

Association of Medicaid Expansion Under the Affordable Care Act With Stage at Diagnosis and Time to Treatment Initiation for Patients With Head and Neck Squamous Cell Carcinoma

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 Supplemental content

IMPORTANCE Medicaid expansions as part of the Patient Protection and Affordable Care Act (ACA) are associated with decreases in the percentage of uninsured patients who have received a new diagnosis of cancer. Little is known about the association of Medicaid expansions with stage at diagnosis and time to treatment initiation (TTI) for patients with head and neck squamous cell carcinoma (HNSCC).

OBJECTIVE To determine the association of Medicaid expansions as part of the ACA with stage at diagnosis and TTI for patients with HNSCC.

DESIGN, SETTING, AND PARTICIPANTS A retrospective cohort study was conducted at Commission on Cancer-accredited facilities among 90 789 patients identified from the National Cancer Database aged 18 to 64 years with HNSCC that was diagnosed during the period from January 1, 2010, to December 31, 2016. Statistical analysis was conducted from February 18 to November 8, 2019.

MAIN OUTCOMES AND MEASURES Outcome measures included health insurance coverage, stage at diagnosis, and TTI. Absolute percentage change in health insurance coverage, crude and adjusted difference in differences (DD) in absolute percentage change in coverage, stage at diagnosis, and TTI before (2010-2013) and after (2014-2016) ACA implementation were calculated for Medicaid expansion and nonexpansion states.

RESULTS Of the 90 789 nonelderly adults with newly diagnosed HNSCC (mean [SD] age, 54.7 [7.0] years), 70 907 (78.1%) were men, 72 911 (80.3%) were non-Hispanic white, 52 142 (57.4%) were between 55 and 64 years of age, and 54 940 (60.5%) resided in states with an ACA Medicaid expansion. Compared with nonexpansion states, the percentage of patients with HNSCC with Medicaid increased more in expansion states after the implementation of the ACA (adjusted DD, 4.6 percentage points [95% CI, 3.7-5.4 percentage points]). The percentage of patients with localized disease (American Joint Committee on Cancer stage I-II) at diagnosis increased in expansion states compared with nonexpansion states for the overall cohort (adjusted DD, 2.3 percentage points [95% CI, 1.1-3.5 percentage points]) and for the subset of patients with nonoropharyngeal HNSCC (adjusted DD, 3.4 percentage points [95% CI, 1.5-5.2 percentage points]). The mean TTI did not differ between expansion and nonexpansion states for the cohort (adjusted DD, -12.7 percentage points [95% CI, -27.4 to 4.2 percentage points]) but improved for patients with nonoropharyngeal HNSCC (adjusted DD, -26.5 percentage points [95% CI, -49.6 to -3.4 percentage points]).

CONCLUSIONS AND RELEVANCE This study suggests that Medicaid expansions were associated with a greater increase in the percentage of patients with HNSCC with Medicaid coverage, an increase in the percentage of patients with localized disease at diagnosis for the overall cohort of patients with HNSCC, and improved TTI for patients with nonoropharyngeal HNSCC.

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The Patient Protection and Affordable Care Act (ACA) increased health insurance coverage options through multiple provisions, most notably by permitting states to expand Medicaid coverage eligibility to individuals with lower income.¹ Several studies have shown a reduction in the percentage of uninsured individuals and increases in the percentage of patients with localized disease (American Joint Committee on Cancer [AJCC] stage I-II) among nonelderly patients with newly diagnosed cancer after Medicaid expansions.²⁻⁷ However, as of September 20, 2019, 14 states had not adopted the Medicaid expansion.⁸

Head and neck squamous cell carcinoma (HNSCC), which is diagnosed in 65 000 patients annually in the United States and results in 14 600 deaths per year,⁹ is a disease for which an advanced stage at presentation is common⁹ and delays in initiating treatment are frequent.¹⁰ Health insurance coverage is thus particularly important for patients with HNSCC to help ensure timely access to care. Patients with HNSCC generally have a lower socioeconomic status and are more likely to be uninsured relative to patients with other cancers.^{2,3} Uninsured patients with HNSCC have a 17% absolute increase of presenting with advanced stage HNSCC,¹¹ 53% higher odds of experiencing treatment delay,¹² and a 14% mean decrease in 5-year overall survival compared with privately insured patients.¹³

A recent study using the Surveillance, Epidemiology, and End Results Program (SEER) cancer registries reported an increase in the percentage of patients with Medicaid and privately insured patients with HNSCC and a decrease in the percentage of uninsured patients with HNSCC associated with the ACA Medicaid expansion.¹³ However, this study could not assess the effects of Medicaid expansion on health insurance coverage across the entire United States.¹⁴ In addition, prior studies evaluating the ACA have focused on cancers for which an effective screening exists.^{4,7,15-17} Because there is no screening test for HNSCC, access to care for physical examination and tissue-based biopsy—and thus health insurance coverage—are critical for the timely recognition of symptoms, early disease stage at diagnosis, and treatment initiation. To date, the downstream association of changes in health insurance coverage with stage at diagnosis and time to treatment initiation (TTI), key metrics for access to care for HNSCC, remain unknown. In this study, we extend prior research about the association of ACA Medicaid expansions with health insurance coverage, disease stage at diagnosis, and TTI in patients with HNSCC.

Methods

Data Collection and Study Population

The National Cancer Database (NCDB) is a hospital-based cancer registry that is a joint program of the American College of Surgeons Commission on Cancer and the American Cancer Society.¹⁸ The NCDB annually collects data from more than 1500 Commission on Cancer-accredited hospitals in the United States, capturing approximately 70% of cancer diagnoses annually.^{19,20} Although the NCDB is a hospital-based

Key Points

Question What is the association of Medicaid expansions under the Patient Protection and Affordable Care Act (ACA) with stage at diagnosis and time to treatment initiation for patients with head and neck squamous cell carcinoma (HNSCC)?

Findings In this cohort study of 90 789 patients with newly diagnosed HNSCC, ACA Medicaid expansions were associated with a greater increase in the percentage of Medicaid-insured patients, an increase in the percentage of patients with localized disease at diagnosis for patients with HNSCC, and improved time to treatment initiation for patients with nonoropharyngeal HNSCC.

Meaning Medicaid expansions under the ACA were associated with improved access to care for patients with HNSCC; selective Medicaid expansion may exacerbate existing regional disparities in access to care and outcomes.

registry, it reflects characteristics of population-based data (eg, SEER) in terms of demographics, disease stage, treatment, and oncologic outcomes for patients with HNSCC.²¹ Variables in the NCDB were coded according to the 2016 Facility Oncology Registry Data Standards Manual.²² Individual state-level data within the NCDB were made available to intramural researchers at the American Cancer Society, enabling analysis of the ACA Medicaid expansion status. The Medical University of South Carolina and Morehouse School of Medicine (Atlanta, GA) Institutional Review Boards deemed this study exempt from review because the data were deidentified.

In this retrospective cohort study, patients aged 18 to 64 years with HNSCC newly diagnosed between January 1, 2010, and December 31, 2016, who received all or part of their first course of treatment at the reporting facility were identified. Diagnoses of HNSCC were filtered with the *International Classification of Diseases for Oncology, Third Edition*,²³ topography codes for the oral cavity, oropharynx, hypopharynx, and larynx, as well as histology codes for SCC (eFigure in the Supplement).

Outcome Measures

Outcome measures included (1) health insurance coverage at diagnosis (uninsured, Medicaid, Medicare, or private insurance), (2) 7th edition AJCC²⁴ stage at diagnosis (localized [I-II] or advanced [III-IV]), and (3) TTI (time interval from diagnosis to treatment initiation). Follow-up for TTI was measured through the treatment date, end-of-study date (December 31, 2016), or 365 days, whichever occurred first.

The primary independent variables of interest were state-level ACA Medicaid expansion status and expansion period. Thirty-one states and the District of Columbia implemented Medicaid expansions by December 31, 2016. The Medicaid expansion period variable was categorized as pre-ACA (2010-2013) and post-ACA (2014-2016). For states that implemented the Medicaid expansion before or after January 2014, the pre-ACA and post-ACA periods were determined using the exact Medicaid expansion implementation date. We performed a sensitivity analysis subcategorizing Medicaid expansion states into early implementation (prior to 2014) and late

implementation (2014 or later). Because no differences in the associations between early and late expansion states and any of the outcome measures were observed, all expansion states were grouped together.

Sociodemographic covariates included race/ethnicity, age, diagnosis year, and income. For income, each patient's residence at the time of diagnosis was linked with zip code-level median family income in the NCDB (from the 2012 American Community Survey²⁵) as a proxy for patient-level family income. To categorize patients' income in relation to the federal poverty level (FPL), the zip code-level median income based on each state's determined income for the FPL for a family of 4 was recategorized as low income ($\leq 138\%$ of FPL), middle income (139%-400% of FPL), or high income ($>400\%$ of FPL).³ Patients with low income were eligible for Medicaid in expansion states, and patients with middle income qualified for premium tax credits on a marketplace health insurance plan. Clinical covariates included comorbidity (weighted Charlson-Deyo score²⁶) and tumor location.

Statistical Analysis

Statistical analysis was conducted from February 18 to November 8, 2019. We compared patients with HNSCC by state Medicaid expansion status using χ^2 tests. To evaluate the association of Medicaid expansion with insurance coverage, disease stage, and TTI, we used statistical methods for quasi-experimental studies, in which patients from expansion states are the intervention group and patients from nonexpansion states are the control group. We calculated the percentages of patients with different insurance coverage and disease stage at diagnosis before (2010-2013) and after (2014-2016) the implementation of the ACA by state Medicaid expansion status. We calculated the mean TTI using the Kaplan-Meier restricted mean survival time method.²⁷ We then implemented difference-in-differences (DD) analyses using crude and adjusted multivariable linear probability models to assess the magnitude of percentage change in the 2 periods by state Medicaid expansion status. The DD analyses, which compare preimplementation and postimplementation policy changes in expansion and nonexpansion states, control for state-level factors that may differ between expansion and nonexpansion states and confound associations between Medicaid expansion and study outcomes. For the adjusted DD, we accounted for age, race/ethnicity, and income level. To minimize bias due to patients who were diagnosed in 2013 and may have initiated therapy in 2014 after obtaining health insurance coverage through the ACA, our DD analyses incorporated a washout period for patients who received a diagnosis in the last quarter of 2013 and in the first quarter of 2014 among states with Medicaid expansion dates effective January 2014. In addition, for DD analysis of TTI, we excluded patients who received a diagnosis in the last 6 months of 2016 to ensure the completeness of treatment information. An additional sensitivity analysis was performed excluding 2010 (the year the ACA was passed) and 2014 (owing to concern that early adopters and the volatile health insurance market might bias results). Subset analyses were performed for patients with oropharynx cancer (OPC) stratified by human papillomavirus (HPV) status for

change in health insurance coverage (eTable 1 in the [Supplement](#)), disease stage (eTable 2 in the [Supplement](#)), and TTI (eTable 3 in the [Supplement](#)) to minimize confounding due to differences in epidemiologic characteristics between HPV and carcinogen-mediated HNSCC,^{28,29} poor stage discrimination for HPV-related OPC in the 7th edition AJCC,^{24,30} and evolving treatment paradigms for OPC.³¹ All *P* values were from 2-sided tests, and results were deemed statistically significant at *P* < .05. All statistical analyses were performed using SAS, version 9.4 software (SAS Institute Inc).

Results

Of the 90 789 nonelderly adults with newly diagnosed HNSCC (mean [SD] age, 54.7 [7.0] years), 70 907 (78.1%) were men, 72 911 (80.3%) were non-Hispanic white, 52 142 (57.4%) were between 55 and 64 years of age, and 54 940 (60.5%) resided in states with an ACA Medicaid expansion. The sociodemographic and clinical characteristics of the cohort are shown in [Table 1](#). Compared with those in Medicaid expansion states, patients with HNSCC living in nonexpansion states were disproportionately uninsured (12.9% vs 5.1%), low income ($\leq 138\%$ of FPL; 10.6% vs 7.4%), and non-Hispanic black (12.9% vs 8.2%).

[Table 2](#) shows the changes in health insurance coverage between the pre-ACA and post-ACA periods for Medicaid expansion and nonexpansion states. Despite the decreases in the percentage of uninsured patients with HNSCC in the post-ACA period, the absolute percentage of patients with newly diagnosed HNSCC without health insurance coverage remained high (8.2% in the post-ACA period). Between the pre-ACA and post-ACA periods, the percentage of uninsured patients with HNSCC decreased from 7.6% to 2.8% (absolute percentage change [APC], -4.7% [95% CI, -5.1% to -4.3%]) in expansion states and from 14.6% to 10.9% (APC, -3.6% [95% CI, -4.3% to -3.0%]) in nonexpansion states. However, the decreases did not differ significantly between expansion and nonexpansion states (adjusted DD, -0.6 percentage points [95% CI, -1.4 to 0.2 percentage points]). Compared with nonexpansion states, expansion states experienced a 4.6 percentage point greater increase in the percentage of patients with HNSCC with Medicaid insurance (adjusted DD, 4.6 percentage points [95% CI, 3.7-5.4 percentage points]) between the pre-ACA and post-ACA periods. The percentage of privately insured patients increased in both expansion states (APC, 2.0% [95% CI, 1.2%-2.8%]) and nonexpansion states (APC, 4.4% [95% CI, 3.4%-5.4%]). Sensitivity analysis excluding 2010 and 2014 did not alter these findings (eTable 4 in the [Supplement](#)).

A total of 70.9% of the overall cohort had AJCC stage III-IV disease. The percentage of patients with HNSCC with AJCC stage I or II disease decreased from the pre-ACA to post-ACA periods in both expansion and nonexpansion states. However, decreases were smaller in Medicaid expansion states, resulting in a relative increase in the percentage of patients with AJCC stage I or II disease compared with nonexpansion states (adjusted DD, 2.3 percentage points [95% CI, 1.1-3.5 percentage points]) ([Figure 1A](#)). In a subset analysis excluding patients with OPC to prevent confounding owing to poor stage

Table 1. Characteristics of Patients Aged 18 to 64 Years With a Diagnosis of Head and Neck Cancer, by State Medicaid Expansion Status, 2010 to 2016

Characteristic	Patients, No. (%)			P Value
	Total (N = 90 789)	Medicaid Expansion State (n = 54 940 [60.5%]) ^a	Medicaid Nonexpansion State (n = 35 849 [39.5%])	
Insurance				
Uninsured	7443 (8.2)	2807 (5.1)	4636 (12.9)	<.001
Medicaid	15 604 (17.2)	10 263 (18.7)	5341 (14.9)	
Medicare	11 066 (12.2)	6588 (12.0)	4478 (12.5)	
Private	56 676 (62.4)	35 282 (64.2)	21 394 (59.7)	
Diagnosis year				
2010	11 858 (13.1)	7079 (12.9)	4779 (13.3)	.03
2011	12 152 (13.4)	7325 (13.3)	4827 (13.5)	
2012	12 560 (13.8)	7504 (13.7)	5056 (14.1)	
2013	13 151 (14.5)	7947 (14.5)	5204 (14.5)	
2014	13 597 (15.0)	8305 (15.1)	5292 (14.8)	
2015	13 904 (15.3)	8540 (15.5)	5364 (15.0)	
2016	13 567 (14.9)	8240 (15.0)	5327 (14.9)	
Median income level				
Low (≤138% FPL)	7854 (8.7)	4048 (7.4)	3806 (10.6)	<.001
Middle (139%-400% FPL)	76 922 (84.7)	46 171 (84.0)	30 751 (85.8)	
High (>400% FPL)	6013 (6.6)	4721 (8.6)	1292 (3.6)	
Race/ethnicity				
Non-Hispanic white	72 911 (80.3)	44 717 (81.4)	28 194 (78.6)	<.001
Non-Hispanic black	9139 (10.1)	4514 (8.2)	4625 (12.9)	
Hispanic	3746 (4.1)	2156 (3.9)	1590 (4.4)	
Other or unknown	4993 (5.5)	3553 (6.5)	1440 (4.0)	
Age group, y				
18-44	7233 (8.0)	4220 (7.7)	3013 (8.4)	<.001
45-54	31 414 (34.6)	18 807 (34.2)	12 607 (35.2)	
55-64	52 142 (57.4)	31 913 (58.1)	20 229 (56.4)	
Sex				
Male	70 907 (78.1)	42 921 (78.1)	27 986 (78.1)	.84
Female	19 882 (21.9)	12 019 (21.9)	7863 (21.9)	
Comorbidity score				
0	72 942 (80.3)	44 455 (80.9)	28 487 (79.5)	<.001
1	13 489 (14.9)	7874 (14.3)	5615 (15.7)	
≥2	4358 (4.8)	2611 (4.8)	1747 (4.9)	
Primary site				
Oral cavity	22 167 (24.4)	13 371 (24.3)	8796 (24.5)	<.001
Hypopharynx	3829 (4.2)	2241 (4.1)	1588 (4.4)	
Larynx	21 718 (23.9)	12 926 (23.5)	8792 (24.5)	
Oropharynx (all)	43 075 (47.4)	26 402 (48.1)	16 673 (46.5)	
Oropharynx, HPV status				
Positive	17 445 (40.5)	11 186 (42.4)	6259 (37.5)	<.001
Negative	6721 (15.6)	3995 (15.1)	2726 (16.3)	
Unknown	18 909 (43.9)	11 221 (42.5)	7688 (46.1)	
Primary treatment				
Surgery with or without adjuvant RT or CRT	37 781 (41.6)	23 273 (42.4)	14 508 (40.5)	<.001
Definitive RT or CRT	53 008 (58.4)	31 667 (57.6)	21 341 (59.5)	

Abbreviations: CRT, chemoradiotherapy; FPL, federal poverty level; HPV, human papillomavirus; RT, radiotherapy.

^a Medicaid expansion states: Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Iowa, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and West Virginia.

discrimination for HPV-related OPC (Figure 1B), the percentage of patients with AJCC stage I or II disease increased in expansion states from 45.0% to 46.7% (APC, 1.7% [95% CI, 0.5% to 2.9%]) but decreased in nonexpansion states from 44.8% to 42.7% (APC, -2.2% [95% CI, -3.6% to -0.7%]; adjusted DD, 3.4 percentage points [95% CI, 1.5-5.2 percentage points]). After excluding patients with OPC, 55.0% of the patients in our study still presented with advanced-stage disease.

In our study, we noted a mean TTI of 84.3 days. Overall, the mean TTI did not differ between expansion and non-expansion states from the pre-ACA to post-ACA periods (Figure 2A), and improvements in TTI for the overall cohort were not statistically significant (adjusted DD, -12.7 percentage points [95% CI, -27.4 to 4.2 percentage points]). In contrast to the overall cohort, patients with nonoropharyngeal HNSCC experienced a significantly larger decrease in mean TTI

Table 2. Changes in Health Insurance Coverage Between the Pre-ACA and Post-ACA Periods Among Patients Aged 18 to 64 Years With a Diagnosis of Head and Neck Cancer by Medicaid Expansion Status

Health Insurance Coverage	Medicaid Expansion State ^a				Medicaid Nonexpansion State				DD, Percentage Points	
	2010 to ACA, %	ACA to 2016, %	Absolute Change, % (95% CI)	Relative Change, %	2010 to ACA, %	ACA to 2016, %	Absolute Change, % (95% CI)	Relative Change, %	Unadjusted	Adjusted ^b
Uninsured	7.6	2.8	-4.7 (-5.1 to -4.3)	-63.2	14.6	10.9	-3.6 (-4.3 to -3.0)	-25.3	-1.1 (-1.9 to -0.3)	-0.6 (-1.4 to 0.2)
Medicaid	16.9	20.0	3.1 (2.4 to 3.7)	18.3	15.7	13.8	-1.9 (-2.6 to -1.2)	-12.1	5.0 (4.0 to 6.0)	4.6 (3.7 to 5.4)
Medicare	12.2	11.8	-0.3 (-0.9 to 0.2)	-3.3	12.0	13.1	1.1 (0.4 to 1.8)	9.2	-1.5 (-2.4 to -0.6)	-0.8 (-1.8 to 0.1)
Private	63.3	65.3	2.0 (1.2 to 2.8)	3.2	57.7	62.1	4.4 (3.4 to 5.4)	7.6	-2.4 (-3.7 to -1.1)	-3.3 (-4.5 to -2.0)

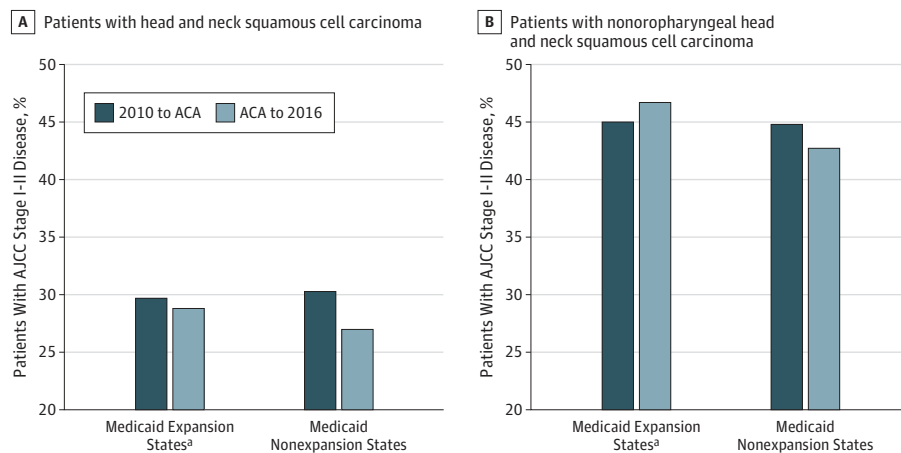
Abbreviations: ACA, Affordable Care Act; DD, difference in differences.

^a Medicaid expansion states: Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Iowa, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota,

Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and West Virginia.

^b Adjusted for diagnosis age, race/ethnicity, and income level.

Figure 1. Changes in Stage at Diagnosis Between the Pre-Affordable Care Act (ACA) and Post-ACA Period Among Patients Aged 18 to 64 Years by Medicaid Expansion Status in the United States



A, Patients with a diagnosis of head and neck squamous cell carcinoma. Change in Medicaid expansion states, -0.9% (95% CI, -1.7% to -0.1%); change in Medicaid nonexpansion states, -3.3% (95% CI, -4.2% to -2.3%); and difference in differences adjusted for diagnosis age, race/ethnicity, and income level, 2.3 percentage points (95% CI, 1.1-3.5 percentage points). B, Patients with a diagnosis of nonoropharyngeal head and neck squamous cell carcinoma. Change in Medicaid expansion states, 1.7% (95% CI, 0.5%-2.9%); change in Medicaid nonexpansion states, -2.2% (95% CI, -3.6% to -0.7%); and difference in differences adjusted for diagnosis age, race/ethnicity, and income level,

3.4 percentage points (95% CI, 1.5-5.2 percentage points).

^a Medicaid expansion states: Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Iowa, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and West Virginia.

in expansion states compared with nonexpansion states (adjusted DD, -26.5 percentage points [95% CI, -49.6 to -3.4 percentage points]). Between the pre-ACA and post-ACA periods, the mean TTI decreased for nonoropharyngeal HNSCC in Medicaid expansion states by 5.5 days but increased for OPC in both expansion and nonexpansion states (Figure 2B).

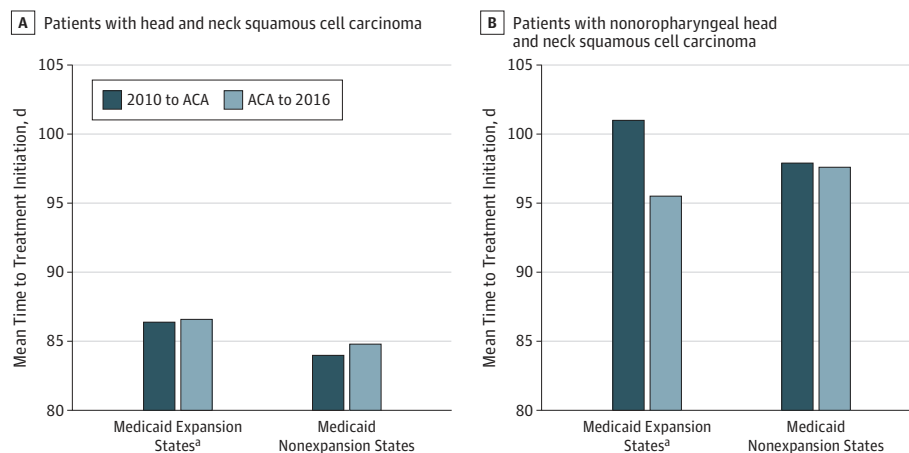
Discussion

Using a large, nationwide database, we evaluated the association of the ACA with insurance coverage, stage at diagnosis, and TTI for nonelderly patients with newly diagnosed HNSCC, a cancer with large disparities in access to care. We

found that Medicaid expansions were associated with a greater increase in Medicaid insurance coverage, increases in the percentage of patients with localized disease (AJCC stage I-II) for the overall cohort of patients with HNSCC and those with nonoropharyngeal HNSCC, and an improved mean TTI for nonoropharyngeal HNSCC. Prior studies have shown that Medicaid expansion under the ACA is associated with reductions in sociodemographic disparities in insurance coverage among patients with newly diagnosed cancer^{2,3}; our findings also highlight the potential for increasing geographical disparities between patients with HNSCC living in Medicaid expansion states and those living in nonexpansion states.

Consistent with prior research examining HNSCC¹³ and other cancers,²⁻⁷ we found that the ACA's Medicaid expan-

Figure 2. Changes in Time to Treatment Initiation Between the Pre-Affordable Care Act (ACA) and Post-ACA Period Among Patients Aged 18 to 64 Years by Medicaid Expansion Status in the United States



A, Patients with a diagnosis of head and neck squamous cell carcinoma. Change in Medicaid expansion states, 0.2 days (95% CI, -2.6 to 3.0 days); change in Medicaid nonexpansion states, 0.8 days (95% CI, -2.0 to 3.6 days); and difference in differences adjusted for diagnosis age, race/ethnicity, and income level, -12.7 percentage points (95% CI, -27.4 to 2.0 percentage points). B, Patients with a diagnosis of nonoropharyngeal head and neck squamous cell carcinoma. Change in Medicaid expansion states, -5.5% (95% CI, -8.3% to -2.8%); change in Medicaid nonexpansion states, -0.3% (95% CI, -3.1% to 2.5%); and difference in differences adjusted for diagnosis age, race/ethnicity,

and income level, -26.5 percentage points (95% CI, -49.6 to -3.4 percentage points).

^a Medicaid expansion states: Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Iowa, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and West Virginia.

sion was associated with decreases in the percentage of uninsured patients with newly diagnosed HNSCC. When comparing expansion states with nonexpansion states, there was no difference in the percentage of uninsured patients between the pre-ACA and post-ACA periods, primarily because the larger increase in Medicaid coverage in expansion states was matched by a relatively larger increase in private coverage in nonexpansion states. These findings likely are associated with the individual mandates and Healthcare Marketplace insurance options in nonexpansion states. Our results differ from those of Cannon et al,¹³ who demonstrated a decrease in the percentage of uninsured patients with HNSCC only in Medicaid expansion states (but not in nonexpansion states) in their analysis of the SEER database from 2007 to 2014. This difference may be associated with the larger sample size (all 50 states and the District of Columbia vs 13 states), the longer time horizon (up to 2016 vs 2014), the study populations (NCDB vs SEER), or the statistical analysis (adjusted DD and use of phase-in period) used in the present study.

Disease Stage at Diagnosis

Because there is no screening test for patients with HNSCC, access to care and health insurance coverage are critical for the timely detection of localized disease. We extend findings showing an association between Medicaid expansion and an increase in the percentage of patients with localized disease at diagnosis among cancers for which effective screening tests exist (eg, colorectal, cervical, and breast cancers)^{4,7,15-17} to demonstrate an association between increases in the percentage of Medicaid-insured patients with HNSCC in expansion states and an increase

in the percentage of patients with localized HNSCC at diagnosis. Although the underlying reason for the association cannot be known from our data, it is possible that there are some benefits of Medicaid over private insurance coverage for this population, such as no cost sharing for health care services. Alternatively, our data may suggest the importance of early evaluation of symptoms through a usual source of care. Interpreting our finding of a benefit in terms of an increase in localized diseases at diagnosis in expansion states can be complicated. Prior studies have demonstrated that patients with HNSCC with Medicaid insurance are more likely to present with advanced-stage HNSCC at diagnosis relative to patients with private insurance.³²⁻³⁴ Studies of other cancers have demonstrated that many uninsured patients with cancer and with low income gain Medicaid coverage only at or after their cancer diagnosis, and they may not have previously had prior access to a usual source of health care for screening recommendations or evaluation of signs and symptoms.³⁵⁻³⁷ A better understanding of the associations between Medicaid coverage continuity in low-income populations and timely evaluation of symptoms, as well as the stage of the disease and the treatment for those with a diagnosis of cancer, will be important.

Although the present study demonstrated that Medicaid expansion was associated with an increase in localized HNSCCs at diagnosis, 70.9% of the overall cohort had AJCC stage III-IV disease. The percentage of patients with localized HNSCC at diagnosis decreased over time in both expansion and nonexpansion states, likely owing primarily to the increasing incidence of HPV-related OPC³⁸ and the poor hazard discrimination of the 7th edition of the AJCC Staging Manual.^{24,30} However, after excluding patients with OPC, 55.0% of the patients in our study still

presented with advanced-stage disease. It is thus clear, regardless of the ACA, that advanced stage at presentation for HNSCC is common and, because of its very strong association with survival,³¹ a critically important problem. Further research is therefore required to better understand patient-, clinician-, and system-level barriers to early recognition and diagnosis to improve outcomes for patients with HNSCC.

Time to Treatment Initiation

Changes in the percentage of uninsured patients between the pre-ACA and post-ACA periods were not associated with a change in the TTI for patients with HNSCC overall, although significant differences in the TTI were noted after stratifying by OPC and Medicaid expansion status. Between the pre-ACA and post-ACA periods, the mean TTI decreased for non-opharyngeal HNSCC in Medicaid expansion states by 5.5 days but increased for OPC in both expansion and nonexpansion states. The clinical significance of improving the TTI by 5.5 days is unknown, but even small changes in the TTI from 7 to 13 days (relative to 1 to 6 days) are associated with a greater odds of T category upstaging and increased mortality for patients with HNSCC.³⁹ Improvements in the TTI for patients with non-opharyngeal HNSCC in Medicaid expansion states may be due to less time spent navigating the health care system for specialty care. That the TTI increased for patients with OPC regardless of state-level Medicaid expansion may be associated with the increasingly complicated treatment planning (eg, intensity-modulated radiotherapy⁴⁰) or treatment availability (eg, transoral robotic surgery) for these patients.⁴¹

Multiple studies have demonstrated a robust association between TTI and oncologic outcomes for patients with HNSCC,¹⁰ although the TTI continues to increase over time.⁴⁰ A TTI of more than 46 to 52 days introduces an excess risk of mortality for patients with HNSCC; additional delays are associated with progressive survival decrements.⁴² In our study, we noted a mean TTI of 84.3 days. Numerous factors beyond insurance coverage are associated with a prolonged TTI, including care fragmentation, treatment at academic centers, nonsurgical treatment, and African American race.⁴⁰ To alter a significantly prolonged TTI for patients with HNSCC, additional modifications of health care delivery beyond improvements in insurance coverage will likely be required (eg, improving transitions of care into academic and/or high-volume centers, streamlining the pretreatment diagnostic and staging evaluation, and reducing radiotherapy planning times).

Public Health and Policy Implications

This study has several important public health and policy implications. Despite the decreases in the percentage of uninsured patients with HNSCC in the post-ACA period, the absolute percentage of patients with newly diagnosed HNSCC without health insurance coverage remains high (8.2% in the post-ACA period) compared with patients with other cancers (eg, 2%-4% for breast cancer^{3,43}). The ACA, by itself, may be insufficient to address health insurance coverage for patients who develop HNSCC. Second, although the lack of health insurance coverage is a critical barrier for accessing care for many patients with HNSCC, delays and variations in the quality of care

delivery across the care continuum continue to be associated with suboptimal outcomes and high rates of mortality.^{10,12,44,45} Third, the data presented herein, in conjunction with data from numerous other studies examining the association of the ACA with health insurance coverage and the delivery of cancer care, can directly inform ongoing discussions about health insurance reform in the United States. We observed a 4-fold higher absolute percentage of uninsured patients with newly diagnosed HNSCC in nonexpansion states relative to expansion states in the post-ACA period (10.9% vs 2.8%) mainly owing to a higher baseline uninsured rate in nonexpansion states. Given the strong association between health insurance coverage and disease stage at diagnosis, treatment delays, and survival for patients with HNSCC, these trends may exacerbate existing regional and state-level disparities in access to care and outcomes. The results from this study and others that show the association of the ACA and selective Medicaid expansion with health insurance coverage and measures of access to care can be used by diverse stakeholders, including policy makers, health insurance companies, patients, and clinicians, to understand the clinical consequences following ACA reforms.

Strengths and Limitations

A major strength of our study is the use of a large, nationwide oncologic database with detailed information on sociodemographic, clinical, institutional, and treatment characteristics of patients with newly diagnosed HNSCC in all 50 states and the District of Columbia. Nevertheless, our study has some limitations. First, the NCDB is a hospital-based, not population-based, registry. However, because the NCDB covers 70% of patients with newly diagnosed cancer in the United States,¹⁹ the demographic characteristics of patients in the NCDB closely mirror those of SEER for HNSCC.²¹ Second, previously uninsured patients may enroll in Medicaid as a result of their cancer diagnosis and be recorded as having Medicaid coverage for the purposes of data collection.^{46,47} Any misclassification would understate the magnitude of the association between Medicaid expansion and changes in insurance coverage, disease stage at diagnosis, and TTI. Tumor HPV status was unknown for 44% of our patients, which limited our ability to analyze how associations of Medicaid expansions with changes in insurance coverage, disease stage, and TTI varied by HPV status. The NCDB lacks information about symptom type and duration to allow for classification of tumors as early or late in their development.⁴⁸ Limited follow-up for patients in the post-ACA period precludes analysis of associations between the ACA and changes in mortality for patients with HNSCC. Future research should therefore analyze the association of changes in health insurance coverage with oncologic outcomes. Last, health insurance coverage is only recorded once, and the association of coverage transitions and disruptions with outcomes cannot be assessed.

Conclusions

Medicaid expansions were associated with a significantly greater increase in the percentage of Medicaid-insured

patients with HNSCC, an increase in localized diseases at diagnosis for the overall cohort, and improved TTI for patients with nonoropharyngeal HNSCC. Selective state-level uptake of Medicaid expansion may exacerbate existing regional dis-

parities in access to care and outcomes among patients with HNSCC. As data mature, additional research addressing the associations of Medicaid expansions with disparities and survival after diagnosis is warranted.

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