.
TABLE 1
Summary of subspecialty advertisements for neurosurgeons

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*A, academic; P, private; SRS, stereotactic radiosurgery.
TABLE 2

Distribution of the most common subspecialty advertisements from 1994 to 2003*

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<th>Private (%)</th>
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* Includes subspecialties making up greater than 5% of subspecialty positions advertised