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Change in Diagnosis and Treatment Following Specialty Voice Evaluation: a National Database Analysis

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Abstract

Objective—We evaluated the association between specialty voice evaluation and changes in laryngeal diagnosis and treatment in patients with laryngeal/voice disorders.

Study Design—Retrospective analysis of a large, national administrative U.S. claims database.

Methods—Patients with a laryngeal disorder based on ICD-9-CM codes from January 1, 2004 to December 31, 2008, seen by an otolaryngologist, and a specialty voice evaluation designated by videolaryngostroboscopy (VLS) within 90 days of the last laryngoscopy were included. Patient diagnosis at the last laryngoscopy visit and the subsequent, initial VLS visit were collected. Specific treatment modalities were tabulated for the 30 day period after the last laryngoscopy and for 30 days after the VLS.

Results—168,444 unique patients saw an otolaryngologist for 273,616 outpatient visits. 6.1% had a VLS performed of which 4000 (23.8%) occurred within 90 days of the last laryngoscopy with a median interval of 30 days (interquartile range 15 – 50 days). Half the patient visits had a change in laryngeal diagnosis. Changes in use of antibiotics, PPIs, voice therapy, and surgical intervention were seen after specialty voice evaluation.

Conclusions—Specialty voice evaluation was associated with changes in laryngeal diagnosis and treatment. Further study is needed to assess the impact on health care costs and patient outcomes.

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Keywords

laryngeal disorders; voice disorders; stroboscopy; dysphonia; voice; diagnosis; treatment

Introduction

Evaluation of patients with laryngeal/voice disorders may occur in a variety of settings including general otolaryngology and specialty voice clinics. Specialty voice evaluation often includes multidisciplinary examination by a laryngologist, a speech-language pathologist and possibly a singing voice specialist. Videolaryngostroboscopy (VLS) is considered an essential component of the multidimensional assessment of patients with laryngeal/voice disorders.^{1, 2} Examination of a national claims database revealed that specialty voice evaluation (as evidenced by VLS assessment) occurred in 6.2% of outpatient otolaryngology visits.³ Specialty voice evaluation has been reported to alter diagnoses and possibly lead to changes in management.^{2, 4-9}

These earlier publications may not be generalizable to the real-world setting. Studies focusing on specific patient populations (i.e., primarily professional voice users) may yield results not representative of the general voice disordered population.³ Furthermore, the diagnostic and treatment changes reported from single specialty centers and individual providers may reflect individual practice patterns, preferences, and biases.^{2, 5-7, 9} Limitations of patient recall, retrospective design, and issues regarding patient selection may also affect the results of some studies.^{5, 6, 9} Thus, a need exists to examine the impact of specialty voice evaluation on patient diagnosis and treatment on a broad, national scale.

The MarketScan® national claims database contains longitudinal data of patients as they navigate through the health care system and thus provides a means to further assess the impact of specialty voice evaluation in a broad patient sample across multiple providers and geographic regions. Such information is important to understand the worth of specialty voice evaluation, an important component in the management of patients with laryngeal/voice disorders. By altering patient diagnosis and treatment, specialty voice evaluation may have implications for patient outcomes and health care costs. The purpose of this study was 1) to examine changes in laryngeal diagnosis among patients who received a specialty voice evaluation during outpatient otolaryngology visits, 2) to identify changes in treatment associated with specialty voice evaluation, and 3) to explore what factors may be related to diagnosis and treatment changes.

Methods

This study was approved by the Duke University Medical Center Institutional Review Board. The MarketScan® Commercial Claims and Encounters dataset and Medicare Supplemental and Coordination of Benefits dataset, a large, national administrative U.S. claims database, was retrospectively analyzed from January 1, 2004 to December 31, 2008. The MarketScan® databases (Truven Health Analytics, Ann Arbor, MI) contain the annual health care claims of approximately 55 million individuals including employees < 65 years

of age, Medicare beneficiaries 65 years of age, and their dependents integrated from all care providers and linked to health care utilization and cost records at the patient level.¹⁰

Patients with a primary or non-primary diagnosis of at least one of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes (Table I) were included if seen as an outpatient by an otolaryngologist during the period January 1, 2004 to December 31, 2008, had a laryngoscopy, and within 90 days subsequently had a specialty voice evaluation, designated by an otolaryngology visit with VLS. The 90 day window between the last laryngoscopy visit and first specialty voice evaluation was chosen to reduce the chances of examining two unrelated voice problems as may occur with a longer timeframe. Since patients with a brainstem stroke may have a disordered voice from nucleus ambiguus involvement, 438.10 and 438.19 (late effects of cerebrovascular disease) were included. The Evaluation and Management (E & M) Current Procedural Terminology (CPT) codes and internal MarketScan® database codes identified outpatient visits (Table 1). Patients who did not see an otolaryngologist as an outpatient and who did not have a specialty voice evaluation within 90 days after a prior laryngoscopy visit were not included.

The CPT code 31579 designated VLS and 31505 and 31575 were classified as laryngoscopy. Because mirror laryngoscopy is included in the E & M code, visits during which a laryngoscopy or VLS code was not provided were grouped with laryngoscopy visits. Age, gender, geographic region (divided into four census regions: northeast, north central, south, and west), and urban versus rural status (based on residence in a metropolitan statistical area (MSA)) were collected. *Otolaryngologists* were classified as otolaryngology, pediatric otolaryngology, or head & neck surgery based on the MarketScan® database dictionary. Specific comorbid conditions were also collected: sinusitis (461.x, 473.x), asthma (493.x), chronic obstructive pulmonary disease (490, 491.xx, 492), gastro-esophageal reflux (530.81), acute pharyngitis (462), acute bronchitis (466.xx), acute upper respiratory illness (465.x), pneumonia (481, 482.xx, 483.x, 486), and allergic rhinitis (477.x).

To assess the association between specialty voice evaluation and diagnosis, the laryngeal/voice diagnoses provided during the last laryngoscopy visit preceding the first specialty voice evaluation and the laryngeal/voice diagnosis at the specialty voice evaluation were tabulated. Although patients may have had more than one laryngoscopy visit and/or specialty voice evaluation with related laryngeal diagnosis change, comparing the last laryngoscopy visit and first specialty voice evaluation related diagnosis permitted an assessment of the initial impact of the specialty voice evaluation on laryngeal diagnosis change. While individual diagnoses may have changed, patients with more than one aggregate laryngeal diagnosis during the last laryngoscopy visit or specialty voice evaluation were classified as “multiple diagnoses.”

When evaluating changes in treatment linked to the specialty voice evaluation, the time period up to 30 days after the last laryngoscopy visit was compared to the 30 days after the first specialty voice evaluation. This timeframe was selected to link interventions to the specific visits. The therapeutic drug classes and generic identification numbers in the MarketScan® database dictionary were used to identify antibiotics and proton pump

inhibitors, the two most costly medication categories.¹¹ CPT codes were used to identify voice evaluation/therapy and laryngeal surgery (Table I).

MarketScan® database management and statistical analysis was completed with SAS version 9.3 (SAS Institute, Cary, NC). Summary statistics were calculated. The frequencies of laryngoscopy and specialty voice evaluation related laryngeal diagnoses and treatments were determined. Separate logistic regressions for the outcomes “diagnosis change” and “treatment change” were performed to assess the impact of specific laryngeal diagnoses, age, gender, geographic region, MSA status, and comorbid conditions on the specific outcome.

Results

54,600,465 unique patients were in the MarketScan® databases from January 1, 2004 to December 31, 2008 of which 536,943 (1%) unique patients had a diagnosis of laryngeal disease. 168,444 (31%) unique patients saw an otolaryngologist as an outpatient with a laryngeal diagnosis for a total of 273,616 visits of which 16,820 (6.1%) were a specialty voice evaluation. Of the 16,820 specialty voice evaluations, 7823 (46.5%) occurred on the initial otolaryngology visit, 3056 (18.2%) occurred after a previous specialty voice evaluation, 1941 (11.5%) occurred between 91 and 1680 days after the last laryngoscopy, 4000 (23.8%) occurred within 90 days after the last laryngoscopy visit and are the subject of this investigation.

The median number of days between the initial specialty voice evaluation and the last laryngoscopy visit was 30 days with an interquartile range of 15 – 50 days. The characteristics of the patients comprising these 4000 outpatient otolaryngology visits are displayed in Table II.

A change in laryngeal diagnosis between the last laryngoscopy visit and the first specialty voice evaluation was identified in 47.9% (Table III). Patient visits with diagnoses of non-specific dysphonia and chronic laryngitis at the last laryngoscopy visit frequently changed to benign laryngeal/vocal fold pathology and multiple diagnoses (Table III). Most (83.6%) of the patient visits with acute laryngitis diagnoses at the last laryngoscopy had a different laryngeal diagnosis at the specialty voice evaluation (Table III). Patient visits with benign laryngeal/vocal fold lesions at the last laryngoscopy visit changed primarily to non-specific dysphonia and multiple diagnoses at the specialty voice evaluation (Table III). Patient visits with vocal fold paralysis and paresis at the last laryngoscopy had diagnostic changes to non-specific dysphonia, multiple diagnoses, from paralysis to paresis (and vice versa), and to benign laryngeal/vocal fold pathology in the case of paresis (Table III).

Differences in treatment patterns were noted between the 30 day period after the last laryngoscopy visit compared to the 30 day period after the initial, subsequent specialty voice evaluation. 59.5% of patient visits had a different treatment involving at least one of the categories of antibiotics, PPIs, laryngeal surgery, or voice therapy while 40.5% did not have a change in treatment status. Specific changes in treatment patterns were noted for antibiotics, PPIs, laryngeal surgery and voice therapy (Table IV).

Logistic regression analysis revealed that acute laryngitis and vocal fold paresis had higher odds of diagnosis change than chronic laryngitis. Laryngeal cancer and non-specific dysphonia were associated with lower odds of diagnosis change than chronic laryngitis. Patient visits in urban regions had lower odds of diagnosis change than rural areas, and the northeast had lower odds for diagnosis change than the south. Patients with sinusitis had lower odds of diagnosis change than patients without sinusitis (Table V). A second logistic regression analysis revealed that benign laryngeal/vocal fold lesions had higher odds for treatment change compared to chronic laryngitis (Table VI).

Discussion

The current study examined associations between specialty voice evaluation and the diagnosis and treatment of patients with laryngeal/voice disorders in a large, longitudinal cohort of outpatient otolaryngology visits. We identified a 47.9% rate of laryngeal diagnosis change after specialty voice evaluation. This finding is similar to prior reports in single institution, tertiary care settings, which reported rates of diagnosis change or additional diagnostic information ranging from 10 to 61%.^{4-6, 8, 9} With prior studies finding voice problems lasting for a mean duration of 17 to 36 months among patients referred to voice specialists, our 30 day median (interquartile range of 15 to 50 days) interval between the last laryngoscopy and initial specialty voice evaluation does suggest that we were likely observing the same episode of voice difficulty and not a separate presentation of a voice problem.^{12, 13} Although other factors such as coding errors, treatment trials, and a developing/evolving disorder could also have influenced the observed laryngeal diagnosis change, the current investigation supports the role of the specialty voice evaluation in the diagnosis of laryngeal/voice disorder patients.

Particular laryngeal disorders may benefit from specialty voice evaluation more than others. Perhaps due to its self-limited nature or mis-diagnosis, acute laryngitis was associated with one of the highest odds for diagnosis change after specialty voice evaluation (Tables III, V). Vocal fold paresis had higher odds of diagnosis change than chronic laryngitis with 73.1% of initial diagnoses changing at the specialty voice evaluation, most commonly to benign vocal fold/laryngeal pathology, multiple diagnoses, and non-specific dysphonia (Table III, V). Chronic laryngitis also had greater odds for diagnosis change after the initial specialty voice evaluation than laryngeal cancer and non-specific dysphonia (Table V). Almost 20% of patient visits with initial non-specific dysphonia and acute and chronic laryngitis diagnoses were diagnosed with multiple laryngeal diagnoses and roughly 10% were identified as having benign laryngeal/vocal pathology after specialty voice evaluation (Table III). Otolaryngologists have been reported to be less comfortable diagnosing laryngeal/voice disorders without obvious structural abnormalities, suggesting a role for specialty voice evaluation.¹⁴ Additionally, 20% of patient visits with initial benign laryngeal/vocal fold pathology were subsequently found to have additional multiple diagnoses after specialty voice evaluation (Table III). Although limited to only 7 patients, non-specific conditions have been initially diagnosed in patients found to have laryngeal cancer.⁹ Similarly, 20.5% of patients with diagnoses of at least presumed laryngeal cancer after specialty voice evaluation had prior diagnoses of acute and chronic laryngitis and non-specific dysphonia (Table III). While the current investigation could not determine which patients were thought

to have LPR at the last laryngoscopy visit, previous studies have found a high rate of diagnostic change after subsequent specialty voice evaluation among patients with presumed LPR.¹⁵⁻¹⁷ Given the association between specialty voice evaluation and diagnosis, the impact on subsequent patient outcomes needs investigation.

Other factors were related to diagnostic changes in laryngeal/voice disorders after specialty voice evaluation (Table V). Patients with sinusitis had lower odds for diagnosis change than those without sinusitis, possibly indicating that the treating otolaryngologist suspected sinusitis was at least part of the cause for the laryngeal/voice disorder. The specialty voice evaluations in the south had higher odds of diagnosis change than the northeast. Urban locations had lower odds of diagnosis change than rural areas. Since the VLS is a tool, its value is dependent on the ability of the clinician to interpret the exam findings. Thus, the impact of specialty voice evaluation including VLS may vary depending on the skill of the clinician.¹⁸ Potential variations among expertise of the otolaryngologists and availability of multi-disciplinary evaluation with voice-trained speech-language pathology colleagues may be related to the geographic variation and are worthy of investigation.

Additionally, specialty voice evaluation was associated with changes in treatment among patients with laryngeal/voice disorders. Of patient visits with prior antibiotic prescription within 30 days of the last laryngoscopy visit, two-thirds did not have an antibiotic within 30 days of the specialty voice evaluation (Table IV). Whether this is due to resolution of the infection, persistence of the voice problem despite an antibiotic trial, or completion of the antibiotic course which is typically less than 30 days in length is not known. Treatment changes related to PPI treatment before and after specialty voice evaluation were also found with 44.5% of patient visits with prior PPI treatment not having a PPI after the specialty voice evaluation and one-fourth receiving PPI after the specialty voice evaluation (Table IV). Similar findings of reduced antibiotic use and reflux evaluation/treatment after specialty voice evaluation were identified in a single institution study.⁹ While we cannot determine the appropriateness of antibiotic or PPI prescriptions, specialty voice evaluation was associated with changes in the utilization of these costly medications. Further study is needed to determine the impact on subsequent health care utilization.

Specialty voice evaluation was linked to changes in the use of voice therapy and surgical intervention. Compared to chronic laryngitis, benign laryngeal/vocal fold pathology had higher odds of treatment changes after specialty voice evaluation (Table VI). Previous reports among dysphonic pediatric patients have found that specialty voice evaluation helped distinguish between benign vocal fold lesions which affected surgical recommendations.⁷ Likewise, among adult patients with dysphonia, surgical counseling was recommended in 10.3%.⁴ In our series, 10.6% of patient visits without laryngeal surgery before had surgery after the specialty voice evaluation. Specialty voice evaluation may also aid in determining which patients with persistent or recurrent dysphonia after laryngeal surgery need voice therapy or repeat surgery.¹⁹ While the exact reasons are not known, roughly 15% of patient visits with laryngeal surgery before had another laryngeal surgery within 30 days after the specialty voice evaluation, and in 11.7% of patient visits in which voice therapy was not obtained prior to specialty voice evaluation, voice therapy occurred

after. The implications of these treatment changes on patient outcomes needs continued investigation.

Certain methodologic issues must be addressed. The accuracy of ICD-9 coding could not be confirmed. However, codes were aggregated into broad groups to lessen the impact of diagnostic imprecision/variability. The influence of patient characteristics, such as severity of the laryngeal/voice problem, professional voice use, and socioeconomic status, on changes in laryngeal diagnosis and treatment could not be measured. Also, we could not determine whether the last laryngoscopy and initial specialty voice evaluation were performed by the same otolaryngologist or if the specialty voice evaluation occurred with speech-language pathologists or in a voice center. While difficult cases may have been more likely to have specialty voice evaluation increasing the rate of diagnosis and treatment change, specialty voice evaluation may not be needed in straightforward cases. The VLS could also have been performed simply for financial reimbursement and may not indicate a more specialized evaluation in some settings. Thus, further study is needed to determine the relative impact of VLS, multi-disciplinary approach with speech-language pathologists, and voice expertise of the otolaryngologist on diagnosis and treatment changes. Because patients had Medicare and commercial employee-sponsored plans, results may not be generalizable to the Medicaid or uninsured population. Despite these limitations, database research has been performed to assess the utilization of various evaluations strategies in other disease states.^{20, 21} This large, population-based study provides insights regarding the associations between specialty voice evaluation and laryngeal diagnosis and treatment-related changes on a national scale across multiple providers and locations.

Conclusions

Specialty voice evaluation was associated with alterations in laryngeal diagnoses in roughly half of patient visits. Moreover, specialty voice evaluation was related to changes in antibiotic and PPI prescriptions, voice therapy, and laryngeal surgery. Future studies are needed to explore the impact of specialty voice evaluation on subsequent health care utilization, costs and patient outcomes. The influence of the timing of specialty voice evaluation and voice training among the treating otolaryngologist on laryngeal diagnosis and resultant treatment also needs examination.

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Table I

Diagnostic, patient visit, and treatment codes employed.

Laryngeal Diagnoses	ICD-9 Codes
Vocal fold paralysis	478.30, 478.32
Bilateral vocal fold paralysis	478.34
Vocal fold paresis	478.31, 478.33
Non-specific dysphonia	784.49, 784.42, 784.40, 784.41
Acute laryngitis	464, 464.01, 464.20, 464.21
Benign laryngeal/vocal fold pathology	478.4, 478.5, 478.6, 478.71, 478.79, 212.1
Other larynx/vagus	478.70, 352.3
Chronic laryngitis	476.0, 476.1
Laryngeal cancer	161.0, 161.1, 161.2, 161.3, 161.8, 161.9
Laryngeal spasm	478.75
Late effect cerebrovascular disease, other speech deficits	438.10, 438.19
Patient Visit Codes	CPT codes
Outpatient visits	99201, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215, 99241, 99242, 99243, 99244, 99245, 99354, 99355 and internal MarketScan® database codes (101, 104, 109, 115, 120, 122)
Treatment Codes	CPT codes
Voice evaluation/therapy	92506, 92507, 92520
Laryngeal surgery	31300, 31320, 31360, 31365, 31367, 31368, 31370, 31375, 31380, 31382, 31390, 31395, 31400, 31420, 31500, 31502, 31510, 31511, 31512, 31513, 31515, 31520, 31525, 31526, 31527, 31528, 31529, 31530, 31531, 31536, 31540, 31541, 31545, 31546, 31560, 31561, 31570, 31571, 31576, 31577, 31578, 31580, 31582, 31584, 31587, 31588, 31590, 31595, 31599, 64716, 64886

Table II

Characteristics of patients among the 4000 patient visits.

Variable	Percent
Age	
0-17	3.3%
18-34	12.1%
35-64	66.7%
> 65	17.9%
Gender	
Male	41.4%
Female	58.6%
Geographic location	
Northeast	18.7%
North Central	24.9%
South	44.5%
West	11.9%
Live in Metropolitan Statistical Area	
Yes	88.5%
No	11.5%
Visit type	
Return	64.1%
New or consult	35.9%
Employment	
Employed	44.8%
Retired	24.5%
Missing, other	30.7%

Table III

Initial diagnosis at specialty voice evaluation by last laryngoscopic diagnosis.

Diagnosis at Last Laryngoscopy Visit *	Diagnosis at Specialty Voice Evaluation *								% Diagnosis Change **
	Acute laryngitis N = 48	Benign vocal fold laryngeal pathology N = 662	Laryngeal cancer N = 122	Chronic laryngitis N = 299	Non-specific dysphonia N = 1498	Vocal fold paralysis N = 207	Vocal fold paresis N = 95	Multiple diagnoses N = 958	
Acute laryngitis N = 125	21	13	3	11	46	2	2	27	83.2%
Benign vocal fold laryngeal pathology N = 698	3	339	9	24	173	8	7	135	51.4%
Laryngeal cancer N = 123	1	5	81	1	7	1	0	27	34.1%
Chronic laryngitis N = 436	5	46	8	190	88	8	9	82	56.4%
Non-specific dysphonia N = 1711	15	188	14	56	1028	50	36	324	39.9%
Vocal fold paralysis N = 231	1	8	0	1	45	98	13	65	57.6%
Vocal fold paresis N = 78	0	7	0	1	23	14	21	12	73.1%
Multiple diagnoses N = 487	2	56	7	15	88	26	7	286	41.3%

* Due to laryngoscopy and videolaryngostroboscopy rates of less than 1%, laryngeal spasm, other larynx/vagus, late effect cerebrovascular disease other speech deficits, and bilateral vocal fold paralysis are not shown in the table.

** Percent of diagnoses at laryngoscopy visit with different diagnosis at specialty voice evaluation (signified by use of videolaryngostroboscopy).

Table IV

Changes in treatment status (30 days after the last laryngoscopy visit compared to the 30 days after the first specialty voice evaluation).

Change in Antibiotics - no. (%)	
Yes to No *	388 (67.4)
No Change *	3,091 (77.3)
No to Yes *	521 (15.2)
Change in proton pump inhibitor - no. (%)	
Yes to No	479 (44.5)
No Change	2,822 (70.5)
No to Yes	699 (23.9)
Change in Surgery - no. (%)	
Yes to No	285 (85.3)
No Change	3,327 (83.2)
No to Yes	388 (10.6)
Change in Voice Therapy - no. (%)	
Yes to No	204 (25.5)
No Change	3,423 (85.6)
No to Yes	373 (11.7)

* No change includes patient visits with none of the specific interventions in the 30 days after the last laryngoscopy and 30 days after the first specialty voice evaluation and those with at least one of the specific interventions in each time period. Percent is calculated out of the 4000 patient visits (i.e. 77.3% of patient visits either had or did not have an antibiotic in both the 30 days after the last laryngoscopy and first specialty voice evaluation).

Yes to No includes patient visits with at least one of the specific interventions in the 30 days after the last laryngoscopy and none in the 30 days after the first specialty voice evaluation. Percent is calculated out of the subgroup of patient visits with the specific treatment in the 30 days after the last laryngoscopy visit (i.e. 67.4% of patient visits with an antibiotic in the 30 days after the last laryngoscopy visit did not have an antibiotic in the 30 days after the first specialty voice evaluation).

No to Yes includes patient visits with none of the specific interventions in the 30 days after the last laryngoscopy and at least one of the specific interventions in the 30 days after the first specialty voice evaluation. Percent is calculated out of the subgroup of patient visits without the specific treatment in the 30 days after the last laryngoscopy visit (i.e. 15.2% of patient visits without an antibiotic in the 30 days after the last laryngoscopy visit had an antibiotic in the 30 days after the first specialty voice evaluation).

Table V

Adjusted odds ratios (OR)* for change in laryngeal/voice diagnoses after the initial specialty voice evaluation compared to 30 days after the last laryngoscopy visit.

		OR(95% CI)	Test Statistic (P-value)
Age Group	65 plus	<i>reference</i>	4.7 (0.4536)
	0-17	1.00 (0.68, 1.48)	
	18-34	0.97 (0.76, 1.24)	
	35-44	0.94 (0.75, 1.18)	
	45-54	1.06 (0.87, 1.31)	
	55-64	1.15 (0.94, 1.40)	
Gender	Male	<i>reference</i>	0.9 (0.3542)
	Female	1.07 (0.93, 1.22)	
Urban or rural	Rural	<i>reference</i>	5.0 (0.0260)
	Urban	0.79 (0.65, 0.97)	
Region	South	<i>reference</i>	11.8 (0.0083)
	Northeast	0.75 (0.63, 0.90)	
	North Central	0.92 (0.78, 1.08)	
	West	1.07 (0.86, 1.32)	
Laryngoscopy Diagnosis	Chronic laryngitis	<i>reference</i>	163.9 (<.0001)
	Unilateral Paralysis	1.06 (0.76, 1.47)	
	Bilateral paralysis	2.98 (0.83, 10.66)	
	Paresis	2.04 (1.19, 3.49)	
	Nonspecific	0.52 (0.42, 0.65)	
	Acute laryngitis	3.99 (2.40, 6.64)	
	Benign lesion	0.84 (0.66, 1.07)	
	Other larynx/vagus	0.78 (0.32, 1.91)	
	Laryngeal cancer	0.41 (0.27, 0.64)	
	Laryngeal spasm	3.95 (1.47, 10.64)	
	Multiple	0.54 (0.41, 0.70)	
Sinusitis	No	<i>reference</i>	12.0 (0.0005)
	Yes	0.60 (0.44, 0.80)	
Asthma	No	<i>reference</i>	0.3 (0.5931)
	Yes	0.90 (0.62, 1.31)	
COPD	No	<i>reference</i>	2.0 (0.1570)
	Yes	1.58 (0.84, 2.97)	
GER	No	<i>reference</i>	1.7 (0.1953)
	Yes	0.88 (0.72, 1.07)	
Acute Pharyngitis	No	<i>reference</i>	0.1 (0.7448)
	Yes	1.07 (0.71, 1.63)	
Acute Bronchitis	No	<i>reference</i>	0.1 (0.7157)
	Yes	1.12 (0.61, 2.05)	
Acute URI	No	<i>reference</i>	1.5 (0.2175)

		OR(95% CI)	Test Statistic (P-value)
Pneumonia	Yes	0.66 (0.34, 1.27)	0.4 (0.5101)
	No	<i>reference</i>	
Allergic rhinitis	Yes	0.75 (0.32, 1.76)	0.7 (0.4033)
	No	<i>reference</i>	
	Yes	1.11 (0.87, 1.40)	

Adjusted Odds Ratio (ORs) (controlling for the presence of other variables) were estimated using multiple logistic regression with corresponding 95% confidence intervals (CIs). ORs can range from 0 to infinity. An OR less than 1 indicates a negative association, an OR equal to 1 indicates no association, and an OR greater than 1 indicates a positive association between two variables. If both the lower and upper limits of the CI are less than 1, there is a significant negative association, whereas if both the lower and upper limits are greater than 1, there is a significant positive association.

Table VI

Adjusted odds ratios (OR)* for change in treatment 30 days after the initial specialty voice evaluation compared to 30 days after the last laryngoscopy visit.

Adjusted OR for Treatment Change*	
Chronic laryngitis	reference
Vocal fold paralysis	0.86 (0.62, 1.19)
Bilateral vocal fold paralysis	0.92 (0.34, 2.54)
Vocal fold paresis	0.85 (0.52, 1.38)
Nonspecific dysphonia	0.94 (0.76, 1.16)
Acute laryngitis	1.00 (0.67, 1.50)
Benign vocal fold/laryngeal lesions	1.31 (1.02, 1.68)
Other larynx/vagus	2.89 (0.95, 8.81)
Laryngeal cancer	1.42 (0.92, 2.18)
Laryngeal spasm	0.42 (0.19, 0.92)
Multiple diagnoses	1.27 (0.97, 1.66)

* Adjusted for age, gender, geographic region, urban vs rural status, and comorbid conditions, none of which were associated with outcome treatment change. Adjusted Odds Ratio (ORs) (controlling for the presence of other variables) were estimated using multiple logistic regression with corresponding 95% confidence intervals (CIs). ORs can range from 0 to infinity. An OR less than 1 indicates a negative association, an OR equal to 1 indicates no association, and an OR greater than 1 indicates a positive association between two variables. If both the lower and upper limits of the CI are less than 1, there is a significant negative association, whereas if both the lower and upper limits are greater than 1, there is a significant positive association.