





Demographic differences in the treatment of unilateral vocal fold paralysis

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Abstract

Objective: To determine the impact of patient demographics and social determinants of health on treatment pathways for unilateral vocal fold paralysis (UVFP) at a tertiary laryngology clinic.

Study design: Retrospective medical record review.

Methods: Patient demographics (age, gender, race, ethnicity, and insurance status) were extracted for adults diagnosed with UVFP between 2009 and 2019. Odds ratios for the associations between sociodemographic factors and UVFP treatment pathways were determined by chi-square analyses.

Results: A total of 1490 UVFP diagnoses were identified during the study period with the majority being female (58%), White (85%), non-Hispanic (97%), and publicly insured (54%). Five treatment pathways were identified: observation, injection laryngoplasty, voice therapy, laryngeal framework surgery/thyroplasty, and reinnervation surgery. There were 538 patients who underwent observation, 512 injection laryngoplasty, 366 voice therapy, 136 thyroplasty, and 26 laryngeal reinnervation surgery. Males were more likely to undergo injection laryngoplasty than females (OR 1.32; CI 1.08–1.61), whereas females were more likely to undergo voice therapy (OR 1.39; CI 1.09–1.76). Patients with public insurance (OR 1.48; CI 1.03–2.14) and Hispanics (OR 2.60; CI 1.18–5.72) were more likely to undergo thyroplasty. Patients who underwent reinnervation surgery were younger than those in other treatment pathways (median: 39.1 years vs. 50.7–56.1 years).

Conclusions: Gender, ethnicity, and insurance status were significantly associated with specific UVFP treatment pathways. Patients with public insurance were more likely to undergo surgical intervention than voice therapy. This data overall supports differences in care pathway utilization for UVFP based on social determinants of health.

Level of evidence: Level IV.

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KEYWORDS

demographics, health care disparities, laryngology, treatment, unilateral vocal fold paralysis

1 | INTRODUCTION

Unilateral vocal fold paralysis (UVFP) is the most common neurological laryngeal disorder resulting in dysphonia and dysphagia. Iatrogenic injury to the recurrent laryngeal nerve (RLN) during surgery is the most common cause of UVFP, most commonly from thyroid/parathyroid, esophageal, anterior cervical disc, and thoracic surgical procedures. Non-iatrogenic causes include neoplasm, traumatic injuries, idiopathic, neurological, inflammatory, and infectious diseases.¹ The true incidence of UVFP remains unknown, but it is estimated to affect approximately 0.41–0.51% of the population.^{2,3} Patients with UVFP typically present with voice changes, hoarseness, or aspiration.⁴ Dysphonia due to UVFP can have a significant impact on functional communication and the quality of life of patients, leading to potential employment challenges, social withdrawal, and associated psychological stress and depression.^{5,6}

The current management approaches for UVFP include expectant observation, behavioral voice therapy, or various surgical options.⁷ The selection of a specific patient's optimal UVFP treatment may be influenced by many patient-related factors including the nature of RLN injury, degree of glottic insufficiency, the severity of dysphonia, patient anxiety, medical comorbidities, and overall general medical prognosis.⁸ Surgical interventions generally involve vocal cord medialization via either injection laryngoplasty, laryngeal framework surgery/type I thyroplasty (with or without arytenoid adduction), or laryngeal reinnervation. Some patients may recover RLN function spontaneously with conservative measures only or may not require surgical intervention if their paralyzed cord is in a favorable position. Options for temporary and permanent surgical interventions are warranted for patients who do not recover spontaneously, have known iatrogenic nerve transection, or are experiencing debilitating symptoms.⁹ A recent systematic review by Siu et al. showed none of the surgical treatment modalities for UVFP were superior to another in voice outcomes or quality of life.⁴

Treatment pathways for UVFP may be impacted by many patient demographics. A recent report examining racial/ethnic and gender disparities in various laryngeal disorders highlighted the significant need for further studies to determine the impact of health care disparities on tertiary laryngology care.¹⁰ A recent study by our group found no significant racial barriers to care access for evaluation of generalized dysphonia within our tertiary referral network.¹¹ We hypothesized that social determinants of health may alter the management of UVFP, and therefore utilized our local health care network to measure associations between patient demographics and social determinants of health on UVFP treatment pathways.

2 | MATERIALS AND METHODS

2.1 | Patient demographics

All patients ≥ 18 years diagnosed with UVFP by one of two fellowship-trained laryngologists at our academic medical center between 2009 and 2019 were included. The following International Classification of Diseases (ICD) codes were used to identify patients with UVFP within our entire health center medical record system stored in a JupyterHub for data analysis: J38, J38.01, 478.3, 478.31, and 478.32. We extracted patient characteristics including age at the time of the procedure, gender, race, ethnicity, and insurance status. This study was approved by the institutional review board of Children's Hospital of Wisconsin, Milwaukee, Wisconsin (PRO 1538127).

2.2 | Treatment pathways

Patients were distributed into five subgroups according to different UVFP treatment pathways: observation or no subsequent procedure, injection laryngoplasty (current procedural terminology [CPT] codes: 31513, 31574, 31570, or 31571), laryngeal framework surgery/type I thyroplasty (CPT codes: 31591 or 31599), reinnervation surgery (CPT code: 31590), and voice therapy (CPT codes: 92520, 92507, 92521, 92522, 92523, or 92524). Patients who underwent subsequent interventions after a trial of observation were excluded from the observation group. Similarly, the voice therapy group excluded patients who underwent prior surgical interventions for UVFP.

2.3 | Statistical analyses

The associations between sociodemographic variables (age, gender, race, ethnicity, and insurance status) and treatment pathways for UVFP were assessed by chi-square analysis. A baseline group that included all the patients diagnosed with UVFP regardless of their treatment modality was used as a reference group for comparison. We calculated the odds ratio according to a two-by-two table in which the baseline group was the non-exposed group, and the five treatment groups were the exposed groups. The effect of treatment was each of four sociodemographic variables from Table 1. The odds ratios and 95% confidence interval (CI) of the odds ratios comparing treatment pathway groups to the baseline group were calculated for all the stratified categories within each sociodemographic variable. $p < .05$ denoted statistically significant differences. All statistical tests were performed using the R language (3.6.1).

TABLE 1 Patient demographics and characteristics across the baseline group and five UVFP treatment subgroups (2009–2019)

	All UVFP patients (n = 1490)		No subsequent procedure ^a (n = 538)		Injection laryngoplasty (n = 512)		Type I thyroplasty (n = 136)		Reinnervation surgery (n = 26)		Voice therapy ^b (n = 366)	
Age, median, y	60.95		52.25		56.09		56.02		39.13		50.69	
Gender, % (no.)												
Female	57.9	(862)	58.7	(316)	51.0	(261)	53.7	(73)	61.5	(16)	65.6	(240)
Male	42.1	(628)	41.3	(222)	49.0	(251)	46.3	(63)	38.5	(10)	34.4	(126)
Race, % (no.)												
White	85.0	(1266)	84.4	(454)	86.9	(445)	87.5	(119)	88.5	(23)	83.6	(306)
Black	11.0	(164)	12.6	(68)	8.0	(41)	6.6	(9)	7.7	(2)	13.4	(49)
Asian	1.6	(24)	1.9	(10)	1.8	(9)	0.7	(1)	0.0	(0)	1.1	(4)
Other	1.5	(23)	0.4	(2)	2.1	(11)	3.7	(5)	0.0	(0)	1.6	(6)
Unknown	0.9	(13)	0.7	(4)	1.2	(6)	1.5	(2)	3.8	(1)	0.3	(1)
Ethnicity, % (no.)												
Hispanic or latino	2.3	(35)	2.2	(12)	2.7	(14)	5.9	(8)	3.8	(1)	1.1	(4)
Not Hispanic or Latino	97.4	(1451)	97.6	(525)	97.1	(497)	93.4	(127)	96.2	(25)	98.6	(361)
Unknown	0.3	(4)	0.2	(1)	0.2	(1)	0.7	(1)	0.0	(0)	0.3	(1)
Insurance status, % (no.)												
Private	44.4	(662)	44.4	(239)	42.6	(218)	34.6	(47)	61.5	(16)	48.6	(178)
Public	54.5	(812)	55.0	(296)	55.7	(285)	64.0	(87)	38.5	(10)	50.5	(185)
Other	0.9	(13)	0.4	(2)	1.6	(8)	0.7	(1)	0.0	(0)	0.8	(3)
Self-pay	0.1	(2)	0.0	(0)	0.2	(1)	0.7	(1)	0.0	(0)	0.0	(0)
No record	0.1	(1)	0.2	(1)	0.0	(0)	0.0	(0)	0.0	(0)	0.0	(0)

Abbreviation: UVFP, unilateral vocal fold paralysis.

^aExcludes patients from other treatment groups.

^bExcludes patients from injection laryngoplasty, type I thyroplasty, and reinnervation surgery groups.

3 | RESULTS

Between 2009 and 2019, two fellowship-trained laryngologists diagnosed 1490 adult patients with UVFP within our academic tertiary referral health system (Table 1). The median age was 60.95 years at the time of the first intervention. Most of our patients were White (85.0%), non-Hispanic or non-Latino (97.4%), female (57.9%), and publicly insured (54.5%). Black and Asian patients made up 11.0% and 1.6% of the patient population, respectively.

Among 1490 UVFP patients, we identified a total of 1578 UVFP treatments which suggests that only a small number of patients utilized more than one treatment option. The largest cohort (538, 34.1%) underwent observation with no subsequent procedure or intervention performed. This was followed by 512 (32.4%) who received injection laryngoplasty, 366 (23.2%) received primary voice therapy, and 136 (8.6%) underwent laryngeal framework surgery/type I thyroplasty, and 26 (1.6%) had reinnervation surgery. For each sociodemographic category, observation was the most common pathway except for males and Hispanics, in which injection laryngoplasty was most common. Patients who underwent reinnervation surgery were younger than those in other treatment pathways (median, 39.1 years vs. 50.7–56.1 years).

We noted a higher proportion of males undergoing injection laryngoplasty (40.0% vs. 30.3%) and type I thyroplasty (10.0% vs. 8.5%, Figure 1A) compared to females. Gender analysis demonstrated higher odds of males undergoing injection laryngoplasty (OR 1.32; CI 1.08–1.61, Table 2) and lower odds of undergoing voice therapy (OR 0.72; CI 0.57–0.92). In contrast, females (27.8% vs. 20.1% males) had higher odds of undergoing voice therapy (OR 1.39; CI 1.09–1.76) and lower odds of undergoing injection laryngoplasty (OR 0.76; CI 0.62–0.93).

Among White patients, there were relatively similar percentages of patients in both observation and injection laryngoplasty groups (35.9 and 35.2%, Figure 1B). In contrast, 41.5% of Black patients were in the observation group and only 25.0% were in the injection laryngoplasty group. Black patients, in comparison to White patients, were more to receive conservative management (observation and voice therapy), although these data did not reach statistical significance (Table 2). Specifically, Black patients had a lower likelihood of undergoing injection laryngoplasty ($p = .053$) or type I thyroplasty ($p = .112$). In contrast, White patients were more likely to receive surgical interventions in comparison to Black patients, again without statistical significance. Across all races, only 16.7% of Asians received voice therapy in comparison to 24.2% of Whites and 29.9% of Blacks.

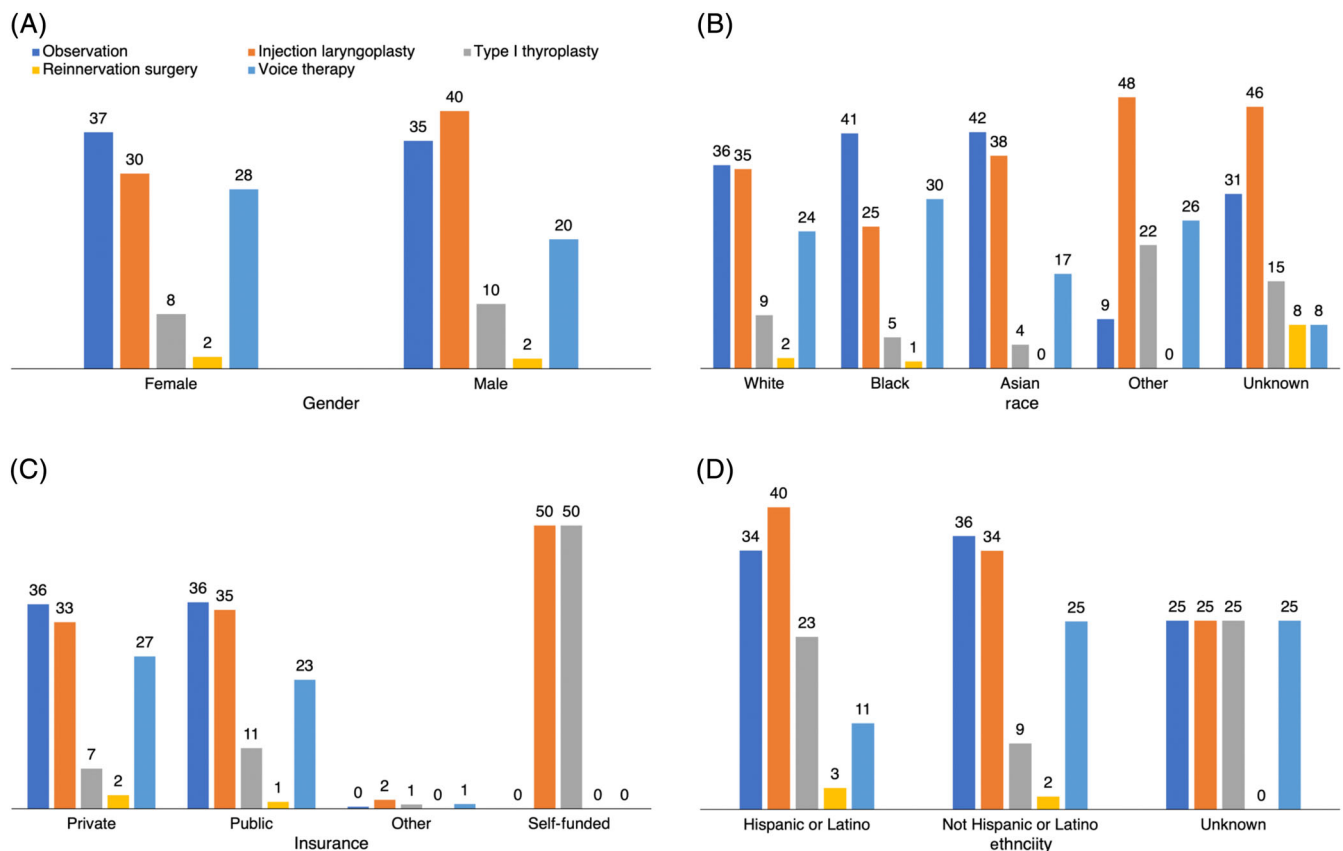


FIGURE 1 Distribution of UVFP treatment pathways across stratified categories of each sociodemographic variable. (A) Gender, (B) Race, (C) Insurance, and (D) Ethnicity. Values are presented as %. UVFP, unilateral vocal fold paralysis

TABLE 2 Odds ratios for different treatment modalities in relation to sociodemographic characteristics

	No subsequent procedure		Injection laryngoplasty		Type I thyroplasty		Reinnervation surgery		Voice therapy	
	OR	(CI)	OR	(CI)	OR	(CI)	OR	(CI)	OR	(CI)
Gender										
Female	1.04	(0.85, 1.27)	0.76	(0.62, 0.93)	0.84	(0.59, 1.20)	1.17	(0.53, 2.59)	1.39	(1.09, 1.76)
Male	0.96	(0.79, 1.18)	1.32	(1.08, 1.61)	1.18	(0.83, 1.69)	0.86	(0.39, 1.90)	0.72	(0.57, 0.92)
Race										
White	0.96	(0.73, 1.26)	1.18	(0.88, 1.58)	1.24	(0.73, 2.10)	1.36	(0.4, 4.56)	0.90	(0.66, 1.23)
Black	1.17	(0.87, 1.58)	0.70	(0.49, 1.01)	0.57	(0.29, 1.15)	0.67	(0.16, 2.88)	1.25	(0.89, 1.76)
Asian	1.16	(0.55, 2.44)	1.09	(0.5, 2.37)	0.45	(0.06, 3.37)	nd	nd	0.67	(0.23, 1.96)
Ethnicity										
Hispanic or Latino	0.95	(0.49, 1.84)	1.17	(0.62, 2.19)	2.60	(1.18, 5.72)	1.66	(0.22, 12.62)	0.46	(0.16, 1.30)
Not Hispanic or Latino	1.09	(0.57, 2.05)	0.89	(0.49, 1.63)	0.38	(0.18, 0.80)	0.67	(0.09, 5.09)	1.94	(0.76, 4.96)
Insurance status										
Private	1.00	(0.82, 1.22)	0.93	(0.76, 1.14)	0.66	(0.46, 0.95)	2.00	(0.9, 4.44)	1.18	(0.94, 1.49)
Public	1.02	(0.84, 1.24)	1.05	(0.86, 1.28)	1.48	(1.03, 2.14)	0.52	(0.24, 1.16)	0.85	(0.68, 1.07)

Note: Bolded values indicate $p < .05$.

In comparison to the non-Hispanic cohort, a higher proportion of Hispanic patients received injection laryngoplasty (40.0% vs. 34.3%) and type I thyroplasty (22.9% vs. 8.8%, Figure 1D). This patient cohort

was also at increased odds of undergoing type I thyroplasty in comparison to non-Hispanic or non-Latino patients (OR 2.60; CI 1.18–5.72 vs. OR 0.38; CI 0.18–0.80).

A higher proportion of patients with public insurance received injection laryngoplasty (35.1 vs. 32.9%) and type I thyroplasty (10.7 vs. 7.1%) when compared to those with private insurance (Figure 1C). Insurance status analysis showed increased odds of patients with public insurance undergoing type I thyroplasty than those with private insurance (OR 1.48; CI 1.03–2.14 vs. OR 0.66; CI 0.46–0.95). Voice therapy showed contrasting results with greater utilization by those with private insurance, but this did not reach statistical significance.

4 | DISCUSSION

In this study, we assessed the association of patient demographics and social determinants of health with UVFP treatment pathways at a tertiary laryngology referral health center over 10 years. This is, to our knowledge, the first report of such analyses specifically in patients with UVFP. Very little is known about disparities in health care delivery for voice disorders in general, much less UVFP. Prior studies utilizing a national survey have found that African Americans, Hispanics, and other minorities were less likely to report voice problems compared to White adults.¹² In addition, these underrepresented groups were more likely to postpone care because they lacked reliable transportation. A recent study from our department showed that utilization of tertiary laryngology services for overall dysphonia care was correlated with race, insurance status, and level of education.¹¹ This current study shows that patient gender, ethnicity, and insurance status significantly correlated with differing treatment pathways.

Among different treatments for UVFP, observation and injection laryngoplasty were the most utilized modalities for all patient groups. Possibly there were more patients with laryngeal paresis, in which observation is more commonly used, than those with paralysis, leading to a higher proportion of patients in the observation group. However, it was not possible to differentiate the two since both use the same ICD codes. In general, these results are reflective of the classical management approach to UVFP and the efficacy of an early intervention. During the first 9–12 months, passive surveillance with no interventions or active surveillance with voice therapy and/or vocal fold medialization by injection laryngoplasty is considered. Permanent and more invasive surgical interventions such as laryngeal framework surgery/type I thyroplasty and reinnervation surgery are indicated when there is poor response to the initial interventions, significant glottal insufficiency, poor overall prognosis of recovery, or severe associated symptoms. In addition, early intracordal injection in newly diagnosed UVFP is associated with reduced pulmonary infections, shorter hospital stays, and improved voice parameters.^{13–16} According to a recent systematic review and meta-analysis, patients with UVFP who do not undergo early injection laryngoplasty are four times more likely to undergo type I thyroplasty or other surgeries in the future.¹⁷ Our overall rate of type I thyroplasty (8.6%) would suggest that this option is reserved for a smaller cohort of patients due to these treatment pathways.

Patients who underwent reinnervation surgery were younger compared to those in other treatment groups. Reinnervation surgery

was likely recommended by providers as a treatment option to a higher proportion of young patients due to evidence suggesting an increased benefit from laryngeal reinnervation in younger patients. According to Paniello et al., patients less than 52 years had better outcomes with reinnervation surgery compared to medialization thyroplasty and significantly better outcomes than those greater than 52 years old with laryngeal reinnervation.¹⁸ It is also possible that these patients are more likely to have a history of neck trauma or intraoperatively identified iatrogenic injury, although our data did not include this analysis.

Gender analysis in this study showed that more females underwent voice therapy in comparison to males and vice versa for injection laryngoplasty. More males may have presented earlier for care leading to the increased offering of injection laryngoplasty in comparison to females. The confounding by age at the time of onset and presentation were not directly evaluated in this analysis. Voice therapy results are congruent with findings from Yeakel et al., which showed more commitment and utilization of voice therapy by females and professional voice users compared to males.¹⁹ Although not statistically significant in our study, we also found that Hispanic and Asian patients were proportionately least represented in the voice therapy cohort. A recent study has demonstrated that Hispanic patients (both English and Spanish speakers) are less likely to adhere to voice therapy.²⁰ Similarly, Huwyler et al. reported significantly lower compliance with voice therapy in non-English-speaking patients than in English-speaking patients, in which non-English-speaking people were more likely to be Hispanic or Asian.²¹ These observed ethnic differences in voice therapy utilization most likely stem from both inherent cultural beliefs and language barriers. Furthermore, we found that more Hispanic or Latino patients (62.9% vs. 43.1% non-Hispanic or non-Latino patients) underwent vocal fold medialization either via injection laryngoplasty or type I thyroplasty. Higher rates of nonadherence to voice therapy and perceived language barriers may have contributed to increased rates of surgical interventions in these Hispanic or Latino patients in our care network.

We found that race did not show statistically significant associations with any UVFP treatment pathway. Black patients received more nonsurgical interventions (observation or voice therapy) compared to White patients. Vamosi et al. reported that nonwhite patient groups were associated with higher no-show rates in voice therapy likely due to transportation availability and differences in income and education.²² A previous study from our group found areas with the highest Black populations in our care network had lower median income and education levels and correspondingly lower utilization rates for tertiary rhinology services.²³ This highlights the importance of understanding contributing factors in adherence and compliance to therapy recommendations in addition to equitable access to specialty care.

Insurance status and different levels of coverage have previously been shown to impact decision-making in treatment selection for many laryngeal pathologies. Prior studies have shown that patients with private insurance are more likely to attend voice therapy in comparison to those with public insurance.^{12,24} This observation was

confirmed by our data. With this additional evidence, it may be inferred that public insurance is a surrogate of lower socioeconomic status and highlights underlying barriers such as lack of reliable transportation or time away from work and family to attend repeated voice therapy sessions. On the other hand, public insurance may provide better coverage with minimal to zero out-of-pocket costs for surgical interventions when compared to private insurance. This was perhaps apparent in our results, as patients with public insurance had higher odds of undergoing surgical interventions (injection laryngoplasty and type I thyroplasty) in comparison to those with private insurance.

There are some limitations to this study. It is a single institution retrospective review with limited external validity. However, this retrospective review allowed us to identify a large UVFP patient cohort over 10 years of care at our institution. It is also noted that some patients in this cohort underwent multiple treatment offerings. We identified 1578 different treatment encounters across 1490 total patients. Therefore, only five percent or fewer patients received more than one intervention or one intervention multiple times. It is reasonable to assume that some of them first underwent injection laryngoplasty, then followed by permanent interventions like laryngeal framework surgery/type I thyroplasty or reinnervation surgery. These care duplications may partially confound overall group treatment rates for the studied parameters. Furthermore, individual treatment selection may be confounded by multiple patient-related factors including the onset of injury, age at the time of presentation, etiology, degree of glottal insufficiency, severity of associated symptoms, patient needs, and medical comorbidities. Provider preference toward certain treatment options and their implicit biases may have contributed to and confounded the observed sociodemographic differences in UVFP treatment pathways. These specific factors should be considered in future studies to better delineate the influence of demographic factors and social determinants on the treatment of UVFP. This study did not account for confounding by indication based on etiology. Disproportionate distribution of etiologies of UVFP among different ages, gender, and races may have affected the distribution of sociodemographic variables across treatment pathways as well. Lastly, social determinants of health include many factors including race, insurance status, education, income level, and geographic location some of which were not comprehensively assessed in this study.

5 | CONCLUSION

Treatment pathways for UVFP were associated with measurable differences in gender, ethnicity, and insurance status in our tertiary laryngology care referral network. Although race was not a statistically significant factor in treatment selection, we observed noticeable racial differences in utilization rates across different treatment types. These results suggest patient demographics and social determinants of health may potentially influence UVFP treatment utilization rates in our tertiary laryngology referral center. Further large-scale studies in a more diverse patient population while controlling for potential confounding variables are required to study the direct impact of these factors on UVFP treatment.

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CONFLICT OF INTEREST

The authors note no conflicts of interest relevant to this study.

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