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Volume and Practice-Setting Shift of Laryngology Procedures During the COVID-19 Pandemic: A Reg-ENT Database Analysis

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Abstract

Objective. The onset of the coronavirus disease 2019 (COVID-19) pandemic changed practice patterns throughout medicine. The purpose of this study is to evaluate changes in the volume and location setting of laryngology procedures after the onset of COVID-19.

Study Design. Retrospective database cohort study.

Setting. Reg-ENT registry.

Methods. Retrospective review from 2017 to 2022 of patients who underwent a laryngology procedure identified by procedure code categorized by site of service code—"ambulatory surgical" versus "office" setting. Based on March 2020 as the cutoff point, the procedures were designated as pre-COVID versus COVID time period.

Results. A total of 5989 patients underwent laryngology procedures. Forty-two percent more procedures were performed in the COVID period (n = 3780) versus pre-COVID (n = 2209). Pre-COVID, the procedure distribution between office and ambulatory surgical setting was 70% (n = 1546) compared with 30% (663). This shifted to 77% (n = 2920) and 23% (n = 860) during COVID, $P = .9$. The most common diagnoses associated with laryngology procedures during the study period were vocal fold paralysis 47% (n = 2831), dysphonia 33% (n = 1392), and laryngotracheal stenosis 14% (n = 838). These trends remained in both pre-COVID and COVID time periods. After the start of the pandemic, among patients undergoing laryngology procedures, there was a 93% increase (n = 284-549) in the diagnosis of laryngotracheal stenosis, 70% increase (n = 520-882 patients) in dysphonia and 69% increase (n = 1054-1777) in vocal fold paralysis.

Conclusion. An increase in laryngology procedures performed after the onset of the COVID-19 pandemic was identified with an overall procedural shift to the office-setting.

Keywords

COVID-19, laryngology, office-based procedures

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Office laryngological procedures have grown in frequency over recent decades due to advances in technology[1] and lower costs.[2] Although initially described in the 19th century, the first modern report of awake, in-office, laryngeal procedures was teflon vocal fold augmentation injection as described by Ward et al.[3] Subsequent decades have seen the use of several different types of less problematic materials for awake vocal fold injections. More recently, in-office steroid injections for idiopathic subglottic stenosis either as a stand-alone intervention or an adjuvant to operative airway dilation, were first described by Hoffman et al,[4] as well as Franco et al[5] in 2017. This technique was subsequently applied to other forms of subglottic stenosis including that acquired after intubation and reported first by Bertelsen et al in 2018.[6] In the past couple of decades several other influential studies in the field of laryngology have focused on awake, office-based procedures and have represented the practice shift of laryngology procedures in the decades leading up to the coronavirus disease 2019 (COVID-19) pandemic.[1,7,8]

Elective surgical procedure delays were common across the United States especially during the early phase of the pandemic due to federal and state restrictions, rationing of health care resources, and fear of iatrogenic COVID-19

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exposure. Mattingly et al examined over 13 million administrative claims from a nationwide health care technology clearinghouse on elective surgical procedure volume from 2019 to 2021 and found a 48% reduction in elective procedures during the initial shutdown period when compared with 2019 (905,444 vs 458,469), with otolaryngology experiencing the most significant decline (30% of the comparable 2019 period, 95% confidence interval [CI]: 0.13-0.46).[9] After the initial shutdown, surgical procedure volumes rebounded to 2019 levels during the ensuing COVID-19 surge (97%; 95% CI: 0.95-1.00) except for otolaryngology procedures (60,090 procedures in 2019 vs 41,701 procedures) during the subsequent COVID-19 surge (70%; 95% CI: 0.65-0.75) potentially due to the persisting masking and distancing guidelines decreasing the rates of upper respiratory disease and due to persistent anxiety about iatrogenic exposure.[9] In an international survey study of over 500 idiopathic subglottic stenosis patients, 40.1% of patients receiving treatment reported delays in undergoing scheduled procedures, with 38.8% experiencing worsening dyspnea as a result.[8] Anxiety and stress were common among patients, with 3 in 4 (75.2%) reporting fear about traveling by public transport and contracting the virus in the hospital and infecting other family members (69.0% and 71.9%, respectively).[10]

Due to the respiratory nature of the severe acute respiratory syndrome coronavirus 2 (SAR-COV2) virus, the COVID-19 pandemic resulted in increased sequela to the upper airway from viral infection itself and from sequelae of the necessary intubations and tracheostomies. During the COVID-19 pandemic, 15% to 30% of hospitalized patients had severe disease requiring endotracheal intubation.[11] Furthermore, there was a backlog of elective cases. All these data suggest that there could have been significant impacts on the volume of laryngology disease and procedures. Indeed, there are anecdotal reports documenting such an effect, but thus far the impact has not been measured in a quantifiable manner. Additionally, due to technological advances, surgical innovation and market changes related to procedure reimbursement; as well as, ambulatory surgical center closures during the pandemic, we hypothesize that there were several potential forces that could have shifted practices toward more office-based otolaryngology procedures. The purpose of this study is to evaluate changes after the onset of the COVID-19 pandemic in the volume of laryngology procedures and the location setting where these procedures were performed utilizing an otolaryngology-specific national database. We hypothesize that after the onset of the COVID-19 pandemic, there would be an increase in procedures occurring in the office setting.

Methods

Data Source

This retrospective, cohort study was conducted using data from the Reg-ear nose and throat (ENT)[sm] registry (American Academy of Otolaryngology–Head and Neck Surgery Foundation [AAO-HNSF]) and the OM1 Real-World Data Cloud (OM1 Inc). The Reg-ENT registry is connected to OM1's real-world data and evidence platforms through a data partnership between OM1 Inc and AAO-HNSF.[12] This study was deemed institutional review board (IRB) exempt by the Albert Einstein and Montefiore IRB.

The OM1 data set is derived from deterministically linked, deidentified, individual-level health care claims, electronic medical records (EMRs), and other data sources covering over 300 million patients in the United States since 2013. The EMR data are from sources geographically representative of the US population and include medication history, prescription information, laboratory results, and diagnoses documented by a health care provider. Medical and pharmacy claims data are linked to the clinical data to fill gaps in patients' clinical care. The medical and pharmacy claims contain billing and coding history on inpatient and outpatient encounters from acute care facilities, ambulatory surgery centers, and clinics.

AAO-HNSF's Reg-ENT registry is the first and largest national-level repository of otolaryngology-specific data. The registry collects complete EMR and billing data from a large, representative network of clinical otolaryngology practices in the United States; as well as, from ancillary services such as audiometry. The data are derived directly from EMRs on a regular basis and stored in a central repository covering the full range of otolaryngology conditions seen in clinical practice, their treatments, and outcomes. All data are deidentified. The registry includes data from approximately 3000 clinicians, 500 practices, and 25 million ENT patient visits since 2015.

Measures

Patients were included based on the use of Current Procedural Terminology (CPT) codes and Healthcare Common Procedure Coding System (HCPCS) for laryngological procedures and the associated International Classification of Diseases (ICD) 9 and 10 codes from 2017 to 2022 with that CPT or HCPCS code (**Table 1**). The site of service code was also extracted and used to stratify the patients into those that had the procedure in the "ambulatory surgical" setting versus the "office" setting. Based on a cutoff point of March 2020, the procedures were designated as pre-COVID versus COVID time period. Demographic data were also collected including age, sex, race, and geographic location. Patients under 18 years old were excluded.

Statistical Analysis

For the purposes of analyzing trends over time, ICD 9 and 10 codes were grouped into vocal paralysis, laryngotracheal stenosis, laryngeal spasm, dysphonia, and other (**Table 1**). Descriptive statistics were used to summarize the demographic and geographic data. Comparisons of the rates pre-COVID versus during

Table 1. Diagnosis and Procedure Codes Used to Identify Patients Who Underwent a Laryngology Procedure in the Reg-ENT Database, 2017 to 2022

Diagnosis categories			
Vocal fold paralysis	ICD9_diagnosis	478.3	Paralysis of vocal cords or larynx, unspecified
		438.31	Unilateral paralysis of vocal cords or larynx, partial
		478.32	Unilateral paralysis of vocal cords or larynx, complete
		478.33	Bilateral paralysis of vocal cords or larynx, partial
		478.34	Bilateral paralysis of vocal cords or larynx, complete
		478.5	Other diseases of vocal cords
	ICD10_diagnosis	J38.01	Paralysis of vocal cords and larynx, unilateral
		J38.02	Paralysis of vocal cords and larynx, bilateral
		J38.00	Paralysis of vocal cords and larynx, unspecified
		J38.3	Other diseases of vocal cords [vocal cord insufficiency]
Laryngotracheal stenosis	ICD10_diagnosis	J38.6	Glottic stenosis, Idiopathic subglottic tracheal stenosis, subglottic stenosis
		J39.8	Acquired tracheal stenosis
		J95.5	Postprocedural subglottic stenosis
		J95.03	Tracheal stenosis after procedure
		Z87.09	History of tracheal stenosis
		Q31.1	Congenital subglottic stenosis
		Q31.2	Hypoplastic larynx
		Q31.8	Congenital anomaly of cricoid cartilage
		Q32.1	Other congenital malformations of the trachea
Dysphonia	ICD9_diagnosis	748.42	Web of larynx
		784.41	Aphonia
	ICD10_diagnosis	R49.0	Dysphonia
		R49.1	Aphonia
Laryngeal spasm	ICD9_diagnosis	478.75	Laryngeal spasm
	ICD10_diagnosis	J38.5	Laryngeal spasm
Other	ICD9_diagnosis	784.42	Web of larynx
	ICD10_diagnosis	J38.7	Other diseases of the larynx (used for spasmodic dysphonia)
		J38.4	Laryngeal edema
		R49.8	Other voice and resonance disorders (Tremor)
Laryngological procedures			
CPT		31570	Laryngoscopy, direct, with injection into vocal cord(s), therapeutic;
		31571	Laryngoscopy, direct, with injection into vocal cord(s), therapeutic; with operating microscope or telescope
		31573	Laryngoscopy, flexible; with therapeutic injection(s) (e.g., chemodenervation agent or corticosteroid, injected percutaneous, transoral, or via endoscope channel), unilateral
		31574	Laryngoscopy, flexible; with injection(s) for augmentation (e.g., percutaneous, transoral), unilateral
		31513	Laryngoscopy, indirect; with vocal cord injection
HCPCS		C9742	Laryngoscopy, flexible fiberoptic, with injection into vocal cord(s), therapeutic, including diagnostic laryngoscopy, if performed
HCPCS		L8607	Injectable bulking agent for vocal cord medialization, 0.1 ml, includes shipping and necessary supplies
HCPCS		S2340	Chemodenervation of adductor muscle(s) of vocal cord
		S2341	Chemodenervation of abductor muscle(s) of vocal cord
ICD9_Procedure		31	Injection of larynx

Abbreviations: CPT, Current Procedural Terminology; HCPCS, Healthcare Common Procedure Coding System; ICD, International Classification of Diseases.

Table 2. Demographics of Patients Who Underwent a Laryngology Procedure in the Reg-ENT Database, 2017 to 2022

	Ambulatory surgical setting				Office setting			
	N = 1523	Pre-COVID, N = 663[a]	COVID, N = 860[a]	*P* value[b]	N = 4466	Pre-COVID, N = 1546[a]	COVID, N = 2920[a]	*P* value[b]
Age				<.001				<.001
		65 (54, 76)	62 (49, 73)			71 (59, 80)	66 (52, 75)	
Sex				.3				.003
Female		385 (58%)	524 (61%)			837 (54%)	1716 (59%)	
Male		278 (42%)	336 (39%)			709 (46%)	1204 (41%)	
Race				<.001				<.001
White		444 (67%)	531 (62%)			1158 (75%)	1921 (66%)	
Not available		124 (19%)	220 (26%)			234 (15%)	543 (19%)	
Black or African American		51 (7.7%)	77 (9.0%)			86 (5.6%)	259 (8.9%)	
Other Race		33 (5.0%)	18 (2.1%)			35 (2.3%)	74 (2.5%)	
Asian		11 (1.7%)	10 (1.2%)			21 (1.4%)	101 (3.5%)	
American Indian or Alaska Native		0 (0%)	2 (0.2%)			3 (0.2%)	6 (0.2%)	
Native Hawaiian or Other Pacific Islander		0 (0%)	2 (0.2%)			8 (0.5%)	14 (0.5%)	
Multiracial						1 (<0.1%)	2 (<0.1%)	
Region				<.001				<.001
Midwest		108 (16%)	369 (43%)			215 (14%)	355 (12%)	
Southeast		132 (20%)	256 (30%)			334 (22%)	729 (25%)	
Southwest		292 (44%)	28 (3.3%)			236 (15%)	19 (0.7%)	
Northwest		62 (9.4%)	165 (19%)			516 (33%)	1559 (53%)	
Pacific		28 (4.2%)	34 (4.0%)			212 (14%)	243 (8.3%)	
Rocky mountains		39 (5.9%)	6 (0.7%)			33 (2.1%)	1 (<0.1%)	
Not available		2 (0.3%)	2 (0.2%)			0 (0%)	14 (0.5%)	

Abbreviations: COVID, coronavirus disease; IQR, interquartile range.
[a]Median (IQR); n (%).
[b]Fisher's exact test for count data with simulated *P* value (based on 2000 replicates).

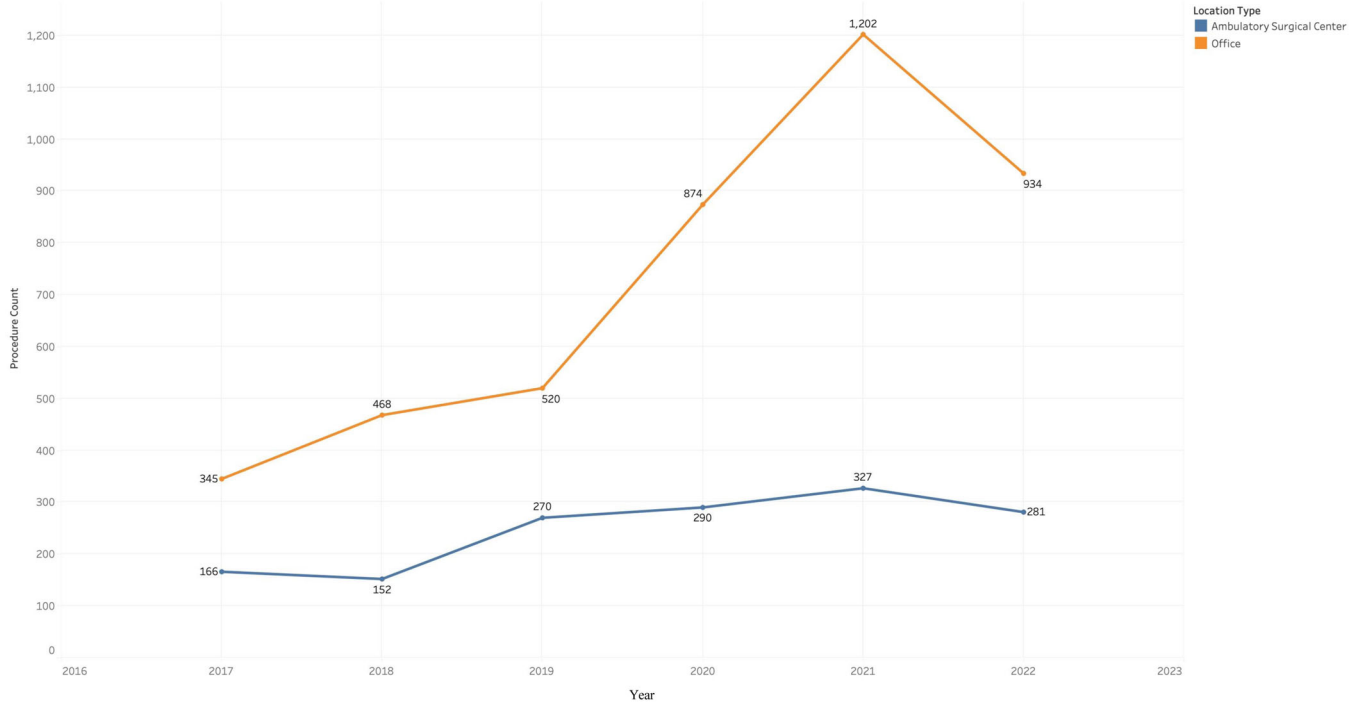

Figure 1. Location setting of laryngology procedure by year in the Reg-ENT database, 2017 to 2022. Laryngology procedures by year by location setting—either ambulatory surgical center or office setting—showing an increase in procedure counts in the office setting during the coronavirus disease 2019 (COVID-19) pandemic.

Table 3. Diagnosis Associated With Laryngology Procedure by Location Setting in the Reg-ENT Database, 2017 to 2022

	Ambulatory surgical setting				Office setting				Total
	N	Pre-COVID, N = 663[a]	COVID, N = 860[a]	*P* value[b]	N	Pre-COVID, N = 1546[a]	COVID, N = 2920[a]	*P* value[b]	N
Diagnosis	1523			<.001	4466			.006	5989
Vocal fold paralysis	719	302 (46%)	417 (48%)		2112	752 (49%)	1360 (47%)		2831
Laryngotracheal stenosis	332	109 (16%)	223 (26%)		506	180 (12%)	326 (11%)		838
Dysphonia and aphonia	315	151 (23%)	164 (19%)		1077	359 (23%)	718 (25%)		1392
Laryngeal spasm	6	0 (0%)	6 (0.7%)		170	38 (2.5%)	132 (4.5%)		176
Other	151	101 (15%)	50 (5.8%)		601	217 (14%)	384 (13%)		752

Abbreviation: COVID, coronavirus disease.
[a]n (%).
[b]Fisher's exact test for count data with simulated *P* value (based on 2000 replicates).

COVID in the different settings were made using the Fisher's exact test for count data with simulated *P* value (based on 2000 replicates). All tests were 2-sided with $\alpha = .05$. Statistical analyses were performed using SAS 9.4 (SAS Institute).

Results

From 2017 through 2022, 5989 patients underwent laryngology procedures. There were 42% more procedures performed in the COVID period (n = 3780) from March 2020 through December 2022 than in the pre-COVID period (n = 2209) from January 2017 through February 2020 (**Table 2**). When looking at the volume trends annually, steady numbers of procedures were seen in 2017 and 2018. However, in 2020 and 2021 a significant increase each year in procedures was seen, with a subsequent leveling off in 2022 (**Figure 1**).

When looking at the location of intervention, 25% (n = 1523) patients were treated in the ambulatory surgical setting versus 75% (n = 4466) patients treated in the office setting. The trends in terms of setting of the

procedures between ambulatory surgical versus office setting were stable from 2017 through 2019. However, starting in 2020 there was a divergence with relatively more procedures occurring in the office setting (**Figure 1**). Most of the volume increase after the onset of the COVID-19 pandemic occurred in the office setting with a 68% increase in 2020 and 38% increase in 2021 when compared with the year prior. A total of 30% (n = 663) versus 70% (n = 1546) patients pre-COVID, while 23% (n = 860) patients versus 77% (n = 2920) patients, $P = .9$, during COVID were treated in the ambulatory surgical setting versus the office setting, respectively.

Focusing on the diagnoses trends, vocal fold paralysis, dysphonia, and laryngotracheal stenosis account for 47% (n = 2831), 33% (n = 1392), and 14% (n = 838) of diagnoses associated with laryngological procedures during the study period. After the start of the pandemic, dysphonia, laryngotracheal stenosis, and vocal fold paralysis account for the largest procedure-related diagnosis increase seen, with the majority being treated in the office setting ($P < .001$, **Table 3**). There was a 93% increase in airway stenosis diagnoses (284 vs 549 patients), 70% increase in dysphonia (520 vs 882 patients), and 69% increase in vocal fold paralysis (1054 vs 1777 patients) in the COVID time period. The diagnosis trends by year are also depicted graphically in **Figures 2** and **3**. **Table 4** shows injection procedure codes by location setting which shows a 136% increase (n = 543-1279) increase in billing CPT code 31574 (typically used for vocal fold augmentation) and 97% increase (n = 284-558) increase in billing CPT code 31573 (typically used for steroid injection) during COVID compared with the pre-COVID period.

Figure 4 represents the overall geographical depiction of the procedure counts by state. A large increase was seen in the relative percentage of laryngology procedures performed in the Midwest (342% increase) in the ambulatory setting, while there was a substantial decrease in the Southwest in both settings (**Table 2**).

Discussion

This retrospective data utilizing a large, otolaryngology-specific database demonstrated a trend toward increasing office-based laryngology procedures in the 3 years preceding the pandemic (2017-2019); followed by an increase in office-based laryngology procedures after the onset of the COVID-19 pandemic. As technology has advanced and reimbursement models have changed, there has been a gradual shift toward more laryngology procedures being done in the office setting over the past few decades as can be seen in the prepandemic years.

All postpandemic years reviewed, 2020 to 2022, showed much higher numbers of office-based laryngological procedures compared with 2017 to 2019. This trend accelerated at first in the 2 years (2020-2021) following the start of the pandemic, with a decrease in 2022 as compared with 2021; however, overall still showing a much higher baseline of office-based laryngology procedures in all postpandemic years compared with prior. This analysis suggests that factors associated with the onset of the COVID-19 pandemic could have further contributed to the

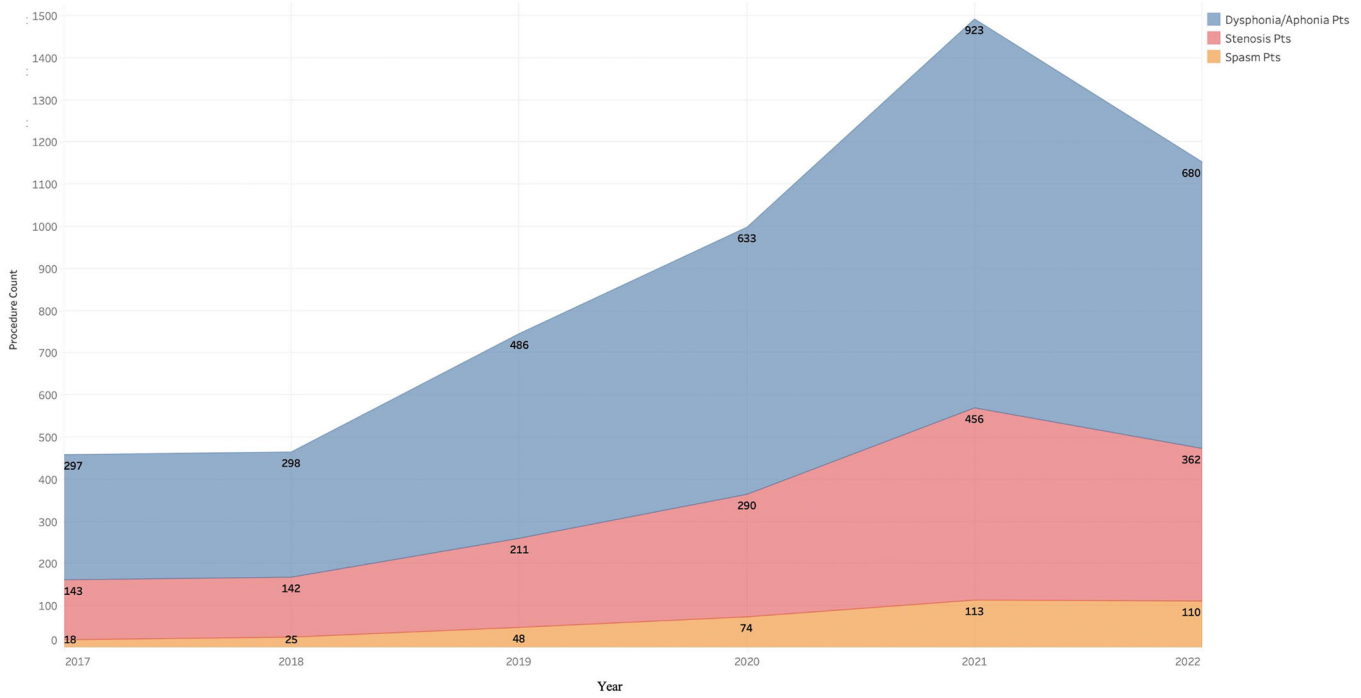

Figure 2. Diagnosis associated with a laryngology procedure by year in the Reg-ENT database, 2017 to 2022. Laryngeal procedure counts by diagnosis by year showing an increase in dysphonia diagnosis driving the increase in procedure counts during the coronavirus disease 2019 (COVID-19) pandemic.

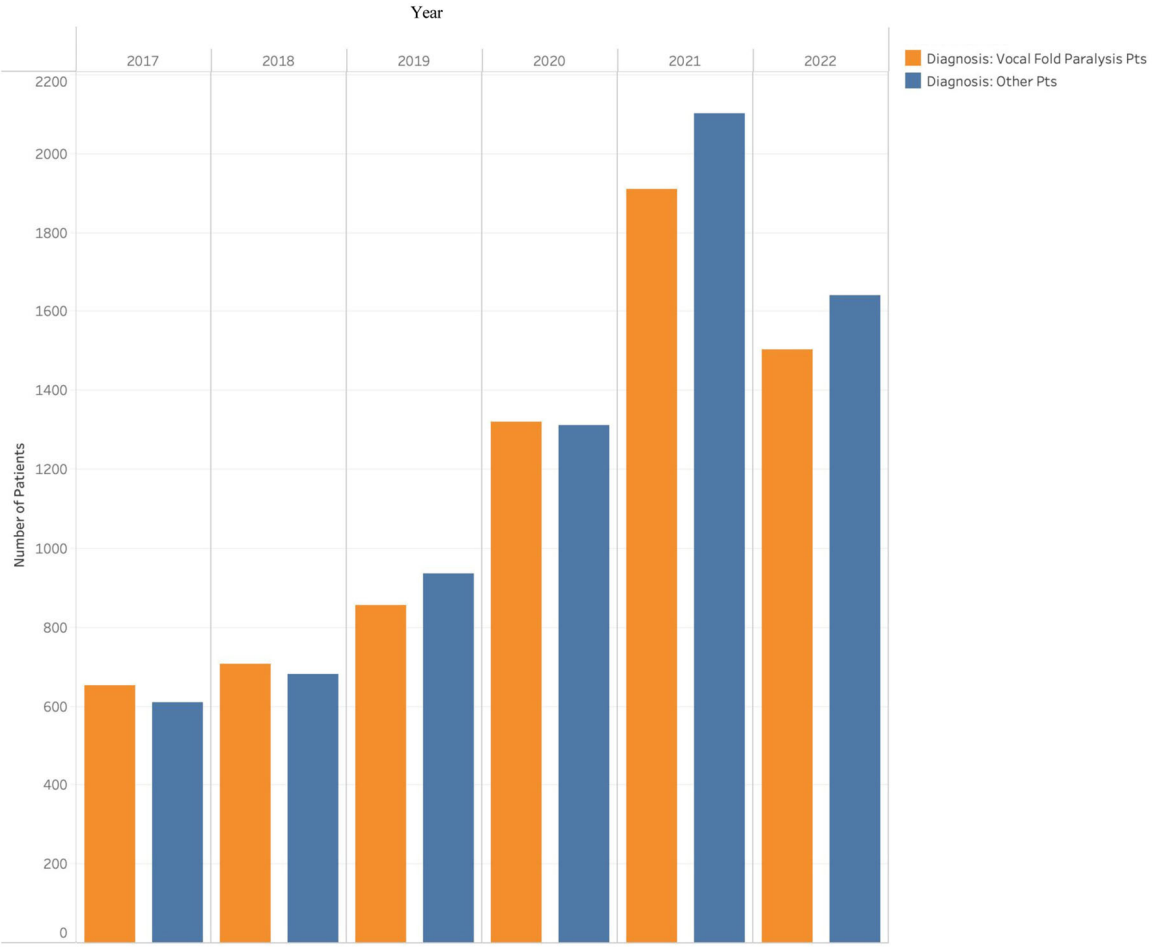

Figure 3. Laryngology diagnosis counts associated with a laryngology procedure by year in the Reg-ENT database, 2017 to 2022. Number of patients receiving a procedure for vocal fold paralysis versus all other diagnoses by year showing the large proportion of procedures performed due to vocal fold paralysis.

already existing growth of in-office laryngology procedures. The diagnoses associated with the increase in laryngological procedures in the COVID time period were laryngotracheal stenosis, dysphonia, and vocal fold paralysis. We hypothesize that the increase in laryngological procedures in the COVID era could be in part due to the increase in these diagnoses from COVID-related clinical and nonclinical implications.

From a clinical perspective, there are multiple potential factors related to COVID-19 pathophysiology that would increase the need for laryngological procedures, including the respiratory nature of the disease, the sequelae related to treatment for severe disease (prolonged intubation and pronation maneuvers) and postviral neuropathy that could have contributed to these changes. During the pandemic, millions of patients were intubated, with a large percentage of those patients emerging from intubation with some sort of upper airway injury. In a prospective study on patients with COVID-19 requiring intubation, outpatient endoscopy revealed laryngotracheal lesions in 40% of patients, with laryngotracheal stenosis and vocal fold paralysis being the most common.[13] Furthermore, systematic reviews found the incidence of dysphonia postintubation to be as high as 76%.[12,14,15] The specific rise in vocal fold paralysis may also be in part due to a postviral vagal neuropathy.[16] In a case series of 16 patients who presented an average of 3 months after COVID-19 infection with a vagal neuropathy, Rapoport et al noted that the patients had a clinical course consistent with postviral neuropathy.[17]

From a nonclinical perspective, there are multiple potential factors related to a COVID-19 increase in laryngological procedures; as well as, a preference for office-based procedures. These factors include logistical challenges in scheduling elective surgical cases, restrictions and limited access to ambulatory surgery facilities that remained in place during the latter half of 2020 and through 2021.[9] Furthermore, delays in patients seeking treatment and initial delay in surgical procedures with known high complication rate of vocal fold paralysis could have resulted in clustering of this diagnosis in the 2020 to 2021 time period.[18-20] Other

Table 4. Laryngeal Injection Procedures by Location Setting in the Reg-ENT Database, 2017 to 2022

	Ambulatory surgical setting				Office setting				
	N	Pre-COVID, N = 663	COVID, N = 860	*P* value[a]	N	Pre-COVID, N = 1546	COVID, N = 2920	*P* value[a]	Total
Laryngeal injection procedure	1523			<.001	4466			<.001	5989
CPT 31570 Laryngoscopy, direct, with injection into vocal cord(s), therapeutic	422	114 (17%)	308 (36%)		203	70 (4.5%)	133 (4.6%)		625
CPT 31571 Laryngoscopy, direct, with injection into vocal cord(s), therapeutic; with operating microscope or telescope	1035	539 (81%)	496 (58%)		1158	501 (32%)	657 (23%)		2193
CPT 31573 Laryngoscopy, flexible; with therapeutic injection(s) (eg, chemodenervation agent or corticosteroid, injected percutaneous, transoral, or via endoscope channel), unilateral	10	0 (0%)	10 (1.2%)		837	289 (19%)	548 (19%)		847
CPT 31574 Laryngoscopy, flexible; with injection(s) for augmentation (eg, percutaneous, transoral), unilateral	7	5 (0.8%)	2 (0.2%)		1815	538 (35%)	1277 (44%)		1822
HCPCS L8607 Injectable bulking agent for vocal cord medialization, 0.1 mL, includes shipping and necessary supplies	49	5 (0.8%)	44 (5.1%)		440	139 (9.0%)	301 (10%)		489
CPT 31513 Laryngoscopy, indirect; with vocal cord injection	0	0 (0%)	0 (0%)		13	9 (0.6%)	4 (0.1%)		13

Abbreviations: COVID, coronavirus disease; CPT, Current Procedural Terminology.
[a]Fisher's exact test for count data with simulated *P* value (based on 2000 replicates).

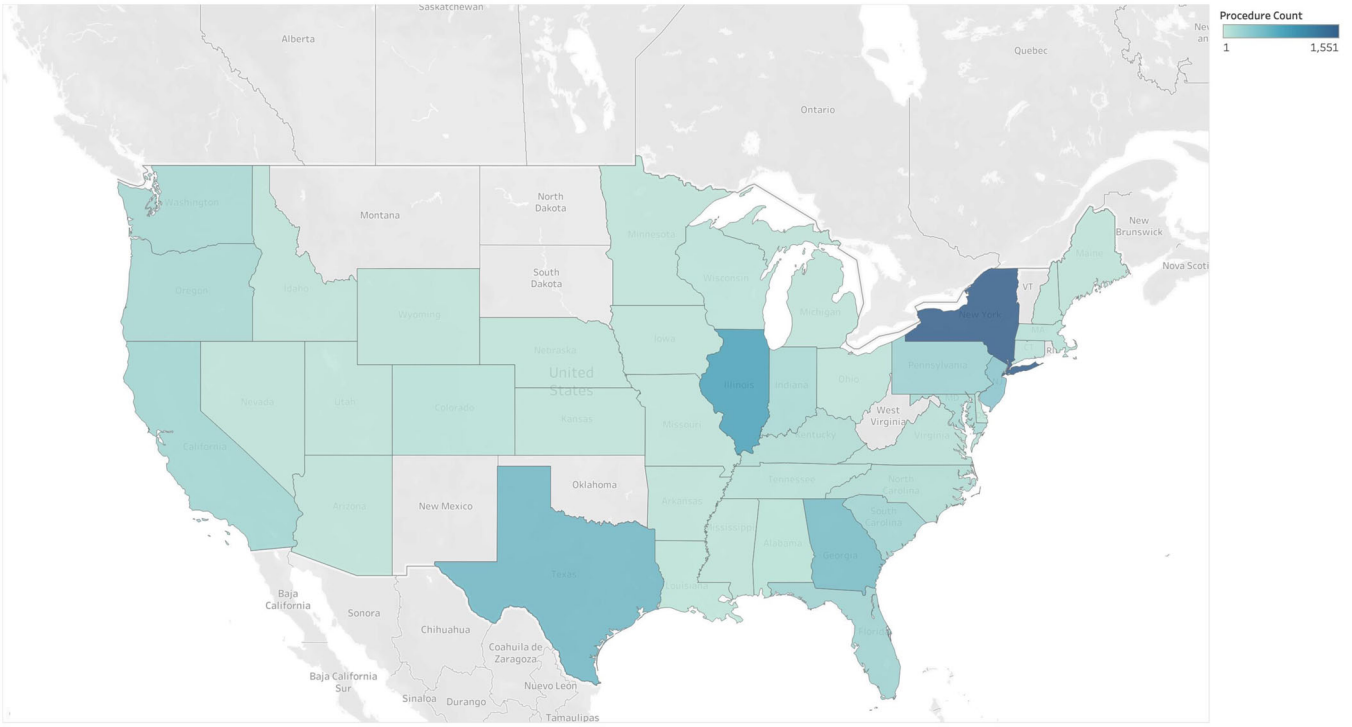

Figure 4. Total laryngology procedure counts by state in the Reg-ENT database, 2017 to 2022. US map with color showing counts of patients who underwent laryngology procedures from 2017 to 2022.

nonclinical factors could be due to patient fear about iatrogenic exposure in an OR setting or the patients' perception that potentially physicians not wanting to increase the burden on the already-taxed hospital systems.[8] Furthermore, in the past couple of decades several other influential studies in the field of laryngology have focused on awake, office-based procedures and have represented the practice shift of laryngology procedures in the decades leading up to the COVID-19 pandemic[1,7,8] pointing to provider preference as a contributing factor. It is unclear how the fear of aerosolization has contributed to these trends, as multiple studies have warned of the aerosolization risks with laryngological procedures.[21] We hypothesize that despite these risks, the availability of appropriate personal protective equipment and the ease of scheduling office procedures as compared with ambulatory surgical procedures could have contributed to the preference for office-based procedures in the COVID-19 era.

There are many limitations to the current study. First, the retrospective nature of the data prevents establishing a direct causal relationship of COVID-19 infection itself as the driver behind the increase in laryngology procedures. An attempt was made to use a claim-based data set to link a history of previously documented COVID-19 infections in the 6 months prior to undergoing the laryngology procedure, but this greatly limited the data set and would have prevented any meaningful analysis from being performed. Second, while Reg-ENT represents a broad swath of geographic and practice settings, it is not fully representative of the entirety of otolaryngology care being delivered in the United States as represented in **Figure 4** which shows which states' otolaryngologists contributed to the registry practice. While the number of otolaryngologists remained fairly static during the study time period and we were able to identify the number of procedures being performed at the large hospital systems, we were unable to directly attribute the patients to particular otolaryngologists due to the deidentified nature of the data set. Thus, while unlikely, particularly high-volume otolaryngologists who may have joined or left Reg-ENT during the study time may have skewed the volume trends seen in the analysis. These data also do not capture information on speech-language pathology and other ancillary services critical to the care of laryngology patients. Lastly, there were only 3 years worth of pre-COVID Reg-ENT data available to compare to the almost 3 years worth of COVID period data. Data were restricted to 2017 to 2022 as this is when Reg-ENT had the most consistent annual number of otolaryngologists contributing data to the registry. Therefore, we cannot fully understand how much the COVID period changes compare to trends over a longer pre-COVID period. Questions remain as to whether the shift to in-office laryngology procedures will continue in the postpandemic era. The data from 2022 did show a decline in procedure numbers compared with 2021. The peak in 2021 could have been due to the large backlog from the prior year; however, overall the COVID-19 era did usher an unprecedented increase of laryngology procedures in the office setting.

Conclusion

This analysis of Reg-ENT data demonstrates an increase in the number of laryngology procedures being performed after the onset of the COVID-19 pandemic, and an overall procedural shift into the office-setting. This represents a continued trend seen even before the pandemic onset. Further investigations could help elucidate the outcomes and efficacy of these procedures, as well as the convenience to patients (eg, time from initial presentation to procedure) and an analysis of health care resource and cost utilizations; data that can also be used for reimbursement advocacy efforts. While each subsequent wave of the COVID-19 variants that arrives seems to result in less severe respiratory and neuropathic disease,[22] we may still experience another rise in upper respiratory disease depending on the efficacy of prior immunity on the next dominant viral variant.

Author Contributions

Raluca Gray, design, analysis, drafting of the manuscript. **Marisa A. Ryan**, design, analysis, drafting of the manuscript. **Vikas Mehta**, design, analysis, drafting of the manuscript.

Disclosures

Competing interests: Dr Mehta is the current Coordinator for Research and Quality for the American Academy of Otolaryngology–Head and Neck Surgery. There are no other conflicts of interest that are upcoming or existed in the past 24 months.

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References

1. Rosen CA, Amin MR, Sulica L, et al. Advances in office-based diagnosis and treatment in laryngology. *Laryngoscope*. 2009;119(suppl 2):S185-S212. doi:10.1002/lary.20712
2. Schimberg AS, Wellenstein DJ, van den Broek EM, et al. Office-based vs. operating room-performed laryngopharyngeal surgery: a review of cost differences. *Eur Arch Otrhinolaryngol*. 2019;276(11):2963-2973. doi:10.1007/s00405-019-05617-z
3. Ward PH, Hanson DG, Abemayor E. Transcutaneous Teflon injection of the paralyzed vocal cord: a new technique. *Laryngoscope*. 1985;95(6):644-649. doi:10.1288/00005537-198506000-00002
4. Hoffman MR, Francis DO, Mai JP, Dailey SH. Office-based steroid injections for idiopathic subglottic stenosis: patient-reported outcomes, effect on stenosis, and side effects. *Ann Otol Rhinol Laryngol*. 2020;129(4):361-368. doi:10.1177/0003489419889066
5. Franco RA, Husain I, Reder L, Paddle P. Awake serial intralesional steroid injections without surgery as a novel targeted treatment for idiopathic subglottic stenosis. *Laryngoscope*. 2018;128(3):610-617. doi:10.1002/lary.26874
6. Bertelsen C, Shoffel-Havakuk H, O'Dell K, Johns MM, Reder LS. Serial in-office intralesional steroid injections in airway stenosis. *JAMA Otolaryngol Head Neck Surg*. 2018;144(3):203-210. doi:10.1001/jamaoto.2017.2800
7. Zeitels SM, Akst LM, Burns JA, Hillman RE, Broadhurst MS, Anderson RR. Office-based 532-nm pulsed KTP laser treatment of glottal papillomatosis and dysplasia. *Ann Otol Rhinol Laryngol*. 2006;115(9):679-685. doi:10.1177/000348940611500905
8. Sulica L, Rosen CA, Postma GN, et al. Current practice in injection augmentation of the vocal folds: indications, treatment principles, techniques, and complications. *Laryngoscope*. 2010;120(2):319-325. doi:10.1002/lary.20737
9. Mattingly AS, Rose L, Eddington HS, et al. Trends in US surgical procedures and health care system response to policies curtailing elective surgical operations during the COVID-19 pandemic. *JAMA Network Open*. 2021;4(12):e2138038. doi:10.1001/jamanetworkopen.2021.38038
10. Anderson C, Sandhu G, Al Yaghchi C. Impact of the COVID-19 pandemic on patients with idiopathic subglottic stenosis. *Ear Nose Throat J*. 2021;100(2_suppl):122S-130S. doi:10.1177/0145561320977467
11. Attaway AH, Scheraga RG, Bhimraj A, Biehl M, Hatipoğlu U. Severe COVID-19 pneumonia: pathogenesis and clinical management. *BMJ*. 2021;372:n436. doi:10.1136/bmj.n436
12. Skoretz SA, Flowers HL, Martino R. The incidence of dysphagia following endotracheal intubation. *Chest*. 2010;137(3):665-673. doi:10.1378/chest.09-1823
13. Félix L, Tavares TL, Almeida VPB, Tiago RSL. Incidence of laryngotracheal lesions after orotracheal intubation in coronavirus disease patients. *Laryngoscope*. 2021;132(5):1075-1081. doi:10.1002/lary.29862
14. Brodsky MB, Levy MJ, Jedlanek E, et al. Laryngeal injury and upper airway symptoms after oral endotracheal intubation with mechanical ventilation during critical care: a systematic review. *Crit Care Med*. 2018;46(12):2010-2017. doi:10.1097/CCM.0000000000003368
15. McIntyre M, Doeltgen S, Dalton N, Koppa M, Chimunda T. Post-extubation dysphagia incidence in critically ill patients: a systematic review and meta-analysis. *Aust Crit Care*. 2021;34(1):67-75. doi:10.1016/j.aucc.2020.05.008
16. Amin MR, Koufman JA. Vagal neuropathy after upper respiratory infection: a viral etiology? *Am J Otolaryngol*. 2001;22(4):251-256. doi:10.1053/ajot.2001.24823
17. Rapoport SK, Alnouri G, Sataloff RT, Woo P. Acute vocal fold paresis and paralysis after COVID-19 infection: a case series. *Ann Otol Rhinol Laryngol*. 2021;13:34894211047829. doi:10.1177/00034894211047829
18. Idrizi A, Gordon AM, Lam A, Conway C, Saleh A. The effect of the coronavirus disease 2019 (COVID-19) pandemic on elective cervical spine surgery utilization and complications in the United States: a nationwide temporal

trends analysis. *World Neurosurg*. 2023;170:e1-e8. doi:10.1016/j.wneu.2022.07.095

19. Le Bihan-Benjamin C, Rocchi M, Putton M, Méric JB, Bousquet PJ. Estimation of oncologic surgery case volume before and after the COVID-19 pandemic in France. *JAMA Network Open*. 2023;6(1):e2253204. doi:10.1001/jamanetworkopen.2022.53204
20. Salenger R, Etchill EW, Ad N, et al. The surge after the surge: cardiac surgery post-COVID-19. *Ann Thorac Surg*. 2020;110(6):2020-2025. doi:10.1016/j.athoracsur.2020.04.018
21. Reddy PD, Nguyen SA, Deschler D. Bronchoscopy, laryngoscopy, and esophagoscopy during the COVID-19 pandemic. *Head Neck*. 2020;42(7):1634-1637. doi:10.1002/hed.26221
22. Reiter ER, Coelho DH, French E, Costanzo RM. COVID-19-associated chemosensory loss continues to decline. *Otolaryngol Head Neck Surg*. 2023;169(5):1386-1389. doi:10.1002/ohn.384