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Mental health and Dysphonia: which comes first, and does that change care utilization?

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Abstract

Objectives: Voice patients have a high prevalence of distress and mental health comorbidities, but it is unknown to what extent distress precedes or follows voice disorder diagnoses. Objectives were to compare (1) proportions of voice patients with mental health diagnoses who were diagnosed with mental health first versus voice first, (2) voice-related diagnoses and care utilization, and (3) time to specialty evaluation in each group.

Methods: Patients with voice and MH diagnoses were identified using ICD-9/10 codes in a large health system data repository from 1/2005–7/2017. Sociodemographics, comorbidities, MH and voice-related diagnoses, and voice-related care utilization were analyzed using descriptive statistics and multivariable regression modeling.

Results: Among the 11,419 patients with both voice and MH diagnoses, 63% (n= 7,251) received MH diagnoses prior to voice diagnoses, compared with 37% with a voice diagnosis first (p <0.0001). The latter group received more specific voice-related diagnoses (e.g., laryngeal cancer (OR 4.27), benign laryngeal neoplasm (OR 1.60)) and were more likely to ever see an otolaryngologist than those receiving MH diagnoses first (p <0.0001).

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Level of evidence: NA

Conclusions: Most patients with voice and mental health diagnoses received a MH diagnosis first. Patients who receive MH diagnoses first appeared to have different voice-related healthcare compared to those who received voice diagnoses first.

Keywords

Laryngology; Voice/dysphonia; Laryngology; Speech language pathology; Laryngology

Keywords

Laryngology; mental health; voice; dysphonia; health services

Introduction:

Patients with voice disorders frequently have significant psychosocial distress and/or mental health (MH) comorbidities¹⁻³. In recent work, we observed in a large health system that 47% of patients with voice diagnoses also had MH diagnoses, compared to a baseline rate of 14% in the overall health system data repository. Patients who had both MH and voice diagnoses were less likely to see an otolaryngologist, more likely to undergo imaging, and more likely to have non-specific voice diagnoses compared to patients who had voice diagnoses but no MH diagnoses.⁴ Although we noted a high prevalence of MH diagnoses and differences in voice-related care utilization associated with MH diagnoses, this study neither examined whether the MH diagnoses preceded or followed the voice diagnoses nor compared these groups.

It has been proposed that psychosocial distress may lead to voice disorders, and alternatively that voice disorders may precipitate distress⁵. These relationships have been observed for a wider range of voice disorders (including vocal fold lesions and paradoxical vocal fold motion disorder) with stress, anxiety, and depression.⁶ A causal relationship between voice disorders and psychosocial disorders remains to be determined.^{7,8} Conceptual models linking vocal disorders and psychosocial disorders include (1) the 'disability model' where physical vocal disorder causes psychosocial disorders, (2) the 'vulnerability model' where psychosocial disorder causes physical vocal disorders, or (3) a combination of the two.⁹ Roy et al in 2000 found that personality traits contributed to certain voice disorders ultimately supporting the vulnerability model but advocated for further investigation in multiple areas of research.⁸ Using a large retrospective voice database, determining the sequence of events between voice disorders and psychosocial problems cannot demonstrate causality, but could be an important first step towards characterizing the real-life experience of patients with both voice and mental health concerns.

To examine this issue, we focused the current study on patients who had both MH and voice diagnoses. We reasoned that if the disability model predominated, the majority of patients would have voice diagnoses followed by MH diagnoses; if the vulnerability model predominated, the majority of patients would have MH diagnoses followed by voice diagnoses; and if mental health and voice were coincident but unrelated, roughly half would receive MH diagnoses first and half would receive voice diagnoses first.

Secondarily, we also sought to understand whether the health care utilization characteristics in the group that had both voice and mental health diagnoses were associated with mental health diagnoses broadly, or whether the order of the diagnoses mattered. That is, did patients with preceding mental health diagnoses have the same experience receiving voice-related healthcare as patients who received mental health diagnoses subsequently? A 2016 study found that patients with colorectal cancer and a comorbid diagnosis of anxiety or depression had longer total health care time and total diagnostic interval to diagnosis of colorectal cancer than patients without mental health comorbidities.¹⁰ It would be important to know if voice patients with mental health diagnoses had similar delays in care.

The objectives of this study were to compare those who received a voice diagnosis first vs. those who received a MH diagnosis first with respect to: (1) proportions of patients in each group, (2) voice-related diagnoses and care utilization, and (3) time to specialty evaluation in each group. These analyses included patients with both voice and mental health diagnoses in records from a large health system. We hypothesized that (1) a greater proportion of patients would have mental health prior to voice diagnoses than vice versa, (2) those with MH diagnoses first would have more non-specific voice diagnoses and more imaging studies, and (3) those with MH diagnoses first would have a longer time to specialty evaluation.

Methods:

Data were collected retrospectively from the University of Minnesota Clinical Data Repository (CDR), which includes data beginning in 2005 from more than 2 million patients seen at 8 hospitals and more than 40 clinics. Information was collected on patients greater than 18 years of age, living or deceased, who did not opt-out from having their data used for research from the time of CDR inception until July 1, 2017. The University of Minnesota institutional review board approved this study (IRB #1512M81630).

Patients were identified using voice and MH diagnosis codes from the *International Classification of Diseases*, Ninth Revision, Clinical Modification (ICD-9-CM) and 10th Revision, Clinical Modification (ICD-10-CM) as previously described (Appendix Table 1).⁴ Mental health diagnosis categories were: depression, anxiety, somatoform disorders, and stress-related/adjustment disorders. Voice related diagnosis categories¹¹ were: acute laryngitis, chronic laryngitis, benign neoplasm of the larynx, laryngeal cancer, nonspecific dysphonia, vocal fold paresis/paralysis, laryngeal stenosis, and laryngeal spasm.

We separated patients based on which diagnosis came first, MH vs voice. We identified the time when either a voice diagnosis or MH diagnosis first entered the patient's chart based on when either a voice diagnosis or MH diagnosis was used as a diagnosis at a visit (regardless of visit type). Outcome measures included voice-related diagnoses, time to specialty treatment in each group, and voice-related healthcare utilization. Covariates included sociodemographics at the patient's first voice-related visit (age, gender, race, zip code, insurance coverage). The Charlson Comorbidity Index (CCI) was used to categorize comorbidity burden and collected from all diagnosis records.^{12,13}

Voice-related healthcare utilization was measured via number and type of provider (primary care versus otolaryngology) of voice-related visits within 1 year following the first voice-related visit, prescription of 6 common voice-related medications^{14,4} within 2 weeks after a voice-related visit, and voice-related tests and procedures performed within 1 year after a voice-related visit. Utilization of radiology and voice evaluations, the 2 most common voice-related tests and procedures identified from previous work, were identified using 2017 Current Procedural Terminology (CPT) codes (Appendix Table 2)^{4,14}.

Descriptive statistics (for categorical variables, counts and percentages; for continuous variables, means and standard deviations) were used to summarize the data. A binomial test was used to assess the temporal relationship between the first voice diagnosis and first mental health diagnosis. The null hypothesis was that having a voice or mental health diagnosis first was equally as likely. Chi-square tests were used to compare diagnoses between patients with MH versus voice diagnosis first. To assess the effect of sociodemographic characteristics on MH diagnosis timing and health care utilization outcomes, multiple logistic regression models were used. In patients with a PCP and ENT visit, time to specialty care was defined as the time from first PCP visit with a voice-related diagnosis to first ENT visit with voice-related diagnosis. Findings in the two groups were analyzed using multiple linear regression. SAS version 9.4 (SAS Institute Inc., Cary, NC) was used for analysis. Sensitivity analyses adjusting for whether a patient saw an otolaryngologist were also performed, with no meaningful impact on our observations.

Results:

We identified 11,419 individuals with both voice and MH diagnoses. Of these, 63% (n = 7251) had a mental health diagnosis first, compared to 37% (n = 4168) who had a voice diagnosis first (p < 0.0001) (Table 1). Both groups had similar male to female ratios, race, age, and comorbidities. There were more Medicaid users in the mental health first group compared to the voice first group (21% versus 11%).

Frequency of voice and mental health diagnoses were compared in patients with MH versus voice diagnosis first. There was a comparable prevalence of patients diagnosed with combined nonspecific dysphonia. Patients with a voice diagnosis prior to mental health diagnosis had higher rates of benign neoplasm of the larynx, laryngeal cancer, vocal fold paresis/paralysis, and laryngeal stenosis, compared to patients with MH diagnoses first (p < 0.0001) (Table 2). Patients with MH diagnoses prior to voice diagnoses had an overall higher number of MH diagnoses in every category including depression, anxiety, somatoform, and stress-related diagnoses.

Accounting for comorbidities, sociodemographic factors associated with receiving a MH diagnosis prior to a voice diagnosis among all patients with both voice and MH diagnoses included age, female gender, private and Medicaid insurance (Table 3). Voice diagnoses associated with receiving a voice diagnosis before a MH diagnosis were more specific compared to those who received the MH diagnosis first, and included benign neoplasm of the larynx, laryngeal cancer, combined nonspecific dysphonia, vocal fold paresis/paralysis, and laryngeal stenosis.

Relationships between sociodemographic factors, comorbidities, voice and MH diagnoses and visit type were assessed for visits within a year of initial voice diagnosis date (Table 4). After adjusting for these factors, patients with a MH diagnosis prior to a voice diagnosis were more likely to see a primary care provider for their voice concern (OR 1.29, $p < 0.0001$) and less likely to ever see an otolaryngologist (OR 0.87, $p = 0.0062$).

Additionally, utilization of common voice-related tests/procedures and voice medications were assessed after adjusting for sociodemographics, comorbidities, voice and MH diagnoses (Table 5). Notably, patients with MH diagnoses prior to voice diagnoses were more likely to have radiology tests (OR 1.47, $p < 0.0001$) and less likely to have a voice evaluation with speech and language pathology (OR 0.81, $p = 0.0011$). There was no difference in medication utilization in either group.

We next examined whether sequence of mental health and voice diagnoses affected time from PCP to ENT. In this cohort, 5.6% ($n = 645$) saw primary care then an ENT. There was no difference in the amount of time from a PCP visit to ENT visit whether the patient had a mental health diagnosis first or voice diagnosis first ($M = 46.7$ [SD 62.6] days vs $M = 47.2$ [SD 68.2] days, $p = 0.82$).

Discussion:

Understanding the relationship between mental health and dysphonia is important because co-occurring mental health problems may impact clinically relevant patient specific factors such as readiness for change, ability to participate in voice treatment, treatment patterns, outcomes, and patient perception/satisfaction. Examining this relationship using clinical data from a large healthcare system offers a new perspective on the association between mental health and voice problems.

This cohort represents mental health and voice patients in a large midwestern healthcare system including university and community hospitals and clinics. The majority of patients were middle aged ($M = 53$ years)¹⁵, white (93%)¹, female (71%)^{1,2}, with high comorbidity burden (68%)^{16,17}, and insured (96%)¹⁸. These characteristics, as well as the proportion of included patients who saw both PCP and ENT, are comparable to previous studies of voice patients with mental health disorders in the literature¹⁹.

We identified over 11,000 patients with both mental health and voice diagnoses in our database. We found that nearly two thirds (63%) of these patients had a mental health diagnosis prior to a voice diagnosis. It is possible that this preponderance is partially due to an age effect in which mental health diagnoses may arise earlier than voice disorders. Although this data source cannot show causality, the imbalance in these proportions could also potentially align with the vulnerability or pre-dispositional model of voice disorders.^{9,8}

While voice diagnoses prior to mental health diagnoses were less common (37%), this represents a significant portion of voice patients with mental health comorbidities. After adjusting for other factors, these patients were more likely to have a structural voice diagnosis (benign neoplasm of the larynx, laryngeal cancer, vocal fold paresis/paralysis, laryngeal stenosis). These patients could be consistent with the disability model in that they

have a structural or neurologic abnormality that precedes a mental health disorder such as depression, anxiety, somatization, or adjustment disorders. Certainly these lesions have been known to have reduced quality of life in prior studies in patients with voice disorders overall²⁰, whether this is related to benign conditions^{21,22} or malignant²³.

It appears that patients with a mental health diagnosis prior to a voice diagnosis have differences in care patterns in that they were more likely to see a primary care provider and have radiology tests done whereas the patients who have voice diagnosis prior to mental health diagnosis were more likely to see an otolaryngologist and have a voice evaluation with a speech therapist. These results have been adjusted for important potential confounders including voice diagnosis type, sociodemographics, and comorbidities. To examine whether these findings are related to delay in receiving specialty care, we examined time from PCP to ENT. We identified no difference in timing, which indicates the above differences in voice care utilization are not attributable to differential delays in care. It is possible that one way to reduce differential delays in care associated with mental health diagnoses could be additional education on voice disorders (as well as awareness of these differential delays in care) for non-otolaryngology groups such as primary care providers.

Limitations of this study include factors inherent to retrospective databases which cannot assess direct causality and have the potential for human error and misclassification of data. These limitations are outweighed by strengths of this study, which include its large size and broad patient population as well as the availability of clinical information that allowed adjustments of our analyses for important covariates.

Our findings raise questions about possible explanations for the observed differences, which persisted after adjusting for important confounders such as sociodemographics, comorbidities and voice diagnoses. These findings may reflect groups of patients whose experiences are described by the vulnerability versus disability models (or a mixture thereof). However, the unequal experiences of these groups in terms of healthcare utilization are not necessarily explained by these models. There could also be other explanations based on unidentified contributors such as patient factors or provider bias which leads to different healthcare paths such as different workup or referral patterns. For example, are patients with pre-existing MH diagnoses less likely to be given referrals, and could this be because it is felt that the referrals are not needed (eg in cases where anxiety is driving a number of somatic concerns)? It is also possible that some of the findings may be explained by differences in coding practices. For example, voice patients seen by otolaryngologists could be more likely to have a voice diagnosis prior to a mental health diagnosis because otolaryngologists may not enter mental health diagnoses into the medical chart as comprehensively as primary care providers. However, our analyses were adjusted for ever seeing an otolaryngologist, making it unlikely that such a difference in coding could account for all of these observations. It is unknown whether these findings are generalizable to mental health patients with non-voice disorders or if this a voice-specific issue.

Future studies could examine these and other possibilities. For example, although time from PCP to specialty evaluation was not different between groups, we observed that those with MH were less likely to ever seen an otolaryngologist. This suggests possible differences in

referral patterns and potentially differences in dysphonia workup with voice patients with MH diagnosed first having more radiology testing and voice patients with MH diagnosed after having more speech evaluations. Improved understanding of these differences in voice care trajectories and the impact on patient outcomes are important avenues of study. Together, increased knowledge of this population of patients could facilitate improved overall voice and quality of life outcomes.

Conclusions:

Most patients with voice and mental health diagnoses received a MH diagnosis prior to a voice diagnosis. Patients who received MH diagnoses first appeared to have different voice-related healthcare compared to those who received voice diagnoses first, receiving more radiology procedures and more primary care visits. Patients with voice diagnoses first were more likely to have a structural/neurologic type voice diagnosis, be seen by an otolaryngologist, and be evaluated by a speech therapist. Future studies will need to seek potential explanations for these observed differences, such as specialty referral patterns from primary care to otolaryngology.

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Appendix

Appendix Table 1:

Voice-related and mental health diagnoses, by category and by codes from the *International Classification of Diseases*, Ninth Revision, Clinical Modification (ICD-9-CM) and 10th Revision, Clinical Modification (ICD-10-CM) 4

Voice-related diagnoses	Mental health diagnoses
<u>Acute laryngitis</u>	<u>Depression</u>
Acute laryngitis without mention of obstruction (464.0, J04.0)	Major depressive disorder, single episode (296.2 * F32 *)
Acute laryngitis with obstruction (464.01, J05.0B)	Major depressive disorder, recurrent episode (296.3 * F33 *)
Acute laryngotracheitis without obstruction (464.2, J04.2)	Atypical depressive disorder (296.82, F32.8)
Acute laryngotracheitis with obstruction (464.21, J05.0)	Depressive type psychosis (298.0, F32.3/F33.3)
<u>Chronic laryngitis</u>	Dysthymic disorder (300.4, F34.1)
Chronic laryngitis (476.0, J37.0)	Prolonged depressive reaction (309.1, F43.21)
Chronic laryngotracheitis (476.1, J37.1)	Depressive disorder, not elsewhere classified (311 * F32.9)

Voice-related diagnoses	Mental health diagnoses
<u>Benign neoplasm of the larynx</u>	<u>Anxiety</u>
Benign neoplasm of the larynx (212.1, D141)	Anxiety disorder, not otherwise specified (300.0 [*] F41 [*])
Neoplasm of uncertain behavior of the larynx (235.6, D38.0)	Obsessive-compulsive disorder (300.3, F42)
Polyp of vocal cord or larynx (478.4, J38.1)	Hypochondriasis (300.7, F45.21/F45.29)
<u>Laryngeal</u>	Chronic motor or vocal tic disorder (307.21, F95.0)
Malignant neoplasm of the glottis (161.0, C32.0)	<u>Somatoform</u>
Malignant neoplasm of the supraglottis (161.1, C32.1)	Somatoform disorder (300.8 [*] , F45.0/F45.1/F45.8/F45.9/F48.8)
Malignant neoplasm of the subglottis (161.2, C32.3)	Conversion disorder (300.11, F44.4)
Malignant neoplasm of the laryngeal cartilage (161.3, C32.8)	<u>Stress-related disorders (including adjustment disorders)</u>
Malignant neoplasm of other specific sites of the larynx (161.8, C32.8)	Adjustment disorder with depressed mood (309.0, F43.21)
cancerMalignant neoplasm of the larynx, unspecified (161.9, C32.9)	Adjustment disorder with anxiety (309.24, F43.22)
<u>Nonspecific dysphonia</u>	Adjustment disorder with mixed anxiety and depressed mood (309.28, F43.23)
Voice and resonance disorder, unspecified (784.4, R49.9)	Other adjustment reactions with predominant disturbance of other emotions (309.29, F43.29)
Aphonia (784.41, R49.1)	Unspecified adjustment reaction (309.9, F43.20)
Dysphonia (784.42, R49.0)	Acute reaction to stress (308 [*] F43.0/R45.7)
Other voice and resonance disorders (784.49, R49.8)	Reaction to severe stress, adjustment disorder (F43 [*])
Other diseases of vocal cords (478.5, J38.3)	Other unspecified adjustment disorder, including posttraumatic stress disorder (309.8 [*] F43.1/F43.12/F43.8)
Edema of larynx (478.6, J38.4)	
Unspecified disease of larynx (478.7, J38.7)	
Cellulitis and perichondritis of larynx (478.71, J38.7)	
Other diseases of larynx, not elsewhere classified (478.79, J38.7)	
Disorders of the 10th nerve (352.3, G52.2)	
<u>Vocal fold paresis/paralysis</u>	
Bilateral paralysis of the vocal cords or larynx, complete (478.34, J38.02)	
Paralysis of vocal cords or larynx, unspecified (478.30, J38.00)	
Unilateral paralysis of the vocal cords or larynx, complete (478.32, J38.01)	
Unilateral paralysis of the vocal cords or larynx, partial (478.31, J38.01)	
Bilateral paralysis of the vocal cords or larynx, partial (478.33, J38.02)	
<u>Laryngeal stenosis</u>	
Stenosis of the larynx (478.74, J38.6)	
<u>Laryngeal spasm</u>	
Laryngeal spasm (478.75, J38.50)	
	* includes all subdivided categories

* includes all subdivided categories

Appendix

Appendix Table 2:

Current Procedural Terminology (CPT) codes for health care utilization

<p>Radiology: 71010, 71015, 71020, 71021, 71022, 71023, 71030, 71034, 71035, 70450, 70460, 70470, 70490, 70491, 70492, 71260, 71270, 70552, 70553, 70540, 70542, 70543</p> <p>Swallow study: 74210, 74220, 74230, 92610, 92611, 92612, 92614, 92615, 92616, 92617</p> <p>Swallow therapy: 92526</p> <p>Voice evaluation/therapy by speech pathology: 92503, 92506, 92507, 92508, 92520</p> <p>Laryngoscopy: 31505, 31575,</p> <p>Stroboscopy: 31579</p> <p>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, 31535, 31600, 31603, 31605, 31610, 43030</p> <p>Chemodenervation: 64613</p> <p>Laryngeal electromyography: 95865</p> <p>Reflux testing/evaluation: 91010, 91011, 91012, 91020, 91030, 91034, 91035, 91037, 91038</p> <p>Radiation therapy: 77263, 77014, 77295, 77290, 77334, 77338, 77300, 77413, 77427, 77336, 77414, 77470, 77301, 77280, 77418</p>

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Table 1:

Description of population of patients with voice disorders and mental health disorders (N = 11419)

	MH then VD	VD then MH	VD + MH
Variable	n (%)	n (%)	N
Total	7251 (63)	4168 (37)	11419
Gender			
Male	1911 (26)	1371 (33)	3282
Female	5340 (74)	2797 (67)	8137
Race			
White	6361 (93)	3554 (93)	9915
Black	281 (4)	150 (4)	429
Other	187 (3)	107 (3)	208
Unknown	422	357	779
Age, y			
Mean (SD)	53 (17)	53 (18)	53 (17)
CCI			
0	1158 (16.0)	716 (17.2)	1874
1	1174 (16.2)	633 (15.2)	1807
2+	4949 (67.8)	2819 (67.6)	7738
Insurance			
Insurance coverage	7114 (98)	3933 (94)	11047
Private	6881 (95)	3735 (90)	10616
Medicare	2246 (31)	1116 (27)	3362
Medicaid	1550 (21)	443 (11)	1993

CCI = Charlson Comorbidity Index, MH = mental health, RUCA = Rural-Urban Commuting Area, SD = standard deviation, VD = voice diagnosis

Table 2:

Voice diagnoses among patients with voice disorders and mental health disorders

	MH then VD n= 7251 (63%)	VD then MH n= 4167 (37%)	VD +MH total N= 114191	P value *
Voice Category n, (%) [†]				
Acute laryngitis	2362 (32.6)	1308 (31.4)	3670	0.1888
Chronic laryngitis	126 (1.7)	96 (2.3)	222	0.0351
Benign neoplasm of the larynx	143 (2.0)	148 (3.6)	291	<.0001
Laryngeal cancer	82 (1.1)	185 (4)	267	<.0001
Combined nonspecific dysphonia	4996 (68.9)	2846 (68.3)	7842	0.4926
Vocal fold paresis/paralysis	280 (3.9)	227 (5.5)	507	<.0001
Laryngeal stenosis	54 (0.7)	80 (2.0)	134	<.0001
Laryngeal spasm	128 (1.8)	88 (2.1)	216	0.1913
Mental health categories n, (%) ^a				
Depression	5502 (75.9)	2195 (52.7)	7697	<.0001
Anxiety	5401(74.5)	2479 (59.4)	7880	<.0001
Somatoform	715 (9.9)	680 (16.3)	1395	<.0001
Stress-related diagnoses (including adjustment disorders)	1502 (20.7)	638 (15.3)	2140	<.0001

* Patients may have multiple voice or mental health diagnoses

[†] P value was calculated via chi-square test

MH = mental health, VD = voice diagnosis

Table 3:

Factors associated with receiving a mental health diagnosis prior to a voice diagnosis among all patients with both voice and mental health diagnoses

	Adjusted Odds Ratio	95% CI	P
Age	1.01	1.00–1.01	0.0004
Sex			
Male	Reference	-	-
Female	1.29	1.18–1.41	<.0001
Race			
White	Reference	-	-
Black	0.82	0.66–1.02	0.072
Other	0.94	0.73–1.21	0.65
Insurance [†]			
Private	2.66	2.27–3.12	<.0001
Medicare	1.11	0.99–1.24	0.078
Medicaid	2.82	2.48–3.21	<.0001
CCI			
0	Reference	-	-
2+	1.21	1.08–1.35	0.0007
Voice diagnosis [‡]			
Acute laryngitis	0.96	0.83–1.11	0.58
Chronic laryngitis	0.74	0.55–0.99	0.045
Benign neoplasm of the larynx	0.62	0.48–0.80	0.0002
Laryngeal cancer	0.22	0.17–0.30	<.0001
Combined nonspecific dysphonia	0.98	0.85–1.13	0.80
Vocal fold paresis/paralysis	0.65	0.53–0.79	<.0001
Laryngeal stenosis	0.35	0.24–0.52	<.0001
Laryngeal spasm	0.83	0.62–1.12	0.23
Acute laryngitis	0.96	0.83–1.11	0.58
Chronic laryngitis	0.74	0.55–0.99	0.045
Benign neoplasm of the larynx	0.62	0.48–0.80	0.0002
Laryngeal cancer	0.22	0.17–0.30	<.0001
Combined nonspecific dysphonia	0.98	0.85–1.13	0.80
Vocal fold paresis/paralysis	0.65	0.53–0.79	<.0001
Laryngeal stenosis	0.35	0.24–0.52	<.0001
Laryngeal spasm	0.83	0.62–1.12	0.23

[†]Referent is not having the specific type of insurance

[‡]Referent diagnosis is not having the specific voice diagnosis

Table 4:

Relationship between factors and visit type among patients with a voice diagnosis

	Primary care visit		Otolaryngology visit (ever)	
	OR (95% CI)	P	OR (95% CI)	P
Increasing age (per year)	1.01 (1.01–1.01)	<.0001	1.00 (1.00–1.01)	0.4410
Sex				
Male	Reference		Reference	
Female	1.17 (1.07–1.28)	0.0007	0.95 (0.86–1.05)	0.2868
Race				
White	Reference		Reference	
Black	0.93 (0.76–1.14)	0.50	0.95 (0.75–1.20)	0.66
Other	0.72 (0.57–0.92)	0.0080	1.23 (0.93–1.62)	0.16
Insurance [‡]				
Private	0.83 (0.71–0.97)	0.020	1.33 (1.10–1.61)	0.0028
Medicare	0.79 (0.71–0.88)	<.0001	0.87 (0.77–0.98)	0.023
Medicaid	0.75 (0.67–0.84)	<.0001	1.14 (0.99–1.30)	0.063
CCI				
0	Reference		Reference	
2+	1.04 (0.94–1.16)	0.44	0.55 (0.49–0.62)	<.0001
Voice diagnosis [‡]				
Acute laryngitis	2.98 (2.56–3.46)	<.0001	0.55 (0.46–0.65)	<.0001
Chronic laryngitis	2.32 (1.69–3.20)	<.0001	2.21 (1.54–3.18)	<.0001
Benign neoplasm of the larynx	1.83 (1.41–2.37)	<.0001	2.48 (1.86–3.31)	<.0001
Laryngeal cancer	0.72 (0.54–0.95)	0.021	6.80 (4.79–9.65)	<.0001
Combined nonspecific dysphonia	1.32 (1.14–1.54)	0.0003	16.11 (13.06–19.88)	<.0001
Vocal fold paresis/paralysis	0.47 (0.38–0.58)	<.0001	4.31 (3.43–5.41)	<.0001
Laryngeal stenosis	0.30 (0.19–0.47)	<.0001	7.07 (4.46–11.21)	<.0001
Laryngeal spasm	0.65 (0.48–0.88)	0.0054	3.22 (2.25–4.60)	<.0001
Mental Health disorder before Voice disorder				
Yes	1.29 (1.18–1.40)	<.0001	0.87 (0.79–0.96)	0.0062
No	Reference		Reference	
Chronic laryngitis	2.32 (1.69–3.20)	<.0001	2.21 (1.54–3.18)	<.0001
Benign neoplasm of the larynx	1.83 (1.41–2.37)	<.0001	2.48 (1.86–3.31)	<.0001
Laryngeal cancer	0.72 (0.54–0.95)	0.021	6.80 (4.79–9.65)	<.0001
Combined nonspecific dysphonia	1.32 (1.14–1.54)	0.0003	16.11 (13.06–19.88)	<.0001
Vocal fold paresis/paralysis	0.47 (0.38–0.58)	<.0001	4.31 (3.43–5.41)	<.0001
Laryngeal stenosis	0.30 (0.19–0.47)	<.0001	7.07 (4.46–11.21)	<.0001
Laryngeal spasm	0.65 (0.48–0.88)	0.0054	3.22 (2.25–4.60)	<.0001
Mental Health disorder before Voice disorder				

	Primary care visit		Otolaryngology visit (ever)	
	OR (95% CI)	P	OR (95% CI)	P
Yes	1.29 (1.18–1.40)	<.0001	0.87 (0.79–0.96)	0.0062
No	Reference		Reference	

[‡]Referent is not having the specific type of insurance

[‡]Referent is not having the specific voice diagnosis

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Table 5:

Likelihood of 3 most common procedures and medication use among patients with a voice diagnosis (capped at 1 year for procedures and 2 weeks for medications)

	Radiology		Voice evaluation		Medications	
	Odds ratio (95% CI)	P	Odds ratio (95% CI)	P	Odds ratio (95% CI)	P
Age	1.01 (1.01–1.02)	<.0001	0.99 (0.99–1.00)	0.0021	1.00 (1.00–1.00)	0.87
Sex						
Male	Reference		Reference		Reference	
Female	1.04 (0.94–1.16)	0.4484	0.80 (0.71–0.91)	0.0004	1.05 (0.96–1.15)	0.30
Race						
White	Reference		Reference		Reference	
Black	0.80 (0.63–1.01)	0.060	1.40 (1.06–1.85)	0.018	1.18 (0.96–1.45)	0.12
Other	0.69 (0.53–0.90)	0.0064	1.19 (0.84–1.68)	0.32	1.04 (0.81–1.33)	0.76
Insurance [†]						
Private	0.92 (0.75–1.11)	0.37	1.37 (1.08–1.73)	0.0094	1.08 (0.92–1.27)	0.36
Medicare	1.17 (1.02–1.34)	0.021	1.49 (1.28–1.73)	<.0001	0.79 (0.71–0.89)	<.0001
Medicaid	1.63 (1.42–1.87)	<.0001	0.97 (0.82–1.14)	0.69	1.06 (0.95–1.19)	0.30
CCI						
0	Reference		Reference		Reference	
2+	5.65 (5.02–6.36)	<.0001	1.26 (1.07–1.48)	0.0056	1.06 (0.95–1.18)	0.27
Voice diagnosis [‡]						
Acute laryngitis	1.60 (1.34–1.92)	<.0001	0.96 (0.78–1.17)	0.67	3.24 (2.79–3.75)	<.0001
Chronic laryngitis	1.30 (0.91–1.85)	0.16	1.91 (1.27–2.87)	0.0019	2.60 (1.91–3.52)	<.0001
Benign neoplasm of the larynx	1.10 (0.81–1.48)	0.55	2.61 (1.95–3.56)	<.0001	1.83 (1.41–2.38)	<.0001
Laryngeal cancer	2.21 (1.40–3.49)	0.0007	2.89 (2.09–4.00)	<.0001	2.67 (2.01–3.54)	<.0001
Combined nonspecific dysphonia	1.41 (1.18–1.68)	0.0001	11.81 (9.01–15.48)	<.0001	2.68 (2.32–3.11)	<.0001
Vocal fold paresis/paralysis	1.72 (1.31–2.26)	<.0001	4.59 (3.69–5.71)	<.0001	0.94 (0.76–1.16)	0.58
Laryngeal stenosis	1.43 (0.91–2.24)	0.12	4.23 (2.75–6.50)	<.0001	2.42 (1.68–3.51)	<.0001
Laryngeal spasm	1.82 (1.26–2.63)	0.0014	3.79 (2.61–5.49)	<.0001	1.64 (1.21–2.23)	0.0016
Mental health disorder before voice disorder						
Yes	1.47 (1.34–1.62)	<.0001	0.81 (0.72–0.92)	0.0011	0.99 (0.91–1.08)	0.88
No	Reference		Reference		Reference	

[†]Referent is not having the specific type of insurance

[‡]Referent is not having the specific voice diagnosis