Discharge destination and readmissions among patients with head and neck cancer

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Abstract
Objective: Lowering hospital readmission rates is a national goal, and presents an opportunity to lower health care costs, improve quality, and increase patient satisfaction. We aim to assess whether discharge disposition is associated with readmission.

Methods: A retrospective cohort study using logistic regression to quantify risk factors of hospital readmission in patients with confirmed head and neck cancer (HNC) who underwent surgery from 2010 to 2018 contained in the Pennsylvania Health Care Cost Containment Council database, which includes patients treated in Pennsylvania hospitals.

Results: The readmission rate in this study was 18.1%. Cancers of the hypopharynx had the highest rates of readmission (29.2%). Male sex (odds ratio [OR]: 0.87, 95% CI: 0.75–1.00), emergent admission (vs. elective admission: OR = 1.33, 95% CI: 1.02–1.74), discharge to home health (vs. home: OR = 1.85, 95% CI: 1.59–2.16), discharge to skilled nursing facility (SNF) (vs. home: OR = 2.21, 95% CI: 1.80–2.72), and having 4+ comorbidities (vs. 0–1: OR = 1.39, 95% CI: 1.09–1.76) were significant risk factors for hospital readmission.

Conclusion: It is necessary to consider the readmission risk associated with HNC patients. Reasons for readmission are multifactorial and can be related to demographics, hospital course, comorbidities, or discharge disposition—this requires further assessment. There is importance in increasing HNC awareness and staff education about the unique needs of this population.

Level of Evidence: 4.

KEYWORDS
clinical research, head and neck, otolaryngology, readmissions, skilled nursing facilities

INTRODUCTION

Unplanned hospital readmissions are a concern due to the costly impact on the patient and the hospital, as well as their negative impact.
on patient outcomes. Accordingly, hospital readmission rates have become a focal point in the assessment of the quality and cost effectiveness of hospital care delivery. Policies have been implemented to limit the number of hospital readmissions. This is true even at the federal level with the establishment of the Hospital Readmissions Reduction Program (HRRP) by the Affordable Healthcare Act. The HRRP reduces reimbursements for hospitals with excess patient readmissions. Initially the HHRP focused on three conditions: myocardial infarction, heart failure, and pneumonia, but has now broadened its scope to include surgical patients (i.e., hip and knee arthroplasty patients). Continued expansion of this program to include further conditions and procedures is anticipated.

Head and neck cancer (HNC) patients are seen as a high-risk population for readmissions, with reported readmission rates ranging from 5.1% to 19.8% and the majority occurring within the first ten days following discharge. Predictors of readmission in this population include various comorbidities, length of stay, wound infections or dehiscence, lower socioeconomic status (SES), inclusion of a reconstructive procedure, and the presence of a total laryngectomy. The cancer site also influences 30-day readmission rates with cancers of the oropharynx, hypopharynx or larynx associated with higher rates of readmission. Several studies have shown that these readmissions occur due to an unmet need for increased supportive care at discharge.

Rehabilitation facilities and skilled nursing facilities (SNFs) are a frequently utilized resource when patients require increased supportive care following a hospital admission. While these facilities are well equipped to provide general rehabilitation for various conditions, HNC patients have unique rehabilitation needs. Specifically, HNC and its treatment can cause significant deficits in a patient's ability to speak and swallow, putting the patient at risk for various related complications if therapy to address these issues is not made a priority during rehabilitation.

Previous literature from other surgical fields has identified discharge to SNF as a risk factor for hospital readmission. One study noted that those who were discharged to SNFs after colectomy were found to have higher rates of readmission compared to patients discharged elsewhere even after controlling for illness severity. Another study found that patients who underwent total knee arthroplasty and were discharged to a postacute care facility, including SNFs and inpatient rehabilitation facilities, had higher rates of unplanned readmissions and infectious complications than patients discharged to home.

The objective of the present study is to investigate the relationship between patient discharge disposition following HNC surgery and risk of readmission. Additionally, this study investigated the association between readmission rate and timing of discharge (weekday vs. weekend). In order to identify the most appropriate discharge disposition for each individual patient, physicians must take several factors into consideration including medical complexity, insurance, social needs, and patient preference. This study will ultimately clarify the influence of the discharge disposition of HNC patients on the rate of hospital readmission.

## 2 MATERIALS AND METHODS

### 2.1 Data source

Data for this analysis were from the Pennsylvania Health Care Cost Containment Council (PHC4). PHC4 is an independent state agency that was established to address increasing health care costs and to engage in public reporting of hospital and healthcare provider performance in Pennsylvania. Hospitals and freestanding surgical facilities are required to submit administrative discharge data for all inpatient and ambulatory surgery procedures to PHC4, who then makes this data available for research. The data used are publicly available and de-identified. As such, this study was deemed exempt from the Penn State College of Medicine Institutional Review Board review.

### 2.2 Study cohort

Our study cohort included all patients admitted to a hospital in Pennsylvania between 2010 and 2018 contained in the PHC4 database who underwent a procedure for HNC. HNC procedures were defined using a primary or secondary International Classification of Disease-9th Revision-Clinical Modification (ICD-9-CM) or International Classification of Disease-10th Revision-Clinical Modification (ICD-10-CM) diagnosis codes (Appendix A) (Table A1). In addition, participants were required to have a primary procedure as defined by ICD-9-CM procedure or International Classification of Diseases 10th Revision Procedure Coding System (ICD-10-PCS) codes (Appendix B) (Table B1). Because the focus of this study was unplanned readmissions, we excluded all patients with a discharge status that included a planned readmission. The final sample included 7020 unique admissions.

### 2.3 Outcome measures

Our primary outcome of interest was inpatient readmission within 30 days of discharge for any reason. PHC4 data include all readmissions to other Pennsylvania hospitals, even if the readmission hospital differed from the index hospital. However, readmissions to hospitals outside of Pennsylvania were not included secondary to the database being limited to Pennsylvania hospitals. Readmissions included all-cause readmissions, and the reasons for readmissions were categorized by primary diagnosis at the time of readmission.

### 2.4 Covariates

There were two covariates of primary interest: whether the patient was discharged to a SNF, and whether the patient was discharged during a weekend. Weekend discharge was defined as Friday through Sunday. In addition, we controlled for several other patient, disease,
| Variable            | Discharged elsewhere (N = 6027) | Discharged to SNF (N = 1013) | Difference | 95% Confidence Lower | Upper |
|---------------------|----------------------------------|------------------------------|------------|----------------------|-------|
| Age                 | 62.4                             | 68.9                         | -6.50      | -7.33                | -5.67 |
| 18–54               | 25.9%                            | 11.6%                        | 14.3%      | 12.0%                | 16.6% |
| 55–64               | 32.3%                            | 28.1%                        | 4.2%       | 1.2%                 | 7.2%  |
| 65–74               | 26.5%                            | 29.7%                        | -3.3%      | -6.3%                | -0.2% |
| 75+                 | 17.4%                            | 32.8%                        | -15.3%     | -18.4%               | -12.3%|
| Sex                 |                                  |                              |            |                      |       |
| Male                | 68.8%                            | 65.0%                        | 3.8%       | 0.7%                 | 7.0%  |
| Female              | 31.2%                            | 35.0%                        | -3.8%      | -7.0%                | -0.7% |
| Race/ethnicity      |                                  |                              |            |                      |       |
| White non-Hispanic  | 86.9%                            | 82.0%                        | 4.8%       | 2.3%                 | 7.3%  |
| Black non-Hispanic  | 6.7%                             | 10.2%                        | -3.4%      | -5.4%                | -1.5% |
| Hispanic and other  | 6.4%                             | 7.8%                         | -1.4%      | -3.2%                | 0.4%  |
| Payer               |                                  |                              |            |                      |       |
| Medicare            | 44.5%                            | 63.4%                        | -18.9%     | -22.1%               | -15.6%|
| Medicaid            | 11.6%                            | 17.2%                        | -5.6%      | -8.1%                | -3.1% |
| Commercial          | 42.2%                            | 18.0%                        | 24.3%      | 21.6%                | 26.9% |
| Other               | 1.6%                             | 1.3%                         | 0.4%       | -0.4%                | 1.1%  |
| Admission type      |                                  |                              |            |                      |       |
| Elective            | 89.3%                            | 80.3%                        | 9.0%       | 6.5%                 | 11.6% |
| Urgent              | 6.8%                             | 9.5%                         | -2.7%      | -4.6%                | -0.8% |
| Emergent            | 3.9%                             | 10.3%                        | -6.3%      | -8.3%                | -4.4% |
| Transfer            |                                  |                              |            |                      |       |
| No                  | 99.2%                            | 96.9%                        | 2.3%       | 1.2%                 | 3.4%  |
| Yes                 | 0.8%                             | 3.1%                         | -2.3%      | -3.4%                | -1.2% |
| Discharge Destination|                                 |                              |            |                      |       |
| Home                | 55.8%                            | 0.0%                         | 55.8%      | 54.5%                | 57.0% |
| Home health         | 43.2%                            | 0.0%                         | 43.2%      | 41.9%                | 44.4% |
| SNF                 | 0.0%                             | 100.0%                       | -100.0%    | -100.0%              | -100.0%|
| Other               | 1.0%                             | 0.0%                         | 1.0%       | 0.8%                 | 1.3%  |
| Admission timing    |                                  |                              |            |                      |       |
| Weekday             | 81.5%                            | 81.9%                        | -0.5%      | -3.0%                | 2.1%  |
| Weekend             | 18.5%                            | 18.1%                        | 0.5%       | -2.1%                | 3.0%  |
| Discharge timing    |                                  |                              |            |                      |       |
| Weekday             | 42.0%                            | 28.0%                        | 13.9%      | 17.0%                | 10.9% |
| Weekend             | 58.0%                            | 72.0%                        | -13.9%     | -17.0%               | -10.9%|
| Charlson Comorbidity Index | 1.9 | 2.3 | -0.38 | -0.45 | -0.32 |
| 0–1                 | 37.3%                            | 24.0%                        | 13.3%      | 10.4%                | 16.2% |
| 2–3                 | 56.5%                            | 61.8%                        | -5.3%      | -8.5%                | -2.0% |
| 4+                  | 6.2%                             | 14.2%                        | -8.0%      | -10.3%               | -5.8% |
| Flap reconstruction |                                  |                              |            |                      |       |
| No                  | 81.6%                            | 71.2%                        | 10.4%      | 7.5%                 | 13.4% |
| Yes                 | 18.4%                            | 28.8%                        | -10.4%     | -13.4%               | -7.5% |
| Tracheostomy        |                                  |                              |            |                      |       |
| No                  | 78.4%                            | 44.2%                        | 34.2%      | 31.0%                | 37.4% |
| Yes                 | 21.6%                            | 55.8%                        | -34.2%     | -37.4%               | -31.0%|

(Continues)
and hospital characteristics that may confound the relationship between discharge location and destination and readmission risk. We also considered length of stay. Patient characteristics that were controlled in multivariable analyses included age, sex, race/ethnicity, and primary payer. Patient comorbidities were controlled using the Deyo adaptation of the Charlson comorbidity index (CCI).\textsuperscript{14,15} We controlled for urgency of the admission (elective, urgent, emergent), and whether the patient was transferred from another hospital. Flap reconstruction was identified using ICD-9-CM procedure codes and ICD-10-PCD codes; details are contained in Appendix C (Table C1). Finally, we controlled for site of disease. Postoperative complications were not included in this analysis.

2.5 | Statistical analysis

The statistical analysis was designed to estimate the association between both discharge destination—discharge to a SNF and discharge timing (weekend vs. midweek discharge) in particular—on readmission. Comparisons were made between patients who were readmitted and those who were not using Student’s t test for continuous variables and chi-square tests for binary and categorical variables. A multivariable model of readmission was fit using logistic regression with readmission as the dependent variable and independent variables consisting of the patient and disease characteristics described above. Results are presented as odds ratios, along with 95% confidence intervals and associated p-values. Because univariate comparisons suggested some covariate imbalance between patients discharged to a SNF and patients discharged elsewhere, we performed a propensity score matching analysis to control for the imbalanced covariates. This technique controls for observable potential confounders by selecting controls from among patients not discharged to a SNF who have the same distribution of characteristics as patients discharged to a SNF. Therefore, this should control for differences between groups observed in Table 1. The propensity score was estimated from fitted values of a logistic regression of SNF discharge on patient and disease characteristics, and matching was performed on the propensity score 1:1 without replacement using a k-nearest neighbor approach and the usual (i.e., 0.2 SD) caliper restriction. The primary outcome of the propensity score analysis was the average effect of treatment on the treated (ATT), which represents the difference in outcome (readmission rate and length of stay) had patients discharged to a SNF been discharged elsewhere.

As a sensitivity analysis, we repeated the propensity score analysis for stratifications on two variables: urgency of admission and site of disease. The ATT was computed for patients admitted on an elective, urgent, and emergent bases, as well as for patients with disease of the oropharynx, oral cavity, larynx, and other sites. All analyses were performed using Stata software (version 14, College Station, TX).

3 | RESULTS

Among the 7020 patients identified in this study, the overall readmission rate was 18.1%. Trending over time, patients discharged to a SNF had consistently higher rates of readmission than patients discharged elsewhere, though the increase for both groups was not statistically significant. When assessing trends in rates of discharge to SNF between 2010 and 2018 a statistically significant increase was observed. Characteristics of patients, stratified by readmission, are presented in Table 2. As compared to patients who were not readmitted, patients who were readmitted were of similar age but were significantly more likely to be male (73.1% vs. 67.2%, \( p < .001 \)).
| Variable                     | Not readmitted (N = 5747) | Readmitted (N = 1273) | Difference | 95% confidence | Lower  | Upper  |
|-----------------------------|---------------------------|-----------------------|------------|----------------|--------|--------|
| Age                         | 63.4                      | 63.3                  | 11.7%      | −0.65          | 0.89   |
| 18–54                       | 24.1%                     | 23.0%                 | 1.0%       | −1.5%          | 3.6%   |
| 55–64                       | 31.5%                     | 32.8%                 | −1.3%      | −4.2%          | 1.5%   |
| 65–74                       | 26.5%                     | 28.7%                 | −2.1%      | −4.9%          | 0.6%   |
| 75+                         | 20.1%                     | 17.4%                 | 2.7%       | 0.4%           | 5.0%   |
| Sex                         |                           |                       |            |                |        |        |
| Male                        | 67.2%                     | 73.1%                 | −5.9%      | −8.6%          | −3.2%  |
| Female                      | 32.8%                     | 26.9%                 | 5.9%       | 3.2%           | 8.6%   |
| Race/ethnicity              |                           |                       |            |                |        |        |
| White non-Hispanic          | 86.2%                     | 85.9%                 | 0.3%       | −1.8%          | 2.4%   |
| Black non-Hispanic          | 7.0%                      | 8.2%                  | −1.2%      | −2.8%          | 0.5%   |
| Hispanic and other          | 6.8%                      | 5.9%                  | 0.9%       | −0.6%          | 2.3%   |
| Payer                       |                           |                       |            |                |        |        |
| Medicare                    | 47.0%                     | 48.4%                 | −1.4%      | −4.4%          | 1.6%   |
| Medicaid                    | 12.2%                     | 13.4%                 | −1.2%      | −3.2%          | 0.9%   |
| Commercial                  | 39.1%                     | 36.9%                 | 2.2%       | −0.7%          | 5.1%   |
| Other                       | 1.7%                      | 1.3%                  | 0.3%       | −0.4%          | 1.0%   |
| Admission type              |                           |                       |            |                |        |        |
| Elective                    | 88.8%                     | 84.4%                 | 4.4%       | 2.3%           | 6.6%   |
| Urgent                      | 7.1%                      | 7.4%                  | −0.3%      | −1.9%          | 1.3%   |
| Emergent                    | 4.1%                      | 8.2%                  | −4.2%      | −5.8%          | −2.6%  |
| Transfer                    |                           |                       |            |                |        |        |
| No                          | 99.1%                     | 98.0%                 | 1.1%       | 2.0%           | 0.3%   |
| Yes                         | 0.9%                      | 2.0%                  | −1.1%      | −2.0%          | −0.3%  |
| Discharge destination       |                           |                       |            |                |        |        |
| Home                        | 51.3%                     | 31.5%                 | 19.8%      | 17.0%          | 22.7%  |
| Home health                 | 34.8%                     | 46.7%                 | −11.9%     | −14.9%         | −8.9%  |
| SNF                         | 12.9%                     | 21.2%                 | −8.3%      | −10.7%         | −5.9%  |
| Other                       | 0.9%                      | 0.6%                  | 0.3%       | −0.2%          | 0.8%   |
| Admission timing            |                           |                       |            |                |        |        |
| Weekday                     | 82.8%                     | 75.6%                 | 7.2%       | 9.7%           | 4.6%   |
| Weekend                     | 17.2%                     | 24.4%                 | −7.2%      | −9.7%          | −4.6%  |
| Discharge timing            |                           |                       |            |                |        |        |
| Weekend                     | 41.4%                     | 33.5%                 | 7.9%       | 10.8%          | 5.0%   |
| Weekday                     | 58.6%                     | 66.5%                 | −7.9%      | −10.8%         | −5.0%  |
| Charlson Comorbidity Index  | 1.9                       | 2.1                   | −0.19      | −0.25          | −0.13  |
| 0–1                         | 36.5%                     | 30.1%                 | 6.5%       | 3.6%           | 9.3%   |
| 2–3                         | 56.8%                     | 59.5%                 | −2.7%      | −5.7%          | 0.2%   |
| 4+                          | 6.7%                      | 10.4%                 | −3.7%      | −5.5%          | −1.9%  |
| Flap reconstruction         |                           |                       |            |                |        |        |
| No                          | 79.5%                     | 82.8%                 | −3.3%      | −1.0%          | −5.6%  |
| Yes                         | 20.5%                     | 17.2%                 | 3.3%       | 1.0%           | 5.6%   |
| Tracheostomy                |                           |                       |            |                |        |        |
| No                          | 75.0%                     | 66.8%                 | 8.1%       | 10.9%          | 5.3%   |

(Continues)
Patients who were readmitted were more likely to have been discharged to a SNF or with home health (21.2% vs. 12.9%, \( p < .001 \) and 46.7% vs. 34.8%, \( p < .001 \), respectively), less likely to have undergone flap reconstruction (17.2% vs. 20.5%, \( p = .004 \)), and more likely to have received a tracheotomy (33.2% vs. 25.0%, \( p < .001 \)). Table 2 also presents site of disease stratified by readmission with noted differences. Overall, there were more cases of cancer of the oropharynx (1439; 20.5%), larynx (1102; 15.7%), oral cavity (1190; 16.9%), and tongue (1237; 17.6%). The highest rates of readmission were among patients with cancers of the hypopharynx (29.2%), while patients with disease of the nasal cavity/middle ear/accessory sinus and salivary gland had the lowest readmission rates.

As seen in Figure 1, most patients were readmitted with a primary diagnosis code for cancer, referred to as cancer care (29.2%). Specifically, cancer care was counted if the principal ICD-9 diagnosis was 140.XX-149.XX (malignant neoplasm of lip, oral cavity, and pharynx) or 161.XX (malignant neoplasm of larynx), or an equivalent ICD-10 diagnosis according to Medicare’s general equivalence mapping of ICD-9 to ICD-10 codes. Readmissions were also common for infection
TABLE 3 Results of multivariable model predicting 30-day readmission for patients with head and neck cancer

| Variable                  | Odds Ratio | 95% Confidence Lower | 95% Confidence Upper | p value |
|---------------------------|------------|----------------------|----------------------|---------|
| **Age**                   |            |                      |                      |         |
| 18–49 Reference           |            |                      |                      |         |
| 50–59                     | 0.944      | 0.800                | 1.115                | .498    |
| 60–69                     | 0.996      | 0.801                | 1.238                | .972    |
| 70+                       | 0.931      | 0.731                | 1.185                | .561    |
| **Sex**                   |            |                      |                      |         |
| Male Reference            | 0.866      | 0.750                | 1.000                | .05     |
| Female                    |            |                      |                      |         |
| **Race/ethnicity**        |            |                      |                      |         |
| White non-Hispanic Reference | 1.022 | 0.804                | 1.299                | .859    |
| Black non-Hispanic        | 0.854      | 0.655                | 1.113                | .243    |
| Hispanic and other        |            |                      |                      |         |
| **Payer**                 |            |                      |                      |         |
| Medicare Reference        |            |                      |                      |         |
| Medicaid                  | 0.866      | 0.682                | 1.100                | .239    |
| Commercial                | 0.938      | 0.781                | 1.127                | .494    |
| Other                     | 0.744      | 0.427                | 1.297                | .297    |
| **Admission type**        |            |                      |                      |         |
| Elective Reference        |            |                      |                      |         |
| Urgent                    | 0.990      | 0.772                | 1.268                | .934    |
| Emergent                  | 1.334      | 1.021                | 1.743                | <.0001  |
| **Transfer**              |            |                      |                      |         |
| No Reference              | 1.513      | 0.906                | 2.528                | .114    |
| Yes                       |            |                      |                      |         |
| **Discharge destination** |            |                      |                      |         |
| Home Reference            |            |                      |                      |         |
| Home health                | 1.850      | 1.586                | 2.158                | <.0001  |
| SNF                       | 2.213      | 1.800                | 2.720                | <.0001  |
| Other                     | 0.886      | 0.411                | 1.907                | .756    |
| **Admission timing**      |            |                      |                      |         |
| Weekday Reference         |            |                      |                      |         |
| Weekend                   | 1.420      | 1.219                | 1.655                | 0       |
| **Discharge timing**      |            |                      |                      |         |
| Weekday Reference         |            |                      |                      |         |
| Weekend                   | 0.785      | 0.687                | 0.897                | 0       |
| **Charlson comorbidity index** | 1.075 | 0.934                | 1.238                | .312    |
| 0–1                       |            |                      |                      |         |
| 2–3                       | 1.075      | 0.934                | 1.238                | .312    |
| 4+                        | 1.385      | 1.087                | 1.763                | .008    |
| **Site**                  |            |                      |                      |         |
| Oropharynx Reference      |            |                      |                      |         |
| Hypopharynx               | 1.001      | 0.701                | 1.430                | .995    |

(Continues)
tracheotomy placement was associated with 3.3 \( p < .001 \) additional days, and gastrotomy tube was associated with 1.3 \( p < .001 \) additional days of hospitalization. The largest association with length of stay was discharge to SNF, which was associated with over five days longer length of stay \( p < .001 \).

Propensity score matching found adequate matches for 979 out of the total 1013 patients discharged to SNF, yielding a matched sample of 1958 patients in the propensity score analysis. After matching, readmission rates were 26.5% for patients discharged to a SNF compared to 19.1% for patients discharged elsewhere, yielding a difference (i.e., ATT) of 7.4% \( p < .001 \). A sensitivity analysis is presented in Figure 2, which shows that the ATT was similar to the overall estimate for patients admitted on an elective basis, but patients admitted on an urgent or emergent basis had lower risk of readmission after matching on propensity to be discharged to a SNF. There was also some variability in ATT across disease site, with highest rates of readmission among patients with disease of the oral cavity and larynx, while patients with disease of the oropharynx and other sites were readmitted at rates that were not significant after matching on propensity to be discharged to a SNF.

4 | DISCUSSION

In recent years, there have been widespread efforts to reduce unplanned hospital readmissions throughout the United States. Hospital readmission rates have been recognized as a readily measurable

| Variable | Coefficient | Lower | Upper | \( p \) value |
|----------|-------------|-------|-------|-------------|
| Larynx   | 2.534       | 2.110 | 2.957 | <.0001      |
| Nasal cavity | 0.364       | 0.950 | 1.678 | .588        |
| Nasopharynx | 1.188       | 0.313 | 2.688 | .121        |
| Oral cavity | 1.254       | 0.823 | 1.685 | <.0001      |
| Salivary gland | 0.634       | 1.159 | 2.036 | <.0001      |
| Skin     | 0.167       | 0.830 | 0.496 | .622        |
| Tongue   | 0.369       | 0.049 | 0.786 | .084        |
| Other    | 0.629       | 0.073 | 1.185 | .027        |

| Flap reconstruction | Coefficient | Lower | Upper | \( p \) value |
|---------------------|-------------|-------|-------|-------------|
| No                  | Reference   | 1.417 | 1.079 | 1.754       | <.0001      |
| Yes                 | 3.259       | 2.922 | 3.597 | <.0001      |

| Gastrostomy tube | Coefficient | Lower | Upper | \( p \) value |
|-----------------|-------------|-------|-------|-------------|
| No              | Reference   | 1.289 | 0.822 | 1.756       | <.0001      |
| Yes             | 1.723       | 1.192 | 2.253 | <.0001      |

\( p < .001 \), tracheotomy placement was associated with 3.3 \( p < .001 \) additional days, and gastrotomy tube was associated with 1.3 \( p < .001 \) additional days of hospitalization. The largest association with length of stay was discharge to SNF, which was associated with over five days longer length of stay \( p < .001 \).

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| Tongue   | 0.369       | 0.049 | 0.786 | .084        |
| Other    | 0.629       | 0.073 | 1.185 | .027        |

| Flap reconstruction | Coefficient | Lower | Upper | \( p \) value |
|---------------------|-------------|-------|-------|-------------|
| No                  | Reference   | 1.417 | 1.079 | 1.754       | <.0001      |
| Yes                 | 3.259       | 2.922 | 3.597 | <.0001      |

| Gastrostomy tube | Coefficient | Lower | Upper | \( p \) value |
|-----------------|-------------|-------|-------|-------------|
| No              | Reference   | 1.289 | 0.822 | 1.756       | <.0001      |
| Yes             | 1.723       | 1.192 | 2.253 | <.0001      |
and standardized metric for quality of healthcare delivery. As such, rates can be tracked nationally to identify system deficiencies and enact financial penalties to incentivize quality improvement. Prior studies investigating readmission rates in HNC patients report a wide range of 5.1% to 19.8%. The variability of readmission rates is likely due to the heterogeneity of HNC patients including variation in cancer location, disease severity, and selection of treatment. Differences in research methodology such as definition of readmission or data collection techniques may also increase variability in reported readmission rates. The rate of readmission for the present study was 18.1%, which is higher than most previous studies. While other studies define readmission as a patient returning to the index institution, our statewide data set is able to identify readmission to any institution within the state. This provides a more accurate picture when using readmission rate to identify gaps in quality of care and explains why the rate in this study is higher than previously reported.

It has been shown that site of the cancer influences the 30-day unplanned readmission rate. Prior studies showed that cancers in the oropharynx, hypopharynx or larynx are more likely to result in readmission. The present study found similar results, with the highest rate of readmission in the hypopharynx, followed by the larynx and oropharynx. This likely reflects the more complex surgery required for patients with disease of the hypopharynx and larynx as well as the anticipated functional deficits associated with surgery in this area.

Timing of hospital discharge may also affect the likelihood of readmission. In the hospital setting, Friday is the most common day for discharge. This may be due to patient preference of being home on weekends, or shortage of hospital staff on the weekends. It has been hypothesized that the quantity of discharges on Fridays may lead to less detailed discharge instructions from hospital staff. Other studies have found that discharge on a weekend was less likely to be readmitted compared to those discharged on a weekday. Although staff may be limited on weekends, it appears not to correlate with an increased rate of readmission. It is possible that increased family member availability may be an important factor in the reduced readmission rate on weekends. With greater support during the transition, communication regarding patient education and follow up care may be more effective.

The HNC population has unique care needs including airway management, nutritional needs, speech, and swallowing therapy, and wound care. Rehabilitation complications depend upon the extent of the treatment and severity of dysfunction. In addition, if a flap is used, it is insensate and immobile on its own, which can further contribute to dysphagia issues. These difficulties are unique from dysphagia secondary to stroke or a neurological disease and as such, require different treatment. This study found that patients who were readmitted were less likely to have undergone flap reconstruction. Although it may be expected that case complexity would show a positive correlation with complication and readmission rates, other factors such as length of stay and timing of complications may substantially influence this relationship. The inclusion of flap reconstruction in a patient's surgical care is associated with an increased length of stay. Additionally, previous literature has shown that the majority of complications occur during a patient's hospitalization including flap failures that require a return to the OR. It should be noted that there is a limitation in using ICD10 for delineating free flap from local skin graft. This could have influenced the reported findings.

One study in Portugal found a prevalence of only 3.36% of patients in SNFs with a tracheotomy, suggesting that SNFs may not be accustomed to managing these patients. The current study showed patients who were readmitted were more likely to have received a tracheotomy or gastrostomy tube. Tracheotomy and gastrostomy tubes are associated with a longer length of stay due to the amount of planning involved, and they continue to require increased levels of care after discharge. In fact, the outpatient
complication rate for patients with tracheotomies is reported to be 15%, with 13% of patients being readmitted for tracheotomy care. Increased length of stay for patients with a tracheotomy or gastrostomy is likely multifactorial as placement of these devices requires multidisciplinary coordination, postprocedure monitoring, thorough education of patients and caregivers, and may complicate discharge planning.

Because of their unique needs, HNC patients are discharged to SNFs at a higher rate than other patients. In accordance with other studies, we found that each year more patients are discharged to a SNF. In the United States, about 3% of all cancers are HNCs. Because of this relatively low prevalence, nurses and caretakers are likely to have less experience in taking care of these patients. This unfamiliarity could possibly lead to readmissions. Goel et al. assessed discharge locations for HNC patients who specifically underwent flap reconstructions. It was discovered that patients who were discharged to home with home health or discharged to a nursing facility had higher rates of readmission when compared to a routine discharge. The present study shows that patients discharged to SNFs are also more likely to be readmitted than patients who are discharged directly home, regardless of preexisting comorbidities. This is in accordance with previous literature from other surgical specialties. However, it should be noted that the use of CCI to control for comorbidities is limited in that it utilizes only four categories and while it is still a useful tool for assessing preexisting comorbidities, it does not account for surgical or medical complications that arise during a patient's hospitalization. This limits the accuracy of propensity score matching.

However, another study that investigated the impact of discharge location in an orthopedic patient population, found different results. For patients undergoing elective spinal surgery, the readmission rate was lower after discharge to a rehabilitation facility. The differences between studies could be related to the fact that patients in the spinal surgery study underwent elective surgery rather than mandatory surgery. In addition, this study controlled for 19 separate variables, including lifestyle factors such as BMI, smoking status, and alcohol use, as well as in-hospital factors such as transfusion <72 h prior to surgery, American Society of Anesthesiologists classification, length of operation, total hospital length of stay, history of previous operation within 30 days of the surgery, and overall 30-day morbidity, in addition to classic comorbid conditions like cardiovascular, neurological, renal conditions. Differences observed between studies may also be due to the fact that rehabilitation facilities are more likely to see orthopedic/neurosurgical patients as compared to HNC patients. Specifically, one study found that 32.4% of patients discharged to a SNF had orthopedic procedures, whereas 2.6% of patients had head and neck procedures. If staff at the rehabilitation centers are more familiar with the needs of orthopedic patients this could in part explain the differences seen between studies.

In addition to SNFs, patients with advanced needs are often discharged home with home health. While not as high risk as discharge to SNF, this study reported increased rates of readmission with discharge to home health compared to routine discharge home. There are several factors that may have led to this observation. First, readmission avoidance may not be a priority for home health care organizations, as the current payment structure does not award these agencies for avoiding readmissions. Additionally, home health care nurses must make quick decisions for patients at the time of a visit, which may even hasten returns to the hospital due to early detection of issues. Patients are more likely to visit the emergency department on the day of a home health care visit. Readmissions could also be affected by the skill level of health care nurses and legal concerns, which may influence nurses to favor a cautious approach, recommending returns to the hospital in order to avoid negative outcomes at home.

Future studies should investigate the implementation of educational programs in hospitals to provide increased supportive care and education. In a pilot study, Graboyes et al. started an informational program for patients who had HNC, to educate the patient and the caregiver. It included a hands-on class with a nurse educator, prehospital discharge competency assessment, and speech-language pathology counseling. This could increase discharges to home with family support and potentially decrease readmission rates because it leaves patients and caregivers more knowledgeable and prepared. Additionally, another study found that implementing a quality care plan that focused on improving communication, education, and discharge planning resulted in 2% fewer readmissions among HNC patients.

While the present study had many strengths, there were also some limitations. Because of the retrospective nature of the study, it was difficult to assess whether the readmissions were planned or unexpected. Due to this limitation, all readmissions were included and although it is probable that some readmissions were for planned secondary procedures, we would not expect these to systematically differ between groups. Additionally, it is not possible to assess the quality of the skilled nursing facility, and the training of the staff at the locations where patients were discharged. While our analyses were designed to maximize the available data to ensure the same distribution of characteristics for our cohorts, we recognize some unobservable variables could not be captured. Uncaptured variables that may influence the risk of readmission and length of stay with discharge to SNF include: unreported comorbidities, frailty, poor healing, surgical complications, and stage of disease. The data set is from a single state and results may not generalize to other states.

5 | CONCLUSION

There are many variables that factor into a physician's decision of discharge location. HNC patients are at high risk for hospital readmission and require unique rehabilitative care with which certain facilities or caregivers may have minimal experience. Variables associated with readmission include male sex, emergent admission, discharge to home health or SNF, and having four or more comorbidities. The increased readmission rate with discharge to SNF is especially important to note as trends show an increase over time in discharges to these facilities. The influence of discharge destination on readmission rate is likely
multifactorial with factors such as underlying patient characteristics, facility resources, personnel experience, facility policies, discharge education, and family support playing a role. This association must be further assessed to identify areas where patient safety can be improved. It is possible that there is a knowledge gap or other concerns that may be prompting a cautious approach and contributing to the higher readmission rates from SNF. For complicated HNC patients that require additional care, it is important to send them to a facility that is equipped with educated staff and resources for these patients. Therefore, we must continue to increase HNC awareness and emphasize the importance of having educated staff knowledgeable about unique HNC conditions. Consideration should be given to implementing patient, caregiver, and nursing staff education programs to improve familiarity with postoperative care and encourage discharge to home when indicated.

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CONFLICT OF INTEREST
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### TABLE A1 Diagnosis codes used to identify head and neck cancer

| Site                              | ICD-9-CM diagnosis codes | ICD-10-CM diagnosis codes                          |
|-----------------------------------|--------------------------|---------------------------------------------------|
| Hypopharynx                       |                          |                                                   |
| 148.0: mal neo postcricoid        | C12: malignant neoplasm of pyriform sinus          |
| 148.1: mal neo pyriform sinus     | C130: malignant neoplasm of postcricoid region    |
| 148.2: mal neo aryepiglott fold   | C131: malignant neoplasm of aryepiglottic fold, hypopharyngeal aspect |
| 148.3: mal neo post hypopharynx   | C132: malignant neoplasm of posterior wall of hypopharynx |
| 148.8: mal neo hypopharynx NEC    | C138: malignant neoplasm of overlapping sites of hypopharynx |
| 148.9: mal neo hypopharynx NOS    | C139: malignant neoplasm of hypopharynx, unspecified |
| Larynx                            |                          |                                                   |
| 161.0: malignant neo glottis      | C320: malignant neoplasm of glottis               |
| 161.1: malig neo supraglottis     | C321: malignant neoplasm of supraglottis          |
| 161.2: malig neo subglottis       | C322: malignant neoplasm of subglottis            |
| 161.3: mal neo cartilage larynx   | C323: malignant neoplasm of laryngeal cartilage  |
| 161.8: malignant neo larynx NEC   | C328: malignant neoplasm of overlapping sites of larynx |
| 161.9: malignant neo larynx NOS   | C329: malignant neoplasm of larynx, unspecified   |
| Nasal cavity/Middle ear/accessory sinus |                        |                                                   |
| 160.0: mal neo nasal cavities     | C300: malignant neoplasm of nasal cavity          |
| 160.2: mal neo maxillary sinus    | C310: malignant neoplasm of maxillary sinus       |
| 160.3: mal neo ethmoidal sinus    | C311: malignant neoplasm of ethmoidal sinus       |
| 160.4: malig neo frontal sinus    | C312: malignant neoplasm of frontal sinus         |
| 160.5: mal neo sphenoid sinus     | C313: malignant neoplasm of sphenoid sinus        |
| 160.8: mal neo access sinus NEC   | C318: malignant neoplasm of overlapping sites of accessory sinuses |
| 160.9: mal neo access sinus NOS   | C319: malignant neoplasm of accessory sinus, unspecified |
| Nasopharynx                       |                          |                                                   |
| 147.1: mal neo post nasopharynx   | C111: malignant neoplasm of posterior wall of nasopharynx |
| 147.2: mal neo lat nasopharynx    | C112: malignant neoplasm of lateral wall of nasopharynx |
| 147.3: mal neo ant nasopharynx    | C113: malignant neoplasm of anterior wall of nasopharynx |
| 147.8: mal neo nasopharynx NEC    | C118: malignant neoplasm of overlapping sites of nasopharynx |
| 147.9: mal neo nasopharynx NOS    | C119: malignant neoplasm of nasopharynx, unspecified |
| Oral Cavity                       |                          |                                                   |
| 140.3: mal neo upper lip, inner  | C003: malignant neoplasm of upper lip, inner aspect |
| 140.4: mal neo lower lip, inner   | C004: malignant neoplasm of lower lip, inner aspect |
| 140.6: mal neo lip, commissure    | C006: malignant neoplasm of commissure of lip, unspecified |
| 140.8: mal neo lip NEC            | C008: malignant neoplasm of overlapping sites of lip |
| 140.9: mal neo lip/vermil NOS     | C030: malignant neoplasm of upper gum             |
| 143.0: malig neo upper gum        | C031: malignant neoplasm of lower gum             |
| 143.1: malig neo lower gum        | C039: malignant neoplasm of gum, unspecified      |
| 143.8: malig neo gum NEC          | C040: malignant neoplasm of anterior floor of mouth |
| 143.9: Malig neo gum NOS          | C041: malignant neoplasm of lateral floor of mouth |
| 144.0: mal neo ant floor mouth    | C048: malignant neoplasm of overlapping sites of floor of mouth |
| 144.1: mal neo lat floor mouth    | C049: malignant neoplasm of floor of mouth, unspecified |
| 144.8: mal neo mouth floor NEC    | C050: malignant neoplasm of hard palate           |
| 144.9: mal neo mouth floor NOS    | C060: malignant neoplasm of cheek mucosa          |
| 145.0: mal neo cheek mucosa       | C061: malignant neoplasm of vestibule of mouth    |
| 145.1: mal neo mouth vestibule    | C062: malignant neoplasm of retromolar area       |
| 145.2: malig neo hard palate      | C0689: malignant neoplasm of overlapping sites of other parts of mouth |
| 145.6: malig neo retromolar       | C069: malignant neoplasm of mouth, unspecified    |
| 145.8: malig neoplasm mouth NEC   |                                                   |
| 145.9: malig neoplasm mouth NOS   |                                                   |
| Site                  | ICD-9-CM diagnosis codes | ICD-10-CM diagnosis codes |
|-----------------------|--------------------------|---------------------------|
| Oropharynx            |                          |                           |
| 141.0: mal neo tongue base | C01: malignant neoplasm of base of tongue |
| 141.6: mal neo lingual tonsil | C024: malignant neoplasm of lingual tonsil |
| 145.3: malig neo soft palate | C051: malignant neoplasm of soft palate |
| 145.4: malignant neoplasm uvula | C052: malignant neoplasm of uvula |
| 145.5: malignant neo palate NOS | C059: malignant neoplasm of palate, unspecified |
| 146.0: malignant neopl tonsil | C090: malignant neoplasm of tonsillar fossa |
| 146.1: mal neo tonsillar fossa | C091: malignant neoplasm of tonsillar pillar (anterior) (posterior) |
| 146.2: mal neo tonsil pillars | C099: malignant neoplasm of tonsil, unspecified |
| 146.3: malign neo vallecula | C100: malignant neoplasm of vallecula |
| 146.4: mal neo ant epiglottis | C101: malignant neoplasm of anterior surface of epiglottis |
| 146.6: mal neo lat oropharynx | C102: malignant neoplasm of lateral wall of oropharynx |
| 146.7: mal neo post oropharynx | C103: malignant neoplasm of posterior wall of oropharynx |
| 146.8: mal neo oropharynx NEC | C108: malignant neoplasm of overlapping sites of oropharynx |
| 146.9: malig neo orophrynill-def | C109: malignant neoplasm of oropharynx, unspecified |
| Other                 |                          |                           |
| 149.0: mal neo pharynx NOS | C140: malignant neoplasm of pharynx, unspecified |
| 149.8: mal neo oral/pharynx NEC | C148: malignant neoplasm of overlapping sites of lip, oral cavity and pharynx |
| 149.9: mal neo orophryn ill-def | C410: malignant neoplasm of bones of skull and face |
| 170.0: mal neo skull/face bone | C411: malignant neoplasm of mandible |
| 170.1: malignant neo mandible | C490: malignant neoplasm of connective and soft tissue of head, face and neck |
| 171.0: mal neo soft tissue head | C760: malignant neoplasm of head, face and neck |
| 195.0: mal neo head/face/neck |                           |
| Salivary              |                          |                           |
| 142.0: malig neo parotid | C07: malignant neoplasm of parotid gland |
| 142.1: malig neo submandibular | C080: malignant neoplasm of submandibular gland |
| 142.2: malig neo sublingual | C089: malignant neoplasm of major salivary gland, unspecified |
| 142.8: mal neo maj salivary NEC |                           |
| 142.9: mal neo salivary NOS |                           |
| Skin                  |                          |                           |
| 140.0: mal neo upper vermilion | C001: malignant neoplasm of external lower lip |
| 140.1: mal neo lower vermilion | C4401: basal cell carcinoma of skin of lip |
| 173.00: malig neo pl skin lip NOS | C4402: squamous cell carcinoma of skin of lip |
| 173.01: basal cell ca skin lip | C44309: unspecified malignant neoplasm of skin of other parts of face |
| 173.02: squamous cell ca skin lip | C44310: basal cell carcinoma of skin of unspecified parts of face |
| 173.10: mal neo eyelid/canth NOS | C44311: basal cell carcinoma of skin of nose |
| 173.11: basal cell ca lid/canth | C44319: basal cell carcinoma of skin of other parts of face |
| 173.12: squam cell ca lid/canth | C44320: squamous cell carcinoma of skin of unspecified parts of face |
| 173.19: mal neo eyelid/canth NEC | C44321: squamous cell carcinoma of skin of nose |
| 173.20: malig neo skin ear NOS | C44329: squamous cell carcinoma of skin of other parts of face |
| 173.20: malig neo skin ear NOS | C44390: other specified malignant neoplasm of skin of unspecified parts of face |
| 173.21: basal cell ca skin ear | C44399: other specified malignant neoplasm of skin of other parts of face |
| 173.22: squam cell ca skin ear | C4440: unspecified malignant neoplasm of skin of scalp and neck |
| 173.29: neo skin ear/ex canl NEC | C4441: basal cell carcinoma of skin of scalp and neck |
| 173.30: mal neo skn face NEC/NOS | C4442: squamous cell carcinoma of skin of scalp and neck |
| 173.30: mal neo skn face NEC/NOS | C4449: other specified malignant neoplasm of skin of scalp and neck |
| 173.31: Bsl cel skn face NEC/NOS |                           |
| 173.32: Sqm cel skn face NEC/NOS |                           |
| 173.39: mal neo skn face NEC/NOS |                           |
| 173.40: mal neo sclp/skn nck NOS |                           |
| Site       | ICD-9-CM diagnosis codes | ICD-10-CM diagnosis codes                          |
|------------|--------------------------|---------------------------------------------------|
|            | 173.40: mal neo scalp/skin nck NOS |                                                   |
|            | 173.41: Basal cell carcinoma scalp/skin nck |                                                   |
|            | 173.42: Squamous cell carcinoma scalp/skin nck |                                                   |
|            | 173.49: mal neo scalp/skin nck NEC |                                                   |
| Tongue     | 141.1: mal neo dorsal tongue | C020: malignant neoplasm of dorsal surface of tongue |
|            | 141.2: mal neo tip/lat tongue | C021: malignant neoplasm of border of tongue       |
|            | 141.3: mal neo ventral tongue | C022: malignant neoplasm of ventral surface of tongue |
|            | 141.4: mal neo ant 2/3 | C023: malignant neoplasm of anterior two-thirds of tongue, part unspecified |
|            | 141.5: mal neo tongue junction | C028: malignant neoplasm of overlapping sites of tongue |
|            | 141.8: malig neo tongue NEC | C029: malignant neoplasm of tongue, unspecified   |
|            | 141.9: malig neo tongue NOS |                                                   |
## APPENDIX B

**TABLE B1**  Procedure codes used to identify cohort

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|-------------------------|--------------------------|
| 16.59: Other exenteration of orbit | 08T0XZZ: resection of right eye, external approach  
08T1XZZ: resection of left eye, external approach  
0KK10ZZ: transfer facial muscle, open approach  
0KK14ZZ: transfer facial muscle, percutaneous endoscopic approach |
| 18.39: Other excision of external ear | 09T00ZZ: resection of right external ear, open approach  
09T04ZZ: resection of right external ear, percutaneous endoscopic approach  
09T0XZZ: resection of right external ear, external approach  
09T10ZZ: resection of left external ear, open approach  
09T14ZZ: resection of left external ear, percutaneous endoscopic approach  
09T1XZZ: resection of left external ear, external approach |
| 25.1: Excision or destruction of lesion or tissue of tongue | 0C570ZZ: destruction of tongue, open approach  
0C573ZZ: destruction of tongue, percutaneous approach  
0C57XZZ: destruction of tongue, external approach |
| 25.2: Partial glossectomy | 0CB70ZZ: excision of tongue, open approach  
0CB73ZZ: excision of tongue, percutaneous approach  
0CB7XZZ: excision of tongue, external approach |
| 25.3: Complete glossectomy | 0CT70ZZ: resection of tongue, open approach  
0CT7XZZ: resection of tongue, external approach |
| 25.4: Radical glossectomy | 0CT70ZZ: resection of tongue, open approach  
0CT7XZZ: resection of tongue, external approach |
| 26.29: Other excision of salivary gland lesion | 0C580ZZ: destruction of right parotid gland, open approach  
0C583ZZ: destruction of right parotid gland, percutaneous approach  
0C590ZZ: destruction of left parotid gland, open approach  
0C593ZZ: destruction of left parotid gland, percutaneous approach  
0C5B0ZZ: destruction of right parotid duct, open approach  
0C5B3ZZ: destruction of right parotid duct, percutaneous approach  
0C5C0ZZ: destruction of left parotid duct, open approach  
0C5C3ZZ: destruction of left parotid duct, percutaneous approach  
0C5D0ZZ: destruction of right sublingual gland, open approach  
0C5D3ZZ: destruction of right sublingual gland, percutaneous approach  
0C5F0ZZ: destruction of left sublingual gland, open approach  
0C5F3ZZ: destruction of left sublingual gland, percutaneous approach  
0C5G0ZZ: destruction of right submaxillary gland, open approach  
0C5G3ZZ: destruction of right submaxillary gland, percutaneous approach  
0C5H0ZZ: destruction of left submaxillary gland, open approach  
0C5H3ZZ: destruction of left submaxillary gland, percutaneous approach  
0C5J0ZZ: destruction of minor salivary gland, open approach  
0C5J3ZZ: destruction of minor salivary gland, percutaneous approach  
0CB80ZZ: resection of right parotid gland, open approach  
0CB83ZZ: Excision of Right Parotid Gland, Percutaneous Approach  
0CB90ZZ: excision of left parotid gland, open approach  
0CB93ZZ: excision of left parotid gland, percutaneous approach  
0CBB0ZZ: excision of right parotid duct, open approach |
| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|-------------------------|
| 0CBB3ZZ                | excision of right parotid duct, percutaneous approach |
| 0CB00ZZ                | excision of left parotid duct, open approach |
| 0CB03ZZ                | excision of left parotid duct, percutaneous approach |
| 0CB07ZZ                | excision of right sublingual gland, open approach |
| 0CB03ZZ                | excision of right sublingual gland, percutaneous approach |
| 0CB04ZZ                | excision of left sublingual gland, open approach |
| 0CBF0ZZ                | excision of left sublingual gland, percutaneous approach |
| 0CBF67ZZ               | excision of left sublingual gland, percutaneous approach |
| 0CB01ZZ                | excision of right submaxillary gland, open approach |
| 0CB03ZZ                | excision of right submaxillary gland, percutaneous approach |
| 0CB04ZZ                | excision of left submaxillary gland, open approach |
| 0CB07ZZ                | excision of left submaxillary gland, percutaneous approach |
| 0CB20ZZ                | excision of minor salivary gland, open approach |
| 0CB21ZZ                | excision of minor salivary gland, percutaneous approach |
| 26.30: Sialoadenectomy, not otherwise specified | 0CB83ZZ: excision of right parotid gland, percutaneous approach |
| 0CB90ZZ                | excision of left parotid gland, open approach |
| 0CB93ZZ                | excision of left parotid gland, percutaneous approach |
| 0CBB0ZZ                | excision of right parotid duct, open approach |
| 0CBB3ZZ                | excision of right parotid duct, percutaneous approach |
| 0CBC0ZZ                | excision of left submaxillary gland, open approach |
| 0CBB3ZZ                | excision of left submaxillary gland, percutaneous approach |
| 0CBF0ZZ                | excision of right submaxillary gland, percutaneous approach |
| 0CBF67ZZ               | excision of left submaxillary gland, percutaneous approach |
| 0CBG0ZZ                | excision of right submaxillary gland, open approach |
| 0CBG3ZZ                | excision of right submaxillary gland, percutaneous approach |
| 0CBH0ZZ                | excision of left submaxillary gland, open approach |
| 0CBH3ZZ                | excision of left submaxillary gland, percutaneous approach |
| 0CBH3ZZ                | excision of left submaxillary gland, percutaneous approach |
| 0CBJ0ZZ                | excision of minor salivary gland, open approach |
| 0CBJ3ZZ                | excision of minor salivary gland, percutaneous approach |
| 26.31: Partial sialoadenectomy | 0CB80ZZ: excision of right parotid gland, open approach |
| 0CB83ZZ                | excision of right parotid gland, percutaneous approach |
| 0CB90ZZ                | excision of left parotid gland, open approach |
| 0CB93ZZ                | excision of left parotid gland, percutaneous approach |
| 0CBB0ZZ                | excision of right parotid duct, open approach |
| 0CBB3ZZ                | excision of right parotid duct, percutaneous approach |
| 0CBC0ZZ                | excision of left submaxillary gland, open approach |
| 0CBB3ZZ                | excision of left submaxillary gland, percutaneous approach |
| 0CBF0ZZ                | excision of right submaxillary gland, percutaneous approach |
| 0CBF67ZZ               | excision of left submaxillary gland, percutaneous approach |
| 0CBG0ZZ                | excision of right submaxillary gland, open approach |
| 0CBG3ZZ                | excision of right submaxillary gland, percutaneous approach |
| 0CBH0ZZ                | excision of left submaxillary gland, open approach |
| 0CBH3ZZ                | excision of left submaxillary gland, percutaneous approach |
| 0CBH3ZZ                | excision of left submaxillary gland, percutaneous approach |
| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| 0CBJ0ZZ                | excision of minor salivary gland, open approach |
| 0CBJ3ZZ                | excision of minor salivary gland, percutaneous approach |

**26.32: Complete sialoadenectomy**

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| OCT80ZZ                | resection of right parotid gland, open approach |
| OCT90ZZ                | resection of left parotid gland, open approach |
| OCTB0ZZ                | resection of right parotid duct, open approach |
| OCTC0ZZ                | resection of left parotid duct, open approach |
| OCTD0ZZ                | resection of right sublingual gland, open approach |
| OCTF0ZZ                | resection of left sublingual gland, open approach |
| OCTG0ZZ                | resection of right submaxillary gland, open approach |
| OCTH0ZZ                | resection of left submaxillary gland, open approach |
| OCTJ0ZZ                | resection of minor salivary gland, open approach |

**27.31: Local excision or destruction of lesion or tissue of bony palate**

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| OC520ZZ                | destruction of hard palate, open approach |
| OC523ZZ                | destruction of hard palate, percutaneous approach |
| OC52XZZ                | destruction of hard palate, external approach |
| OCB20ZZ                | excision of hard palate, open approach |
| OCB23ZZ                | excision of hard palate, percutaneous approach |
| OCB2XZZ                | excision of hard palate, external approach |

**27.32: Wide excision or destruction of lesion or tissue of bony palate**

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| OCB20ZZ                | excision of hard palate, open approach |
| OCB23ZZ                | excision of hard palate, percutaneous approach |
| OCB2XZZ                | excision of hard palate, external approach |
| OCT20ZZ                | resection of hard palate, open approach |
| OCT2XZZ                | resection of hard palate, external approach |
| ONBR0ZZ                | excision of maxilla, open approach |
| ONBR3ZZ                | excision of maxilla, percutaneous approach |
| ONBR4ZZ                | excision of maxilla, percutaneous endoscopic approach |

**27.42: Wide excision of lesion of lip**

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| OCB00ZZ                | excision of upper lip, open approach |
| OCB03ZZ                | excision of upper lip, percutaneous approach |
| OCB0XZZ                | excision of upper lip, external approach |
| OCB10ZZ                | excision of lower lip, open approach |
| OCB13ZZ                | excision of lower lip, percutaneous approach |
| OCB1XZZ                | excision of lower lip, external approach |

**27.49: Other excision of mouth**

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| OCB33ZZ                | excision of soft palate, percutaneous approach |
| OCB3XZZ                | excision of soft palate, external approach |
| OCB40ZZ                | excision of buccal mucosa, open approach |
| OCB43ZZ                | excision of buccal mucosa, percutaneous approach |
| OCB4XZZ                | excision of buccal mucosa, external approach |

**29.33: Pharyngectomy (partial)**

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| 09BN0ZZ                | excision of nasopharynx, open approach |
| 09BN3ZZ                | excision of nasopharynx, percutaneous approach |
| 09BN4ZZ                | excision of nasopharynx, percutaneous endoscopic approach |
| 09BN7ZZ                | excision of nasopharynx, via natural or artificial opening |
| 09BN8ZZ                | excision of nasopharynx, via natural or artificial opening endoscopic |
| 09TN0ZZ                | resection of nasopharynx, open approach |
| 09TN4ZZ                | resection of nasopharynx, percutaneous endoscopic approach |
| 09TN7ZZ                | resection of nasopharynx, via natural or artificial opening |
| 09TN8ZZ                | resection of nasopharynx, via natural or artificial opening endoscopic |
| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|-------------------------|--------------------------|
| 0CBM0ZZ: excision of pharynx, open approach |
| 0CBM3ZZ: excision of pharynx, percutaneous approach |
| 0CBM4ZZ: excision of pharynx, percutaneous endoscopic approach |
| 0CBM7ZZ: excision of pharynx, via natural or artificial opening |
| 0CBM8ZZ: excision of pharynx, via natural or artificial opening endoscopic |
| 0CTM0ZZ: resection of pharynx, open approach |
| 0CTM4ZZ: resection of pharynx, percutaneous endoscopic approach |
| 0CTM7ZZ: resection of pharynx, via natural or artificial opening |
| 0CTM8ZZ: resection of pharynx, via natural or artificial opening endoscopic |

29.39: Other excision or destruction of lesion or tissue of pharynx

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|-------------------------|--------------------------|
| 095N0ZZ: destruction of nasopharynx, open approach |
| 095N3ZZ: destruction of nasopharynx, percutaneous approach |
| 095N4ZZ: destruction of nasopharynx, percutaneous endoscopic approach |
| 095N7ZZ: destruction of nasopharynx, via natural or artificial opening |
| 095N8ZZ: destruction of nasopharynx, via natural or artificial opening endoscopic |
| 09BN0ZZ: excision of nasopharynx, open approach |
| 09BN3ZZ: excision of nasopharynx, percutaneous approach |
| 09BN4ZZ: excision of nasopharynx, percutaneous endoscopic approach |
| 09BN7ZZ: excision of nasopharynx, via natural or artificial opening |
| 09BN8ZZ: excision of nasopharynx, via natural or artificial opening endoscopic |
| 0C5M0ZZ: destruction of pharynx, open approach |
| 0C5M3ZZ: destruction of pharynx, percutaneous approach |
| 0C5M4ZZ: destruction of pharynx, percutaneous endoscopic approach |
| 0C5M7ZZ: destruction of pharynx, via natural or artificial opening |
| 0C5M8ZZ: destruction of pharynx, via natural or artificial opening endoscopic |
| 0CBM0ZZ: excision of pharynx, open approach |
| 0CBM3ZZ: excision of pharynx, percutaneous approach |
| 0CBM4ZZ: excision of pharynx, percutaneous endoscopic approach |
| 0CBM7ZZ: excision of pharynx, via natural or artificial opening |
| 0CBM8ZZ: excision of pharynx, via natural or artificial opening endoscopic |

30.09: Other excision or destruction of lesion or tissue of larynx

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|-------------------------|--------------------------|
| 0C5S0ZZ: destruction of larynx, open approach |
| 0C5S3ZZ: destruction of larynx, percutaneous approach |
| 0C5S4ZZ: destruction of larynx, percutaneous endoscopic approach |
| 0C5S7ZZ: destruction of larynx, via natural or artificial opening |
| 0C5S8ZZ: destruction of larynx, via natural or artificial opening endoscopic |
| 0C5T0ZZ: destruction of right vocal cord, open approach |
| 0C5T3ZZ: destruction of right vocal cord, percutaneous approach |
| 0C5T4ZZ: destruction of right vocal cord, percutaneous endoscopic approach |
| 0C5T7ZZ: destruction of right vocal cord, via natural or artificial opening |
| 0C5T8ZZ: destruction of right vocal cord, via natural or artificial opening endoscopic |
| 0C5V0ZZ: destruction of left vocal cord, open approach |
| 0C5V3ZZ: destruction of left vocal cord, percutaneous approach |
| 0C5V4ZZ: destruction of left vocal cord, percutaneous endoscopic approach |
| 0C5V7ZZ: destruction of left vocal cord, via natural or artificial opening |
| 0C5V8ZZ: destruction of left vocal cord, via natural or artificial opening endoscopic |
| 0CBR0ZZ: excision of epiglottis, open approach |

(Continues)
| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|-------------------------|--------------------------|
| 0CBR3ZZ                 | excision of epiglottis, percutaneous approach |
| 0CBR4ZZ                 | excision of epiglottis, percutaneous endoscopic approach |
| 0CBR7ZZ                 | excision of epiglottis, via natural or artificial opening |
| 0CBR8ZZ                 | excision of epiglottis, via natural or artificial opening endoscopic |
| 0CBS0ZZ                 | excision of larynx, open approach |
| 0CBS3ZZ                 | excision of larynx, percutaneous approach |
| 0CBS4ZZ                 | excision of larynx, percutaneous endoscopic approach |
| 0CBS7ZZ                 | excision of larynx, via natural or artificial opening |
| 0CBS8ZZ                 | excision of larynx, via natural or artificial opening endoscopic |
| 0CBT0ZZ                 | excision of right vocal cord, open approach |
| 0CBT3ZZ                 | excision of right vocal cord, percutaneous approach |
| 0CBT4ZZ                 | excision of right vocal cord, percutaneous endoscopic approach |
| 0CBT7ZZ                 | excision of right vocal cord, via natural or artificial opening |
| 0CBT8ZZ                 | excision of right vocal cord, via natural or artificial opening endoscopic |
| 0CBV0ZZ                 | excision of left vocal cord, open approach |
| 0CBV3ZZ                 | excision of left vocal cord, percutaneous approach |
| 0CBV4ZZ                 | excision of left vocal cord, percutaneous endoscopic approach |
| 0CBV7ZZ                 | excision of left vocal cord, via natural or artificial opening |
| 0CBV8ZZ                 | excision of left vocal cord, via natural or artificial opening endoscopic |
| 0CDT0ZZ                 | extraction of right vocal cord, open approach |
| 0CDT3ZZ                 | extraction of right vocal cord, percutaneous approach |
| 0CDT4ZZ                 | extraction of right vocal cord, percutaneous endoscopic approach |
| 0CDT7ZZ                 | extraction of right vocal cord, via natural or artificial opening |
| 0CDT8ZZ                 | extraction of right vocal cord, via natural or artificial opening endoscopic |
| 0CDV0ZZ                 | extraction of left vocal cord, open approach |
| 0CDV3ZZ                 | extraction of left vocal cord, percutaneous approach |
| 0CDV4ZZ                 | extraction of left vocal cord, percutaneous endoscopic approach |
| 0CDV7ZZ                 | extraction of left vocal cord, via natural or artificial opening |
| 0CDV8ZZ                 | extraction of left vocal cord, via natural or artificial opening endoscopic |

30.21: Epiglottidectomy

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|-------------------------|--------------------------|
| 0CSR0ZZ                 | destruction of epiglottis, open approach |
| 0CSR3ZZ                 | destruction of epiglottis, percutaneous approach |
| 0CSR4ZZ                 | destruction of epiglottis, percutaneous endoscopic approach |
| 0CSR7ZZ                 | destruction of epiglottis, via natural or artificial opening |
| 0CSR8ZZ                 | destruction of epiglottis, via natural or artificial opening endoscopic |
| 0CBR0ZZ                 | excision of epiglottis, open approach |
| 0CBR3ZZ                 | excision of epiglottis, percutaneous approach |
| 0CBR4ZZ                 | excision of epiglottis, percutaneous endoscopic approach |
| 0CBR7ZZ                 | excision of epiglottis, via natural or artificial opening |
| 0CBR8ZZ                 | excision of epiglottis, via natural or artificial opening endoscopic |
| 0CTR0ZZ                 | resection of epiglottis, open approach |
| 0CTR4ZZ                 | resection of epiglottis, percutaneous endoscopic approach |
| 0CTR7ZZ                 | resection of epiglottis, via natural or artificial opening |
| 0CTR8ZZ                 | resection of epiglottis, via natural or artificial opening endoscopic |

30.22: Vocal cordectomy

| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|-------------------------|--------------------------|
| 0CBT0ZZ                 | excision of right vocal cord, open approach |
| 0CBT3ZZ                 | excision of right vocal cord, percutaneous approach |
| 0CBT4ZZ                 | excision of right vocal cord, percutaneous endoscopic approach |
| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| 0CBT7ZZ                | excision of right vocal cord, via natural or artificial opening |
| 0CBT8ZZ                | excision of right vocal cord, via natural or artificial opening endoscopic |
| 0CBV0ZZ                | excision of left vocal cord, open approach |
| 0CBV3ZZ                | excision of left vocal cord, percutaneous approach |
| 0CBV4ZZ                | excision of left vocal cord, percutaneous endoscopic approach |
| 0CBV7ZZ                | excision of left vocal cord, via natural or artificial opening |
| 0CBV8ZZ                | excision of left vocal cord, via natural or artificial opening endoscopic |
| 0CTT0ZZ                | Resection of Right Vocal Cord, Open Approach |
| 0CTT4ZZ                | resection of right vocal cord, percutaneous endoscopic approach |
| 0CTT7ZZ                | resection of right vocal cord, via natural or artificial opening |
| 0CTT8ZZ                | resection of right vocal cord, via natural or artificial opening endoscopic |
| 0CTV0ZZ                | resection of left vocal cord, open approach |
| 0CTV4ZZ                | resection of left vocal cord, percutaneous endoscopic approach |
| 0CTV7ZZ                | resection of left vocal cord, via natural or artificial opening |
| 0CTV8ZZ                | resection of left vocal cord, via natural or artificial opening endoscopic |
| 0CBS0ZZ                | excision of larynx, open approach |
| 0CBS3ZZ                | excision of larynx, percutaneous approach |
| 0CBS4ZZ                | excision of larynx, percutaneous endoscopic approach |
| 0CBS7ZZ                | excision of larynx, via natural or artificial opening |
| 0CBS8ZZ                | excision of larynx, via natural or artificial opening endoscopic |
| 0B110F4                | bypass trachea to cutaneous with tracheostomy device, open approach |
| 0B110Z4                | bypass trachea to cutaneous, open approach |
| 0B113F4                | bypass trachea to cutaneous with tracheostomy device, percutaneous approach |
| 0B113Z4                | bypass trachea to cutaneous, percutaneous approach |
| 0B114F4                | Bypass Trachea to Cutaneous with Tracheostomy Device, Percutaneous Endoscopic Approach |
| 0B114Z4                | Bypass Trachea to Cutaneous, Percutaneous Endoscopic Approach |
| 0CTS0ZZ                | resection of larynx, open approach |
| 0CTS4ZZ                | resection of larynx, percutaneous endoscopic approach |
| 0CTS7ZZ                | resection of larynx, via natural or artificial opening |
| 0CTS8ZZ                | resection of larynx, via natural or artificial opening endoscopic |
| 0T710ZZ                | resection of right neck lymphatic, open approach |
| 0T714ZZ                | resection of right neck lymphatic, percutaneous endoscopic approach |
| 0T720ZZ                | resection of left neck lymphatic, open approach |
| 0T724ZZ                | resection of left neck lymphatic, percutaneous endoscopic approach |
| 0B110F4                | bypass trachea to cutaneous with tracheostomy device, open approach |
| 0B110Z4                | bypass trachea to cutaneous, open approach |
| 0B113F4                | bypass trachea to cutaneous with tracheostomy device, percutaneous approach |
| 0B113Z4                | bypass trachea to cutaneous, percutaneous approach |
| 0B114F4                | bypass trachea to cutaneous with tracheostomy device, percutaneous endoscopic approach |
| 0B114Z4                | bypass trachea to cutaneous, percutaneous endoscopic approach |
| 0CTS0ZZ                | resection of larynx, open approach |
| 0CTS4ZZ                | resection of larynx, percutaneous endoscopic approach |
| 0CTS7ZZ                | resection of larynx, via natural or artificial opening |
| 0CTS8ZZ                | resection of larynx, via natural or artificial opening endoscopic |
| 0GTG0ZZ                | resection of left thyroid gland lobe, open approach |
| 0GTG4ZZ                | resection of left thyroid gland lobe, percutaneous endoscopic approach |
| 0GTH0ZZ                | resection of right thyroid gland lobe, open approach |
| ICD-9-CM procedure code | ICD-9-CM procedure codes |
|------------------------|--------------------------|
| 0GTH4ZZ: resection of right thyroid gland lobe, percutaneous endoscopic approach |
| 0GTK0ZZ: resection of thyroid gland, open approach |
| 0GTK4ZZ: resection of thyroid gland, percutaneous endoscopic approach |
| 40.40: Radical neck dissection, not otherwise specified |
| 0TT10ZZ: resection of right neck lymphatic, open approach |
| 0TT14ZZ: resection of right neck lymphatic, percutaneous endoscopic approach |
| 0TT20ZZ: resection of left neck lymphatic, open approach |
| 0TT24ZZ: resection of left neck lymphatic, percutaneous endoscopic approach |
| 40.41: Radical neck dissection, unilateral |
| 0TT10ZZ: resection of right neck lymphatic, open approach |
| 0TT14ZZ: resection of right neck lymphatic, percutaneous endoscopic approach |
| 0TT20ZZ: resection of left neck lymphatic, open approach |
| 0TT24ZZ: resection of left neck lymphatic, percutaneous endoscopic approach |
| 40.42: Radical neck dissection, bilateral |
| 0TT10ZZ: resection of right neck lymphatic, open approach |
| 0TT14ZZ: resection of right neck lymphatic, percutaneous endoscopic approach |
| 0TT20ZZ: resection of left neck lymphatic, open approach |
| 0TT24ZZ: resection of left neck lymphatic, percutaneous endoscopic approach |
| 76.31: Partial mandibulectomy |
| ONBT0ZZ: excision of right mandible, open approach |
| ONBT3ZZ: excision of right mandible, percutaneous approach |
| ONBT4ZZ: excision of right mandible, percutaneous endoscopic approach |
| ONBV0ZZ: excision of left mandible, open approach |
| ONBV3ZZ: excision of left mandible, percutaneous approach |
| ONBV4ZZ: excision of left mandible, percutaneous endoscopic approach |
| 76.41: Total mandibulectomy with synchronous reconstruction |
| ONRT07Z: replacement of right mandible with autologous tissue substitute, open approach |
| ONRT0JZ: replacement of right mandible with synthetic substitute, open approach |
| ONRT0KZ: replacement of right mandible with nonautologous tissue substitute, open approach |
| ONRT37Z: replacement of right mandible with autologous tissue substitute, percutaneous approach |
| ONRT3JZ: replacement of right mandible with synthetic substitute, percutaneous approach |
| ONRT3KZ: replacement of right mandible with nonautologous tissue substitute, percutaneous approach |
| ONRT47Z: replacement of right mandible with autologous tissue substitute, percutaneous endoscopic approach |
| ONRT4JZ: replacement of right mandible with synthetic substitute, percutaneous endoscopic approach |
| ONRT4KZ: replacement of right mandible with nonautologous tissue substitute, percutaneous endoscopic approach |
| ONRV07Z: replacement of left mandible with autologous tissue substitute, open approach |
| ONRV0JZ: replacement of left mandible with synthetic substitute, open approach |
| ONRV0KZ: replacement of left mandible with nonautologous tissue substitute, open approach |
| ONRV37Z: replacement of left mandible with autologous tissue substitute, percutaneous approach |
| ONRV3JZ: replacement of left mandible with synthetic substitute, percutaneous approach |
| ONRV3KZ: replacement of left mandible with nonautologous tissue substitute, percutaneous approach |
| ONRV47Z: replacement of left mandible with autologous tissue substitute, percutaneous endoscopic approach |
| ONRV4JZ: replacement of left mandible with synthetic substitute, percutaneous endoscopic approach |
| ONRV4KZ: replacement of left mandible with nonautologous tissue substitute, percutaneous endoscopic approach |
### TABLE C1 ICD-9-CM and ICD-10-PCS codes used to identify flap reconstruction

| ICD-9-CM procedure codes for flap reconstruction | ICD-10-PCS codes for flap reconstruction |
|-------------------------------------------------|------------------------------------------|
| 86.60                                           | OHR0X73, OHR0XK3, OHR0XK4, OHR1X73, OHR1XK3, OHR1XK4, OHR4X73, OHR4XK3, OHR4XK4, OHR5X73, OHR5XK3, OHR5XK4, OHR6X73, OHR6XK3, OHR6XK4, OHR7X73, OHR7XK3, OHR7XK4, OHR8X73, OHR8XK3, OHR8XK4, OHR9X73, OHR9XK3, OHR9XK4, OHRAX73, OHRAXK3, OHRAXK4, OHRBX73, OHRBXK3, OHRBXK4, OHRCKX73, OHRCKXK3, OHRCKXK4, OHRDX73, OHRDXK3, OHRDXK4, OHRFX73, OHRFXK3, OHRFXK4, OHRGX73, OHRGXK3, OHRGXK4, OHRJX73, OHRJXK3, OHRJXK4, OHRKX73, OHRKXK3, OHRKXK4, OHRMX73, OHRMXK3, OHRMXK4, OHRNX73, OHRNXK3, OHRNXK4 |