Am J Otolaryngol 40 (2019) 102290

Contents lists available at ScienceDirect

Am J Otolaryngol

journal homepage: www.elsevier.com/locate/amjoto

National 30-day readmission and prolonged length of stay after vestibular schwannoma surgery: Analysis of the Nationwide Readmissions Database

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ARTICLE INFO

Keywords:
Vestibular schwannoma
Readmission
Prolonged length of stay
Readmission
Lateral skullbase surgery
Acoustic neuroma

ABSTRACT

Purpose: To determine the risk factors for unanticipated readmission, prolonged index admission, and discharge to a facility after vestibular schwannoma surgery.
Materials and methods: Retrospective cohort study of those undergoing surgery for vestibular schwannoma in the Nationwide Readmissions Database (2013–2014). Main outcome measures included readmission rate, length of stay, discharge destination.
Results: There were 4585 cases identified. The overall unanticipated readmission rate was 8.1%, and 9.1% had a prolonged length of stay (PLOS) of ≥7 days. Mean and median LOS were 4.63 and 4.00 days, respectively, and > 90% of patients were discharged after 7 days. Disposition to a facility occurred in 6.7% of cases. Teaching hospitals were protective against unintended readmission (odds ratio [OR] 0.44, $p < .001$). Major functional loss was associated with PLOS (OR 12.55, $p < .001$). High volume centers were associated with decreased risk of PLOS (OR 0.46, $p < .001$) and facility discharge (OR 0.68, $p < .001$). The most common readmission diagnoses included "other nervous system complications" (n = 128), cerebrospinal fluid leak (n = 71), "other postoperative infection" (n = 61), and meningitis (n = 59).
Conclusions: Unanticipated readmission and prolonged LOS following vestibular schwannoma surgery are common, with varied sociodemographic, hospital, and patient factors independently associated with each. Further studies are needed to investigate targeted interventions aimed at minimizing readmission and prolonged LOS using the factors outlined above.

1. Introduction

Vestibular schwannomas are the most common lesions of the cerebellopontine angle, account for 6% of all intracranial tumors [1], and have an annual incidence of 11.5/1 million people per year [2]. While the median age at diagnosis has not changed, average tumor size has decreased appreciably over the years with easier access to magnetic resonance imaging and an increasing number of smaller tumors discovered in older patients [3]. Treatment typically consists of watchful waiting with serial imaging, microsurgical resection, or stereotactic/conventional radiotherapy, with relevant variables being tumor control, potential morbidity, cranial nerve preservation, quality of life, and patient preference [4–6].

Microsurgical resection of a vestibular schwannoma is typically achieved with a combined approach by otolaryngology and neurosurgery. Due to the sensitive location of the tumor, the attendant morbidity can be quite severe, and includes vertigo, hearing loss, cranial neuropathies, cerebrospinal fluid (CSF) leak, hemorrhage, meningitis and other superficial/deep space infections, intracranial hypertension, stroke, seizure, and death [7–10]. Because of the complexity of the procedure and potential for untoward events, hospital length of stay (LOS) and discharge destination may be variable. As there is a paucity of data with respect to nationwide, multi-institutional quality outcomes following vestibular schwannoma surgery and an increasing focus on

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https://doi.org/10.1016/j.amjoto.2019.102290
Received 27 July 2019

Table 1
Top reasons for readmission following vestibular schwannoma resection.

	%	n	ICD-9 code
Other nervous system complication	37.4	128	997.09
CSF leak	20.8	71	349.81, 388.61
Other postoperative infection	17.8	61	998.59
Meningitis	17.3	59	322.9, 047.9, 320.9
Central nervous system complication	8.2	28	997.01
Acute kidney Injury	7.0	24	584.9
Urinary Tract Infection	6.7	23	599.0
Pulmonary embolism	6.4	22	415.19, 415.11
Nausea and vomiting	6.4	22	787.01, 787.02
Hypokalemia	5.3	18	276.8
Obstructive hydrocephalus	5.3	18	331.4
Anemia	4.9	17	285.9
Hyposmality/hyponatremia	4.1	14	276.1
Cerebral edema	4.1	14	348.5
Encephalopathy	3.8	13	348.39

Abbreviations: ICD-International Classification of Disease, CSF-cerebrospinal fluid.

quality-driven payments and care, we used the Nationwide Readmissions Database (NRD) to characterize risk factors for readmission, prolonged LOS (PLOS), and discharge to a facility in patients following microsurgical resection of a vestibular schwannoma.

2. Materials and methods

2.1. Description of the nationwide readmissions database

We extracted data from the NRD for years 2013 and 2014 in order to determine the frequency and risk factors for unintended 30-day readmission, PLOS, and discharge to a facility following surgical resection of a vestibular schwannoma. The NRD was developed as part of the Healthcare Utilization Project (HCUP), which is sponsored by the Agency for Healthcare Research and Quality and draws on the resources of federal, state, and industry partnerships to create the largest dataset of longitudinal encounter-level hospital care in the United States. The NRD includes data from all payers as well as the uninsured, with the most recent iteration representing over 56% of all United States hospitalizations and 36 million weighted discharges (17 million unweighted). Patient sociodemographic, comorbidity, diagnostic, and procedural data are available for each admission, as are admission-related data such as point of entry, LOS, and cost. Hospital-level characteristics such as size, ownership, location, and teaching status are included as well [11–13].

2.2. Patient population, inclusion and exclusion criteria

Our study included adult patients ≥18 years of age who underwent resection of a vestibular schwannoma as defined by an *International Classification of Disease*, *Ninth Revision*, *Clinical Modification* (ICD-9-CM) procedure code 04.01 with concurrent ICD-9 diagnosis codes 225.1 or 192.0. We excluded patients who had a readmission > 30 days after discharge or planned readmission ≤30 days, pregnant women, and those who died on index admission.

Patients with a same-day readmission were also excluded as they likely represented transfers to other hospitals. Due to inadequate follow-up, all patients undergoing an index procedure in the month of December were excluded [12–14].

2.3. Variable definitions

NRD variable definitions can be found within the data dictionary [15] with the following modifications: Insurance status was stratified into Medicare, Medicaid, Private, None, No charge, and Other (workman's compensation, Veteran's Affairs, and Title V), while Urban/Rural was stratified into metropolitan and non-metropolitan as found in the Center for Disease Control and Prevention classification scheme [16]. The All Patient Refined Diagnostic Related Grouping (APR-DRG) mortality and severity of illness subclasses were simplified to minor, moderate, and major. A modified Charlson score for comorbid conditions was calculated from available relevant comorbidities [17] and simplified to 0, 1, or ≥2. Substance abuse included alcohol and drug abuse, and psychiatric conditions included depression and psychoses. A high volume facility was designated as one that was in the ≥90th percentile for volume within the cohort, or ≥38 cases.

2.4. Outcomes

As patients in the NRD have unique linkage numbers, they are able to be tracked across admissions and hospitals within the same state. Unintended readmission was defined as any non-elective hospitalization within 30 days of an index admission. While multiple readmissions within 30 days are possible, analysis of baseline characteristics was done only for the index admission in accordance with the literature [12–14]. Length of stay (LOS) was categorized as prolonged if ≥7 days, as this was the 90th percentile for the cohort. Discharge disposition was categorized as either home (with or without ancillary services) or to a facility, which included short-term hospitals and skilled nursing facilities.

2.5. Statistical analysis

Statistical analysis was performed with IBM® SPSS® Statistics 24 (Armonk, NY). Simple summary statistics were tabulated. All values and statistics are based off weighted data with weighted values determined by the dataset. Univariate analysis included Pearson chi-square for categorical variables; inclusion into a multivariable logistic regression model was contingent upon $p \leq .10$. Models were created for outcomes of interest, all tests were two-sided, and final threshold for significance was set at $p \leq .05$. Bonferroni corrections were not performed, and no complications with a value of $n \leq 10$ were reported to maintain confidentiality. As the NRD data are de-identified, this study was granted exemption by our institutional review board.

3. Results

Our cohort consisted of 4585 hospitalizations for patients undergoing surgical resection of their vestibular schwannomas. There were 4243 index admissions with an unintended 30-day readmission rate of 8.1% (n = 342), 9.1% experiencing a prolonged index admission of ≥7 days, and 6.7% being discharged to a facility.

Of the 342 patients readmitted within 30 days of their index admission, the top ICD-9 codes associated with their readmission were “other nervous system complication” (37.4%, n = 128,), cerebrospinal fluid (CSF) leak (20.8%, n = 71), “other postoperative infection” (17.8%, n = 61), and meningitis (17.3%, n = 59). Complications occurring in < 10% of readmissions included “central nervous system complication,” acute kidney injury, urinary tract infection, pulmonary embolism, obstructive hydrocephalus, cerebral edema, and nausea/vomiting (Table 1).

In univariate analysis, no and other insurance (p = .003), Charlson score of 1, low volume facility, small hospital size, privately owned for-profit hospitals, non-teaching hospitals, PLOS (all $p \leq .001$), and discharge to a facility (p = .011) were all associated with higher rates of readmission (Table 2). In multivariate analysis, other insurance, moderate loss of function, Charlson score of 1, and PLOS were all independently associated with higher readmission rates. Protective against readmission were being treated in a teaching hospital and receiving care in a larger hospital. Procedure-specific hospital volume was not associated with readmission (Fig. 1).

Table 2
Summary statistics and univariate analysis.

	Readmitted ≤30 days		Prolonged index admission		Discharge to facility	
	No	Yes	No	Yes	No	Yes
	% (n = 4243)	% (n = 342)	% (n = 4168)	% (n = 417)	% (n = 4279)	% (n = 306)
Age (years)						
18–44	93.0 (1327)	7.0 (100)	92.2 (1316)	7.8 (112)	97.5 (1392)	2.5 (35)
45–64	92.9 (2305)	7.1 (176)	91.7 (2275)	8.3 (207)	93.8 (2326)	6.2 (155)
65–79	90.6 (575)	9.4 (60)	85.8 (545)	14.2 (90)	83.9 (533)	16.1 (102)
≥80	87.8 (36)	12.2 (5)	78.6 (33)	21.4 (9)	65.9 (27)	34.1 (14)
p	0.117		< 0.001		< 0.001	
Sex						
Male	92.5 (1871)	7.5 (151)	89.4 (1807)	10.6 (215)	93.4 (1888)	6.6 (134)
Female	92.6 (2373)	7.4 (191)	92.1 (2361)	7.9 (202)	93.3 (2391)	6.7 (173)
p	0.981		0.001		0.872	
Insurance						
Medicare	90.8 (689)	9.2 (70)	85.0 (645)	15.0 (114)	81.0 (614)	19.0 (144)
Medicaid	90.6 (251)	9.4 (26)	75.5 (209)	24.5 (68)	92.8 (257)	7.2 (20)
Private	93.4 (3071)	6.6 (216)	93.7 (3079)	6.3 (208)	96.7 (3180)	3.3 (107)
None	86.8 (59)	13.2 (9)	73.5 (50)	26.5 (18)	86.8 (59)	13.2 (9)
Other	88.0 (161)	12.0 (22)	96.7 (177)	3.3 (6)	86.9 (159)	13.1 (24)
No charge	100.0 (6)	0.0 (0)	100.0 (6)	0.0 (0)	100.0 (6)	0.0 (0)
p	0.003		< 0.001		< 0.001	
Urban/rural						
Metro area	92.1 (3541)	7.9 (302)	90.3 (3469)	9.7 (374)	93.3 (3585)	6.7 (258)
Non-metro	94.6 (689)	5.4 (39)	94.1 (685)	5.9 (43)	94.0 (684)	6.0 (44)
p	0.019		0.001		0.505	
Residence						
In-state	91.8 (3334)	8.2 (296)	90.4 (3281)	9.6 (350)	93.4 (3390)	6.6 (241)
Out of state	95.3 (909)	4.7 (45)	93.0 (887)	7.0 (67)	93.2 (889)	6.8 (65)
p	< 0.001		0.012		0.846	
Income quartile						
Top	91.3 (1328)	8.7 (127)	92.4 (1346)	7.6 (110)	96.1 (1399)	3.9 (57)
Second	93.2 (1238)	6.8 (90)	92.7 (1231)	7.3 (97)	92.5 (1229)	7.5 (99)
Third	93.2 (1031)	6.8 (75)	87.2 (964)	12.8 (141)	91.4 (1010)	8.6 (95)
Bottom	92.3 (573)	7.7 (48)	90.3 (561)	9.7 (60)	92.4 (574)	7.6 (47)
p	0.172		< 0.001		< 0.001	
Mortality risk						
Minor	93.4 (3202)	6.6 (226)	95.2 (3264)	4.8 (164)	96.6 (3311)	3.4 (116)
Moderate	92.6 (653)	7.4 (52)	85.7 (604)	14.3 (101)	89.1 (628)	10.9 (77)
Major	85.8 (388)	14.2 (64)	66.4 (300)	33.6 (152)	75.1 (340)	24.9 (113)
p	< 0.001		< 0.001		< 0.001	
Loss of function						
Minor	95.6 (2284)	4.4 (104)	97.9 (2338)	2.1 (50)	97.3 (2323)	2.7 (65)
Moderate	89.7 (1144)	10.3 (132)	89.9 (1146)	10.1 (129)	93.8 (1196)	6.2 (79)
Major	88.5 (816)	11.5 (106)	74.2 (683)	25.8 (238)	82.4 (760)	17.6 (162)
p	< 0.001		< 0.001		< 0.001	
Charlson score						
0	93.4 (3402)	6.6 (241)	92.8 (3379)	7.2 (264)	95.3 (3473)	4.7 (170)
1	88.7 (634)	11.3 (81)	88.5 (634)	11.5 (82)	90.9 (650)	9.1 (65)
≥2	91.2 (207)	8.8 (20)	68.7 (156)	31.3 (71)	68.3 (155)	31.7 (72)
p	< 0.001		< 0.001		< 0.001	
Substance abuse						
No	92.7 (4187)	7.3 (331)	91.2 (4120)	8.8 (398)	93.3 (4216)	6.7 (302)
Yes	83.6 (56)	16.4 (11)	71.6 (48)	28.4 (19)	94.0 (63)	6.0 (4)
p	0.005		< 0.001		0.816	
Psychiatric condition						
No	92.7 (3801)	7.3 (301)	92.1 (3778)	7.9 (324)	94.2 (3865)	5.8 (237)
Yes	91.5 (442)	8.5 (41)	80.8 (391)	19.2 (93)	85.5 (414)	14.5 (70)
p	0.363		< 0.001		< 0.001	
Coagulopathy						
No	92.6 (4203)	7.4 (331)	91.3 (4141)	8.7 (397)	93.6 (4248)	6.4 (289)
Yes	85.4 (41)	14.6 (11)	58.3 (28)	41.7 (20)	64.6 (31)	35.4 (17)
p	0.059		< 0.001		< 0.001	
Hypertension						
No	93.1 (2724)	6.9 (202)	93.0 (2720)	7.0 (205)	96.2 (2816)	3.8 (110)
Yes	91.6 (1520)	8.4 (120)	87.2 (1448)	12.8 (212)	88.2 (1463)	11.8 (196)
p	0.058		< 0.001		< 0.001	
Obese						
No	92.8 (3721)	7.2 (290)	91.3 (3664)	8.7 (347)	93.5 (3751)	6.5 (260)
Yes	91.0 (523)	9.0 (52)	87.8 (504)	12.2 (70)	92.0 (528)	8.0 (46)
p	0.122		0.006		0.169	
Weight loss						
No	92.7 (4199)	7.3 (332)	91.2 (4134)	8.8 (397)	93.8 (4249)	6.2 (283)
Yes	81.5 (44)	18.5 (10)	63.0 (34)	37.0 (20)	55.6 (30)	44.4 (24)

(*continued on next page*)

Table 2 (*continued*)

	Readmitted ≤30 days		Prolonged index admission		Discharge to facility	
	No	Yes	No	Yes	No	Yes
	% (n = 4243)	% (n = 342)	% (n = 4168)	% (n = 417)	% (n = 4279)	% (n = 306)
p	0.002		< 0.001		< 0.001	
Electrolyte disturbance						
No	93.2 (3877)	6.8 (282)	92.5 (3849)	7.5 (310)	94.5 (3932)	5.5 (227)
Yes	86.2 (367)	13.8 (59)	74.9 (319)	25.1 (107)	81.5 (347)	18.5 (79)
p	< 0.001		< 0.001		< 0.001	
High volume facility						
No	90.1 (1690)	9.9 (185)	85.3 (1600)	14.7 (275)	90.0 (1687)	10.0 (188)
Yes	94.2 (2554)	5.8 (157)	94.8 (2568)	5.2 (142)	95.6 (2592)	4.4 (118)
p	< 0.001		< 0.001		< 0.001	
Hospital bed size						
Small	80.4 (90)	19.6 (22)	92.9 (104)	7.1 (8)	94.6 (106)	5.4 (6)
Medium	93.4 (891)	6.6 (63)	91.7 (876)	8.3 (79)	91.1 (870)	8.9 (85)
Large	92.7 (3262)	7.3 (257)	90.6 (3188)	9.4 (331)	93.9 (3303)	6.1 (215)
p	< 0.001		0.426		0.008	
Hospital ownership						
Private, non-profit	92.9 (3298)	7.1 (252)	90.9 (3228)	9.1 (323)	93.2 (3311)	6.8 (240)
Private, investor-owned	84.7 (122)	15.3 (22)	84.7 (122)	15.3 (22)	75.7 (109)	24.3 (35)
Government	92.5 (824)	7.5 (67)	91.8 (818)	8.2 (73)	96.4 (859)	3.6 (32)
p	0.001		0.023		< 0.001	
Teaching hospital						
Metro non-teaching	87.2 (259)	12.8 (38)	92.6 (275)	7.4 (22)	92.3 (274)	7.7 (23)
Metro teaching	92.9 (3978)	7.1 (304)	90.9 (3891)	9.1 (391)	93.5 (4002)	6.5 (280)
Non-metro	100.0 (6)	0.0 (0)	33.3 (2)	66.7 (4)	33.3 (2)	66.7 (4)
p	0.001		< 0.001		< 0.001	
PLOS						
No	93.8 (3908)	6.2 (260)	–	–	96.1 (4005)	3.9 (164)
Yes	80.6 (336)	19.4 (81)	–	–	65.7 (274)	34.3 (143)
p	< 0.001		–		< 0.001	
Disposition to facility						
No	92.8 (3972)	7.2 (307)	93.6 (4005)	6.4 (274)	–	–
Yes	88.9 (272)	11.1 (34)	53.4 (164)	46.6 (143)	–	–
p	0.011		< 0.001		–	

Abbreviations: PLOS-prolonged length of stay.

PLOS was defined to be the top 10% for the cohort, or ≥7 days. Mean and median LOS were 4.63 and 4.00 respectively. Nearly 81% of patients were discharged by postoperative (POD) 5, and 91% by POD 7. In univariate analysis, PLOS was associated with patients ≥80 years old, those with Medicaid or without insurance, sicker as measured by mortality risk and various comorbid conditions, lower volume facilities, and private for-profit hospitals (Table 2). In multivariate analysis, having Medicaid or no insurance, being from out-of-state, having low income, severe loss of function, high Charlson comorbidity score, and discharge to a facility were all independent risk factors for PLOS. A high volume hospital was the only factor independently associated with decreased risk of PLOS (Fig. 2).

Discharge to a facility was associated was more common in older patients, worse functional measures, several comorbidities, care in larger and private for-profit hospitals, as well as those with PLOS in univariate analysis (Table 2). In our logistic regression models, increasing age, lower income, various comorbid conditions, larger hospital sizes, private for-profit hospitals, and PLOS were independently associated with facility discharge (Fig. 3).

In univariate analysis, private investor-owned hospitals were more likely than private non-profit hospitals to have patients of moderate/severe mortality risk (31.2% versus 23.1%), moderate/severe loss of function (26.2% versus 17.3%), and to have patients with Charlson score of ≥1 (37.2% versus 21.0%) (all $p < .001$). Teaching hospitals were more likely to have patients with higher moderate/severe mortality risk (25.2% versus 14.3%) and moderate/severe loss of function (47.0% versus 33.2%) (both $p < .001$) but no difference in Charlson comorbidity scores.

4. Discussion

Herein we present the national landscape of unintended readmission, PLOS, and discharge to a facility following vestibular schwannoma resection. To our knowledge, this is the first report using the NRD to assess PLOS and discharge to a facility, with a scarcity of literature reflective of the nation as a whole examining these outcomes. Multi-institutional data with respect to readmission have been previously reported using the NRD as well as the National Surgical Quality Improvement Program (NSQIP) [10,18].

We found procedure-specific high volume centers (as defined by being in the ≥90th percentile for this cohort) to be independently protective against PLOS and discharge to a facility, but not with unintended readmission. Interestingly, in their analysis of the NRD in acoustic neuroma resection, Babadjouni et al. reported that for each additional 10 cases a center performed, the 30- and 90-day readmission rate was found to decrease by 8% and 6% respectively [18]. While using the same dataset, it is possible that their treatment of hospital volume as a continuous scale and ours as a percentile cutoff contributed to differing statistical results. Our regrouping of certain variables in our logistic regression models and exclusion criteria may also have played a

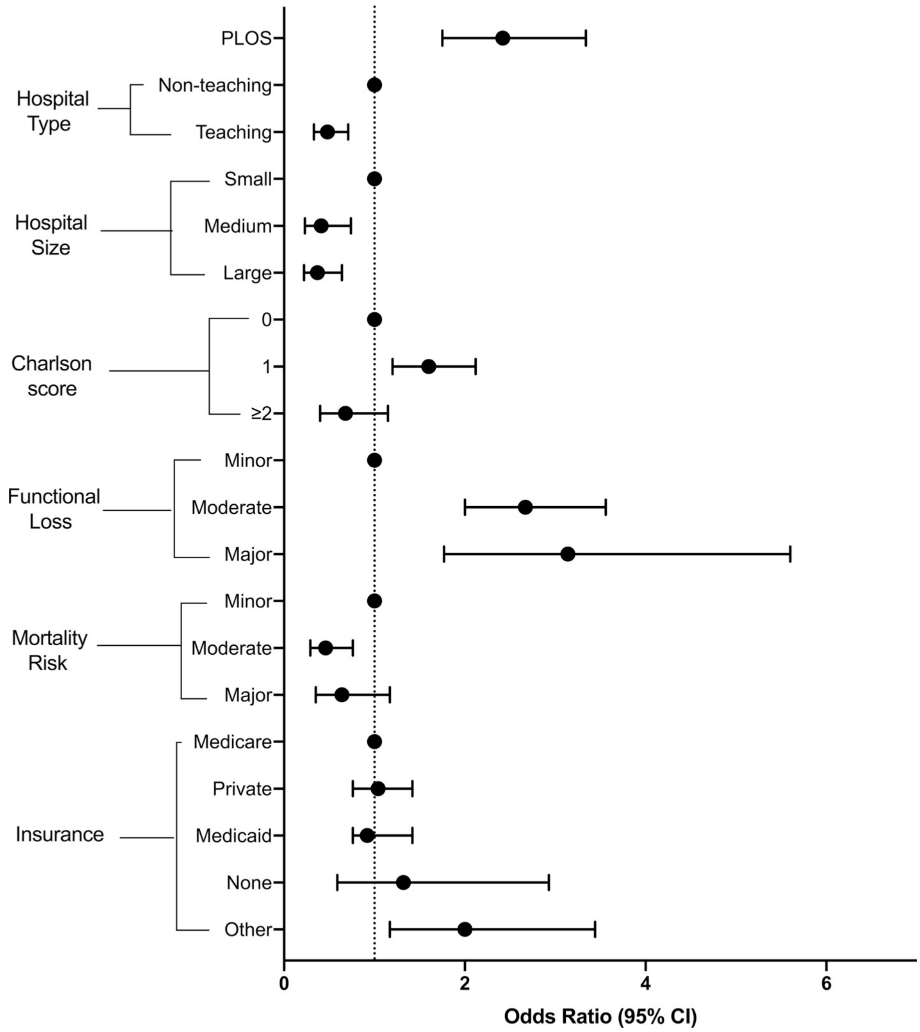

Fig. 1. Forest plot depicting factors independently associated with unintended 30-day readmission. A vertical line marks an odds ratio of 1. Abbreviations: PLOS-prolonged length of stay, CI-confidence interval.

role. As microsurgical resection of a vestibular schwannoma is a highly complex procedure requiring a skilled multidisciplinary team of physicians, technicians, operating room staff, and neurointensivists, it is possible that there are more streamlined protocols for postoperative care, more equipped intensive care units, and more resources devoted toward those patients [19]. As a result, routine discharges, shorter LOS, and other quality measures have been reported using the California Hospital Inpatient Discharge Databases [20], Nationwide Inpatient Sample [21], Maryland Health Service Cost Review Commission [22], and California Hospital Discharge Database [23] for higher volume hospitals as well as providers. Unfortunately, the NRD is unable to track specific providers, but with fewer surgical complications in higher volume providers [21], shorter hospital stays and more routine discharges would be expected.

In addition to procedure-specific hospital volume, other hospital factors such as whether the facility was a teaching hospital or whether it was non-profit were risk factors for suboptimal outcomes. Specifically, non-teaching hospitals had significantly higher readmission rates despite having lower acuity patients, and private investor-owned hospitals were more likely to have discharges to a facility likely due to higher indices of disease severity. In the literature, teaching hospitals have been found to have lower cost hospitalizations for vestibular schwannoma surgery [1] but have not been found to play a role in discharge destination [21]. A large study of the Veterans Affairs (VA) NSQIP of multiple surgical specialties including otolaryngology and neurosurgery comparing outcomes in teaching and non-teaching cases showed that unadjusted mortality rates were not significantly different between the two groups, nor were unadjusted morbidity rates in six of seven subspecialties analyzed [24]. Teaching hospitals have been found to have equivalent or superior outcomes for a variety of medical and surgical conditions spanning pediatric and adult populations in nationwide samples [25–27]. The decision of whether to discharge a patient to home with or without services versus an inpatient rehabilitation facility is often a nuanced choice and often depends on local practice patterns, anticipated and actual patient recovery, and patient factors such as social support, insurance status, and age [28]. While the NRD does not track patient social support, we did find older age and lower income to be associated with discharge to a facility. It is possible that patients with less financial resources are unable to rehabilitate at home or that insurance type will dictate certain patterns based on

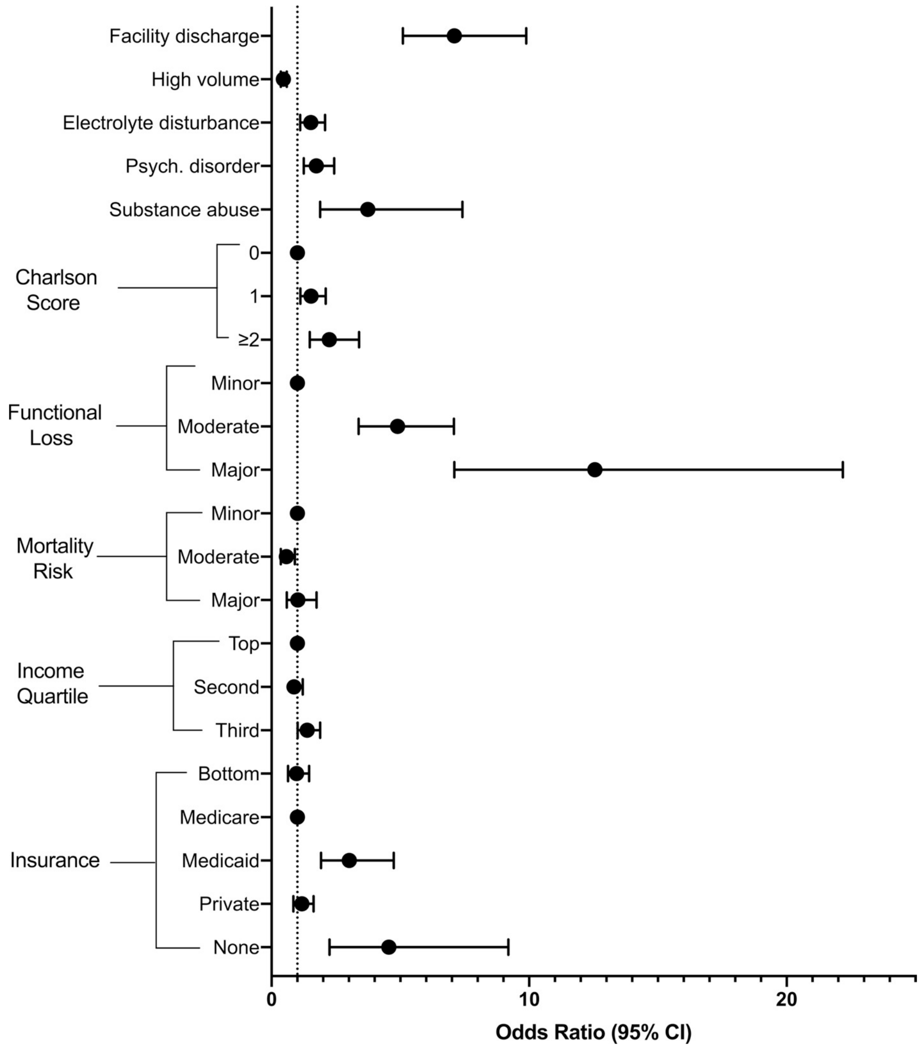

Fig. 2. Forest plot depicting factors independently associated with prolonged length of stay. A vertical line marks an odds ratio of 1. Abbreviations: Psych-psychiatric, CI-confidence interval.

reimbursement rates.

A significant independent cofactor in unintended readmission and PLOS after vestibular schwannoma surgery was disease severity in the way of functional loss. While we could not adjust for tumor size or specific types of disability, patients with larger tumors, cranial neuropathies, and general debility would be expected to have a more protracted hospital course postoperatively or return to the hospital for medical optimization. It is interesting to note, however, that disease severity did not correlate with discharge to a facility. In Samii et al.'s analysis of elderly patients undergoing lateral suboccipital craniotomy for vestibular schwannoma resection, they noted preoperative capacity for self-care as measured by Karnofsky score to be an important determinant of outcome, with low Karnofsky scores associated with worse postoperative outcomes [29]. With an increasing number of acoustic schwannomas being found in older patients [3], functional status should be an important factor in surgical decision making and goals of care. While only comprising 0.9% of our cohort, patients ≥80 years of age were at higher risk of PLOS and facility discharge in univariate analysis.

There are several limitations to this study, some of which are inherent to performing a retrospective analysis of national data. Due to lack of availability in the database, important variables such as tumor size, surgical approach, and individual surgeon volume could not be adjusted for; these factors have been shown to affect postoperative functional outcomes after vestibular schwannoma resection [21,30]. Additionally, timing of various complications, readmission, and postoperative visits would be informative. While unlikely to be a significant source of underestimation, patients cannot be tracked as readmissions if they are readmitted in a different state than their index admission; this is due to the creation of unique identifiers in each state [18]. Finally, this dataset is generated from discharge summaries and therefore subject to inappropriate or incorrect documentation and coding.

In analyzing over 4500 microsurgical resections of vestibular schwannomas in the United States over a two year period, we have identified several factors associated with readmission, PLOS, and discharge to a facility. Further research is needed to determine targeted interventions for reducing these outcomes in this population.

Support/funding

None.

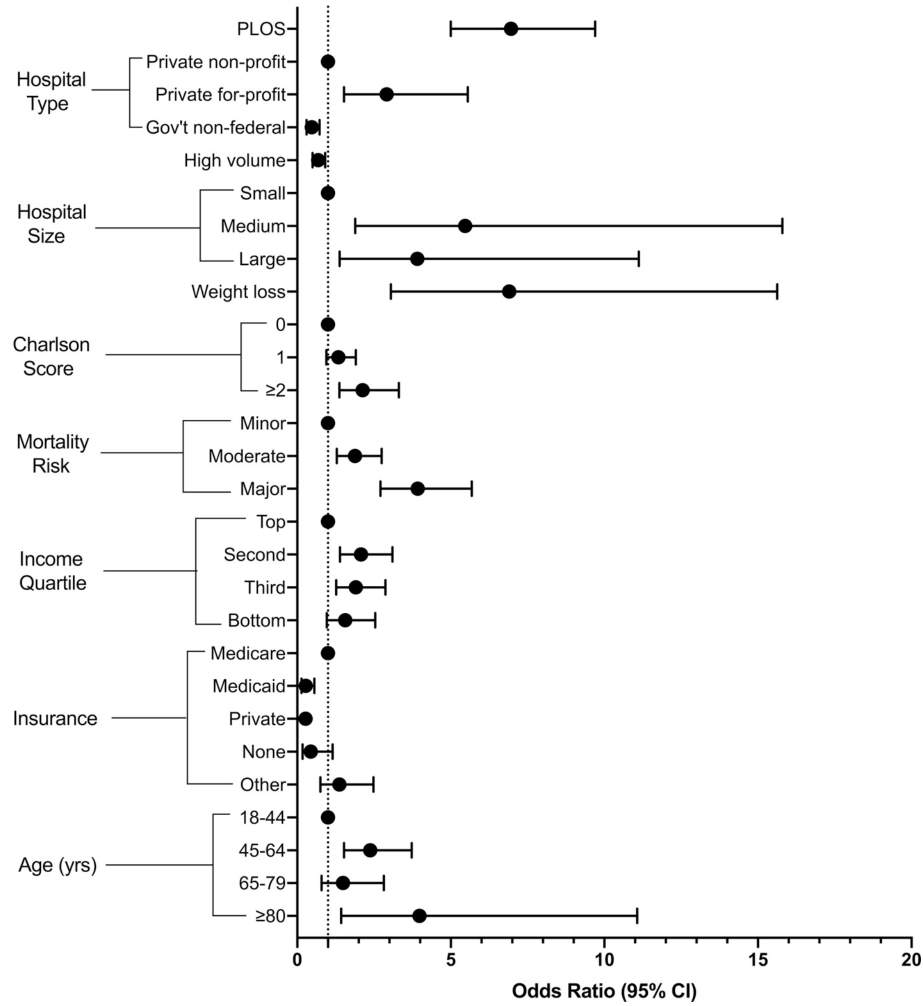

Fig. 3. Forest plot depicting factors independently associated with discharge to a facility. A vertical line marks an odds ratio of 1. Abbreviations: PLOS-prolonged length of stay, Gov't-government, yrs-years, CI-confidence interval.

Declaration of competing interest

Dr. George Wanna is a surgical advisory board member for Oticon, MedEl and a consultant for Med El, Cochlear, and Advanced Bionics. Dr. Maura Cosetti has received travel grants from MedEl, Cochlear, and Stryker, educational research grants from Advanced Bionics, and performs clinical research with Advanced Bionics, Cochlear, and Otonomy. The authors do not believe these relationships present a conflict of interest with respect to this original report.

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