

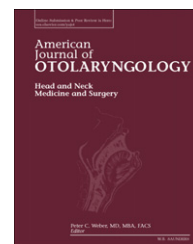


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Voicing an impact: who does the National Institutes of Health support for voice disorder research? ☆



Scott J. Schwartz, BS^{a,*}, Peter F. Svider, MD^a, Priyanka Shah, MD^a,
Giancarlo Zuliani, MD^{a,b}, Jean Anderson Eloy, MD, FACS^{c,d,e},
Michael Setzen, MD^{f,g}, Adam J. Folbe, MD^a

^a Department of Otolaryngology – Head and Neck Surgery, Wayne State University School of Medicine, Detroit, MI, USA

^b Section of Otolaryngology, Department of Surgery, John D. Dingell VA Medical Center, Detroit, MI, USA

^c Department of Otolaryngology – Head and Neck Surgery

^d Center for Skull Base and Pituitary Surgery, Neurological Institute of New Jersey, Newark, NJ, USA

^e Department of Neurological Surgery, Rutgers New Jersey Medical School, Newark, NJ, USA

^f Rhinology Section, North Shore University Hospital, Manhasset, NY, USA

^g Department of Otolaryngology, New York University School of Medicine, New York, NY, USA

ARTICLE INFO

Article history:

Received 8 October 2014

ABSTRACT

Purpose: Interest in a variety of neoplastic, functional, neurological, and age-related laryngeal disorders has contributed to the development of laryngology as an established subspecialty. Funding support plays a critical role in facilitating scholarship within the field. Our objectives were to evaluate who is receiving funding from the NIH for topics relevant to voice disorders, and further describe temporal trends in grants awarded.

Methods: The NIH RePORTER database was searched for grants relevant to voice disorders. Data were further organized by PI specialty, academic department, and funding totals. Furthermore, PI scholarly impact, as measured by the *h-index*, was calculated.

Results: A total of 830 funded fiscal years (for 232 unique projects) totaling \$203 million have supported projects examining voice disorders. A plurality of projects (32.8%) was awarded to PIs in otolaryngology departments, followed by 17.2% to speech pathology/communication sciences departments. Although year-to-year variation was noted, otolaryngology departments received approximately 15% of funding annually. Funded otolaryngologists had similar scholarly impact values to individuals in other specialties.

Conclusions: The study of voice disorders involves an interdisciplinary approach, as PIs in numerous specialties receive NIH funding support. As they receive a considerable proportion of this funding and had similar *h-indices* compared to other specialties involved, otolaryngologists

☆ Financial disclosures: None.

* Corresponding author at: Department of Otolaryngology – Head and Neck Surgery, Wayne State University School of Medicine, 4201 St. Antoine, 5E-UHC, Detroit, MI 48201. Tel.: +1 313 577 0804; fax: +1 313 577 8555.

E-mail address: sschwartz@med.wayne.edu (S.J. Schwartz).

have just as much scholarly impact despite being a smaller specialty. As speech and language pathologists also comprised a significant proportion of individuals in this analysis, enhanced cooperation and encouragement of interdisciplinary scholarly initiatives may be beneficial.

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1. Introduction

Expansion of technological capabilities over the past two decades has increased our understanding of pathophysiological mechanisms responsible for voice and laryngeal-related disorders. Consequently, increased interest in a variety of neoplastic, functional, neurological, and age-related laryngeal disorders has contributed to the development of laryngology as an established subspecialty. Extramural funding support may play a critical role in facilitating scholarship within the field. Prior analyses in multiple specialties have noted an association between greater scholarly impact and receiving funding awards from several organizations, most importantly the National Institutes of Health (NIH) [1-10]. Awards from the NIH are considered the "gold standard" in biomedical research, as this organization is the largest supporter of scientific inquiry in the world [11-13]. Nonetheless, funding opportunities have declined in recent years [14], increasing the competition for these grants. In many cases, ability to procure external funding is necessary for the viability of a primary investigator (PI), as many institutions may be unable to provide significant funding via internal mechanisms.

The management of patients with voice disorders is an inherently interdisciplinary undertaking, with close cooperation between a variety of professionals including (but not limited to) otolaryngologists and speech and language pathologists (SLP) being integral for appropriate diagnosis and management of patients. These lessons may certainly be carried over to the discipline of research, as close cooperation may be crucial, particularly in the current funding environment. Our objectives were to evaluate who receives funding from the NIH for topics relevant to voice disorders, and further describe temporal trends in grants awarded.

2. Methods

The authors accessed the NIH RePORTER database and collected all data in October 2013. Using the advanced search function, the authors inputted the following phrase into the search text: "vocal cord" OR "vocal fold" OR "vocal cord polyp" OR "vocal cords" OR "vocal folds" OR "vocal cord polyps" OR "vocal cord nodule" OR "vocal cord paralysis" OR "vocal cord paresis" OR "reinke" OR "spasmodic dysphonia" OR "dysphonia" OR "laryngeal papillomatosis" OR "laryngitis". The search was limited to project title and/or project abstract, and included all years from 1989 until the present. After the initial search yielded 878 hits, multiple authors looked over the data and removed 48 hits that were not relevant to the study of voice and voice disorders. We did include studies that focused on certain pathogens relevant to voice disorders including parmyxovirus and coronavirus, as long as the abstracts mentioned a connection to voice and/or voice disorders.

Ultimately, 830 out of 878 hits (94.53%) were included in the final data. The NIH RePORTER Website shows each funded year as a separate hit, so many of these results were simply different fiscal years of the same project. The authors used each entry's project number and title to determine which entries were from the same project for multiyear projects (but represented different fiscal years of funding), and we aggregated these totals to come up with 232 different projects along with each project's respective aggregated funding total. These 232 unique projects represented 830 fiscal years of funding.

The funding totals for each grant were available only after the year 2000. There was also a small subset of grants after the year 2000 that did not have funding data, and these were not included in monetary calculations. In total, 566 out of 830 (68.2%) funding years were included in the final data. These funding years corresponded to 167 of the initial 232 projects (72.0%) that were included in the final data set. All funding data were then adjusted for inflation using the United States Department of Labor Bureau of Labor Statistics Consumer Price Index Calculator based on the year the funding was received.

The NIH RePORTER Website provides the department and institution that most of the PIs were serving when they were awarded grants. For the PIs that did not have this information available on the NIH RePORTER database, the authors conducted an Internet search to find out in which department and institution they had conducted their research during the fiscal year a grant was awarded. Online faculty profiles and academic CVs were among the resources used to determine this information. For those PIs where no reliable information could be found, they were included in the "unknown/other" category throughout the data collection process.

An online search was conducted in the same fashion as above to determine the specialty and terminal degree of PIs listed in this database. Additionally, each PI's scholarly impact, as measured by the *h-index*, was calculated using the Scopus database.

The *h-index* is an objective bibliometric that indicates the frequency at which an author is being cited on a consistent basis [15]. In other words, it is an effective measure of the consistency with which an author is having impact upon scholarly discourse within a field. It's strengths, limitations, and definition have been discussed extensively in the literature [15,16]. Prior analyses have noted a strong association with research productivity, academic promotion, extramural funding, and even level of training among otolaryngologists [6,9,10,17].

3. Results

Encompassing records since 1989, the NIH RePORTER system revealed funding for 830 fiscal years for 232 different projects related to voice disorders. The NIH RePORTER system only reports

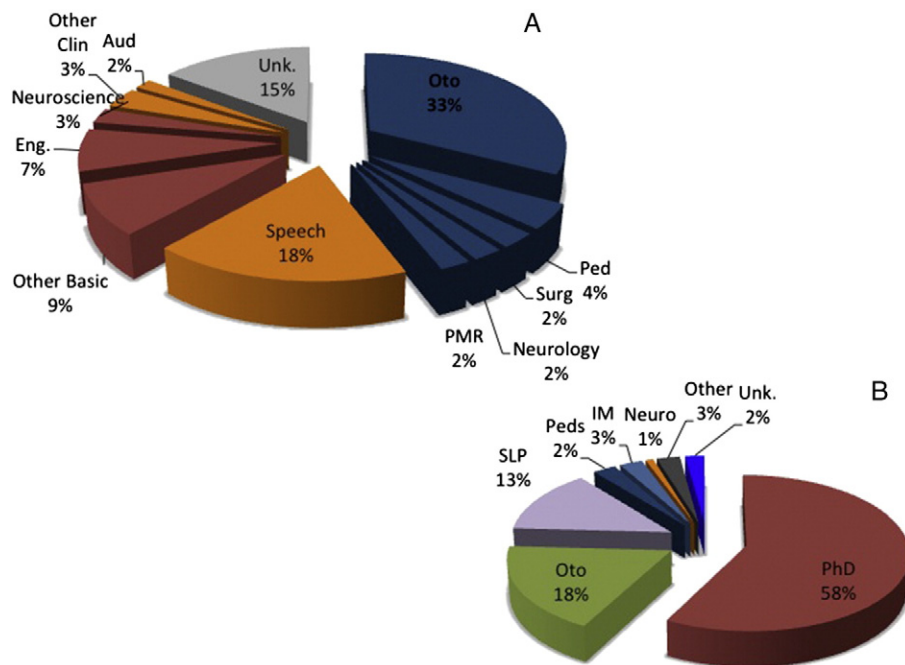


Fig. 1 – Breakdown of the departments under which PIs received NIH awards for voice related research. Oto = otolaryngology, Ped = pediatric, Surg = surgery, PMR = physical medicine and rehabilitation, Speech = speech/communication departments, Other Basic = basic science departments (other than neuroscience), Eng = engineering (includes all types of engineering), Other Clin = other clinical department, Aud = audiology/acoustic sciences departments. This figure is out of the 232 different projects awarded grants included in this analysis. (A) Breakdown by department. (B) PI specialty.

specific dollar amounts for grants from 2000, and of these 232 projects, 167 (71.9%) had reported funding values.

A plurality (32.8%) of 232 different grants was awarded to PIs in otolaryngology departments (Fig. 1), with speech pathology/communication departments being the next most common recipients (17.7%). When organizing awards by PI specialty, the majority (57.8%) of awards went to PIs with PhDs (excluding SLPs), followed by otolaryngologists and SLPs (Fig. 1). Upon further examination of awards to otolaryngology departments, 37 of 76 projects (48.7%) had otolaryngologists as PIs (Table 1), with the most common practitioners being non-fellowship-trained and pediatric otolaryngologists. Upon examination of temporal trends, year to year variation was noted, with a notable trend being a significant increase in funding from 2003 to 2012 among PIs in surgery departments (Fig. 2A). Nonetheless, the proportion of funding awarded to otolaryngology PIs remained relatively consistent during most years of this time period (Fig. 2B). Upon examination

of *h-index* of PIs receiving awards, otolaryngologists had statistically higher *h-indices* than SLPs ($p = 0.03$) (Fig. 3), while differences did not reach statistical significance compared to other specialties (p -values > 0.05). Examination of aggregate NIH funding per PI organized by PI specialty is noted in Table 2.

4. Discussion

The study of laryngology and voice disorders is becoming an increasingly interdisciplinary field. Speech pathologists, PhD researchers, engineers, and of course otolaryngologists all contribute to this broad and ever-changing area of study. This can be partly attributed to new clinical practice guidelines, where clinicians are recommended to refer to voice therapy rather than prescribing antibiotics for treating routine voice disorders such as hoarseness [18]. Because of this interdisciplinary approach a healthy portion of the current research on voice disorders is being completed by speech pathologists, only occasionally in conjunction with otolaryngology departments. While PhD researchers and otolaryngologists comprise over 70% of NIH funded research on the topic, speech pathology research makes up over 13% of the total (Fig. 1B). An increasingly collaborative approach between otolaryngologists and speech pathologists could lead further research opportunities, particularly in light of the current increasingly competitive funding atmosphere.

Inevitably, this leads to a question: how impactful is the research done by speech pathologists compared to research headed by otolaryngologists? To quantitatively measure this, the authors used the *h-index* of each principal investigator.

Table 1 – Primary investigators in otolaryngology departments.

Specialty	# Of projects (%)
Otolaryngology	37 (48.7%)
Non-fellowship-trained	18 (23.6%)
Pediatric	9 (11.8%)
Laryngology	5 (6.6%)
Facial plastic surgery	3 (3.9%)
Head and neck	2 (2.6%)
PhD (excluding SLPs)	25 (32.9%)
Speech and language pathologist	10 (13.2%)
Internal medicine	2 (2.6%)
MD/PhD student	1 (1.3%)
Research assistant	1 (1.3%)

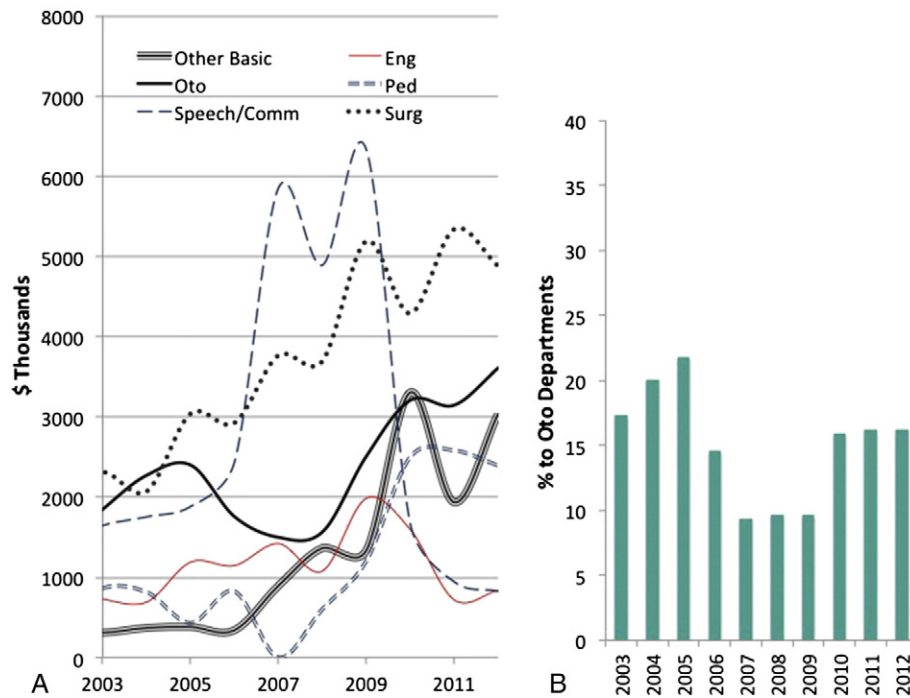


Fig. 2 – Specialty/terminal degree breakdown of PIs receiving NIH grants for voice disorder research. Oto = otolaryngologist, SLP = speech and language pathologist, PhD = PhDs excluding SLPs with doctorates, Peds = pediatricians/pediatric subspecialties, IM = internal medicine, Neuro = neurologists, Unk. = information unavailable.

Upon comparison of speech pathologists to otolaryngologists that received NIH funding for their research, there was a significant difference ($p < 0.05$) between the *h*-indices of the two groups, with otolaryngologists having a significantly higher *h*-index than speech pathologists. While statistically significant, the practical significance of this result is questionable. Although this measure has utility as an objective indicator of the frequency at which an individual is having an impact upon scholarly discourse within his or her field, prior analyses have noted that scholarly impact values vary widely by factors such as size of one’s field, as this may have a

substantial impact on the size of audiences for a field’s journals, ultimately affecting objective bibliometrics such as the *h*-index [10].

Laryngology as an established subspecialty is a relatively novel trend, and some have noted that the supply of fellowship-trained laryngologists remains insufficient for the purposes of training otolaryngology residents in the U.S. [19] This likely has contributed to the further proliferation of fellowship-training opportunities in recent years. A recent survey of otolaryngology residents revealed that less than half (41%) of respondents felt they had adequate operative laryngology instruction during their residency training, with approximately the same number reporting that they were comfortable providing laryngology care [20]. In light of these findings, only 6 of 42 (14.3%) projects with otolaryngologist PIs

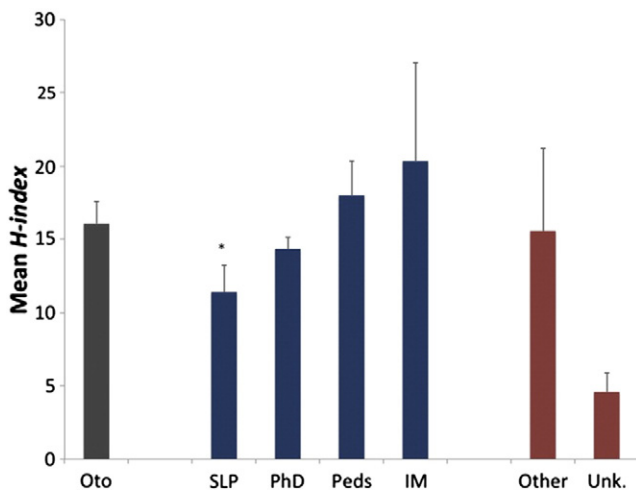


Fig. 3 – Scholarly impact, as measured by *h*-index, of PIs in various specialties (abbreviations same as Fig. 2).

Table 2 – Primary investigators receiving awards.

Specialty	Years funded (median)	\$ Thousands per PI (since 2000)	P-value vs oto
Diagnostic radiology	3	104	1.0
Internal medicine	6	470	} 0.48
Internal medicine specialties	2	219	
Neurology	5	2665	0.33
Otolaryngology	4	984	-
Pediatrics	5	2861	} 0.09
Pediatrics specialties	4	723	
PhD (excluding SLPs)	3	1006	0.23
Speech/language pathologist	3	331	0.002

involved a fellowship-trained laryngologist (Table 1). This suggests that there may be room for structured research opportunities in laryngology fellowships that encourage incorporation of basic and clinical research in subsequent careers.

One way to encourage organization of these structured research opportunities may be to recruit and ultimately retain PhD researchers in otolaryngology departments. Over half of all NIH funded projects in voice disorders (58%) were granted to PhDs (Fig. 1). By having PhD researchers in otolaryngology departments, residency trainees interested in voice disorders and laryngology fellows may have additional opportunities to produce meaningful and impactful research. Fundamentally, this can be achieved by receiving significant support from external funding organizations, most notably the NIH. Furthermore, this may also encourage the advancement of clinical research in the field of voice disorders due to the enhanced scholarly atmosphere. Our analysis notes a minority (6.6%) of funded projects in otolaryngology departments are headed by fellowship-trained laryngologists (Table 1). It is only logical that if residency trainees are exposed to voice disorder research early in their training, there will be more interest and academic scholarship in the field later in their careers.

With NIH funding becoming ever more increasingly competitive, continued cooperation between otolaryngologists and SLPs is necessary. While the percentage of NIH funding to otolaryngology departments has remained consistent in recent years, interdisciplinary approaches to clinical and basic science research can have a large impact on the medical community (Fig. 2B). Recently, surgery departments have received the largest portion of NIH grants for voice disorder research (Fig. 2A). It is important to note that many of these occur at institutions where otolaryngology is a *division* of the surgery department, and not its own stand-alone department.

It is evident that SLPs are producing a significant portion (13%) of NIH funded research concerning voice disorders (Fig. 1). SLPs are not only confined to clinical practice anymore, but now have a growing and active role in research. The specific roles of SLPs working in otolaryngology departments are becoming more clearly defined as well in recent years. For example, a coordinated interdisciplinary approach between SLPs and otolaryngologists in voice therapy treatment has been shown to increase patient compliance [21]. SLPs also have a developing role in nonoperative management of head and neck cancers by identifying silent dysphagia and implementing prophylactic swallowing intervention [22]. Increased collaboration with SLPs as integral members of otolaryngology departments may have both significant clinical and research benefits.

The analysis had several limitations due to our study design. The data were collected from the NIH RePORTER database system; funding totals in the database are only available for projects that occurred in 2000 or later. This comprised approximately 28% of the total, and included some projects that went on for many years that could potentially have been issued large NIH grants. In retrospect there may have been some limitations in our search criteria, and we could have possibly included such search broad terms as “voice treatment” or “larynx” to encompass the large amount of research being done under the topic of normal voice function. We did, however, want to stay true to our initial topic of focusing solely on voice disorders. Also, due to the

large number of projects in our data analysis, it was difficult at times to group the projects into their proper specialties or categories. Many of the PIs were grouped into the “unknown” category by the NIH RePORTER database, and the authors used Internet searches to discover the specialties of these individuals. Certain principal investigators could not be properly categorized by Internet searches and were thus unfortunately placed into this “unknown” grouping, possibly clouding the true nature of categorical differences between specialties in funding. There was also the issue of not categorizing each grant into specific types, such as certain training grants given out by the NIH. This could be a direction for future research, looking into the need for laryngology fellowship programs to obtain these NIH training grants to further promote scholarship in the field of voice disorders.

5. Conclusions

Voice disorders encompass a variety of different fields, with research on the subject being performed by a variety of different practitioners. In these modern times, mid-level providers are an important and emerging component of the medical community, with their roles becoming essential to patient care. In this vein, it is important to recognize that research being done by SLPs is a growing and impactful slice of the whole pie. Working side-by-side with SLPs will help secure vital NIH funding and place otolaryngologists at the forefront of research that could be most beneficial to patients. The growing field of laryngology as a subspecialty could also stand to benefit from the increase hiring of PhDs in academic positions in departments. Otolaryngologists working together with PhDs in structured research blocks during residency and fellowship could lead to amplified scholarly impact; the funding power that PhDs possess should not be overlooked, as this financial support is necessary for the advancements in the field.

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