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Affordable Care Act and cancer stage at diagnosis in an underserved population

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ABSTRACT

The Patient Protection and Affordable Care Act (ACA) has increased insurance coverage among underserved individuals, but the effect of ACA on cancer diagnosis is currently debated, particularly in Medicaid non-expansion states. Therefore, we aimed to assess the effect of ACA implementation on stage at diagnosis among underserved cancer patients in Texas, a Medicaid non-expansion state. We used data from the institutional registry of the JPS Center for Cancer Care, which serves an urban population of underserved cancer patients. Eligible individuals were aged 18 to 64 years and diagnosed with a first primary invasive solid tumor between 2008 and 2015. We used a natural experiment framework and interrupted time-series analysis to assess level (i.e. immediate) and slope (over time) changes in insurance coverage and cancer stage at diagnosis between pre- and post-ACA periods. Our study population comprised 4808 underserved cancer patients, of whom 51% were racial/ethnic minorities. The prevalence of uninsured cancer patients did not immediately change after ACA implementation but modestly decreased over time (PR = 0.94; 95% CL: 0.90, 0.98). The prevalence of early- and advanced-stage diagnosis did not appreciably change overall or when stratified by screen-detectable cancers. Our results suggest that ACA implementation decreased the prevalence of uninsured cancer patients but had little effect on cancer stage at diagnosis in an underserved population. Given that Texas is a Medicaid non-expansion state, Medicaid expansion and alternative approaches may need to be further explored to improve earlier cancer diagnosis among underserved individuals.

1. Introduction

The Patient Protection and Affordable Care Act (ACA) was signed into law in 2010 and aimed to improve insurance coverage for uninsured individuals in the United States (National Conference of State Legislatures, 2011). A key feature of ACA was initiation of the Health Insurance Marketplace in October 2013, which provided a resource for individuals and families without employer-sponsored coverage to select a health insurance plan from competing insurers (Sommers et al., 2014). Another key feature of the ACA was expansion of Medicaid coverage to individuals aged 18 to 65 years with incomes up to 138% of the federal poverty level by January 2014, but 17 states opted out of Medicaid expansion as of June 2018 (Garfield et al., 2018). ACA implementation reduced the number of uninsured individuals from 50.7 million (16.3%) in 2009 (DeNavas-Walt et al., 2010) to 28.5 million (8.8%) in 2017 (Berchick et al., 2018) nationally, and from 6.4 million (26%) (US Census Bureau, 2009) in 2009 to 4.8 million (17.3%) in 2017 (Berchick et al., 2018) for Texas. This reduction was particularly notable in Medicaid expansion states (Blumenthal and Collins, 2014; Courtemanche et al., 2018a; Courtemanche et al., 2016; Frean et al., 2017; Jemal et al., 2017; Kominski et al., 2017; Simon et al., 2017; Sommers et al., 2015; Sommers et al., 2014; Wherry and Miller, 2016), but the effect of ACA implementation on cancer diagnosis is currently debated. In particular, evidence for an effect of ACA on cancer stage at diagnosis is inconsistent (Fedewa et al., 2015; Han et al., 2016; Jemal et al., 2017; Robbins et al., 2015; Sabik and Adunlin, 2017; Simon et al., 2017; Smith and Fader, 2018; Soni et al., 2018). More importantly, few studies (Simon et al., 2017; Sommers et al., 2016; Sommers et al., 2015;

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Wherry and Miller, 2016) have specifically addressed the effect of ACA on underserved populations, who were the primary target of ACA implementation.

Underserved populations have socioeconomic barriers to care and are often diagnosed with advanced stage of cancer (Behbakht et al., 2001; Bitterman et al., 2015; Lim et al., 2012; Patel et al., 2006). Emerging evidence suggests that ACA implementation improved cancer stage at diagnosis in Medicaid expansion states (Han et al., 2018; Jemal et al., 2017; Soni et al., 2018), which may be attributable to removal of barriers to care and screening for certain cancers. Nevertheless, the effect of ACA implementation on cancer stage at diagnosis among underserved populations in Medicaid non-expansion states is unknown. The lack of information about underserved populations may be partially related to under-representation of these populations in established cancer research cohorts or registries such as the Surveillance, Epidemiology and End Results (SEER) program (National Cancer Institute). Public hospitals that comprise the healthcare safety-net are the primary source of health services for underserved individuals and may be the optimal setting to study the effects of ACA on cancer stage at diagnosis for this population (Lewin et al., 2000). Therefore, we aimed to assess the effect of ACA implementation on cancer stage at diagnosis among underserved cancer patients at an urban public hospital in Texas, which is a Medicaid non-expansion state with the highest prevalence of uninsured individuals.

2. Methods

2.1. Setting

The JPS Center for Cancer Care is a Comprehensive Community Cancer Program that has been accredited by the Commission on Cancer since 2010. The Center is part of JPS Health Network, a large urban safety-net health system that serves Tarrant County, TX (population > 2million). JPS Health Network is defined as a core safety-net provider and a member of America's Essential Hospitals. Core safety-net providers serve as a primary source of care for underserved populations who have socioeconomic barriers to care, which includes individuals who are racial/ethnic minorities, immigrants, uninsured, underinsured, chronically ill (physical or mental), disabled, homeless, or inmates (Adler and Newman, 2002; Andrulis, 1998; Lewin, 2000). Some individuals may be chronically underserved, whereas other individuals may be transiently underserved because of changes in personal or structural circumstances (e.g. insurance instability (McKillop et al., 2018)).

2.2. Study population

We used data from an institutional registry at the JPS Center for Cancer Care, which maintains a cancer program accredited by the Commission on Cancer. This center is part of an urban public hospital network that serves Tarrant County, TX (population > 2million) and is a primary source of care for underserved individuals. We defined "underserved" as populations with socioeconomic barriers to care (Adler and Newman, 2002; Andrulis, 1998; Lewin, 2000). This population relies on safety-net institutions for health care needs and includes individuals who are racial/ethnic minorities, immigrants, uninsured, underinsured, chronically ill (physical or mental), disabled, homeless, or inmates (Lewin, 2000). Patients eligible for our study were aged 18 to 64 years and diagnosed with a first primary invasive solid tumor between January 1, 2008 and December 31, 2015. We excluded patients with hematologic malignancies given differences in staging systems from solid tumors. Individuals diagnosed in the fourth quarter of 2013 and the first quarter of 2014 were excluded to account for the phase-in period of ACA. In addition, we excluded patients with incomplete information on date of diagnosis.

We applied the same eligibility criteria to cancer diagnosis data from Tarrant County, Texas, which is the source population for underserved patients who receive care at the JPS Center for Cancer Care, and to Texas overall. Data for Tarrant County and Texas were derived from the Texas Cancer Registry, a statewide population-based registry that is gold certified by the North American Association of Central Cancer Registries for data quality and completeness (Texas Department of State Health Services, 2016). The Texas Cancer Registry includes information about demographics, cancer diagnosis, treatment, and follow-up for vital status. This study was approved by the North Texas Regional Institutional Review Board (IRB# 2017-109).

2.3. Variables

Our outcomes of interest were insurance status at diagnosis and cancer stage at diagnosis, which was defined using the 2000 Surveillance Epidemiology and End Results (SEER) summary stage (localized, regional, or distant). Early stage diagnosis was defined as localized SEER summary stage and advanced stage diagnosis was defined as distant stage.

2.4. Data analysis

We assessed the effect of ACA implementation in 2014 (i.e. all ACA provisions except Medicaid expansion by 2014) on insurance status and cancer stage at diagnosis using a natural experiment framework and interrupted time-series analysis (Bernal et al., 2017). An interrupted time-series analysis is useful for assessing the effects of population-level interventions (i.e. pre- and post-intervention) and avoids individual-level unmeasured confounding, which threatens the validity of intervention estimates from conventional observational study designs (Bernal et al., 2017; Biglan et al., 2000). We defined the post-ACA (i.e. intervention) period as April 1, 2014 to December 31, 2015 and the pre-ACA period as January 1, 2008 to September 30, 2013. Given that our time-series data represented cross-sections of the hospital, county, and state populations diagnosed with cancer, we estimated prevalence for each outcome of interest, where the numerators represented either the number of uninsured cancer patients or the number of patients with either early- or advanced-stage cancer diagnoses. The denominators for our prevalence estimates were the number of patients diagnosed with primary invasive solid tumors within each quarter. For early and advanced cancer stage at diagnosis, the numerators were the number of individuals with localized and distant stage, respectively. For insurance status at diagnosis, the numerators were the number of uninsured patients at diagnosis. Prevalence was aggregated over 3-month intervals to facilitate stable estimates. Our analyses assumed an impact model with both level and slope change after ACA implementation. We used generalized linear models with Poisson distributions and log link function to estimate prevalence ratios (PR) between post- and pre-ACA periods, which assessed a level change after ACA implementation. In addition, we estimated PRs for the slope of change per quarter between pre- and post-ACA periods. Lastly, we assessed PRs stratified by screen- and non-screen-detectable cancers, where screen-detectable was defined according to the American Cancer Society (American Cancer Society, 2008, 2013, 2015). We did not consider lung cancer as screen-detectable because the first American Cancer Society recommendation for lung cancer screening was in 2013 (American Cancer Society, 2013), which would pertain to only the post-ACA period.

3. Results

Our underserved population comprised 4808 adults diagnosed with a first primary invasive solid tumor between January 1, 2008 and December 31, 2015 (Fig. 1). Table 1 summarizes the overall and intervention-stratified distribution of patient characteristics. Racial/ethnic minorities comprised 51% of our underserved population. The distribution of the majority of demographic characteristics did not

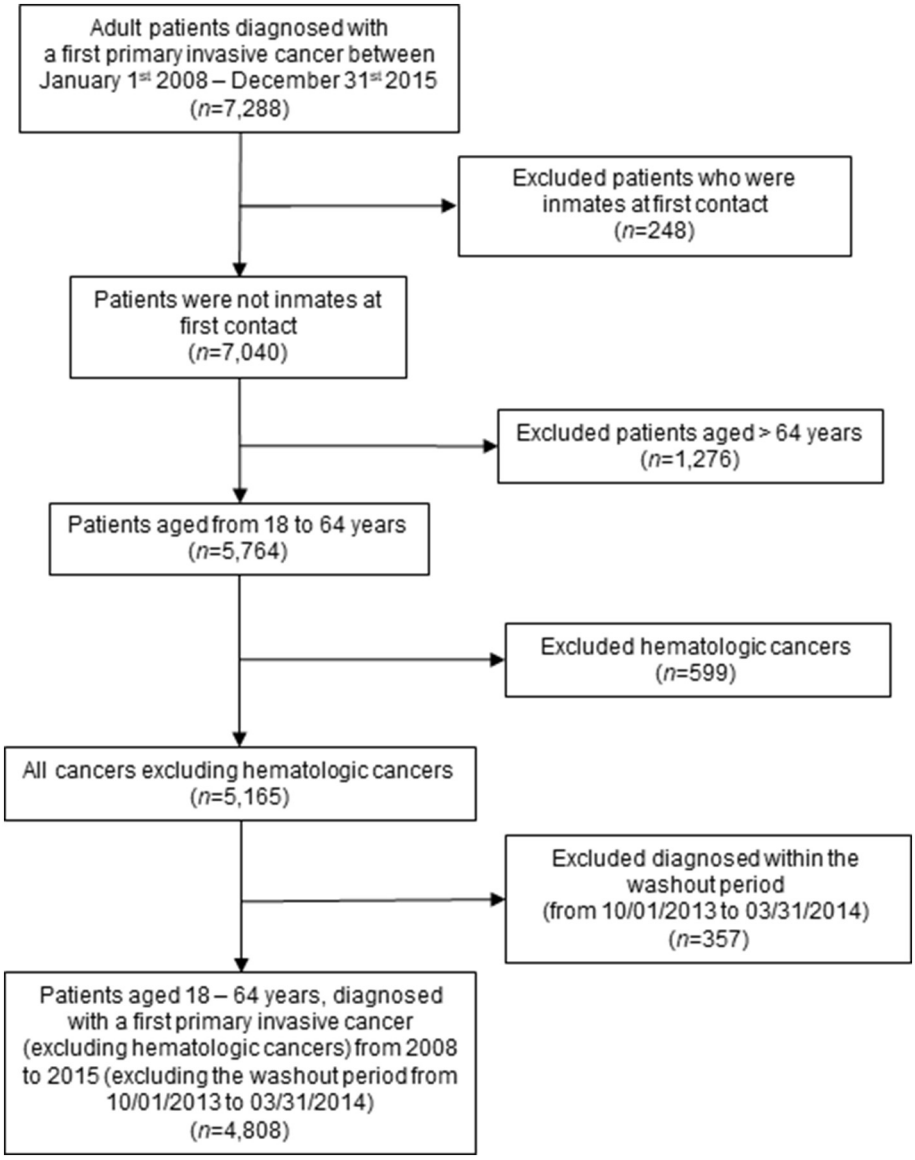

Fig. 1. Selection of underserved cancer patients using the JPS Oncology Registry.

dramatically shift after the implementation of the ACA. The prevalence of uninsured individuals decreased from 64% to 59%, whereas private insurance increased from 5.1% to 13% after ACA implementation.

Fig. 2 and Supplementary Table S1 illustrate the change in prevalence of uninsured cancer patients after ACA implementation. We observed an immediate decrease (i.e. level change) in the prevalence of uninsured cancer patients at the beginning of the post-ACA period for Tarrant County (PR = 0.72; 95% CL: 0.59, 0.89) and Texas overall (PR = 0.81; 95%CL: 0.76, 0.86) but not for underserved cancer patients (PR = 0.99; 95% CL: 0.80, 1.2). The prevalence of uninsured individuals decreased by 6% each quarter in the post-ACA period among underserved cancer patients (PR = 0.94; 95% CL: 0.90, 0.98), and smaller reductions over time for Tarrant County (PR = 0.97; 95% CL: 0.94, 1.0) or Texas overall (PR = 0.99; 95% CL: 0.98, 1.0).

Fig. 3 and Supplementary Table S2 describe the changes in prevalence of early and advanced stage diagnosis after the ACA implementation among all cancer patients. In particular, the prevalence of early stage diagnosis at the beginning of post-ACA period decreased among underserved cancer patients, but the estimates were compatible with a substantial decrease or modest increase in early stage diagnosis (PR = 0.85; 95% CL: 0.64, 1.1). A modest increase in the prevalence of early stage diagnosis was observed post-ACA period for Tarrant County and Texas overall. In addition, the prevalence of advanced-stage diagnosis after ACA implementation decreased by 3% each quarter for Texas overall (PR = 0.97; 95% CL: 0.96, 0.98), which was largely observed for non-screen-detectable cancers.

Supplementary Tables S3–S4 and Supplementary Figs. S1–S2 summarize our analyses exploring the effect of ACA on cancer stage stratified by screen-detectable status. We observed nominal or no change in level or slope for early or advanced stage diagnoses for screen-detectable or non-screen-detectable cancers after ACA implementation except for an immediate reduction in advanced-stage screen-detectable cancers among Tarrant County cancer patients (PR = 0.73, 95% CL: 0.46, 1.2) and an immediate reduction in the prevalence of early-stage non-screen-detectable cancers after ACA implementation among underserved cancer patients (PR = 0.83, 95% CL: 0.59, 1.2), but both estimates were compatible with substantial reductions or modest increases. In addition, we observed a modest reduction in the prevalence of non-screen-detectable advanced cancers over time for Texas overall (PR = 0.97, 95% CL: 0.96, 0.97).

Table 1
Characteristics of underserved adults diagnosed with primary solid tumors at the JPS Center for Cancer Care (2008–2015).

	Overall (n = 4808) n (%)	Pre-ACA[a] period (n = 3656) n (%)	Post-ACA[b] period (n = 1152) n (%)
Age group (years)			
18–44	1043 (22)	790 (22)	253 (22)
45–54	1555 (32)	1227 (34)	328 (28)
55–64	2210 (46)	1639 (45)	571 (50)
Sex			
Female	2626 (55)	2031 (56)	595 (52)
Male	2182 (45)	1625 (44)	557 (48)
Race/ethnicity			
Non-Hispanic White	2334 (49)	1835 (50)	499 (43)
Non-Hispanic Black	1137 (24)	843 (23)	294 (26)
Hispanic	1070 (22)	787 (22)	283 (25)
Non-Hispanic Other[c]	253 (5.3)	178 (4.9)	75 (6.5)
Missing value	14 (0.29)	13 (0.36)	1 (0.09)
Insurance at diagnosis			
Uninsured	3010 (63)	2328 (64)	682 (59)
Private	334 (7.0)	187 (5.1)	147 (13)
Public	1246 (26)	946 (26)	300 (26)
Other	131 (2.7)	116 (3.2)	15 (1.3)
Missing value	87 (1.8)	79 (2.2)	8 (0.69)
SEER summary stage			
Local	1709 (36)	1288 (35)	421 (37)
Regional	1352 (28)	1011 (28)	341 (30)
Distant	1343 (28)	1051 (29)	292 (25)
Missing value	404 (8.4)	306 (8.4)	98 (8.5)

[a] The pre-ACA period is defined as 01/01/2008–09/30/2013.
[b] The post-ACA period is defined as 04/01/2014–12/31/2015.
[c] Includes American Indian, Asian, Native Hawaiian and Pacific islander.

4. Discussion

Our results suggest a decrease in the prevalence of uninsured patients among underserved, Tarrant County, and Texas cancer patients over time. Nevertheless, our results do not suggest earlier cancer detection among underserved cancer patients following ACA implementation, even for screen-detectable cancers. Rather, the prevalence of early-stage cancers modestly decreased at the beginning of the post-ACA period among underserved cancer patients, which could be the consequence of access to care affecting the detection of previously undiagnosed cancers that progressed to regional stage. We observed a similar lack of improvement in stage at diagnosis among cancer patients in Tarrant County and Texas overall.

Our finding of a decreased prevalence of uninsured individuals is consistent with prior studies that assessed the effect of ACA implementation (Blumenthal and Collins, 2014; Courtemanche et al., 2016; Frean et al., 2017; Jemal et al., 2017; Kominski et al., 2017; Sommers et al., 2015; Wherry and Miller, 2016). For example, prior studies of non-elderly individuals from national surveys reported reductions in the prevalence of uninsured individuals in the general population ranged between 6% and 7.9% (Frean et al., 2017; Sommers et al., 2015). The reduction of uninsured individuals in low-income populations was 5.2% to 7.4% greater for Medicaid expansion states compared with non-expansion states (Sommers et al., 2015; Wherry and Miller, 2016). Specifically for low-income cancer patients, a prior study that used the National Cancer Database reported a 6% reduction in uninsured individuals for Medicaid expansion states and only 1.4% for non-expansion states (Jemal et al., 2017). We observed a greater reduction in uninsured prevalence than prior studies in non-expansion states, which may be attributable to a substantially higher pre-ACA prevalence of uninsured patients (64%) in our underserved cancer population. The pre-ACA prevalence of uninsured among low-income cancer patients in Medicaid non-expansion states overall was 14.7% (Jemal et al., 2017). Growth of Medicaid coverage among eligible but unenrolled individuals between late 2013 and December 2015 was only 6% in Texas, which would not explain our observed reduction in uninsured individuals (Kaiser Family Foundation, 2019).

Prior studies reported inconsistent effects of ACA implementation on cancer stage at diagnosis (Han et al., 2018; Han et al., 2016; Jemal et al., 2017; Robbins et al., 2015; Sabik and Adunlin, 2017; Smith and Fader, 2018; Soni et al., 2018). Studies that reported increased early stage diagnosis primarily focused on young adults and assessed early ACA provisions (e.g. dependent coverage expansion) (Han et al., 2016;

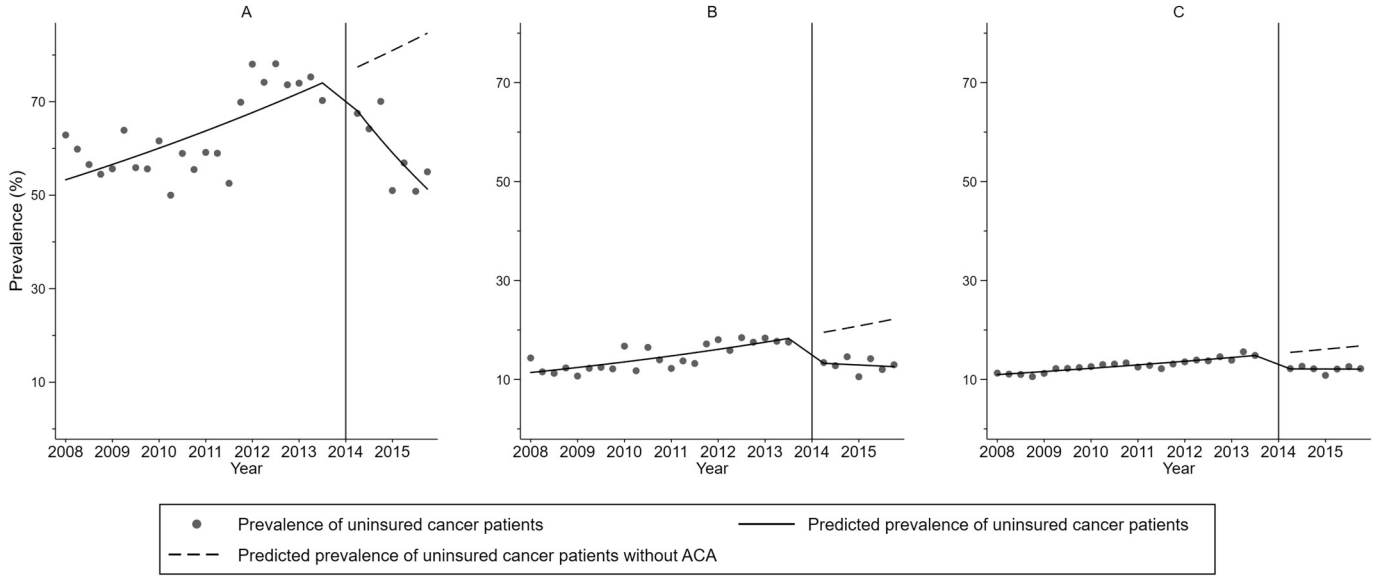

Fig. 2. The effect of Affordable Care Act implementation on insurance status among patients diagnosed with first primary cancers in an underserved population, Tarrant County, and Texas overall.
A. Underserved cancer population
B. Tarrant County cancer population
C. Texas cancer population.

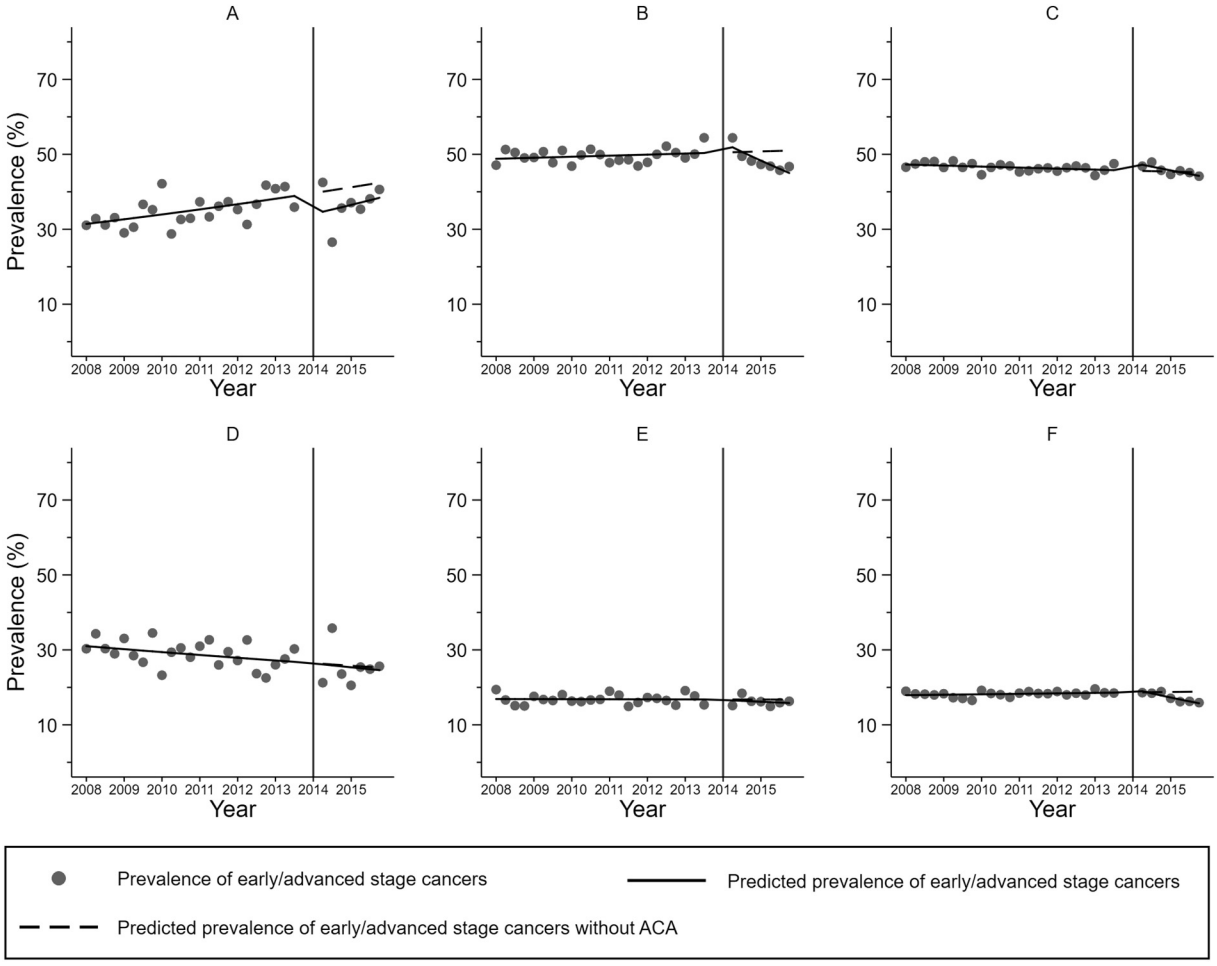

Fig. 3. The effect of Affordable Care Act implementation on stage at diagnosis among patients diagnosed with first primary cancers in an underserved population, Tarrant County, and Texas overall.
A. Prevalence of early stage among underserved cancer patients
B. Prevalence of early stage among cancer patients in Tarrant County
C. Prevalence of early stage among cancer patients in Texas overall
D. Prevalence of advanced stage among underserved cancer patients
E. Prevalence of advanced stage among cancer patients in Tarrant County
F. Prevalence of advanced stage among cancer patients in Texas overall.

Robbins et al., 2015; Smith and Fader, 2018). We identified three studies that assessed the effect of ACA implementation on cancer stage at diagnosis which reported an earlier stage of cancer diagnosis after ACA implantation among Medicaid expansion states, but these studies suggested smaller or no impact on cancer stage at diagnosis in states without Medicaid expansion (Han et al., 2018; Jemal et al., 2017; Soni et al., 2018). Medicaid enrollment reportedly increases the number of individuals with a usual source of care (Winkelman et al., 2018), which can increase the use of preventive services (Blewett et al., 2008) and earlier detection of cancer. States that did not expand Medicaid may not be able to influence this cascade (Griffith et al., 2017). In particular, Texas residents did not increase the use of preventive or other healthcare services as much compared with other southern states that expanded Medicaid during the same time period (Sommers et al., 2016). We thus speculate that the lack of Medicaid expansion in Texas may partially explain the lack of improvement in earlier cancer detection in our population. An even greater reduction in uninsured individuals, which may only be feasible by large-scale policy changes such as Medicaid expansion, or longer follow-up duration may be necessary to observe effects on cancer stage at diagnosis. In addition, underserved populations have barriers to care beyond insurance such as inconsistent transportation and low health literacy (Allen et al., 2008; Chase et al., 2012; Escriba-Aguir et al., 2016; Fernandez and Becker, 2017). Consequently, increased availability of self-purchased insurance may not sufficiently overcome other barriers to earlier diagnosis.

Several limitations should be considered when interpreting our findings. Our analysis cannot be used to infer whether ACA had an effect on cancer incidence (e.g. through detecting previously undiagnosed cases or through screening that detected pre-malignant lesions and prevented malignancy). Rather, our analysis addresses whether ACA affected stage distribution among individuals diagnosed with cancer. Underserved individuals who acquired insurance coverage because of ACA could have chosen other hospitals, and thus would not be represented in our post-ACA population. This phenomenon could manifest as a selective loss to follow-up, which could underestimate the effect of the ACA in our population. In addition, the follow-up duration for our post-ACA period is limited, which is relevant for all studies to date that assessed the effect of ACA implementation. The short post-ACA follow-up period would preclude detection of lagged effects on cancer stage at diagnosis. Lastly, interrupted time-series analysis are generally less sensitive to confounding by population characteristics than conventional analyses (Bernal et al., 2017), but other population-level interventions during this period could result in unmeasured confounding of the observed effects. For example, low-income, uninsured,

or under-insured women in Texas are eligible for low-cost breast and cervical cancer screening through the Breast and Cervical Cancer Services offered by Texas Department of State Health Services. Individuals in Tarrant County are eligible for free or low-cost cancer screenings through Tarrant County Indigent Health Care Program, Federally Qualified Health Centers, Moncrief Cancer Resources, or American Cancer Society North Texas Region (Texas Cancer Information). In addition, 42% of cancer patients in our hospital were enrolled in a hospital-based assistance program, which is offered to patients as an insurance supplement or as a form of primary coverage for individuals who meet certain eligibility criteria (i.e. a Tarrant County resident who has taken full advantage of state or federal assistance programs and has an annual income $\leq$250% of the federal poverty limit) (John Peter Smith Health Network). These programs were operational since the pre-ACA period and could have mitigated the effect of ACA implementation. Nevertheless, the lack of stage migration was not limited to underserved cancer patients. Cancer patients in Tarrant County and Texas overall also had a lack of stage migration after ACA implementation, which suggests that competing hospital-based or other local interventions may not be an alternate explanation for our results.

In summary, our results suggest that ACA implementation did not immediately impact earlier cancer diagnosis. To strengthen the available evidence, future studies may need to assess the effect of ACA on cancer stage at diagnosis after a longer follow-up period to detect potential lagged effects. If the effect of ACA on insurance coverage and cancer stage at diagnosis is largely attributable to Medicaid expansion, as reported in some studies (Courtemanche et al., 2018b; Frean et al., 2017), then changing state-level policies in non-expansion states would require consideration. Nevertheless, Medicaid expansion could require overcoming political and social opposition in some states, which may not be easily addressed. Medicaid expansion is uncertain in Texas, particularly given a recent ruling by a federal judge in Texas that could prevent Medicaid expansion (Keith, 2019). Therefore, alternate approaches should be explored to facilitate earlier cancer diagnosis among underserved individuals. For example, some hospitals offer hospital-based insurance or financial assistance programs for uninsured individuals, but little information is available about the impact of these programs on outcomes. For screen-detectable cancers, alternatives that are not dependent on insurance coverage or regular interaction with the healthcare system may be necessary, such as screening promoted through targeted community outreach programs (Gupta et al., 2014). The challenge of improving earlier cancer diagnosis among underserved individuals will likely require a combination of approaches to be successful.

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Declaration of Competing Interest

The authors have no financial or non-financial competing interests to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2019.06.006.

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