Health Insurance and Stage at Diagnosis of Laryngeal Cancer

Does Insurance Type Predict Stage at Diagnosis?

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Objective: To examine whether patients with no insurance or Medicaid are more likely to present with advanced-stage laryngeal cancer.

Design: Retrospective cohort study from the National Cancer Database, 1996-2003.

Setting: Hospital-based practice.

Participants: Patients with known insurance status diagnosed as having invasive laryngeal cancer at Commission on Cancer facilities (N=61,131) were included. Adjusted and unadjusted logistic regression models analyzed the likelihood of presenting at a more advanced stage.

Main Outcome Measures: Overall stage of laryngeal cancer (early vs advanced) and tumor size (T stage) at diagnosis.

Results: Patients with advanced-stage laryngeal cancer at diagnosis were more likely to be uninsured (odds ratio [OR], 1.97; 95% confidence interval [CI], 1.79-2.15) or covered by Medicaid (OR, 2.40; 95% CI, 2.21-2.61) compared with those with private insurance. Similarly, patients were most likely to present with the largest tumors (T4 disease) if they were uninsured (OR, 2.92; 95% CI, 2.60-3.28) or covered by Medicaid (OR, 3.97; 95% CI, 3.56-4.34). Patients who were black, between ages 18 and 56 years, and who resided in zip codes with low proportions of high school graduates or low median household incomes were also more likely to be diagnosed as having advanced disease and/or larger tumors.

Conclusions: Individuals lacking insurance or having Medicaid are at greatest risk for presenting with advanced laryngeal cancer. Results for the Medicaid group may be influenced by the postdiagnosis enrollment of uninsured patients. It is important to consider the impact of insurance coverage on stage at diagnosis and associated morbidity, mortality, quality of life, and costs.

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lected by population-based cancer registries. The National Cancer Database (NCDB) provides a unique opportunity to study the relationship between insurance status and stage at diagnosis because information on insurance status has been collected for all patients since 1996. The purpose of the present study is to examine the relationship between the patient’s insurance status at the time of diagnosis and American Joint Commission on Cancer (AJCC) overall stage and T stage at presentation among patients diagnosed as having laryngeal cancer from 1996 to 2003 reported to the NCDB.

The NCDB is a national hospital-based cancer registry jointly sponsored by the American College of Surgeons and the American Cancer Society. Prior to 1997, submissions of records of patients with cancer to the NCDB were voluntary and open to all cancer facilities in the United States. Beginning in 1997, data collection was mandated as a requirement of the Commission on Cancer approved programs. Since 1999, approximately 75% of newly diagnosed cancers in the United States have been captured in the database.

Cases of invasive squamous cell carcinoma of the larynx diagnosed from 1996 to 2003 were extracted from the NCDB using the appropriate International Classification of Diseases–Oncology, Third Edition (ICD-O-3) site and histology codes (n=76,529). Data were abstracted using coding guidelines documented in the Registry Operations and Data Standards (ROADS) manual for cases diagnosed from 1996 to 2002 and the Facility Oncology Registry Data Standards (FORDS) manual for the diagnosis year 2003; the fourth, fifth, and sixth editions of the AJCC Manual for Staging of Cancer, and the second and third editions of the WHO International Classification of Disease for Oncology. For cases diagnosed prior to 2001, reported International Classification of Diseases–Oncology, Second Edition (ICD-O-2) tumor morphology codes were recoded to the ICD-O-3 codes. Site codes selected were C10.1 (anterior surface of epiglottis), C13.1 (aryepiglottic fold), C32.0 to C32.3 (glottis, supraglottis, subglottis, and laryngeal cartilage), C32.8 (overlapping lesion of larynx), and C32.9 (larynx, not otherwise specified [NOS]). The captured histology codes included 8045, 8051, 8052, 8070, 8078, 8083, 8084, 8090 to 8094, 8097, 8123, 8147, 8560, and 8570 for squamous cell and/or basal squamous cell cancer.

From the patients with the correct site and histology codes (n=76,529), only patients who were treated at the reporting institution (n=72,262), who had stage I to IV at presentation (n=65,541), and who were 18 years or older (n=65,521) were included. Patients with unknown insurance status were excluded (n=4,390 [6.7%]), leaving 61,131 in the final study population. Institutional review board approval was not required for this study, which did not include individual identifiers.

The primary independent variable was the FORDS data element for primary payer/insurance at diagnosis. The FORDS codes were grouped into the following categories: Medicaid, Medicare (which included both Medicare alone and Medicare with supplement), uninsured (which included FORDS codes for not insured—NOS, not insured—charity write-off, and not insured—self-pay), other government funded plans (Department of Veterans Affairs [VA], Indian Health Service, Public Health Service, welfare, state-funded NOS, and federally funded NOS), and private insurance plans (health maintenance organization [HMO], preferred provider organization [PPO], managed care NOS, private insurance, Tricare/CHAMPUS [Civilian Health and Medical Program of the Uniformed Services], military, and insured NOS). The plans in the private insurance category were grouped together because these plans represent either privately purchased insurance (purchased by the individual, a family member, and/or employer) or insurance provided by the military that functions in a similar manner as private insurance (Tricare/CHAMPUS). Generally, all patients 65 years and older are eligible for Medicare enrollment regardless of comorbidity. Persons younger than 65 years who are either disabled or have renal failure or amyotrophic lateral sclerosis are also covered by Medicare. Since those with Medicare insurance who are younger than 65 years may be substantially different than those 65 years and older, the Medicare category was dichotomized by age (18-64 years and ≥65 years).

Other independent variables included sex (male and female), race (white, black, Hispanic, and other, which included Asian American/Pacific Islander and Native American), age (categorized as covariates into quartiles of 18-56, 57-64, 65-72, and ≥73 years), US census region of residence (West, Midwest, Northeast, and South), education (proportion in patient’s zip code of residence without a high school degree based on national quartiles of the 2000 US census as ≥29%, 20%-28.9%, 14%-19.9%, and <14%), and median household income in patient’s zip code of residence based on national quartiles of the 2000 US census as less than $30,000, between $30,000 and $34,999, between $35,000 and 45,999, and $46,000 or more.

Type of treatment facility (community hospital, community cancer facility, and teaching/research facility) was also included as an independent variable because prior analyses have demonstrated variation in stage by facility type. The 3 types of treatment facilities that function in a similar manner as private insurance plans (hospital, outpatient, and freestanding ambulatory care) were grouped into the following categories: teaching/research facilities differ from community hospitals that treat 300 cancer cases a year and have a full range of services for cancer care, but patients need referral for portions of their treatment. Community cancer centers are facilities that offer the same range of services as the community hospitals but have at least 750 annual cancer cases and conduct weekly cancer conferences. Teaching/research facilities differ from community cancer facilities in that the teaching/research facilities have residency programs and ongoing cancer research. Of the 39 National Cancer Institute (NCI) Comprehensive Cancer Programs, 29 participate in the Commission on Cancer approvals program and are included among teaching/research facilities in this study.

Two separate analyses were performed. The first analysis used a dichotomized-dependent variable describing stage at diagnosis, categorized as early (stages I and II) or advanced (stages III and IV). In the second analysis, the second dependent variable was the reported T stage at diagnosis, categorized as T1, T2, T3, and T4.

Analyses were performed with SAS version 9.1 (SAS Statistical Institute, Cary, North Carolina). Statistical testing was conducted via the SAS procedure for logistic regression (PROC LOGISTIC). Initial (unadjusted) logistic regression models analyzed the likelihood of presenting with advanced vs early stage and of presenting at more advanced T stage based on each independent variable separately (ie, 1 at a time). Additional regression analyses controlled for all independent variables found to be statistically significant in these univariate models. Proportional logistic models were not justified for examining the T stage at diagnosis as the dependent variable because the score test result for the proportional odds assumption was significant (ie, regression lines for cumulative logits were not parallel). Therefore, we used a generalized logistic model (the SAS glogit link option for PROC LOGISTIC) to compare patients with T2, T3, or T4 stages at diagnosis separately with the referent T1 group. Patients with missing data for the significant covariates were excluded from the multivariate logistic regression models, leaving 51,504 (84.3%) patients eligible for these analyses. We assessed whether the adjusted models (ie, including all significant independent variables) had a significantly better fit than the unadjusted models (ie, only including insurance status). Goodness of fit was tested by computing the change in deviance (ΔD) from the adjusted models to the unadjusted models and assessing the significance using the likeli-
### RESULTS

A total of 61,131 patients with laryngeal cancer were eligible for analyses. There were 32,665 (53.4%) with early-stage disease and 28,466 (46.6%) with advanced-stage disease. The distribution of T\(^a\) stage included 22,693 (37.1%) with T1 disease, 15,111 (24.7%) with T2 disease, 13,541 (22.2%) with T3 disease, and 9,786 (16.0%) with T4 disease. Table 1 compares the characteristics of patients presenting with early- vs advanced-stage disease. Table 2 presents similar results, illustrating patient characteristics by T stage. Patients with advanced-stage disease or more advanced T stage were more likely to be uninsured or have Medicaid or other government-funded plans than were those with early-stage disease. The proportion of women having T4 disease (compared with T1 disease) increased compared with men; that is, 19.9% of patients with T4 lesions were female (an increase from 17.4% female among patients with T1 disease). Conversely, the proportion of men having T4 disease (compared with T1 disease) decreased; ie, 80% of all patients with T4 disease were male, a decrease from 82.6% male among patients with T1 disease. The proportion of patients who were black increased as T stage and overall stage increased. A higher proportion of patients who were younger than 65 years, lived in the South census region of the United States, and lived in zip codes with lower median incomes and lower proportion of high school graduates also had more advanced T and overall stage. Patients with advanced disease were more likely to be treated at a teaching/research facility. Table 3 presents corresponding logistic regression results for analyses relating insurance type to the likelihood of presenting with advanced disease controlling for patient sex, age, race, treatment facility type, zip code–based education and income categories, and US census region. The likelihood ratio test statistic for the adjusted model was statistically significant (\(\Delta D = 30,191.4\); \(P < .05\)). After controlling for covariates, patients who are uninsured (odds ratio [OR], 1.97; 95% confidence interval [CI], 1.79-2.15) or who have Medicaid insurance (OR, 2.40; 95% CI, 2.21-2.61) were more likely to present with advanced-stage disease than those with private insurance. Patients with insurance through other government plans (OR, 1.34; 95% CI, 1.22-1.48) were also more likely to present with advanced-stage disease than were those with private insurance. Patients with Medicare insurance, regardless of age, were also more likely to present with advanced-stage disease than were those with private insurance, although the increased risk of advanced disease among Medicare patients was less than that among uninsured or Medicaid patients. Patients who were female, black, between ages 18 and 56 years, or resided in zip codes with low proportions of high school graduates or with median household annual income less than $46,000 were also at increased risk of presenting with advanced-stage laryngeal cancer. Patients who lived in the Midwest and South census regions were at marginally decreased risk of advanced disease. Patients treated at teaching/research facilities were more likely to present with advanced disease.

#### Table 1. Characteristics of Patients Diagnosed as Having Early- vs Advanced-Stage Laryngeal Cancer (National Cancer Database, 1996-2003)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Early Stage (n = 32,665)</th>
<th>Advanced Stage (n = 28,466)</th>
<th>Wald (\chi^2)</th>
<th>(P) Value (\alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary payer/insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uninsured</td>
<td>1431 (4.4)</td>
<td>2465 (8.7)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>1542 (4.7)</td>
<td>3421 (12.1)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Medicare, age 18-64 y</td>
<td>1450 (4.4)</td>
<td>1873 (6.6)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Medicare, age (\geq 65) y</td>
<td>14,165 (43.4)</td>
<td>9730 (34.2)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Other government-funded plans</td>
<td>1668 (5.1)</td>
<td>1786 (6.3)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Private insurance plans(^d)</td>
<td>12,409 (38.0)</td>
<td>9191 (32.3)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-56 (^a)</td>
<td>6874 (21.0)</td>
<td>8229 (28.9)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>57-64</td>
<td>7041 (21.6)</td>
<td>7267 (25.5)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>65-72</td>
<td>8828 (27.0)</td>
<td>6936 (24.4)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>(\geq 73)</td>
<td>9922 (30.4)</td>
<td>6034 (21.2)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Facility type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community hospital</td>
<td>5531 (16.9)</td>
<td>4026 (14.1)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Community cancer facility</td>
<td>14,351 (43.9)</td>
<td>9935 (34.9)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Teaching/research facility(^a)</td>
<td>11,201 (34.3)</td>
<td>13,378 (47.0)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Unknown(^e)</td>
<td>1582 (4.8)</td>
<td>1127 (4.0)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Census region of residence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>5697 (17.4)</td>
<td>4489 (15.8)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Midwest</td>
<td>7911 (24.2)</td>
<td>6553 (23.0)</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>Northeast(^a)</td>
<td>6652 (20.4)</td>
<td>5905 (20.7)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>South</td>
<td>12,262 (37.5)</td>
<td>11,388 (40.0)</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Unknown(^e)</td>
<td>143 (0.4)</td>
<td>131 (0.5)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Proportion without high school degree, %(^f)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\geq 29.0)</td>
<td>6720 (20.6)</td>
<td>7475 (26.3)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>20.0-28.9</td>
<td>8084 (24.7)</td>
<td>7688 (27.0)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>14.0-19.9</td>
<td>7517 (23.0)</td>
<td>6022 (21.2)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>(&lt;14.0)</td>
<td>8826 (27.0)</td>
<td>5880 (20.7)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Unknown(^e)</td>
<td>1518 (4.6)</td>
<td>1401 (4.9)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Median household income, $(^g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(&lt;30,000)</td>
<td>5805 (17.8)</td>
<td>6590 (23.2)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>30,000-34,999</td>
<td>6574 (20.1)</td>
<td>6122 (21.5)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>35,000-45,999</td>
<td>8932 (27.3)</td>
<td>7487 (26.3)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>(\geq 46,000)</td>
<td>9886 (30.1)</td>
<td>6870 (24.1)</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Unknown(^e)</td>
<td>1518 (4.6)</td>
<td>1397 (4.9)</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: NA, not applicable.

\(^a\)Reference group.

\(^b\)Results from univariate logistic regression analyses.

\(^c\)Department of Veterans Affairs, Indian Health Service, and Public Health Service.

\(^d\)Health maintenance organization, preferred provider organization, managed care, Tricare, military, and insured NOS (not otherwise specified).

\(^e\)Excluded from logistic regression model analyses.

\(^f\)US 2000 census data for zip code of residence.

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Table 4 presents the final logistic regression model predicting T-stage disease by insurance type while controlling for sex, age, race, treatment facility type, zip code level education and income, and US census region of the country. The likelihood ratio test statistic for the adjusted model was again statistically significant (ΔD = 34933.3 [P < .05]).

Similar to the results in Table 3, uninsured patients and those with Medicaid insurance were more likely than patients with private insurance to present at more advanced T stages, and this association was strongest for the most advanced stage (T4) (OR, 2.92 and 3.97, respectively). The relationship between other covariates (sex, race, age, treat-
In general, most interactions between insurance type and race were not statistically significant; those that achieved statistical significance were marginal (.01 < P < .05). The odds of presenting with advanced disease were lower among younger Hispanics with Medicare (OR, 0.61 [P = .04]), Hispanics with insurance from other government plans (OR, 0.60 [P = .03]), and patients of “other race” with Medicaid (OR, 0.63 [P = .04]) than among whites with comparable insurance. Overall, we conclude that among patients with a particular type of insurance (or lack of insurance), differences by race have little impact on the likelihood of presenting with advanced stage.

We also explored the relationship between laryngeal subsites (supraglottic larynx, glottic larynx, and subglottic larynx) and stage at presentation. Fewer than 1000 cases of subglottic cases were available, and thus no meaningful relationships were found owing to lack of power. Again, all insurance types were strongly associated with stage of diagnosis for supraglottic cancer and glottic cancers with the exception of Medicare (age <65 years), which was not associated with stage of presentation for supraglottic subsites. A significant limitation of this subsite analysis is the difficulty with coding subsite of origin for laryngeal lesions (eg, transglottic cancers).

TABLE 3. Adjusted Odds Ratios (ORs) for Patients With Advanced- vs Early-Stage Laryngeal Cancer (National Cancer Database, 1996-2003 [n = 51 504])

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary payer/insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uninsured</td>
<td>1.97 (1.79-2.15)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Medicaid</td>
<td>2.40 (2.21-2.61)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Medicare, age 18-64 y</td>
<td>1.52 (1.38-1.67)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Medicare, age ≥65 y</td>
<td>1.30 (1.21-1.40)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Other government-funded plans a</td>
<td>1.34 (1.22-1.48)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Private insurance plans b</td>
<td>1 [Reference]</td>
<td>...</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.78 (0.74-0.82)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Female</td>
<td>1 [Reference]</td>
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</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-56</td>
<td>1 [Reference]</td>
<td>...</td>
</tr>
<tr>
<td>57-64</td>
<td>0.91 (0.85-0.96)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>65-72</td>
<td>0.72 (0.66-0.77)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥73</td>
<td>0.57 (0.52-0.61)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>1.38 (1.29-1.46)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.03 (0.92-1.15)</td>
<td>.22</td>
</tr>
<tr>
<td>Other</td>
<td>1.08 (0.92-1.28)</td>
<td>.09</td>
</tr>
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<td>White</td>
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<tr>
<td>Facility type</td>
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<tr>
<td>Community hospital</td>
<td>0.68 (0.64-0.73)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Community cancer facility</td>
<td>0.66 (0.63-0.70)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Teaching/research facility</td>
<td>1 [Reference]</td>
<td>...</td>
</tr>
<tr>
<td>Census region of residence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>0.96 (0.90-1.03)</td>
<td>.22</td>
</tr>
<tr>
<td>Midwest</td>
<td>0.92 (0.87-0.98)</td>
<td>.01</td>
</tr>
<tr>
<td>South</td>
<td>0.94 (0.88-0.99)</td>
<td>.03</td>
</tr>
<tr>
<td>Northeast</td>
<td>1 [Reference]</td>
<td>...</td>
</tr>
<tr>
<td>Proportion without high school degree, % c</td>
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<td></td>
</tr>
<tr>
<td>≥29.0</td>
<td>1.20 (1.11-1.31)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>20.0-28.9</td>
<td>1.17 (1.09-1.25)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>14.0-19.9</td>
<td>1.11 (1.04-1.18)</td>
<td>.002</td>
</tr>
<tr>
<td>&lt;14.0</td>
<td>1 [Reference]</td>
<td>...</td>
</tr>
<tr>
<td>Median household income, $ c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 000</td>
<td>1.12 (1.03-1.21)</td>
<td>.008</td>
</tr>
<tr>
<td>30 000-34 999</td>
<td>1.11 (1.03-1.19)</td>
<td>.004</td>
</tr>
<tr>
<td>35 000-45 999</td>
<td>1.10 (1.03-1.17)</td>
<td>.008</td>
</tr>
<tr>
<td>≥46 000</td>
<td>1 [Reference]</td>
<td>...</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.

a US 2000 census data for zip code of residence.
b Health maintenance organization, preferred provider organization, managed care, CHAMPUS (Civilian Health and Medical Program of the Uniformed Services), military, and insured NOS (not otherwise specified).
c Department of Veterans Affairs, Indian Health Service, and Public Health Service.

Our principal finding was that for patients diagnosed as having laryngeal cancer between 1996 and 2003 at American College of Surgeons Commission on Cancer–approved hospitals, health insurance status was an important predictor of advanced stage and larger tumor size. Compared with patients with private insurance, those who were uninsured or had Medicaid insurance had a higher likelihood of being diagnosed as having advanced stage and with T2, T3, and T4 disease than those with private insurance. Individuals with Medicare insurance also had increased risk of presenting with advanced disease and larger tumors compared with patients with private insurance, although this association was not as strong as that for uninsured and Medicaid patients. Other factors associated with more advanced disease at diagnosis were sex (women at higher risk), age (younger patients at higher risk), race (African Americans at highest risk), treatment facility type (teaching/research facilities at higher risk), and residence in a zip codes with a higher proportion of individuals without a high school degree and low household income.

Insurance type, sociodemographic characteristics, and other factors differed significantly between those with early-stage and advanced-stage laryngeal cancer. Our analysis controlled for sex, race, age, and treatment facility type in the logistic regression models to adjust for differences in patient mix between early- and advanced-stage cancer groups. Ecological data on education attainment and household income were included to control for area-level factors; individual-level socioeconomic characteristics were not available. Census area of residence was included to control for variations in health care access, cultural differences, or health care utilization in the different regions of the United States.15,16

In multivariate analysis, the type of health insurance remained the strongest predictor of stage at diagnosis.
and tumor size, with the OR for larger primary tumors (T stage) at diagnosis increasing in a stepwise fashion from T1 to T4 for all insurance types relative to private insurance. The relative risk of being diagnosed as having T4 disease was highest for uninsured and Medicaid patients (OR, 2.92 and 3.97, respectively). Individuals who were female, younger than 56 years, and black were also at higher risk of presenting with larger tumors than were their demographic counterparts.

Insurance type may be related to likelihood of having a regular health care provider and seeking care for symptomatic disease (ie, the delay between first seeking care and definitive diagnosis). Lack of health insurance is strongly associated with barriers to access for health care in other studies. For example, the National Health Interview Survey found that in 2002-2003, 46.7% of uninsured adults aged between 18 and 64 years had no usual source of health care, compared with 9.3% of adults with health insurance.\(^{17}\) In 2003, 38.1% of adults younger than 65 years with no health insurance reported no visits to physician’s offices, emergency departments, and home visits in the past 12 months, compared with 12.8% of insured adults.\(^{17}\) Individuals without health insurance are also less likely to report use of cancer preventive services such as mammography, Papanicolaou testing, and colorectal cancer testing.\(^{17,18}\) A prior study that linked Florida cancer registry records with hospital discharge records to obtain insurance status found that patients without insurance coverage or with Medicaid insurance were more likely to be diagnosed as having late-stage cancer at a several sites (eg, colon-

### Table 4. Multivariate Analysis Adjusted Odds Ratios (ORs) for Patients With T2, T3, or T4 vs T1 Laryngeal Cancer

(National Cancer Database, 1996-2003 [n = 51,504])

<table>
<thead>
<tr>
<th>Variable</th>
<th>T2 OR (95% CI) P Value</th>
<th>T3 OR (95% CI) P Value</th>
<th>T4 OR (95% CI) P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary payer/insurance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uninsured</td>
<td>1.55 (1.38-1.74) &lt;.001</td>
<td>2.21 (1.97-2.47) &lt;.001</td>
<td>2.92 (2.60-3.28) &lt;.001</td>
</tr>
<tr>
<td>Medicaid</td>
<td>2.04 (1.83-2.28) &lt;.001</td>
<td>2.93 (2.64-3.26) &lt;.001</td>
<td>3.97 (3.56-4.34) &lt;.001</td>
</tr>
<tr>
<td>Medicare, age 18-64 y</td>
<td>1.44 (1.29-1.62) &lt;.001</td>
<td>1.77 (1.58-1.99) &lt;.001</td>
<td>1.78 (1.56-2.02) &lt;.001</td>
</tr>
<tr>
<td>Medicare, age ≥65 y</td>
<td>1.19 (1.10-1.29) &lt;.001</td>
<td>1.38 (1.26-1.50) &lt;.001</td>
<td>1.38 (1.25-1.51) &lt;.001</td>
</tr>
<tr>
<td>Other government-funded plans(^{a})</td>
<td>1.19 (1.06-1.34) .003</td>
<td>1.26 (1.12-1.42) &lt;.001</td>
<td>1.42 (1.25-1.61) &lt;.001</td>
</tr>
<tr>
<td><strong>Private insurance plans(^{b})</strong></td>
<td>1 [Reference] ... 1 [Reference] ... 1 [Reference] ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.67 (0.63-0.71) &lt;.001</td>
<td>0.70 (0.66-0.74) &lt;.001</td>
<td>0.88 (0.82-0.94) &lt;.001</td>
</tr>
<tr>
<td>Female</td>
<td>1 [Reference] ... 1 [Reference] ... 1 [Reference] ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-56</td>
<td>1 [Reference] ... 1 [Reference] ... 1 [Reference] ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57-64</td>
<td>0.92 (0.86-0.99) .02</td>
<td>0.87 (0.81-0.93) &lt;.001</td>
<td>0.86 (0.80-0.93) &lt;.001</td>
</tr>
<tr>
<td>65-72</td>
<td>0.76 (0.70-0.83) &lt;.001</td>
<td>0.65 (0.59-0.71) &lt;.001</td>
<td>0.71 (0.64-0.79) &lt;.001</td>
</tr>
<tr>
<td>≥73</td>
<td>0.64 (0.59-0.71) &lt;.001</td>
<td>0.52 (0.47-0.57) &lt;.001</td>
<td>0.57 (0.52-0.64) &lt;.001</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>1.18 (1.10-1.27) &lt;.001</td>
<td>1.41 (1.31-1.52) &lt;.001</td>
<td>1.57 (1.45-1.70) &lt;.001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.88 (0.77-1.01) .06</td>
<td>0.98 (0.85-1.12) .74</td>
<td>1.12 (0.98-1.29) .11</td>
</tr>
<tr>
<td>Other</td>
<td>0.91 (0.75-1.11) .34</td>
<td>0.98 (0.85-1.20) .83</td>
<td>1.09 (0.88-1.35) .43</td>
</tr>
<tr>
<td>White</td>
<td>1 [Reference] ... 1 [Reference] ... 1 [Reference] ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Facility type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community hospital</td>
<td>0.84 (0.79-0.91) &lt;.001</td>
<td>0.67 (0.62-0.72) &lt;.001</td>
<td>0.62 (0.57-0.67) &lt;.001</td>
</tr>
<tr>
<td>Community cancer facility</td>
<td>0.82 (0.78-0.87) &lt;.001</td>
<td>0.64 (0.61-0.68) &lt;.001</td>
<td>0.60 (0.56-0.64) &lt;.001</td>
</tr>
<tr>
<td>Teaching/research facility</td>
<td>1 [Reference] ... 1 [Reference] ... 1 [Reference] ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Census region of residence</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>1.04 (0.96-1.12) .32</td>
<td>0.96 (0.88-1.04) .32</td>
<td>1.03 (0.94-1.13) .47</td>
</tr>
<tr>
<td>Midwest</td>
<td>1.02 (0.95-1.10) .58</td>
<td>0.97 (0.90-1.04) .41</td>
<td>0.90 (0.83-0.98) .02</td>
</tr>
<tr>
<td>South</td>
<td>0.96 (0.90-1.03) .22</td>
<td>0.98 (0.91-1.05) .50</td>
<td>0.97 (0.90-1.05) .46</td>
</tr>
<tr>
<td>Northeast</td>
<td>1 [Reference] ... 1 [Reference] ... 1 [Reference] ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Proportion without high school degree, % (^{c})</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥29.0</td>
<td>1.18 (1.08-1.30) &lt;.001</td>
<td>1.28 (1.16-1.41) &lt;.001</td>
<td>1.41 (1.26-1.57) &lt;.001</td>
</tr>
<tr>
<td>20.0-28.9</td>
<td>1.06 (0.98-1.14) .16</td>
<td>1.20 (1.10-1.30) &lt;.001</td>
<td>1.25 (1.14-1.38) &lt;.001</td>
</tr>
<tr>
<td>14.0-19.9</td>
<td>1.13 (1.05-1.21) .001</td>
<td>1.17 (1.08-1.27) &lt;.001</td>
<td>1.14 (1.05-1.25) .003</td>
</tr>
<tr>
<td>&lt;14.0</td>
<td>1 [Reference] ... 1 [Reference] ... 1 [Reference] ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median household income, $(^{d})</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 000</td>
<td>1.13 (1.03-1.24) .009</td>
<td>1.16 (1.05-1.27) .004</td>
<td>1.16 (1.04-1.29) .009</td>
</tr>
<tr>
<td>30 000-34 999</td>
<td>1.15 (1.06-1.25) &lt;.001</td>
<td>1.15 (1.05-1.25) .002</td>
<td>1.18 (1.07-1.30) &lt;.001</td>
</tr>
<tr>
<td>35 000-45 999</td>
<td>1.11 (1.03-1.19) .004</td>
<td>1.12 (1.04-1.21) .002</td>
<td>1.13 (1.04-1.23) .004</td>
</tr>
<tr>
<td>≥46 000</td>
<td>1 [Reference] ... 1 [Reference] ... 1 [Reference] ...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.

\(^{a}\)Department of Veterans Affairs, Indian Health Service, Public Health Service, welfare, state-funded NOS (not otherwise specified), and federally funded NOS.

\(^{b}\)Health maintenance organization, preferred provider organization, managed care NOS, private insurance, CHAMPUS (Civilian Health and Medical Program of the Uniformed Services), military, and insured NOS.

\(^{c}\)US 2000 census data for zip code of residence.

\(^{d}\)National Cancer Database, 1996-2003 [n = 51,504]
rectum, melanoma, breast, and prostate) than were pa-

tients with commercial indemnity insurance. One recent study reported that regarding of income, uninsured indi-

viduals use recommended health care services less often than those who are insured.

Little has been published about factors that affect stage at diagnosis among patients with laryngeal cancer patients. Hoarseness, dysphagia, otalgia, and voice changes commonly appear in early disease; despite these early symptoms, some patients present with advanced stage. Investigators have reported that patients with fee-for-service insurance are more likely to use cancer screening tests—other evidence of how insurance status may affect stage at diagnosis. The relationship between insurance and late-stage disease may also reflect a delay in seeking medical care by uninsured or underinsured symptomatic patients because of a lack of available qualified providers or other barriers. In such cases, by the time an uninsured or Medicaid recipient receives medical attention, the disease is advanced.

There are limitations to this study. First, some patients who were categorized as having Medicaid may have presented with no insurance coverage; the application for Medicaid coverage may have commenced on diagnosis, and coverage may be extended retroactively to the date of diagnosis. Previous studies suggest that patients who enroll in Medicaid at the time of cancer diagnosis may have more advanced-stage disease than do patients enrolling in Medicaid prior to diagnosis, although after controlling for stage at diagnosis, there were no significant differences in survival between early and late Medicaid enrollees. However, because information on date of Medicaid enrollment is not available in the NCDB, we were unable to adjust for this and may thus be undercounting the actual number of uninsured pa-

tients at the time of diagnosis. Similarly, no information is available on the type of insurance coverage prior to cancer diagnosis or the consistency of this coverage. Many individu-

als in the United States may experience periods of being uninsured, and these periods are generally longer among lower-income individuals. The impact of lack of consistent insurance coverage on cancer stage at diagnosis is unknown.

We also did not have information on the distance traveled to treatment facility, which may relate to access to care. We did not have individual level information on income, education, or other socioeconomic status mea-

sures and relied on estimates based on zip codes. We also lacked information on the time delay between presenta-

tion of symptoms and the diagnosis of laryngeal cancer. This information would have helped to define where lapses or potential gaps in access to care occur when individuals are not insured or underinsured.

In conclusion, our analyses provide the first assessment, to our knowledge, of the strong association between medical insurance and stage of laryngeal cancer at diagnosis among a large, generalizable cohort. Insurance coverage is a highly modifiable factor that affects not only tumor associated morbidity and mortality but also quality of life and economic costs.

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Author Contributions: Dr Chen had full access to all the data in the study and takes responsibility for the integ-

rity of the data and the accuracy of the data analysis. Study concept and design: Chen, Schrag, Halpern, and Ward. Ac-

quisition of data: Stewart and Ward. Analysis and inter-

pretation of data: Chen, Schrag, and Ward. Drafting of the manuscript: Chen, Schrag, and Halpern. Critical revision of the manuscript for important intellectual content: Chen, Schrag, Halpern, Stewart, and Ward. Statistical analysis: Chen, Schrag, and Halpern. Administrative, technical, and material support: Chen, Stewart, and Ward. Study supervision: Chen and Ward.

Financial Disclosure: None reported.

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gust 20, 2006; Chicago, Illinois.

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