

# Health Insurance Coverage Disruptions and Access to Care and Affordability among Cancer Survivors in the United States

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## ABSTRACT

**Background:** Lack of health insurance is associated with having problems with access to high-quality care. We estimated prevalence and evaluated associations of insurance coverage disruptions and access to health care and affordability among cancer survivors in the United States.

**Methods:** Adult cancer survivors ages 18 to 64 years with current private or public health insurance were identified from the 2011 to 2018 National Health Interview Survey ( $n = 7,186$ ). Health insurance coverage disruption was measured as self-reports of any time in the prior year without coverage. Outcomes included preventive services use, problems with care affordability, and cost-related medication nonadherence in the prior year. We used separate multivariable logistic models to evaluate associations between coverage disruptions and study outcomes by current insurance coverage.

**Results:** Among currently insured survivors, 3.7% [95% confidence interval (95% CI), 3.0%–4.4%] with private, and 7.8%

(95% CI, 6.5%–9.4%) with public insurance reported coverage disruptions in 2011 to 2018. We estimated that approximately 260,000 survivors ages 18 to 64 years had coverage disruptions in 2018. Among privately and publicly insured survivors, those with coverage disruptions were less likely to report all preventive services use (16.9% vs. 36.2%; 14.6% vs. 25.3%, respectively) and more likely to report any problems with care affordability (55.0% vs. 17.7%; 71.1% vs. 38.4%, respectively) and any cost-related medication nonadherence (39.4% vs. 10.1%; 36.5% vs. 16.3%, respectively) compared with those continuously insured (all  $P < 0.05$ ).

**Conclusions:** Coverage disruptions in the prior year were associated with problems with health care access and affordability among currently insured survivors.

**Impact:** Reducing coverage disruptions may help improve access and affordability for survivors.

## Introduction

Cancer is one of the most expensive medical conditions to treat in the United States (1). Cancer survivors have increased risk of treatment-related late and lasting effects (2) as well as second cancers and greater medical needs (3); however, survivors frequently delay or forgo recommended care because of cost, even many years after completion of cancer treatment (4, 5). Having health insurance coverage is strongly associated with access to care and affordability (6, 7). Uninsured cancer survivors are less likely to have a usual source of care or receive preventive services (8) and are more likely to delay or forgo care or have medication nonadherence due to costs (9, 10) than survivors with health insurance.

Some adults experience health insurance coverage losses and/or transition gaps between different types of coverage leading to insurance coverage disruptions (11). For example, individuals may lose employment-based private coverage when leaving a job; gig economy contractors (e.g., Uber or Lyft drivers) may experience unstable

coverage; and Medicaid enrollees may lose coverage if they are no longer income-eligible because of income fluctuations. Most studies evaluate the effects of insurance coverage measured only at a single time point. In the few studies specifically evaluating coverage disruptions, they were associated with less frequent receipt of cancer prevention or screening (12, 13), advanced stage at diagnosis (14, 15), treatment delays and lower likelihood of receiving treatment (16, 17), and worse survival (16, 18). However, little is known about the adverse effects of coverage disruptions on survivorship care. In addition, prior studies mostly evaluated coverage disruptions in Medicaid enrollees only and did not evaluate coverage disruptions among individuals with private health insurance coverage. To address these knowledge gaps, we used recent nationally representative data to examine the association of health insurance coverage disruptions in the prior year and access to and receipt of care and affordability among adult cancer survivors reporting current public or private coverage.

## Materials and Methods

### Data and sample

Adult cancer survivors ages 18 to 64 years were identified from the 2011 to 2018 National Health Interview Survey (NHIS), a nationally representative household survey conducted annually by the National Center for Health Statistics (NCHS; ref. 19). The response rates ranged from 53.0% to 66.3% between 2011 and 2018. The NCHS assigns a sample weight to each NHIS respondent to account for complex survey design and nonresponse through a four-stage adjustment (20, 21). Cancer survivors were identified by affirmative responses to a question about ever being told by a doctor or other health professional that they had cancer or a malignancy of any kind. Consistent with earlier studies, adults with only nonmelanoma skin cancer and skin cancer of unknown type were excluded (4). We then restricted the sample to

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**Note:** Supplementary data for this article are available at Cancer Epidemiology, Biomarkers & Prevention Online (<http://cebp.aacrjournals.org/>).

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those who reported current health insurance coverage at the time of the survey and responded to the insurance disruption question. A total of 7,186 adult cancer survivors were identified for the study. Because questions about prescription drug use in the past 12 months were only added to the NHIS in 2013, we evaluated cost-related changes in medication use with NHIS data from 2013 to 2018 ( $N = 4,624$ ).

### Measures

Respondents were asked to describe their current health insurance coverage as well as coverage disruption in the prior 12 months. Current health insurance coverage was categorized as any private insurance or only public insurance, including Medicaid, Medicare, and/or other public coverage. Health insurance coverage disruption (yes/no) was defined by the question: "In the past 12 months, was there any time when you did not have any health insurance coverage?" Adults were defined as having coverage disruptions if they answered "yes" to this question; continuously insured if they answered "no."

Outcomes include preventive services use, problems with care affordability, and cost-related medication nonadherence in the past 12 months. Use of preventive services recommended by the United States Preventive Services Task Force and collected by the NHIS was measured with questions about receipt of any blood pressure check, blood cholesterol check, flu shot, and dental care. Problems with care affordability was measured by questions on if the individual needed but did not get the following care because could not afford it: medical care, prescription medicine, mental health care, see a specialist, and follow-up care. To ensure comprehensiveness, forgoing dental and vision services were also included because some plans cover certain dental and vision services that are medically necessary to maintain health. Medication nonadherence (skipping, taking less, and delaying medication to save money) was measured only among those who confirmed prescription drug use during the past 12 months. We also created summary measures for (i) all preventive services use, (ii) any problems with care affordability, and (iii) any cost-related medication nonadherence. Exact wording of questions is listed in Supplementary Table S1.

### Statistical analysis

Analyses were stratified by current health insurance type (any private or only public insurance coverage). Descriptive statistics were used to compare sociodemographic characteristics between continuously insured versus with coverage disruptions in the prior year. We used the NHIS survey design and sampling weight information to calculate national estimates of survivors ages 18 to 64 years reporting coverage disruptions in 2018. We used separate multivariable logistic regression models to evaluate associations of coverage disruptions and preventive services use, problems with care affordability, and cost-related medication nonadherence, controlling for potential confounders suggested by earlier research (11, 22, 23), including survey year as a categorical variable, age group, sex, race/ethnicity, marital status, educational attainment, and geographic region. We tested the differences in the associations between coverage disruptions and study outcomes across current health insurance coverage types with the inclusion of an interaction term of insurance type by coverage disruption status in the models. Adjusted odds ratios (AOR) and 95% confidence intervals (95% CI) as well as adjusted percentages were reported. Adjusted percentages were calculated using Stata margins command (24). All analyses accounted for the complex survey design and nonresponse using SAS 9.4 to generate analytic sample and StataIC 14 for modeling. Statistical tests were two-sided, and  $\alpha$  was set at 0.05.

### Sensitivity analysis

Sensitivity analysis included family income as a percentage of federal poverty level (FPL; <100% FPL, 100–399% FPL,  $\geq 400$  FPL%, missing) in multivariable models for survivors currently with any private coverage to account for the associations of income with health care access and affordability (25–28). We conducted another sensitivity analysis to examine the associations of coverage disruptions and access to health care and care affordability by cancer site, including female breast, colorectal, prostate cancers, and other sites combined. We also conducted a sensitivity analysis to estimate the robustness of associations to unmeasured confounding, such as employment status, which is associated with both insurance disruptions and access to care. We used the *E*-value methodology, in which *E*-value represents the largest strength (risk ratio) of association that an unmeasured confounder could have with both the exposure and outcome to explain a specific exposure–outcome association, conditional on the measured covariates (29).

## Results

The majority of cancer survivors reported private health insurance coverage at the time of the survey and were long-term survivors with 2 or more years since last cancer diagnosis (Table 1). Across the years, 3.7% (95% CI, 3.0%–4.4%) survivors ages 18 to 64 years with private health insurance, and 7.8% (95% CI, 6.5%–9.4%) with public insurance reported coverage disruptions. We estimated that 167,849 (95% CI, 73,894–261,804) and 95,544 (95% CI, 27,753–163,335) cancer survivors ages 18 to 64 years reported coverage disruptions in the United States in 2018, respectively. Cancer survivors with coverage disruptions were more likely to be younger regardless of current health insurance type. Among privately insured survivors, racial/ethnic minorities and those who were not married were more likely to report coverage disruptions. The average durations of uninsurance were 4.9 (95% CI, 4.2–5.7) months for those currently with private insurance and 5.0 (95% CI, 4.4–5.6) months for those currently with public insurance. Percentages of reporting coverage disruptions in the prior year for survivors currently with any private insurance coverage increased from 2.6% (95% CI, 1.9%–3.6%) in 2011 to 2013 to 5.0% (95% CI, 3.6%–6.9%) in 2014 and 2015, with no significant change observed for 2016 to 2018; for survivors currently with public coverage, percentage of reporting coverage disruptions in the prior year was largely unchanged comparing 2014 and 2015 (8.4%; 95% CI, 7.5%–9.3%) to 2011 to 2013 (7.6%; 95% CI, 6.4%–9.0%), and significantly decreased to 4.0% (95% CI, 3.3%–4.9%) in 2016 to 2018 (Supplementary Table S2).

After controlling for other sociodemographic characteristics among currently insured cancer survivors, those with coverage disruptions were less likely to report each individual preventive service, including blood pressure check, blood cholesterol check, flu shot, and dentist visit, regardless of their health insurance type (Table 2). For example, among both privately and publicly insured cancer survivors, those with coverage disruptions were less likely to have flu shot than those continuously insured (AOR = 0.38; 95% CI, 0.25–0.56; AOR = 0.63; 95% CI, 0.41–0.98, respectively).

Having health insurance coverage disruptions was also associated with higher likelihood of reporting problems with affordability in both privately and publicly insured survivors (Table 2). For example, regardless of current insurance type, survivors with coverage disruptions were more likely to report problems with affordability for care such as prescription medicine, dental care, eyeglasses, seeing a

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**Table 1.** Characteristics of cancer survivors by type of current health insurance coverage, 18–64 years, NHIS, 2011–2018 ( $N = 7,186$ ).

	Current health insurance coverage									
	Any private					Public only				
	Continuously insured		With disruption		<i>P</i>	Continuously insured		With disruption		<i>P</i>
<i>n</i>	Weighted %	<i>n</i>	Weighted %	<i>n</i>		Weighted %	<i>n</i>	Weighted %		
Total	4,782	96.3	196	3.7		2,023	92.2	185	7.8	
Age group					<b>&lt;0.001</b>					<b>&lt;0.001</b>
18–39	574	92.9	48	7.1		308	90.6	52	9.4	
40–54	1,612	95.9	78	4.1		614	93.9	62	6.1	
55–64	2,596	97.4	70	2.6		1,101	95.5	71	4.5	
Sex					0.11					0.12
Male	1,581	97.1	52	2.9	655	94.4	48	5.6		
Female	3,201	95.9	144	4.1	1,368	92.5	137	7.6		
Race/ethnicity					<b>&lt;0.001</b>					0.27
Non-Hispanic white only	3,898	97.0	146	3.1		1,285	94.4	123	5.6	
All other race/ethnicities	884	93.3	50	6.7		738	91.7	62	8.3	
Current marital status					<b>&lt;0.001</b>					0.72
Married	2,803	97.1	82	2.9		546	95.3	55	4.7	
Not married <sup>a</sup>	1,979	94.6	114	5.5		1,477	91.7	130	8.3	
Educational attainment					0.49					0.70
High school graduate or less	1,210	96.0	57	4.1	1,060	92.4	97	7.6		
Some college or more	3,572	96.5	139	3.5	963	94.2	88	5.8		
Health conditions other than cancer					0.97					0.60
Yes	3,044	96.3	120	3.7	1,669	93.1	140	6.9		
No	1,738	96.3	76	3.7	354	94.0	45	6.0		
Year(s) since last cancer diagnosis					0.64					<b>0.013</b>
<2	768	96.0	33	4.1	381	88.3	54	11.7		
2+	3,986	96.4	162	3.6	1,620	93.1	129	6.9		
Survey year					<b>0.026</b>					<b>0.031</b>
2011–2013	1,780	97.4	56	2.6	755	91.6	81	8.4		
2014–2015	1,246	95.0	73	5.0	580	92.4	55	7.6		
2016–2018	1,756	96.2	67	3.8	688	96.0	49	4.0		

Note: Boldface type indicates statistical significance ( $P < 0.05$ ).<sup>a</sup>Not married includes widowed, divorced, separated, or never married.

specialist and follow-up care (all  $P < 0.001$ ) compared with continuously insured survivors.

Among survivors currently insured with either private and public insurance, those with coverage disruptions were more likely to report all measures of cost-related medication nonadherence, including skipping medication, taking less medication, and delaying filling a prescription, than those continuously insured (Table 2). For example, among both private and publicly insured cancer survivors, those with coverage disruptions were more likely to report skipping medication (AOR = 4.66; 95% CI, 2.66–8.14; AOR = 3.03; 95% CI, 1.76–5.21, respectively) than those continuously insured. In general, the magnitude of associations between coverage disruptions and access and affordability were similar across current health insurance coverage type.

Figure 1 shows the adjusted percentages of summary measures of preventive services use, any problems with health care affordability, and any cost-related medication nonadherence by current insurance type and coverage disruption status. For currently insured survivors with private and public coverage, those with disruptions reported lower percentages of all preventive services use (16.9% vs. 36.2%; 14.6% vs. 25.3%, respectively, Fig. 1A) and higher percentages of any problems with affordability (55.0% vs. 17.7%; 71.1% vs. 38.4%, respectively, Fig. 1B) and any cost-related medication nonadherence (39.4% vs. 10.1%; 36.5% vs. 16.3%, respectively, Fig. 1C) compared with those continuously insured. Adjusted percentages of reporting each outcome by coverage

disruptions and health insurance type are presented in Supplementary Table S3.

### Sensitivity analysis

The associations of coverage disruptions and access to health care and affordability were largely unchanged after adjusting for family income as a percentage of FPL among survivors with private insurance (Supplementary Table S4). We did not observe any differences in the associations of coverage disruptions and study outcomes by cancer site (Supplementary Table S5). To estimate the robustness of associations for unmeasured confounding, we calculated *E*-values and found that they were large (Supplementary Table S6), suggesting extensive unmeasured confounding would be required to eliminate observed associations between coverage disruptions and care access and affordability. For example, for the association of coverage disruption and all preventive services use among any privately insured, the *E*-value for this point estimate was 5.33 and for the upper confidence interval limit was 2.97. This means that the observed risk-ratio of 0.38 could be explained by an unmeasured cofounder that was associated with both coverage disruption and use of preventive services by a risk-ratio of 5.33-fold each, but weaker cofounding could not do so. The upper confidence interval limit 2.97 means that the observed association of coverage disruptions and all preventive services use would be no longer significant with an unmeasured cofounder that was associated with both coverage disruption and use of preventive services by a risk-ratio of 2.97-fold each, but weaker cofounding could not do so.

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**Table 2.** Associations of health insurance coverage disruptions and access to health care and care affordability among currently insured cancer survivors, 18–64 years, NHIS, 2011–2018.

	Current health insurance coverage				Ratio of adjusted OR (95% CI) <sup>a</sup>
	Any private		Public only		
	Continuously insured (ref)	With disruptions Adjusted OR (95% CI)	Continuously insured (ref)	With disruptions Adjusted OR (95% CI)	
Preventive service use					
Blood pressure check	1	<b>0.33 (0.17–0.65)</b>	1	<b>0.51 (0.26–1.00)</b>	0.65 (0.25–1.69)
Blood cholesterol check	1	<b>0.33 (0.21–0.51)</b>	1	<b>0.57 (0.36–0.88)</b>	0.58 (0.32–1.07)
Flu shot	1	<b>0.38 (0.25–0.56)</b>	1	<b>0.63 (0.41–0.98)</b>	0.59 (0.34–1.04)
Dentist visit	1	<b>0.33 (0.22–0.50)</b>	1	<b>0.49 (0.31–0.75)</b>	0.68 (0.39–1.21)
Problems with care affordability					
Medical care	1	<b>7.76 (4.95–12.17)</b>	1	<b>6.53 (4.21–10.13)</b>	1.19 (0.64–2.20)
Prescription medicine	1	<b>6.09 (3.88–9.58)</b>	1	<b>3.95 (2.54–6.13)</b>	1.54 (0.81–2.95)
Mental care	1	<b>2.91 (1.50–5.64)</b>	1	1.75 (0.92–3.33)	1.66 (0.61–4.53)
Dental care	1	<b>4.75 (3.07–7.35)</b>	1	<b>3.42 (2.27–5.14)</b>	1.39 (0.74–2.62)
Eyeglasses	1	<b>3.74 (2.36–5.93)</b>	1	<b>2.46 (1.58–3.82)</b>	1.52 (0.78–2.98)
See a specialist	1	<b>6.06 (3.60–10.21)</b>	1	<b>3.77 (2.37–5.98)</b>	1.64 (0.82–3.29)
Follow-up care	1	<b>5.42 (3.01–9.78)</b>	1	<b>5.04 (2.95–8.62)</b>	1.10 (0.50–2.42)
Cost-related medication nonadherence					
Skipping medication	1	<b>4.66 (2.66–8.14)</b>	1	<b>3.03 (1.76–5.21)</b>	1.54 (0.68–3.45)
Taking less medication	1	<b>3.93 (2.19–7.05)</b>	1	<b>3.66 (2.06–6.50)</b>	1.07 (0.46–2.50)
Delaying filling a prescription	1	<b>6.86 (4.09–11.51)</b>	1	<b>3.06 (1.73–5.42)</b>	<b>2.24 (1.03–4.89)</b>

Note: Data from 2011 to 2018 NHIS.  $N = 7,185$  for preventive services use, forgoing medical care, prescription medicine, mental care, dental care, and eyeglasses because of cost (2011–2018);  $n = 6,476$  for forgoing seeing a specialist and follow-up care because of cost (2011–2017);  $n = 4,624$  for cost-related medication nonadherence (2013–2018). All models adjusted for survey year, age, sex, race/ethnicity, marital status, educational attainment, and region. Boldface type indicates statistical significance ( $P < 0.05$ ).

<sup>a</sup>Ratio of adjusted OR was calculated by the odds ratio of reporting outcomes comparing survivors with coverage disruptions to those without among any privately insured to the odds ratio of reporting outcomes comparing survivors with coverage disruptions to those without among other public insured, representing the differences in the associations between study outcomes and coverage disruptions across current health insurance coverage types.

## Discussion

In this study, we used recent national data to examine the associations between health insurance coverage disruptions and access to and receipt of care and affordability among cancer survivors. We found that about 260,000 currently insured cancer survivors aged 18 to 64 years experienced coverage disruptions in the past 12 months in 2018. Regardless of insurance type, survivors with coverage disruptions were less likely to report preventive services use and more likely to report problems with affordability and cost-related medication nonadherence. Our findings highlight the adverse associations between health insurance coverage disruptions and cancer survivorship care. Understanding the impacts of coverage disruption among survivors is critical with ongoing changes in health insurance coverage options in the United States, especially given the high out-of-pocket burden faced by cancer survivors (3, 30, 31).

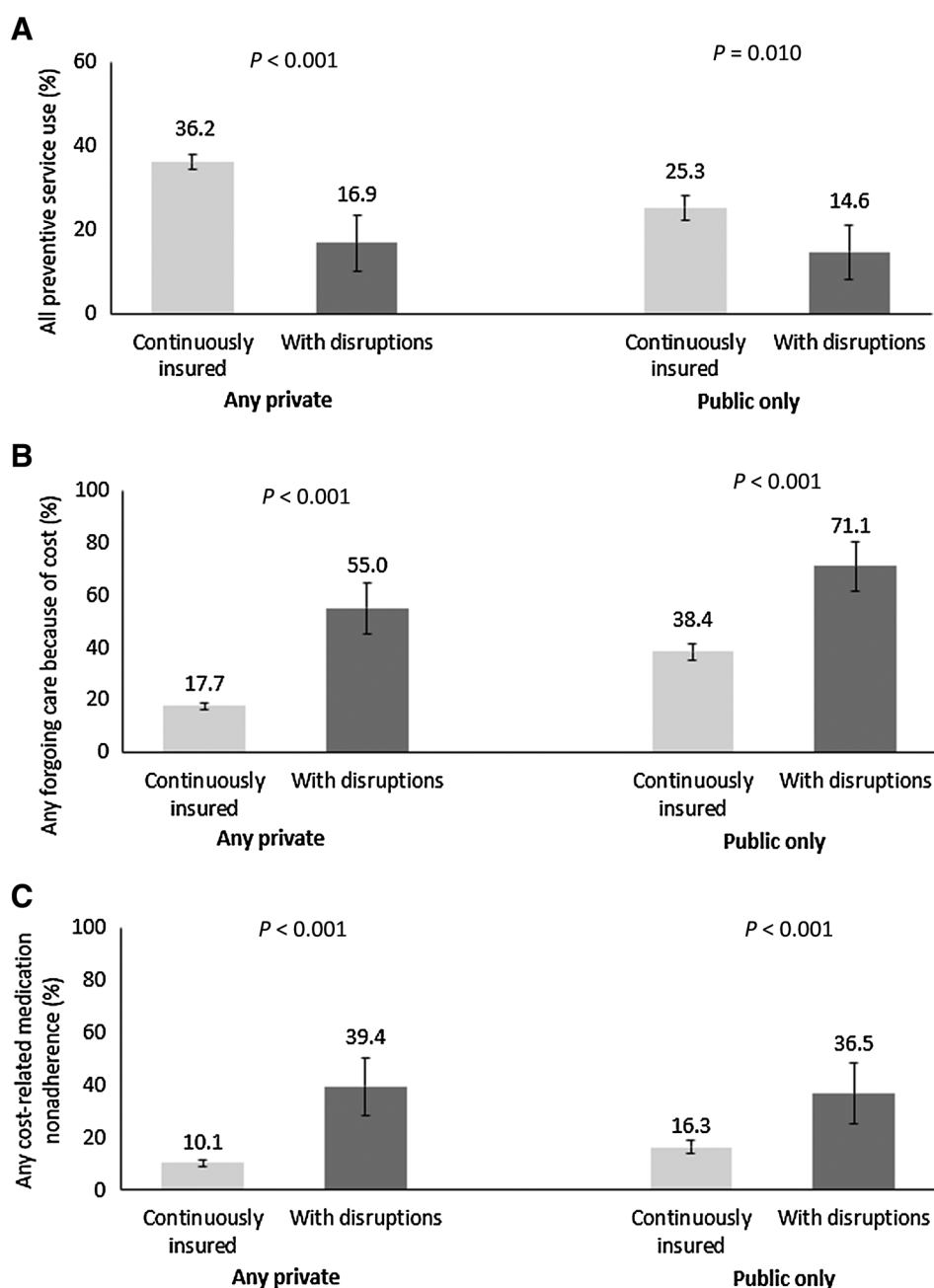
Most earlier studies focused on coverage disruptions and care access and outcomes among Medicaid enrollees (32), and little research has been conducted among cancer survivors with private insurance coverage. This study helps to fill this research gap. We found that coverage disruptions were adversely associated with care access and affordability for survivors reporting current private insurance. A cancer diagnosis and its subsequent treatment can limit the ability to work and cause job change and even coverage losses for patients (33). Leaving jobs or changing to part-time jobs often causes income reduction, which may amplify financial barriers to accessing health care. Furthermore, employers sometimes offer discounts on insurance premiums for employees who undergo preventive check-ups and flu shots

are often given at large workplaces, which could partially explain the lower preventive services use percentages among survivors with coverage disruptions. Future studies with longitudinal data on the subsequent consequences of cancer history, job losses, coverage disruptions, and the adverse health outcomes are warranted.

Historically, coverage disruptions have been more common among individuals with low income, racial or ethnic minorities, and Medicaid enrollees (11, 23, 34). Among Medicaid enrollees with newly diagnosed cancer, a substantial percentage enrolled in Medicaid only after a cancer diagnosis (14, 35). Medicaid enrollees who gained coverage only after cancer diagnosis are more likely to lose coverage post-treatment (36), and may have problems accessing high quality survivorship care. Several federal-level provisions under the Affordable Care Act (ACA) may help reduce coverage disruptions. For example, the establishment of Marketplace under the ACA provides private health insurance coverage options for individuals and families without employer-sponsored insurance with subsidies available for those with income 100% to 400% of FPL. More specifically, elimination of preexisting conditions exclusions under the Marketplace may promote private insurance continuity. Other provisions, such as the dependent coverage expansion which allows young adults to remain on their parents' private insurance plans until the age of 26 years, may also help reduce coverage disruptions common in young adult cancer survivors.

State-level policies may also help reduce coverage disruptions. For example, some states expanded Medicaid eligibility under the ACA for low-income adults, which may facilitate public insurance continuity. An earlier study showed that Medicaid expansion had a protective effect on coverage continuity (37). Some states, including New York

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**Figure 1.**

Health insurance coverage disruptions and access to health care and care affordability among currently insured cancer survivors, adjusted. **A**, Health insurance coverage disruptions and all preventive services use. **B**, Health insurance coverage disruptions and any forgoing care because of cost. **C**, Health insurance coverage disruptions and any cost-related medication nonadherence. Data from the NHIS, 2011–2018.  $N = 7,185$  for all preventive services use (2011–2018);  $n = 6,476$  for forgoing any care because of cost (2011–2017);  $n = 4,624$  for any cost-related medication nonadherence (2013–2018). All models adjusted for survey year, age, sex, race/ethnicity, marital status, educational attainment, and region.

and Minnesota, have established Basic Health Programs under the ACA, which provide health plans at lower premiums than the Marketplace plans for adults with a family income of 133% to 200% of FPL. In this study, we found that the percentages of reporting coverage disruptions for the past year increased in 2014 and 2015 for currently privately insured survivors, suggesting gains in coverage related to the ACA among previously uninsured. The percentages with disruptions decreased in 2016 to 2018 for the publicly insured, suggesting the protective effects of the ACA for Medicaid coverage disruption, which was consistent with finding from earlier study (38). In contrast, some studies projected that coverage disruptions could actually increase due to switching coverage and eligibility changes (39, 40). With the maturation of data post-ACA, assessing the trend of coverage disruption

and association of the ACA and coverage disruptions will be important for future research.

In contrast, the emergence of some policies may aggravate coverage instability. For example, Medicaid work requirements may increase prevalence and frequency of coverage disruptions among cancer survivors. For example, a recent study evaluating the effects of implementation of Medicaid work requirements in Arkansas found that they were associated with disenrollment of eligible residents (41). Future studies with longitudinal data are needed to examine the associations of Medicaid work requirements and coverage disruptions. Increasing enrollment in short-term health plans, which are not regulated under the ACA and can exclude those with preexisting conditions and not cover mandated “essential health benefits,” such as

prescription drugs and preventive care (42) may lead to effective coverage disruptions.

This study is limited by the cross-sectional design and we were only able to examine the associations rather than the causality of coverage disruptions and study outcomes; future studies with longitudinal data and more detailed information on insurance changes are warranted. In this study, we focused on examining the associations of coverage disruption in the prior year and access to care and affordability among survivors currently covered by private or public health insurance; but we were not able to identify the type of health insurance coverage at the point when disruption happened. However, similar patterns were observed among individuals currently privately or publicly insured, suggesting that our conclusion is not likely to change when reclassifying by coverage type when disruption happened. The NHIS does not collect information about the reason(s) for the coverage disruption. We were also not able to assess switching coverage and eligibility changes due to the unavailability of these data, which are important areas for future research. In addition, we were not able to examine association between the duration of coverage disruptions and access to care and affordability due to the relatively small sample of cancer survivors. We were also not able to control for clinical characteristics, such as cancer stage at diagnosis and treatment received due to the unavailability of the data in the NHIS. We did not evaluate outcomes such as cancer recurrence and survival; this will be important for future research. Despite these limitations, we used recent national data to quantify the association between health insurance coverage disruptions among cancer survivors and access to health care and affordability in the United States.

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## Health Insurance Coverage Disruptions among Cancer Survivors

In summary, this study found that among both privately and publicly insured cancer survivors, those with coverage disruptions were less likely to report preventive services use; and were more likely to report problems with affordability and medication nonadherence because of cost.

## Disclosure of Potential Conflicts of Interest

Z. Zheng reports grants from AstraZeneca (Dr. Zheng reports grant/research support from AstraZeneca outside the scope of this study and employment with the American Cancer Society, which receives grants from private and corporate foundations, including foundations associated with companies in the health sector for research) outside the submitted work. No potential conflicts of interest were disclosed by the other authors.

## Authors' Contributions

**J. Zhao:** Conceptualization, data curation, formal analysis, methodology, writing—original draft, writing—review and editing. **X. Han:** Conceptualization, methodology, writing—review and editing. **L. Nogueira:** Conceptualization, methodology, writing—review and editing. **Z. Zheng:** Conceptualization, methodology, writing—review and editing. **A. Jemal:** Conceptualization, methodology, writing—review and editing. **K.R. Yabroff:** Conceptualization, supervision, methodology, writing—review and editing.

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# Cancer Epidemiology, Biomarkers & Prevention

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