








Association of Medicaid Expansion With Cancer Stage and Disparities in Newly Diagnosed Young Adults

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Abstract

Background: Young adults (YAs) experience higher uninsurance rates and more advanced stage at cancer diagnosis than older counterparts. We examined the association of the Affordable Care Act Medicaid expansion with insurance coverage and stage at diagnosis among YAs newly diagnosed with cancer. **Methods:** Using the National Cancer Database, we identified 309 413 YAs aged 18-39 years who received a first cancer diagnosis in 2011-2016. Outcomes included percentages of YAs without health insurance at diagnosis, with stage I (early-stage) diagnoses, and with stage IV (advanced-stage) diagnoses. We conducted difference-in-difference (DD) analyses to examine outcomes before and after states implemented Medicaid expansion compared with nonexpansion states. All statistical tests were 2-sided. **Results:** The percentage of uninsured YAs decreased more in expansion than nonexpansion states (adjusted DD = -1.0 percentage points [ppt], 95% confidence interval [CI] = -1.4 to -0.7 ppt, $P < .001$). The overall percentage of stage I diagnoses increased (adjusted DD = 1.4 ppt, 95% CI = 0.6 to 2.2 ppt, $P < .001$) in expansion compared with nonexpansion states, with greater improvement among YAs in rural areas (adjusted DD = 7.2 ppt, 95% CI = 0.2 to 14.3 ppt, $P = .045$) than metropolitan areas (adjusted DD = 1.3 ppt, 95% CI = 0.4 to 2.2 ppt, $P = .004$) and among non-Hispanic Black patients (adjusted DD = 2.2 ppt, 95% CI = -0.03 to 4.4 ppt, $P = .05$) than non-Hispanic White patients (adjusted DD = 1.4 ppt, 95% CI = 0.4 to 2.3 ppt, $P = .008$). Despite the non-statistically significant change in stage IV diagnoses overall, the percentage declined more (adjusted DD = -1.2 ppt, 95% CI = -2.2 to -0.2 ppt, $P = .02$) among melanoma patients in expansion relative to nonexpansion states. **Conclusions:** We provide the first evidence, to our knowledge, on the association of Medicaid expansion with shifts to early-stage cancer at diagnosis and a narrowing of rural-urban and Black-White disparities in YA cancer patients.

Cancer is the leading disease causing death among young adults (YAs) in the United States (1). An estimated 83 700 YAs aged 20-39 years were diagnosed with cancer in the United States in 2020 (2). Compared with other age groups, YAs often experience higher uninsurance rates and present with more advanced stage of cancer at diagnosis (3,4). Among YA patients with cancer, those uninsured or underinsured, who are disproportionately concentrated in racial or ethnic minority YAs often present with advanced-stage disease and have inferior survival outcomes (5-7). Expanding health insurance coverage may improve access to care for timely detection, diagnosis, and treatment of cancer.

The Affordable Care Act (ACA) contains multiple provisions to enhance health insurance coverage for YA populations. Notably, the 2010 Dependent Coverage Expansion extended coverage up to age 26 years in all states, and Medicaid expansion encouraged states to expand Medicaid coverage to all low-income adults (8), including the entire age spectrum of YAs as defined by the National Cancer Institute (9). As of March 2021, 39 states (including Washington, DC) had opted to expand Medicaid through the ACA (10).

A growing body of research has shown insurance coverage gains associated with the ACA Medicaid expansion in patients aged younger than 65 years (11-17). However, findings of the

few studies examining the downstream effect of Medicaid expansion on cancer stage at diagnosis or cancer survival in non-elderly patients are mixed (11–17). For example, whereas 2 analyses reported an increase in early-stage diagnoses in the first year post ACA (13,16), a more recent study found no change in breast cancer presentation in the 2-year period following ACA implementation (18). The short post ACA time used in many studies may explain, at least in part, the mixed findings because the health impact of policy changes may require longer time to manifest.

Notably, no studies to our knowledge have assessed the association of Medicaid expansion specifically among YAs with cancer, a group not age-eligible for application of most screening guidelines that affect early stage at presentation (ie, breast, colorectal, or lung cancer screening) (19). Insurance coverage for access to timely physical examination and diagnostic testing is essential to promptly recognize symptoms and identify cancer at an early stage for YAs. Although several studies focusing on nonelderly patients showed a narrowing of sociodemographic disparities in insurance coverage in states that expanded Medicaid (13,17,20), there have not been YA age group-specific analyses. The impact of Medicaid expansion on gaps in YAs' insurance coverage and cancer stage is poorly understood. Historically, this age group experienced disparities in health insurance coverage by race or ethnicity and rurality (21,22).

To fill these knowledge gaps, we used national data before and after the ACA to examine the association of Medicaid expansion with changes in insurance coverage and disease stage at initial diagnosis among YAs newly diagnosed with cancer, overall and by sociodemographic factors.

Methods

Data Source and Study Sample

We analyzed the 2011–2016 data from the National Cancer Database (NCDB), a hospital-based cancer registry cosponsored by the American College of Surgeons Commission on Cancer and the American Cancer Society (23). The NCDB provides sociodemographic, diagnosis, and treatment information for newly diagnosed cancer patients across the United States and accounts for over 70% of all incident cancer patients in the country (23). The use of the NCDB for this study was deemed exempt by the institutional review board of the Morehouse School of Medicine in Atlanta, Georgia.

We identified all male or female YA patients aged 18–39 years who were newly diagnosed with a first primary cancer between January 1, 2011, and December 31, 2016, in the United States. Patients with incomplete information on diagnosis date necessary to determine pre- or postexpansion status or with noninvasive (stage 0) cancers were excluded. These criteria yielded 309 413 patients for the analysis of health insurance coverage. For the analysis of stage at diagnosis, we restricted to 245 135 patients following additional exclusion of 1) 40 643 patients diagnosed with cancers without an applicable American Joint Committee Classification (AJCC) staging scheme (24) (eg, brain tumor, leukemia) and 2) 23 635 patients with testis cancer due to high percentages (12%–30% after 2014) of unknown stage observed exclusively among testis cancer patients. Notably, patients with unknown stage (5%) of all other cancers were included in our main analysis, because unknown stage often reflects a lack of staging evaluation. A sensitivity analysis excluding these patients was performed as a robustness check.

Outcome Measures

Primary outcomes are health insurance coverage and stage at cancer diagnosis. The NCDB provides information on patient primary payer or insurance carrier at the time of cancer diagnosis. Based on this information, patients were categorized as having no health insurance, Medicaid coverage, private insurance (including TRICARE and military), or other insurance (Medicare including dual-eligible and with supplement, Veterans Affairs, Indian or Public Health Service, or unknown).

Disease stage at diagnosis in the NCDB was categorized based on pathological stage or clinical stage if pathological stage was missing or unknown according to the AJCC tumor, nodes, and metastases staging scheme (24). Two dichotomous variables were derived to indicate whether YAs had stage I (early-stage) cancer and stage IV (advanced-stage) cancer at diagnosis according to the AJCC staging scheme.

Covariates

Sociodemographic factors included sex, age group (18–25 years, 26–34 years, 35–39 years), self-reported race or ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic others, unknown race or ethnicity), and residence metropolitan statistical area (MSA) status (metropolitan, non-MSA urban, non-MSA rural, unknown). Consistent with previous studies (11,14), zip code-level median household income was used as a proxy of patient-level family income and converted to percent of the federal poverty level (FPL) by assuming a family size of 4. Income was then classified as low ($\leq 138\%$ of FPL), middle (139%–400% of FPL), or high ($> 400\%$ of FPL).

Statistical Analysis

We applied the difference-in-difference (DD) method to examine changes in the percentages of patients who had no insurance, Medicaid, or private insurance at diagnosis and the percentages of stage I diagnoses or stage IV diagnoses before and after the implementation of the expansion in states that expanded Medicaid coverage (“expansion states”) compared with states that did not (“nonexpansion states”). The DD method accounts for secular trends and common shocks (eg, provisions affecting all states) that may confound the association between Medicaid expansion and study outcomes (25,26).

More specifically, our DD analysis included 32 expansion states. Between January 2011 and December 2016 (our study period), 24 states and Washington, DC had expanded Medicaid by January 2014 and 7 states expanded later (Michigan: April 1, 2014; New Hampshire: August 15, 2014; Pennsylvania: January 1, 2015; Indiana: February 1, 2015; Alaska: September 1, 2015; Montana: January 1, 2016; Louisiana: July 1, 2016) (27). We also included 19 nonexpansion states that did not implement the expansion at any point during our study period. Medicaid expansion status was determined based on patients' residence by state.

Consistent with prior studies (28–30), the years 2011 through 2013 were designated as the preexpansion period and 2014 through 2016 as the postexpansion period for states that expanded Medicaid in January 2014 and for nonexpansion states. For states that expanded Medicaid after January 2014, we used the month of the state's implementation of Medicaid expansion as the beginning of the postexpansion period.

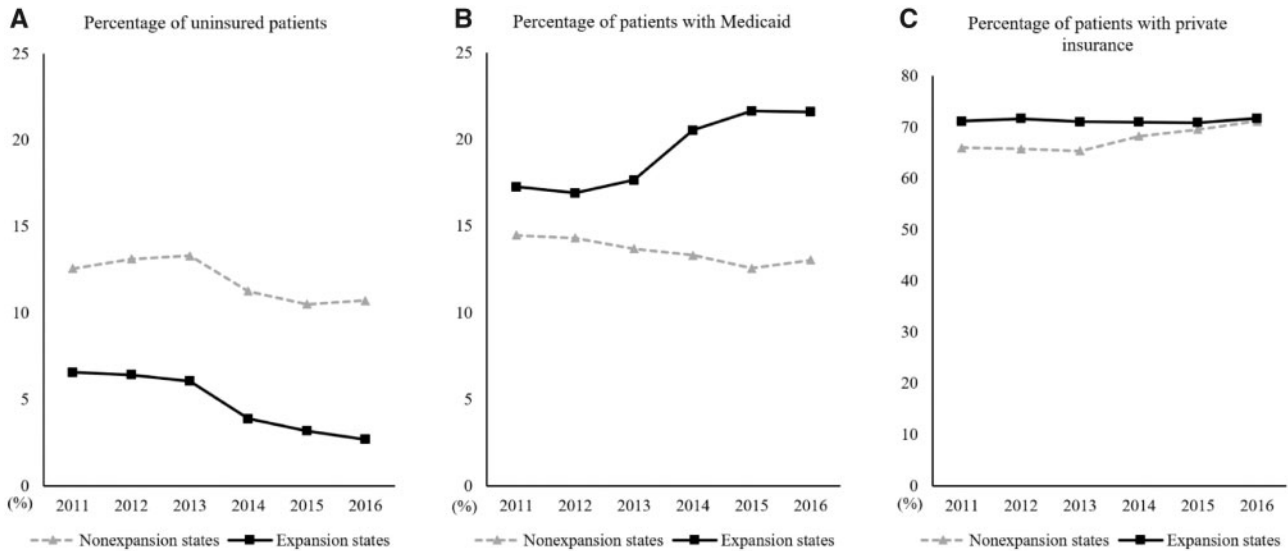


Figure 1. Trends in the percentages of uninsured patients, patients with Medicaid, and patients with private insurance among newly diagnosed cancer patients aged 18-39 years in Medicaid expansion states vs nonexpansion states, 2011-2016. A) The trend in the percentage of uninsured patients. B) The trend in the percentage of patients with Medicaid. C) The trend in the percentage of patients with private insurance.

An assumption of the DD method is parallel trends between expansion and nonexpansion states in the preexpansion period (25). We tested this assumption graphically (Figures 1 and 2) and by performing a falsification test as suggested in previous DD studies (11,31). Non-statistically significant difference in outcomes between expansion and nonexpansion states when a pseudo-policy change year was used (detailed in Supplementary Table 1, available online) supported the parallel trends assumption, except in the cases of percentage uninsured and percentage with Medicaid where slightly divergent trends began preexpansion. This could be partly accounted for by including the secular trend in DD models (32).

Linear probability models were used in DD analysis (33). Crude percentages, pre-post differences, and crude and adjusted DD were estimated. Adjusted DD was calculated

controlling for sex, age group, race or ethnicity, zip code-level income, and MSA. Consistent with prior DD analyses (32), we further adjusted for preexpansion linear time trends given the nonparallel trends in percentage uninsured and percentage with Medicaid. We also included residence state as a random effect to account for within-state clustering, consistent with previous studies on Medicaid expansion and health-care outcomes (28,34,35). DD analyses were conducted for YA patients overall and stratified by sociodemographic factors (ie, age groups, race or ethnicity, zip code-level income, and residence MSA status) to examine the differential effects of Medicaid expansion across YA subpopulations. When examining the expansion-associated change in cancer stage at diagnosis, DD analyses were performed for all cancers combined and then by cancer type for the 10 most prevalent cancers among the US YA population.

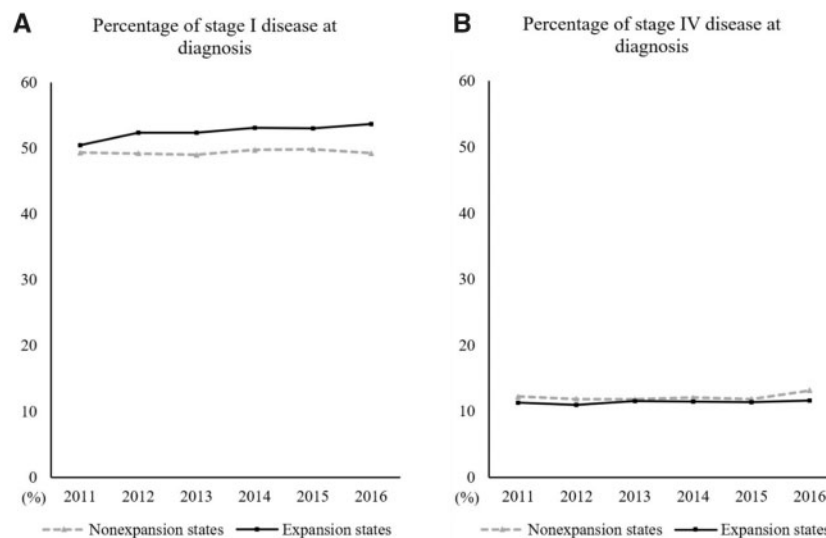


Figure 2. Trends in the percentage of stage I disease at diagnosis and the percentage of stage IV disease at diagnosis among newly diagnosed young adult cancer patients aged 18-39 years in Medicaid expansion states vs nonexpansion states, 2011-2016. A) The trend in the percentage of stage I disease at diagnosis. B) The trend in the percentage of stage IV disease at diagnosis.

Table 1. Characteristics of newly diagnosed young adult cancer patients aged 18-39 years, 2011-2016^a

Characteristics	Total, No. (%)	Medicaid expansion states, No. (%)	Nonexpansion states, No. (%)	p ^b
Total No.	309 413	193 109	116 304	
Sex				<.001
Male	114 901 (37.1)	72 386 (37.5)	42 515 (36.6)	
Female	194 512 (62.9)	120 723 (62.5)	73 789 (63.4)	
Age, y				<.001
18-25	54 366 (17.6)	34 733 (18.0)	19 633 (16.9)	
26-34	133 945 (43.3)	83 763 (43.4)	50 182 (43.1)	
35-39	121 102 (39.1)	74 613 (38.6)	46 489 (40.0)	
Race or ethnicity				<.001
Non-Hispanic White	208 684 (67.4)	132 768 (68.8)	75 916 (65.3)	
Non-Hispanic Black	36 668 (11.9)	18 333 (9.5)	18 335 (15.8)	
Hispanic	40 033 (12.9)	24 243 (12.6)	15 790 (13.6)	
Non-Hispanic other	20 273 (6.6)	15 040 (7.8)	5233 (4.5)	
Unknown	3755 (1.2)	2725 (1.4)	1030 (0.9)	
Zip code-level median household income				<.001
Low (≤138 FPL)	22 314 (7.2)	12 098 (6.3)	10 216 (8.8)	
Middle (139-400 FPL)	258 544 (83.6)	159 592 (82.6)	98 952 (85.1)	
High (>401 FPL)	27 085 (8.8)	20 259 (10.5)	6826 (5.9)	
Unknown	1470 (0.5)	1160 (0.6)	310 (0.3)	
Residence MSA status				<.001
Metropolitan	262 625 (84.9)	166 841 (86.4)	95 784 (82.4)	
Non-MSA urban	35 022 (11.3)	19 414 (10.1)	15 608 (13.4)	
Non-MSA rural	3786 (1.2)	1716 (0.9)	2070 (1.8)	
Unknown	7980 (2.6)	5138 (2.7)	2842 (2.4)	
Year of cancer diagnosis				.02
2011	49 203 (15.9)	30 674 (15.9)	18 529 (15.9)	
2012	50 570 (16.3)	31 280 (16.2)	19 290 (16.6)	
2013	51 331 (16.6)	32 138 (16.6)	19 193 (16.5)	
2014	52 573 (17.0)	33 046 (17.1)	19 527 (16.8)	
2015	53 438 (17.3)	33 246 (17.2)	20 192 (17.4)	
2016	52 298 (16.9)	32 725 (16.9)	19 573 (16.8)	
Cancer stage at diagnosis				<.001
I	139 855 (45.2)	89 478 (46.3)	50 377 (43.3)	
II	49 335 (15.9)	30 416 (15.8)	18 919 (16.3)	
III	35 399 (11.4)	21 507 (11.1)	13 892 (11.9)	
IV	28 628 (9.3)	17 397 (9.0)	11 231 (9.7)	
Unknown ^c	15 553 (5.0)	9465 (4.9)	6088 (5.2)	
Not applicable ^d	40 643 (13.1)	24 846 (12.9)	15 797 (13.6)	
Cancer site				<.001
Thyroid	55 048 (17.8)	36 403 (18.9)	18 645 (16.0)	
Female breast	46 687 (15.1)	28 525 (14.8)	18 162 (15.6)	
Testis	23 699 (7.7)	15 504 (8.0)	8195 (7.0)	
Melanoma	20 554 (6.6)	13 303 (6.9)	7251 (6.2)	
Colon or rectum	15 161 (4.9)	9121 (4.7)	6040 (5.2)	
Non-Hodgkin lymphoma	15 225 (4.9)	9569 (5.0)	5656 (4.9)	
Cervix	14 445 (4.7)	8171 (4.2)	6274 (5.4)	
Hodgkin lymphoma	14 600 (4.7)	9298 (4.8)	5302 (4.6)	
Other	103 994 (33.6)	63 215 (32.7)	40 779 (35.1)	
Brain or other nervous system	14 168 (4.6)	8785 (4.5)	5383 (4.6)	
Leukemia	13 766 (4.4)	8381 (4.3)	5385 (4.6)	
Kidney	10 375 (3.4)	6140 (3.2)	4235 (3.6)	
Uterus	8007 (2.6)	4708 (2.4)	3299 (2.8)	
Soft tissue including heart	7048 (2.3)	4299 (2.2)	2749 (2.4)	
Lung	4502 (1.5)	2758 (1.4)	1744 (1.5)	
Ovary	6204 (2.0)	3777 (2.0)	2427 (2.1)	
Oral cavity or pharynx	5981 (1.9)	3647 (1.9)	2334 (2.0)	
Bones or joints	3299 (1.1)	1952 (1.0)	1347 (1.2)	
Stomach	3028 (1.0)	1912 (1.0)	1116 (1.0)	
All other rare cancers	22 249 (7.2)	13543 (7.0)	8706 (7.5)	

^a Authors' analysis of the 2011-2016 National Cancer Database. FPL = federal poverty level; MSA = metropolitan statistical area.

^b P values were from 2-sided χ^2 tests.

^c Included patients (<0.1%) with occult stage.

^d Cancers without an applicable American Joint Committee Classification (AJCC) staging scheme; these cancers were excluded in our analysis of stage at diagnosis.

Table 2. Changes in health insurance coverage associated with Medicaid expansion among newly diagnosed young adult cancer patients aged 18-39 years, 2011-2016^a

Outcomes	Expansion states			Nonexpansion states			Crude model		Adjusted model ^b	
	Pre-ME, %	Post-ME, %	Absolute difference (95% CI), ppt	Pre-ME, %	Post-ME, %	Absolute difference (95% CI), ppt	DD (95% CI), ppt	P ^c	DD (95% CI), ppt	P ^c
Uninsured	6.3	3.0	-3.2 (-3.4 to -3.1)	13.0	10.8	-2.2 (-2.6 to -1.8)	-1.1 (-1.5 to -0.7)	<.001	-1.0 (-1.4 to -0.7)	<.001
Medicaid	17.1	21.7	4.6 (4.3 to 5.0)	14.1	13.0	-1.2 (-1.6 to -0.8)	5.8 (5.3 to 6.3)	<.001	5.4 (4.8 to 5.9)	<.001
Private	71.4	71.0	-0.4 (-0.8 to 0.02)	65.7	69.7	4.0 (3.4 to 4.5)	-4.4 (-5.0 to -3.7)	<.001	-4.2 (-4.8 to -3.5)	<.001

^a Authors' analysis of the 2011-2016 National Cancer Database. CI = confidence interval; DD = difference in difference; ME = Medicaid expansion; ppt = percentage points.

^b Adjusted model: regression models also adjusted for age, sex, race or ethnicity, zip code-level income, residence metropolitan statistical area status, and linear time trends as well as state adjusted as a random effect.

^c P values were calculated from linear probability regression models and reflect 2-sided test of statistical significance.

P values from χ^2 tests and regression models for crude and adjusted DD were calculated. All results were determined as statistically significant at $P < .05$. All statistical tests were 2-sided.

Results

Sample Characteristics

Of the 309 413 YAs, more than one-half were female (62.9%) and non-Hispanic White (67.4%), and nearly one-half (43.3%) were aged 26-34 years (Table 1). The most common types of cancer among YA patients were thyroid, female breast, testis, melanoma, colon or rectum, cervix, brain or other nervous system, and hematologic cancers.

Sociodemographic characteristics differed by state's expansion status. Compared with YAs residing in expansion states, those in nonexpansion states were more likely to be non-Hispanic Black (15.8% vs 9.5%, $P < .001$) and to reside in zip codes with low-income level (8.8% vs 6.3%, $P < .001$) and less likely to reside in metropolitan areas (82.4% vs 86.4%, $P < .001$).

Expansion-Associated Changes in Insurance Coverage

From the preexpansion to postexpansion periods, the percentage of YAs with Medicaid increased (absolute percentage change [APC] = 4.6 percentage points [ppt]; 95% confidence interval [CI] = 4.3 to 5.0 ppt) in expansion states and decreased in nonexpansion states (APC = -1.2 ppt, 95% CI = -1.6 to -0.8 ppt); in contrast, the percentage of privately insured YAs did not change in expansion states and increased (APC = 4.0 ppt, 95% CI = 3.4 to 4.5 ppt) in nonexpansion states (Table 2; Figure 1). Consequently, the percentage of uninsured YAs decreased more in expansion states (APC = -3.2 ppt, 95% CI = -3.4 to -3.1 ppt) than nonexpansion states (APC = -2.2 ppt, 95% CI = -2.6 to -1.8 ppt), resulting in a relative reduction of 1.0 ppt (95% CI = -1.4 to -0.7 ppt, $P < .001$) in the percentage of uninsured YAs in expansion compared with nonexpansion states in adjusted DD models.

In stratified analyses, the changes in insurance coverage were observed across YA subgroups by race or ethnicity, levels of zip code income, MSA status, and age groups (Supplementary Table 2, available online). Specifically, the expansion-associated reductions in the percentage of uninsured YAs were larger in magnitude among non-Hispanic Black and Hispanic (vs non-Hispanic White) patients, rural (vs urban) areas, and poorer areas.

Expansion-Associated Changes in Stage at Diagnosis

Overall, the percentage of YAs with stage I disease at diagnosis did not change in nonexpansion states; in contrast, it increased from 51.6% to 53.5% in expansion states (APC = 1.9 ppt, 95% CI = 1.4 to 2.4 ppt) from the preexpansion to postexpansion periods (Table 3; Figure 2). This resulted in an increase (adjusted DD = 1.4 ppt, 95% CI = 0.6 to 2.2 ppt, $P < .001$) in the percentage of stage I diagnoses in expansion states compared with nonexpansion states. No statistically significant change was observed in the percentage of stage IV diagnoses in expansion relative to nonexpansion states (Table 4; Figure 2; Supplementary Table 3, available online).

In subgroup analyses by cancer type, DD estimates showed a relative increase in stage I diagnoses in expansion compared with nonexpansion states across specific cancer types, except

Table 3. Changes in the percentage of stage I disease at diagnosis associated with Medicaid expansion among newly diagnosed young adult cancer patients aged 18-39 years, 2011-2016^{a,b}

Cancer site	Expansion states			Nonexpansion states			Crude model		Adjusted model ^c	
	Pre-ME, %	Post-ME, %	Absolute difference (95% CI), ppt	Pre-ME, %	Post-ME, %	Absolute difference (95% CI), ppt	DD (95% CI), ppt	P ^d	DD (95% CI), ppt	P ^d
All cancer types combined	51.6	53.5	1.9 (1.4 to 2.4)	49.1	49.6	0.4 (-0.2 to 1.1)	1.4 (0.6 to 2.2)	<.001	1.4 (0.6 to 2.2)	<.001
Thyroid	91.3	94.3	3.0 (2.5 to 3.6)	88.6	92.0	3.4 (2.6 to 4.3)	-0.4 (-1.4 to 0.6)	.43	-0.7 (-1.6 to 0.3)	.18
Female breast	32.2	34.9	2.7 (1.6 to 3.8)	32.4	33.2	0.8 (-0.5 to 2.2)	1.9 (0.1 to 3.6)	.04	1.8 (0.03 to 3.5)	.046
Melanoma	67.8	69.5	1.7 (0.1 to 3.2)	64.8	64.7	-0.2 (-2.4 to 2.0)	1.8 (-0.9 to 4.5)	.18	2.0 (-0.6 to 4.7)	.13
Colon and rectum	17.0	17.4	0.4 (-1.1 to 2.0)	15.9	15.4	-0.5 (-2.4 to 1.3)	0.9 (-1.5 to 3.3)	.45	0.9 (-1.6 to 3.3)	.49
Non-Hodgkin lymphoma	31.0	30.7	-0.3 (-2.2 to 1.6)	28.9	28.4	-0.5 (-2.9 to 1.9)	0.2 (-2.8 to 3.2)	.90	0.2 (-2.8 to 3.2)	.89
Cervix	62.1	61.4	-0.7 (-2.8 to 1.4)	58.5	57.3	-1.2 (-3.7 to 1.2)	0.5 (-2.7 to 3.8)	.74	0.3 (-3.0 to 3.5)	.87
Hodgkin lymphoma	10.1	9.8	-0.3 (-1.5 to 0.9)	11.7	10.1	-1.6 (-3.3 to 0.05)	1.3 (-0.8 to 3.4)	.21	1.3 (-0.8 to 3.3)	.23
Other	44.4	45.5	1.0 (0.02 to 2.0)	45.2	45.3	0.2 (-1.1 to 1.4)	0.8 (-0.7 to 2.4)	.30	1.1 (-0.5 to 2.7)	.16

^a Authors' analysis of the 2011-2016 National Cancer Database. CI = confidence interval; DD = difference in difference; ME = Medicaid expansion; ppt = percentage points.

^b Cases without applicable stages (eg, leukemia, brain tumor) were excluded. Testicular cancer cases were excluded due to high percentage of unknown stage observed exclusively among patients with testicular cancer.

^c Adjusted model: regression models also adjusted for age, sex, race or ethnicity, zip code-level income, residence metropolitan statistical area status, and linear time trends as well as state adjusted as a random effect.

^d P values were calculated from linear probability regression models and reflect 2-sided test of statistical significance.

for thyroid; yet, the positive estimate was statistically significant only for female breast cancer (adjusted DD = 1.8 ppt, 95% CI = 0.03 to 3.5 ppt, $P = .046$) (Table 3). DD models also showed a statistically significant decrease in stage IV melanoma diagnoses (adjusted DD = -1.2 ppt, 95% CI = -2.2 to -0.2 ppt, $P = .02$) and a marginally statistically significant decrease in stage IV cervix cancer diagnoses (adjusted DD = -1.6 ppt, 95% CI = -3.3 to 0.1 ppt, $P = .06$) in expansion relative to nonexpansion states (Table 4).

In subgroup analyses by sociodemographic factors, expansion-associated changes in the percentage of stage I diagnoses varied across YA subgroups by age category, race or ethnicity, or residence MSA status (Table 5). Increases in stage I diagnoses were observed across all subgroups in expansion states and in most subgroups in nonexpansion states, although not all were statistically significant. Specifically, in expansion states, the percentage of stage I diagnoses increased the most among non-Hispanic Black patients (APC = 2.1 ppt [95% CI = 0.5 to 3.6 ppt] vs 1.8 ppt in both non-Hispanic White [95% CI = 1.2 to 2.4 ppt] and Hispanic patients [95% CI = 0.3 to 3.2 ppt]) and among YAs residing in rural areas (APC = 6.4 ppt [95% CI = 1.1 to 11.7 ppt] vs 1.8 ppt [95% CI = 1.3 to 2.4 ppt] in those residing in metropolitan areas). In contrast, in nonexpansion states, non-statistically significant changes were observed across these subgroups. Consequently, the relative increase in stage I diagnoses in expansion compared with nonexpansion states was larger in magnitude among non-Hispanic Black patients (adjusted DD = 2.2 ppt, 95% CI = -0.03 to 4.4 ppt, $P = .05$) than non-Hispanic White patients (adjusted DD = 1.4 ppt, 95% CI = 0.4 to 2.3 ppt, $P = .008$) and among YAs living in rural areas (adjusted DD = 7.2 ppt, 95% CI = 0.2 to 14.3 ppt, $P = .045$) compared with those living in metropolitan areas (adjusted DD = 1.3 ppt, 95% CI = 0.4 to 2.2 ppt, $P = .004$). Notably, DD models showed no statistically significant change ($P > .1$) in stage I diagnoses among Hispanic patients. Moreover, among YAs, we observed a larger expansion-associated shift to stage I diagnoses in younger patients aged 18-25 years (adjusted DD = 3.1 ppt, 95% CI = 1.0 to 5.1 ppt) compared with those aged 26-34 years (adjusted DD = 1.6 ppt, 95% CI = 0.3 to 2.8 ppt) and aged 35-39 years (adjusted DD = 0.6 ppt, 95% CI = -0.6 to 1.9 ppt).

Findings were similar in the sensitivity analysis that excluded patients with unknown stage (Supplementary Tables 4-7, available online).

Discussion

Using a nationwide large sample of YAs newly diagnosed with cancer, our DD analyses demonstrated a statistically significant reduction in the percentage of uninsured YA patients associated with Medicaid expansion. Medicaid coverage gains in expansion states were greater than private insurance gains in nonexpansion states (potentially through private coverage options under the ACA) (8). Moreover, DD analyses revealed an expansion-associated shift to presentation with early stage at diagnosis, especially among YAs living in rural areas and non-Hispanic Black patients. Importantly, our findings of reduced disparities in expansion states suggest a widening of geographic disparities between YA cancer patients residing in expansion states and those residing in nonexpansion states.

These findings are consistent with cancer-specific studies reporting reductions in noninsurance following Medicaid expansion (11,12,17) and the few studies reporting increases in early-stage diagnoses among patients younger than 65 years old (13,16). For example, Medicaid expansion was associated with small increases in early-stage diagnoses among nonelderly cancer patients during the first year following expansion (13). However, the magnitude of the association was larger in our study, likely reflecting a longer time horizon postexpansion, different data sources, and the specific impact on a younger population for which most screening guidelines do not exist. In particular, our study focused on YAs aged 18-39 years, a population with the highest uninsurance rate across age groups before the ACA (36).

Given the lower overall incidence of cancer in YAs compared with older adults, there are no regular screening guidelines (ie, mammograms, colorectal screening) for common cancers in the YA population. The notable exception is the application of Pap smears and human papillomavirus screening for early detection of cervical cancer (19). Accordingly, the shift toward stage I

Table 4. Changes in the percentage of stage IV disease at diagnosis associated with Medicaid expansion among newly diagnosed young adult cancer patients aged 18–39 years, 2011–2016^{a,b}

Cancer site	Expansion states			Nonexpansion states			Crude model		Adjusted model ^c	
	Pre-ME, %	Post-ME, %	Absolute difference (95% CI), ppt	Pre-ME, %	Post-ME, %	Absolute difference (95% CI), ppt	DD (95% CI), ppt	P ^d	DD (95% CI), ppt	P ^d
All cancer types combined	11.3	11.4	0.1 (–0.2 to 0.4)	12.0	12.4	0.4 (–0.03 to 0.8)	–0.3 (–0.8 to 0.2)	.24	–0.4 (–0.9 to 0.1)	.14
Thyroid	0.3	0.4	0.01 (–0.1 to 0.1)	0.4	0.4	–0.03 (–0.2 to 0.1)	0.03 (–0.2 to 0.2)	.76	0.03 (–0.2 to 0.2)	.79
Female breast	5.9	6.2	0.2 (–0.3 to 0.8)	5.9	6.7	0.8 (0.1 to 1.5)	–0.5 (–1.4 to 0.4)	.24	–0.5 (–1.4 to 0.4)	.28
Melanoma	2.9	3.2	0.3 (–0.3 to 0.8)	2.9	4.3	1.4 (0.5 to 2.2)	–1.1 (–2.2 to –0.1)	.04	–1.2 (–2.2 to –0.2)	.02
Colon and rectum	26.4	26.8	0.4 (–1.4 to 2.2)	27.2	27.7	0.5 (–1.8 to 2.8)	–0.1 (–3.0 to 2.8)	.94	0.1 (–2.8 to 3.0)	.97
Non-Hodgkin lymphoma	30.9	32.0	1.1 (–0.8 to 3.0)	32.3	32.8	0.6 (–1.9 to 3.0)	0.5 (–2.6 to 3.6)	.74	0.6 (–2.5 to 3.7)	.72
Cervix	6.9	6.7	–0.2 (–1.3 to 0.9)	6.3	7.6	1.4 (0.1 to 2.6)	–1.6 (–3.3 to 0.1)	.06	–1.6 (–3.3 to 0.1)	.06
Hodgkin lymphoma	17.8	20.1	2.3 (0.7 to 3.9)	18.1	19.3	1.1 (–1.0 to 3.2)	1.2 (–1.5 to 3.8)	.39	1.4 (–1.2 to 4.0)	.29
Other	19.7	18.8	–0.9 (–1.7 to –0.1)	19.5	19.0	–0.5 (–1.4 to 0.5)	–0.4 (–1.7 to 0.8)	.49	–0.7 (–2.0 to 0.5)	.25

^a Authors' analysis of the 2011–2016 National Cancer Database. CI = confidence interval; DD = difference in difference; ME = Medicaid expansion; ppt = percentage points.

^b Cases without applicable stages (eg, leukemia, brain tumor) were excluded. Testicular cancer cases were excluded due to high percentage of unknown stage observed exclusively among patients with testicular cancer.

^c Adjusted model: regression models also adjusted for age, sex, race or ethnicity, zip code-level income, residence metropolitan statistical area status, and linear time trends as well as state adjusted as a random effect.

^d P values were calculated from linear probability regression models and reflect 2-sided test of statistical significance.

disease at diagnosis observed for all cancers combined, as well as the statistically significant drop in stage IV melanoma diagnoses, all suggest improved access to health-care services for timely symptom assessment, following Medicaid expansion (6,37). It is also possible that increased access to routine primary care visits lead to incidental detection following the expansion (6,37). The shift to stage I diagnoses observed among YAs living in rural areas and non-Hispanic Black patients further highlights the role of the ACA in narrowing sociodemographic disparities in access to cancer care. Of note, although the postexpansion shift towards stage I diagnoses was high for all YA cancers combined, the DD estimates for stage I diagnoses were suggestive but only statistically significant for breast cancer, potentially due to limited power given the smaller sample sizes of other specific cancer sites.

Importantly, YAs diagnosed at an earlier stage may require less aggressive therapies, have lower risks for subacute or late morbidity related to cancer therapies, and bear lower out-of-pocket burden of medical costs (38). Earlier cancer stage at diagnosis was historically associated with better survival outcomes (39) and will need to be confirmed in this population in the future. In addition, as described in a recent study (40), Medicaid expansion can also enhance individuals' ability to maintain health insurance and reduce coverage disruptions, which would be associated with improvements in access to care post diagnosis and treatment and, ultimately, better survival (41,42). This is germane to YA cancers where survivorship care is imperative for mitigating the late effects of cancer therapy. Thus, future studies should quantify the impact of the ACA Medicaid expansion on maintaining insurance coverage post cancer diagnosis and longer-term outcomes such as late morbidity, financial hardship, and survival rates, as well as sociodemographic disparities in these outcomes, among YA cancer survivors.

Besides the lack of health insurance, other barriers to early cancer diagnosis may exist for YA cancer patients. We found that although expansion-associated reductions in uninsurance rates were observed among Hispanic patients and those residing in low-income areas (Supplementary Table 2, available online), the insurance gains have not translated to an increase in stage I diagnoses among these YA groups (Table 5). This finding suggests that studies of other barriers to receiving timely care for cancer detection are needed. These include barriers related to culture, language, health literacy, immigration status, and competing obligations during young adulthood (43,44). Future efforts beyond expanding insurance coverage are needed to improve the delivery and quality of health care for early detection of YA cancers.

This study had some limitations. Although the patient sample from our data was not population based, the NCDB—a hospital-based cancer registry with data from American College of Surgeons Commission on Cancer-accredited facilities across all states and territories—captures over 70% of all new cancer cases in the United States, with the highest case coverage of nearly 80% for YAs (45). Furthermore, previous comparisons between the NCDB and population-based cancer registries have shown similarity in patient characteristics (45,46). As in other studies using cancer registry data, patients' health insurance status was documented only once in the NCDB, with no indication of when Medicaid enrollment occurred. More research is needed to distinguish YAs with Medicaid preceding a cancer diagnosis from those who gained Medicaid on diagnosis and to assess the effects of insurance continuity on health outcomes subsequent to a cancer diagnosis, including cancer treatment, survivorship care, and mortality.

Table 5. Changes in the percentage of stage I disease at diagnosis associated with Medicaid expansion by sociodemographic factors among newly diagnosed cancer patients aged 18-39 years, 2011-2016^{a,b}

Characteristics	Expansion states			Nonexpansion states			Crude model		Adjusted model ^c	
	Pre- ME, %	Post- ME, %	Absolute differ- ence (95% CI), ppt	Pre- ME, %	Post- ME, %	Absolute differ- ence (95% CI), ppt	DD (95% CI), ppt	P ^d	DD (95% CI), ppt	P ^d
Age group										
18-25 y	51.5	54.2	2.7 (1.5 to 4.0)	49.8	49.5	-0.2 (-2.0 to 1.5)	3.0 (0.8 to 5.1)	.006	3.1 (1.0 to 5.1)	.004
26-34 y	53.6	55.5	1.9 (1.2 to 2.7)	51.1	51.5	0.4 (-0.5 to 1.4)	1.5 (0.2 to 2.7)	.02	1.6 (0.3 to 2.8)	.01
35-39 y	49.6	51.1	1.5 (0.7 to 2.2)	47.0	47.7	0.7 (-0.3 to 1.6)	0.8 (-0.4 to 2.0)	.21	0.6 (-0.6 to 1.9)	.33
Race or ethnicity^e										
Non-Hispanic White	54.1	55.9	1.8 (1.2 to 2.4)	52.7	53.1	0.4 (-0.4 to 1.2)	1.4 (0.4 to 2.4)	.006	1.4 (0.4 to 2.3)	.008
Non-Hispanic Black	37.7	39.7	2.1 (0.5 to 3.6)	36.9	36.5	-0.3 (-1.9 to 1.2)	2.4 (0.2 to 4.6)	.03	2.2 (-0.03 to 4.4)	.05
Hispanic	47.6	49.3	1.8 (0.3 to 3.2)	46.2	47.0	0.8 (-1.0 to 2.6)	1.0 (-1.3 to 3.3)	.41	1.0 (-1.3 to 3.3)	.39
Non-Hispanic other	52.2	53.8	1.6 (-0.1 to 3.4)	49.0	50.6	1.6 (-1.4 to 4.6)	-0.05 (-3.5 to 3.5)	1.00	0.6 (-2.9 to 4.0)	.75
Zip code-level median household income^e										
High (>400 FPL)	57.3	58.4	1.1 (-0.4 to 2.6)	56.3	55.7	-0.6 (-3.2 to 2.0)	1.7 (-1.3 to 4.7)	.27	1.5 (-1.4 to 4.5)	.31
Middle (139-400 FPL)	51.6	53.3	1.7 (1.2 to 2.3)	49.7	49.9	0.2 (-0.5 to 0.9)	1.5 (0.6 to 2.4)	<.001	1.5 (0.7 to 2.4)	<.001
Low (≤138 FPL)	43.5	47.0	3.4 (1.4 to 5.5)	38.7	42.3	3.5 (1.4 to 5.7)	-0.1 (-3.0 to 2.9)	.96	-0.04 (-2.9 to 2.9)	.98
Residence MSA status^e										
Metropolitan	51.7	53.6	1.8 (1.3 to 2.4)	49.3	49.8	0.5 (-0.2 to 1.2)	1.4 (0.5 to 2.2)	.003	1.3 (0.4 to 2.2)	.004
Non-MSA urban	50.8	52.7	1.9 (0.3 to 3.5)	47.9	49.3	1.4 (-0.4 to 3.1)	0.5 (-1.9 to 2.9)	.68	0.6 (-1.8 to 2.9)	.63
Non-MSA rural	46.6	53.0	6.4 (1.1 to 11.7)	48.1	47.9	-0.2 (-5.0 to 4.6)	6.7 (-0.5 to 13.8)	.07	7.2 (0.2 to 14.3)	.045

^a Authors' analysis of the 2011-2016 National Cancer Database. CI = confidence interval; DD = difference in difference; FPL = federal poverty level; ME = Medicaid expansion; MSA = metropolitan statistical area; ppt = percentage points.

^b Cases without applicable stages (eg, leukemia, brain tumor) were excluded. Testicular cancer cases were excluded due to high percentage of unknown stage observed exclusively among patients with testicular cancer.

^c Adjusted model: regression models also adjusted for linear time trends, age, sex, race or ethnicity, zip code-level income, and residence MSA status, when applicable, as well as state as a random effect.

^d P values were calculated from linear probability regression models and reflect 2-sided test of statistical significance.

^e Data for unknown categories not shown.

Prior research has suggested that Medicaid status might be underreported in cancer registries (47). However, in a DD framework, we were interested in outcome changes over time; any systematic error associated with Medicaid underreporting would not affect our findings. Another limitation was the lack of individual-level income in the NCDB. Any nondifferential measurement error from using zip code-level income (as a proxy for individual income) would bias results toward the null, potentially underestimating the reduction in disparities of insurance coverage and early diagnoses following the ACA. Future studies with information on individual-level income are needed to better understand the changes in YA cancer disparities post ACA. Additionally, causality could not be determined given the observational nature of this study; it is possible that aspects of the ACA other than expanding Medicaid eligibility may differentially affect expansion vs nonexpansion states. Moreover, given the smaller sample sizes for subgroup analyses, there was less power to detect statistical significance within or across strata. Lastly, our ability to determine the severity of illness at presentation was limited for patients with brain tumors and leukemia, which have a high incidence in YAs but do not have staging criteria akin to other cancers (48).

Despite these limitations, this study provides compelling evidence on the benefit of Medicaid expansion under the ACA, with statistically significant increases in health insurance coverage and early-stage diseases at diagnosis in YAs with cancer and with greater increases among vulnerable populations, including non-Hispanic Black patients and those living in rural areas. This is a large initial step in addressing the disparities that YA patients, a group with unique health-care needs, have faced in cancer care and outcomes. As states consider

expanding Medicaid eligibility or continuing the current expansion, our findings highlight the benefits of public health insurance for early cancer diagnoses among medically vulnerable populations in the United States. As newer data become available, future research should monitor changes associated with the expansion beyond 2016 as well as the downstream survival benefit from insurance coverage gains and earlier stage at diagnosis. Future research should also investigate the differential or synergistic effects of multiple provisions (such as Medicaid expansion and Dependent Coverage Expansion) under the ACA on YA cancer outcomes (49,50).

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XJ: Drafting of the initial manuscript. XJ, SMC, ACM, JZ, LN, AJ, KRY, XH: Review and critical revision. SMC, ACM, KRY: Supervision.

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Data Availability

The data underlying this article were provided by the American College of Surgeons and accessed at the American Cancer Society by permission. The data cannot be shared publicly per the Data User Agreement. The National Cancer Database Participant User Files are available through application to investigators associated with the Commission on Cancer accredited cancer programs (<https://www.facs.org/quality-programs/cancer/ncdb/puf>).

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