Geographical Neurosurgery Workforce Analysis from 1990 to 2005 Improves Our Understanding of the Role of Market Factors

Todd C. Hankinson, M.D., M.B.A., Leif-Erik S. Bohman, B.A., Monique Vanaman, B.A., Natalia Egorova, Ph.D., M.P.H., J Mocco, M.D., Katie O. Orrico, J.D., Jeffrey N. Bruce, M.D., and Deborah L. Benzil, M.D.

High-profile media coverage of the crisis facing the emergency medical care system in the United States and the flight of specialists from certain geographic regions has prompted recent investigations by both the Council of State Neurosurgical Societies and the American Association of Neurological Surgeons (AANS) to evaluate the condition of the neurosurgical workforce.[11,14] Medical workforce prediction and analysis have been notoriously challenging tasks. Traditional models, introduced in 1933, were based upon statistical analyses of disease incidence and the time required to treat each illness.[11,14] More recently, the Council of Medical Specialty Societies developed a "trend approach" in which the general economy is considered to be the primary driver of workforce behavior.[11] Aspects of neurosurgical practice that are responsive to economic conditions include reimbursement, the behavior of managed care providers, and changes in practice overhead. The cost of professional liability insurance (PLI) represents a considerable component of practice overhead for most neurosurgeons, with an estimated mean cost of approximately $75,000 in 2004.[7] In addition to the financial burden,[5] the psychological effects of the medical malpractice environment have been shown to influence physician practice.[27,32,35]

During the last 50 years, there have been five periods during which marked decreases in the effective supply of professional liability policies have produced significant elevations in PLI premiums.[24] After a period of economic prosperity correlated with stable premiums during the 1990s, there was a significant loss of supply in the PLI market after the decline of the stock market in 2000. This was reflected by the withdrawal of the St. Paul Companies, the second largest medical PLI carrier in the country, from the market in late 2001.[26] By the summer of 2002, the American Medical Association declared 12 states to be in medical liability "crisis" (New York, New Jersey, Pennsylvania, West Virginia, Ohio, Florida, Georgia, Mississippi, Texas, Nevada, Oregon, and Washington) (*Fig. 19.1*). A modest economic recovery occurred between 2002 and 2005, but the "crisis" environment in the 12 states did not resolve during this interval.[6] Organizations representing both caregivers and medical insurers have claimed that the increased cost of PLI associated with the current crisis has forced physicians to relocate, retire prematurely, and limit or exclude high-risk procedures from their practices.[10,13,25] Initial investigations of the topic have been unable draw definitive conclusions regarding these claims.[13,16,23,25,28,29]

The goals of this study were to analyze geographic shifts in the neurosurgical workforce between 1990 and 2005 and to determine if changes were influenced by the PLI environment.

MATERIALS AND METHODS

Basic Methodology

To calculate the per capita neurosurgical workforce between 1990 and 2005, records of AANS/Congress of Neurological Surgeons (CNS) membership[3,4] and U.S. Census data[9] were examined. We divided the period from 1990 to 2005 into two sections: the decade from 1990 to 2000 and the period from 2000 to 2005. Data were analyzed at three time points: 1990, 2000, and 2005. These time periods were selected based on general economic trends, the timing of events consistent with instability in the PLI market, and the availability of census data.

We calculated the number of per capita active AANS/CNS members at each time point. These data were examined at the state level to determine if shifts in per capita neurosurgeons could be identified. Geographical workforce shifts were then examined for the presence of "crisis" as a variable.

American Association of Neurological Surgeons Data Sets

Official AANS/CNS membership databases were used to calculate the neurosurgical workforce at each time point.[3,4]

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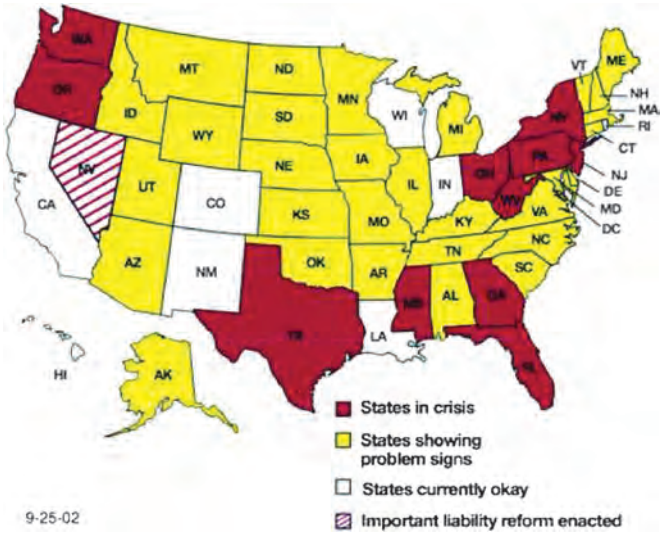

FIGURE 19.1. 2002 American Medical Association crisis state map. Reprinted with permission from the American Medical Association.

A database including the business address and AANS/CNS membership status of each member was created and organized by zip code. These data were subsequently condensed to the state level.

U.S. Census Data Sets

U.S. population estimates from the 1990 and 2000 decennial censuses and the 2005 annual population estimate were collected from the U.S. Census Bureau.[9] Data regarding total population were collected and divided by zip code (1990 and 2000) or by county (2005). Population change between time points was calculated and condensed to the state level.

Data Analysis

For each time point, a state-level ranking system based on the number of neurosurgeons per capita was created. Washington, DC, was treated as a separate state, producing a total of 51 states at each time point. The state with the largest number of neurosurgeons per capita was given the ranking "1" and that with the smallest was given "51." Comparison of rank between time points was completed and the change in rank calculated. The mean change in rank was then determined and trends in crisis states were compared with those in noncrisis states. "Crisis" was assigned based on 2002 American Medical Association data.[8] The likelihood that an improvement occurred in a crisis or noncrisis state was compared using χ^2 analysis and odds ratios (ORs) with 95% confidence intervals (CIs) calculated. Statistical significance was assigned to results with a P value <0.05.

RESULTS

General Workforce Trends

There was no evidence that geographical shifts in the neurosurgical workforce correlated with demographic variables such as population growth (*Fig. 19.2*) or geographical region of a given state (*Fig. 19.3*).

Rank Order Analysis

Rank order analysis between 1990 and 2005 demonstrated that crisis states (N = 12) had a mean change of −3.75 rank positions. Most of this change occurred between 2000 and 2005 (−2.83 rank positions). In contrast, noncrisis states (N = 39) had a mean change of +1.15 positions between 1990 and 2005 and +0.87 between 2000 and 2005.

Between 1990 and 2000, crisis states had a mean change of −0.92 positions, whereas noncrisis states had a mean change of +0.28 positions (*Fig. 19.4*).

During the period between 1990 and 2005, a state with an improvement in ranking was more likely to be a noncrisis than crisis state (OR, 1.44; 95% CI, 0.39–5.27). During the

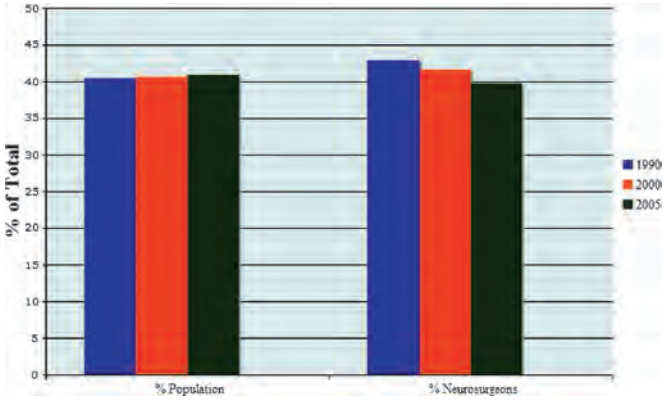

FIGURE 19.2. Percentage of total U.S. population and neurosurgeons in the six largest states, 1990 to 2005.

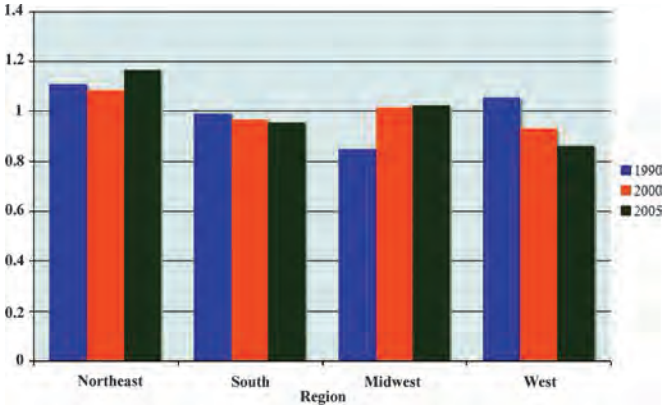

FIGURE 19.3. Ratio of percent neurosurgeons to percent total population by region, 1990 to 2005.

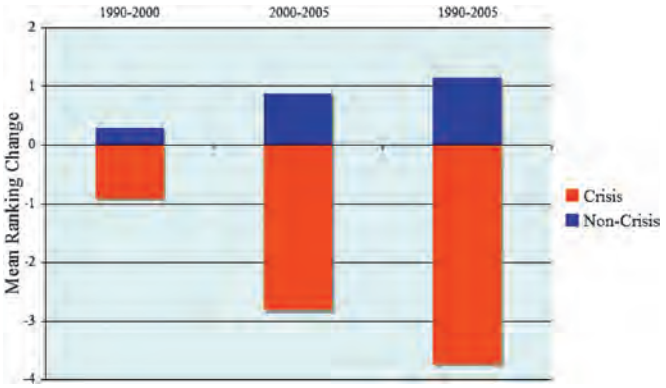

FIGURE 19.4. Mean change in rank, crisis versus noncrisis.

TABLE 19.1. Ranking improvements in crisis versus noncrisis states

Time Period	Improvement	No Improvement	Odds Ratio
1990–2000			
Crisis (n = 12)	6	6	
Noncrisis (n = 39)	20	19	1.05
2000–2005			
Crisis (n = 12)	5	7	
Noncrisis (n = 39)	19	20	1.33
1990–2005			
Crisis (n = 12)	6	6	
Noncrisis (n = 39)	23	16	1.44

period from 2000 to 2005, a state with an improvement was 33% more likely to be a noncrisis state (OR, 1.33; 95% CI, 0.35–4.92). During the period between 1990 and 2000, an improvement in rank was 5% more likely to occur in a noncrisis state (OR, 1.05; 95% CI, 0.28–3.83; *Table 19.1*).

DISCUSSION

Analysis of medical workforce has most often focused on predicting a future surplus/deficit of physicians[15,18,31,33,34] or reacting to perceived threats to a specific sector of the medical workforce.[1,17,19,21,22] Previous investigations of the neurosurgical workforce include both practice surveys and general analyses.[2,11,30] There has also been significant work examining the effect of tort reform on physician supply.[16,20,23] This article represents the first study to quantitatively analyze the neurosurgical workforce and its relationship to the PLI market during periods of variable general economic prosperity.

Recently, two significant studies related the PLI environment to physician supply. The first investigation,[20] published in 2003, demonstrated that states that had enacted a cap on noneconomic damages between 1970 and 2000 were found to be home to approximately 12% more physicians per capita than states lacking such laws. The second study[23] compared physician supply trends between states that did and did not enact legal reforms aimed at limiting malpractice liability between 1985 and 2001. The authors found that 3 years after the passage of reforms, physician supply increased by 3.3% in states that enacted measures aimed at directly limiting liability. Although the authors of the second paper completed some analysis at the specialty level, both of these works focused primarily on the population of all physicians. Despite the importance of gathering data regarding all physicians, one potential limitation is the dilution of findings regarding the most severely affected specialties. Our article, by contrast, examines only the neurosurgical population, making the results more relevant to our field of interest but less generalizable. Despite this difference in study populations, the conclusions of both papers were consistent with our finding that the PLI environment is a component of a multifactorial system influencing physician supply.

Two further studies used physician survey techniques to assess the impact of PLI crisis within individual states.[13,28] A 2003 survey of physicians in rural Florida[13] reported that 78.4% of general surgeons and 73.6% of surgical specialists eliminated services during the year before the survey. Among this group, 91% reported that finding or paying for PLI played a significant role in their decision to reduce services. The authors also found that 35% of respondents intended to leave their community within 2 years. This and a follow-up report by the same authors[12] concluded that the current PLI crisis had considerable influence on the delivery of medical care in rural Florida.

In a 2005 survey of Pennsylvania specialist physicians,[28] less than 4% of respondents indicated that PLI concerns would "definitely" motivate them to move all or a portion of their practice outside the state within 2 years. Nevertheless, 29% indicated that they were "very likely" or "somewhat likely" to do so. In addition, 80% of respondents indicated that the local supply of specialists had decreased during the preceding 3 years, with PLI costs identified as the primary driver of this movement. The authors concluded that a decrease in the supply of surgical specialists was likely to occur during the 2 years after their survey and that the most common response to concerns regarding PLI was for physicians to reduce or eliminate high-risk procedures from their practices. These papers both indicate that reduction of services is a common response to PLI pressures. Our study was not designed to assess this variable. Analysis of these papers requires the reader to recognize that survey data often describe intent rather than action. The findings of both surveys are generally consistent with the results of our study, although our data quantitatively examined completed activities rather than studying the intentions of neurosurgeons in response to a PLI crisis.

An additional report[29] used insurance department administrative databases to detect whether physician supply changes in Pennsylvania between 1993 and 2002 could be identified. The authors defined 1999 to 2002 as the period of crisis. They found that the supply of obstetrician–gynecologists decreased slightly during the crisis period, but other high-risk specialties did not demonstrate an equivalent finding. Interestingly, 14.5 to 15.5% of high-risk specialists left practice during each year of the study with no difference between the crisis (1999–2002) and noncrisis (1993–1998) periods. This high rate of turnover suggests that strenuous conditions may have been present in Pennsylvania before the defined PLI instability was identified on a national level and before the crisis period defined by the authors. This study was similar to ours in that it retrospectively examined specialist behavior and divided the period of study based on the presence or absence of PLI crisis, although the study end date (2002) may not have detected delayed movement by physicians who attempted to endure the crisis environment. This emphasizes the importance of time point selection in workforce studies. During the latter phases of our investigation, three crisis states enacted legislation designed to address PLI conditions. Texas passed reforms late in 2004, Mississippi in 2004, and Georgia in 2005. Given the timing of these actions relative to the period under investigation, it is unlikely that effects of the new legislation were reflected in our data set. Nevertheless, both of these studies demonstrate the importance of time point selection, because the general economic and PLI environments within each state are highly dynamic.

This report is the first to quantitatively link the PLI environment with neurosurgical practice behavior. The results of this study suggest that between 1990 and 2005, the local PLI environment correlated with the choices neurosurgeons made with regard to the geographical location of their practices. During the initial decade, a period of economic growth and relative stability in PLI markets, factors outside the scope of study were most influential in neurosurgeons' choices. However, during the last 5 years studied, general economic volatility likely destabilized many delicately balanced PLI markets. This increased the influence of the local PLI environment in neurosurgeons' decision-making and was reflected by movement within the workforce. Our study additionally demonstrates that characteristics such as a state's population size or regional location did not influence neurosurgical workforce decisions. The modest magnitude of the change in rank we found is consistent with the conclusions of previous authors[20,23] that the PLI environment is one of many factors influencing medical workforce behavior and that this influence varies in response to other dynamic environmental conditions. Additionally, the small number of crisis states ($n = 12$) limited the power of our calculations and may have prevented us from detecting a significant difference between the behavior of neurosurgeons in crisis versus noncrisis states. Nevertheless, our results imply a relationship between the PLI environment and neurosurgical workforce, and this relationship merits further investigation.

At the current time (and during the period of our study), no definitive database of practicing neurosurgeons has been established. Between 1990 and 2005, improvements in data gathering by the AANS and CNS generated a significant increase in the captured membership. There is no evidence that data-gathering improvements occurred to varying extents in different locations. Therefore, the relative change in practicing neurosurgeons is a reasonable estimate of changes in the neurosurgical workforce. Future trend analysis will become more robust with continued improvements in data collection. A more complete understanding of workforce behavior will require the analysis of qualitative practice parameters such as the prevalence of neurosurgeons who perform high-risk procedures or cover emergency room call. Additionally, the influence of regional income variability was not within the scope of this study and remains as a topic for future study.

Workforce studies such as this one can potentially help neurosurgical policymakers predict future supply requirements and evaluate the effects of current policy. Additionally, comprehension of the means through which the economy affects the neurosurgical workforce will facilitate the evolution of our educational structure and the establishment of effective incentive mechanisms, allowing neurosurgeons to meet the demands of our patient population and retain a high level of job satisfaction.

CONCLUSION

Our study of the neurosurgical workforce between 1990 and 2005 indicates that the PLI environment influenced geographical movement. Our findings confirm previous conclusions that PLI conditions are one of many mechanisms through which economic conditions manifest themselves on neurosurgical practice. These conclusions are consistent with previous studies examining the general physician population. Continued work will further elucidate the specific economic factors that most profoundly influence the neurosurgical workforce and which conditions influence the magnitude of their effects.

Disclosure

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