Distribution of the Head and Neck Surgical Oncology Workforce in the United States

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Brief Running Title: Head and Neck Surgery Workforce Distribution

Keywords: head and neck surgeon, head and neck fellowship, head and neck cancer, physician directory, workforce

Abstract

Background:

The present study aims to investigate the geographic distribution of the current head and neck surgery workforce in the United States.

Methods:

We reviewed publicly available sources to locate all fellowship-trained head and neck surgeons. The number of surgeons in each state was compared against head and neck cancer incidence data from the Centers for Disease Control.

Results:

The median number of fellowship-trained surgeons per state was 7.1 (SD: 9.8). The mean number of new head and neck cancer cases per surgeon was 277.5 (SD: 136.0). The number of graduates increased annually by 1 per 100,000,000 people. Ten states (20%) had case/surgeon ratios >1 SD above the national average, while 3 (6%) were >1 SD below the average.

Conclusion:

Head and neck surgical oncologists are located in most states, but not uniformly. Most states are within the normative distribution of the workforce; however, several states are overserved or underserved.

Introduction

Medical education has undergone a rapid expansion over the last two decades. Since 2002, the number of students entering medical school has increased by 37.5%. [1] Accordingly, the number of otolaryngology residency positions has increased significantly as well. [2] Within the field of head and neck surgical oncology specifically, the number of American Head and Neck Society (AHNS) accredited fellowships has increased by 1.82% on average per year – from seven fellowship spots in 1997 to 50 in 2022. [3] The majority of these were preexisting but not accredited by the AHNS.

Interestingly, there is significant geographic variability in the practice locations of surgeons graduating from AHNS-accredited fellowships. A recent study by Lin et al. demonstrated that 98.4% of graduates from 1997-2017 practice in urban centers. [4] This is conceivable, as head and neck oncologic surgery typically requires academic affiliation with high-volume centers to perform ablative and reconstructive surgery. [5] However, it could be concerning in that it might limit access to care among head and neck cancer patients living in rural areas. These individuals may need to travel great distances to receive adequate care, which has been shown to negatively impact follow-up and survival rates. [6]

If the number of fellowships continue to increase at the current rate, and the percent of graduates choosing to practice in concentrated healthcare markets remains high, some regions in the United States may see a supply-demand mismatch between head and neck cancer patients and providers. This may have important implications in the planning of fellowship training and availability of patient care. The purpose of the present study is, first to investigate the distribution of the current head and neck surgery workforce to quantify any existing geographical mismatch in the number of head and neck cancer patients and number of fellowship-trained head

and neck surgical oncologists. Secondly, we aim to project trends into the future to assess any potential future supply-demand mismatch.

Methods

All data used in this study were derived from publicly available sources. Accordingly, this study was determined to be exempt from review per the standing policy of the NYU Langone Health Institutional Review Board.

Fellowship-Trained Head and Neck Surgeons

We reviewed the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) directory to estimate the number fellowship-trained head and neck surgical oncologists in the United States. The AAO-HNS directory allows users to identify otolaryngologists by state of practice and subspecialty. For each of the fifty states and District of Columbia (D.C.), the directory was used to generate a list of all otolaryngologists who designated themselves as practicing "Head & Neck Surgery." The list of American Head & Neck Society (AHNS) fellowship graduates was also reviewed from 1997-2020. Additional surgeons who were not listed in the AAO-HNS directory, were identified and added to the list. Then, each surgeon's directory page was reviewed to confirm whether they had completed a head and neck surgical oncology fellowship. Surgeons who were listed as having completed fellowships in either "Head & Neck Oncology" or "Microvascular and Head & Neck Reconstruction" were included in our sample. If no fellowship was listed in the directory, the physician's institutional or personal webpage was identified through the Google search engine using the query "head and neck surgery + *Physician Name*." The educational history section was then reviewed for completion of a fellowship in head and neck oncology or reconstruction. Those who completed such fellowships were also included in our sample. This attempted to encompass those head and neck

surgeons that came from general surgery or oral surgery residency training. The total number of fellowship-trained head and neck surgical oncologists was tabulated for each state.

Recent Fellowship Graduate Practice Locations

The American Head and Neck Society (AHNS) fellowship graduate directory was reviewed, and a list of graduates from 2011 to 2020 was generated. We searched for each graduate using the Google search engine using the query "head and neck surgery + *Graduate Name*." We recorded each graduate's most recently listed state and country of practice, as well as their type of practice setting (University vs. private).

US Head and Neck Cancer Incidence

The Centers for Disease Control and Prevention United States Cancer Statistics (CDC USCS) data visualization tool was queried for the annual age-adjusted incidence of cancers commonly treated by head and neck surgical oncologists. Cancers of the larynx, oral cavity and pharynx, and thyroid diagnosed from 2011 to 2018 were included. Cancer incidence data were available for all 50 states and D.C., with the exception of the state of Nevada.

Statistical Analysis - Geographic Distribution of Head and Neck Surgeons

For each state, we calculated the ratio of the total number of head and neck cancer cases diagnosed in 2018 per fellowship-trained head and neck surgeon. The mean number of cases per surgeon and standard deviation were then calculated. States with a case per surgeon ratio more than one standard deviation above the mean were considered to be underserved, while those with a ratio less than one standard deviation below the mean were categorized as overserved. The

proportions of recent fellowship graduates practicing in underserved and overserved areas were then calculated.

Statistical Analysis - Trends in Fellowship Growth

Annual trends in the number of head and neck surgery fellowship graduates and the incidence of head and neck cancer were determined using linear regression. Additionally, correlation analysis was used to assess whether a relationship existed between the number of fellowship graduates and cancer incidence. All hypothesis testing was two-sided with an alpha level of 0.05. All analyses were performed using R version 4.1.2 (R Foundation, Vienna) and its associated packages.

Results

A total of 437 fellowship-trained head and neck surgeons were identified in the AAO-HNS directory and the list of graduates from AHNS fellowships. The median number of surgeons in each state was 4 (range: 0-52). Six states (Alaska, Delaware, Idaho, North Dakota, Rhode Island, and Wyoming) did not have any fellowship-trained head and neck surgeons, while New York had 52 surgeons, the most of any state.

The number of head and neck surgeons in each state per 100,000 people is depicted in **Figure 1**. The median combined incidence of thyroid, larynx, oral cavity and pharynx cancers in 2018 was 1,531.5 (range: 157-10,693). The cancer incidence in each state per number of head and neck surgeons is depicted in **Figure 2**. The mean number of new head and neck cancer cases per fellowship-trained surgeon was 277.5 (standard deviation: 136.0) per year. Defining the normative range of cases per surgeon as within one standard deviation of the mean, we identified 10 underserved states and 3 overserved states (**Table 1**). Among underserved states, the median

number of cases per surgeon was 523 (range: 469-878, Hawaii and Mississippi, respectively). Among overserved states, the median number was 78 (range: 39-139, Washington D.C. and New York, respectively).

We identified 330 surgeons who graduated from accredited head and neck surgery fellowships between 2011 and 2020 and currently practice in the United States. Most graduates were male (233, 71%), and most currently practice at a University institution (284, 86%). The number of women graduates increased every year from 3 (15%) in 2011 to 16 (46%) in 2020 ($R = 0.66$, $p=0.004$). Most graduates (308, 93.33%) completed residency in otolaryngology, and the remainder were trained in general surgery (19, 5.76%) and oral and maxillofacial surgery (3, 0.91%). Thirty-six graduates (11%) practice at the same institution where they completed their fellowship, and 62 (19%) practice in the same state as their fellowship. Most graduates (285) practice in a state in the normative range of cases per surgeon. Seven graduates (2%) practice in an underserved area, and 38 (12%) practice in an overserved area (**Figure 3**).

Linear regression analysis showed that the number of head and neck surgery fellowship graduates increased annually by 1 position per 100,000,000 people in the United States ($p=0.02$) (**Figure 4**). By contrast, no significant increase was seen in the combined annual incidence of head and neck cancers ($p=0.70$). Furthermore, there was no correlation between the number of fellowship graduates and the annual incidence of these cancers ($p=0.24$).

Discussion

The present study systematically details the landscape of the head and neck oncology workforce in the United States today. Our results highlight the geographic variation in practice locations of head and neck surgeons, with some states having more than 5 times the number of

head and neck surgeons per capita as others. Coastal states tended to have more otolaryngologists per capita than those in the Midwest. This pattern is similar to that found by Gadkaree et al., who analyzed the distribution of all residency-trained otolaryngologists in the United States. [7] While our study did not look at factors associated with a higher density of surgeons, previous reports suggest that subspecialty surgical care is more readily available in metropolitan zip codes, places with higher socioeconomic status, and counties with a higher rate of college graduates. [7,8]

The average number of new head and neck cancer cases per year, per fellowship-trained head and neck surgeon in our study was 277. The total cancer incidence in our study included oral cavity, pharyngeal, laryngeal, and thyroid cancer. While cancers of the oral cavity, pharynx and larynx are predominantly managed by head and neck surgical oncologists, the management of thyroid cancer is more complex. Endocrine surgeons, general surgeons and general otolaryngologists participate in thyroid cancer management. Additionally, the CDC does not report the incidence of non-melanoma cutaneous cancers. The head and neck are the most common regions for non-melanoma skin cancers, and with the aging US population, these cancers are on the rise. Cutaneous malignancies are treated by a much larger group of physicians, such as dermatologists, general surgeons, general otolaryngologists, and plastic surgeons. Thus, the average number of head and neck cancer cases per head and neck surgeon in our study may be an overestimation or an underestimation. Nonetheless, this analysis allows for comparison to be made between states.

Our study found a large range in the number of cases per surgeon in each state. From a patient care perspective, this indicates that there is some geographic disparity in access to care for head and neck cancer patients. More specifically, we found 10 states to be underserved and 3

states to be overserved. There is no standard definition for an adequate workload for head and neck surgeons. We used the mean case volume $\pm$ 1 standard deviation as an estimate for a normal case volume given that the case volume in underserved and overserved states were far above or far beneath this range respectively.

There are several potential reasons why three states were identified as overserved in our analysis. New York had the greatest number of fellowship-trained head and neck surgeons (52) of any state in the AAO-HNS directory. It is also likely that surgeons practicing in New York serve patients in neighboring states such as New Jersey and Connecticut. Similarly, while Washington D.C. appears to be an overserved area, surgeons practicing there likely serve patients from Maryland and Virginia. Nebraska is the other state with the number of head and neck surgeons (9) in excess of the national average. Nebraska is neighboring two states (Wyoming and South Dakota), one with no head and neck surgeons and the other with a low number of practicing surgeons. In addition, there are two major head and neck centers located in Omaha (University of Nebraska and the Methodist Hospital) which is on the boarder of Iowa and receives many patients from this state which may possibly explain this phenomenon.

Between the years of 2011 and 2020, we identified 330 AHNS accredited head and neck surgery fellowship graduates who currently practice in the United States. Of these graduates, 86% currently practice in a university setting. In a similar analysis of head and neck fellowship graduates between 1997 and 2017, Lin et al. found that 70% of graduates continued to practice in academic institutions. [4] This could represent a potential source of continued geographic disparity in the care of head and neck cancers. From 1997 to 2017, Lin et al. also found that 25% of trainees chose to practice in the same state as their fellowship training. [4] We found that more recently, only 19% of fellows choose to practice in the same state as their fellowship which may

represent an increased willingness of trainees to relocate. Only 29% of fellowship graduates in our study were female, though the proportion of female graduates has increased significantly from 15% in 2011 to almost half (46%) in 2020. This is an encouraging and positive trend which shows that head neck surgery is increasingly becoming more popular with women surgeons. Similarly, Lin et al. reported a linear increase in female participation in head and neck surgery fellowships from 1997 to 2017. [4] The level of participation of women in head and neck surgery fellowships is comparable to the proportion of women graduating from medical school in recent years (46% versus 51% for medical school graduation). [9,10]

Lastly, we found that 2011-2020 head and neck surgery fellowship graduates were 5 times more likely to practice in an overserved state than in an underserved state. Why more graduates enter practice in a state that has more head and neck surgeons is a complex process that could be related to existence of an adequate infrastructure, availability of academic institution and personal and professional preferences of the graduates. This observation deserves further study by different stakeholders such as public health officials of the underserved states. In addition, since a significant proportion of graduates continue to practice in the state of their training, it might be worthwhile to investigate if establishing fellowship training in these underserved states could help to reduce the observed discrepancies.

A recent study of the Surveillance, Epidemiology and End Results (SEER) database demonstrated that the incidence of head and neck cancer (excluding thyroid cancer) in the United States has fluctuated significantly over the past 20 years with a slight average annual percentage increase of 0.6%. [11] It is speculated that although traditional risk factors including tobacco and alcohol abuse have decreased among the population, stagnation in head and neck cancer rates may be attributable to widespread HPV prevalence. [12] Independent studies of thyroid cancer

reveal that the incidence of thyroid cancer that was increasing for many years has been more steady in most recent years. [13] Analysis of CDC USCS data in our study support both these previous reports and show that as a whole, head and neck cancer incidence has remained relatively stable over the last 10 years.

Concomitantly, the number of fellows graduating from AHNS-accredited fellowships every year has increased significantly. It is unclear what percentage of the increase in graduates is due to non-accredited fellowships becoming accredited versus the establishment of new accredited programs. The data in our study was not sufficiently detailed to account for this. Nonetheless, the increase in the number of fellowship graduates in our study is in line with the increasing demand for fellowships. Results of a recent study surveying otolaryngology residents show that 46% of residents in 2011 chose to complete fellowship in any subspecialty, while 62% of residents in 2019 chose to complete fellowship. [14] Across all years, 19% of residents chose to pursue head and neck oncology. At the current rate of growth of head and neck fellows, the number of practicing surgeons may eclipse cancer incidence in some states creating a supply-demand mismatch. This is particularly true if graduates continue to practice in overserved states as opposed to underserved states. While we could not identify any significant over supply of head and neck surgeons currently, monitoring of the current growth rate should be an important goal for the American Head and Neck Society.

The primary limitation of this study was our source of data. The AAO-HNS directory may not have been exhaustive in listing the total number of head and neck trained surgeons in each state. However, this data was still useful for making relative statistical comparisons between states. Additionally, while the AHNS directory of fellowship graduates is reliable, it is certainly not exhaustive and does not account for non-accredited program graduates. As a result,

we may have underestimated the total number of head and neck-trained fellows as well as overestimated the rate of fellowship growth. We also chose to include thyroid cancer in our analysis, as this is commonly treated by head and neck surgeons. However, we recognize that other specialties also manage this disease, which may decrease the reliability of our case volume calculations. On the other hand, we could not account for nonmalignant processes that are commonly treated by head and neck surgeons (e.g. benign salivary tumors, benign thyroid disease) and other areas, such as general otolaryngology, in which head and neck surgeons may practice.. Similarly, we are unable to account for variations in the practices of individual surgeons. For example, some surgeons' practices may consist primarily of reconstructive and microvascular surgery, while others may be focused on head and neck endocrine surgery or even more general otolaryngology. Importantly, we do not know if the current median of cases is the appropriate amount, only that it is relatively consistent across many states relative to incidence of cancer and population. Lastly, because the AAO-HNS provides data at the state level, we were unable to assess the impact of referrals across state lines, nor could we assess whether surgeons were uniformly distributed within each state. Despite these limitations in data acquisition and analysis, this is the most comprehensive study of publicly available data on the head and neck oncology workforce. Future studies should aim to be more granular in terms of calculating the number of fellowship-trained surgeons as well as the head and neck cancer incidence, perhaps by including rarer malignancies like sinonasal cancer, salivary tumors, and head and neck sarcomas and paragangliomas.

Conclusions

Geographic disparities in the concentration of fellowship-trained head and neck oncologists in the United States exist. When accounting for head and neck cancer incidence, most states in the United States are adequately served by head and neck oncologic surgeons. Several states, however, are underserved and a few appear to be overserved. The number of AHNS accredited graduates has increased every year, over the last decade. The recent fellowship graduates are more likely to practice in overserved states than in underserved states. This has the potential to create an oversupply of head and neck surgeons in the future without necessarily improving disparities.

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Table 1: States that were identified as overserved and underserved in terms of cancer incidence per number of head and neck surgeons.

Underserved	Overserved
Alaska	Nebraska
Delaware	New York
Hawaii	Washington D.C.
Idaho	
Indiana	
Maine	
Mississippi	
North Dakota	
Rhode Island	
Wyoming	

Figure 1: Number of fellowship-trained head and neck surgeons in each state per 100,000 people as identified in the AAO-HNS directory. (a) shows data represented geographically. States in white did not have any head and neck surgeons in the directory. (b) shows data represented graphically.

Figure 1a: AAO-HNS Number of Head and Neck Surgeons Per 100,000 people

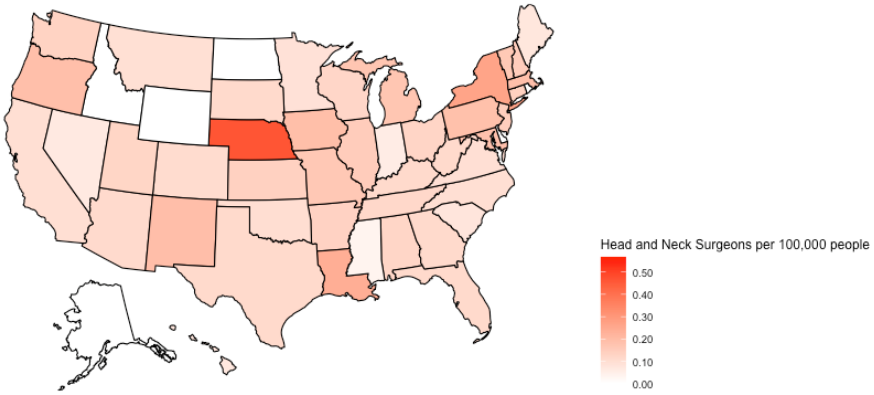

Figure 2: Head and neck cancer incidence in each state per 100,000 people as identified through CDC USCS reports. (a) shows data represented geographically. States in grey either did not have cancer incidence reported in the USCS data (Nevada) or had no head and neck surgeons in the AAO-HNS directory (all others). (b) representation of the cases per surgeon ratio of each state relative to the national mean (blue line). States with case per surgeon ratios above 1 standard deviation (green line) were considered “underserved” while states with case per surgeon ratios below 1 standard deviation line were considered “overserved”.

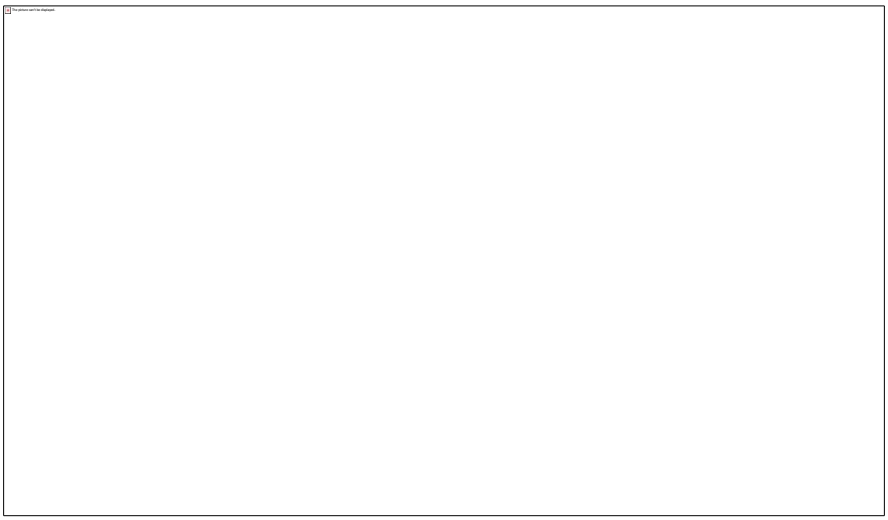


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Figure 3: States in which graduates of AHNS-accredited head and neck oncology fellowships between the years of 2011 and 2020 currently practice.

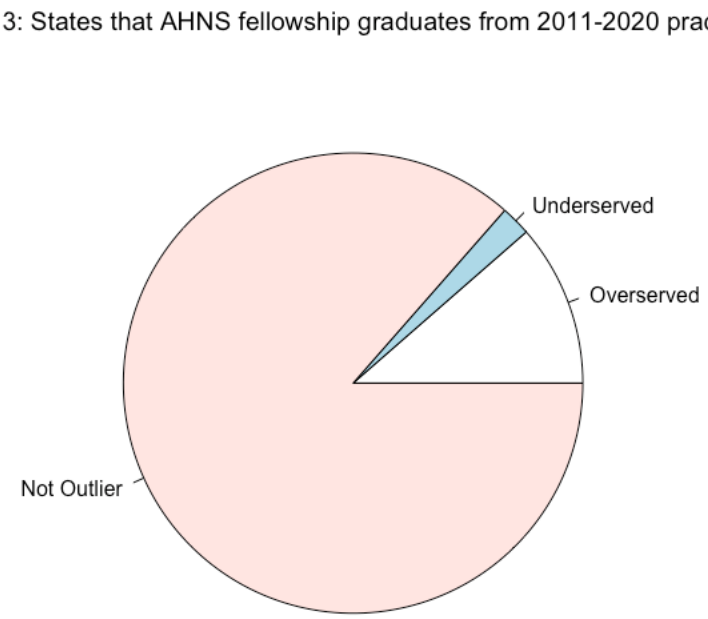

Figure 4: Annual trends in the number of head and neck surgery fellowship graduates and the incidence of head and neck cancer. Head and neck surgery fellowship data was tabulated from the AHNS directory and incidence of head and neck cancer was from derived from CDC USCS data.